# PART II: SOLUTIONS TO PROBLEMS AND CASES

## CHAPTER 1
### INTRODUCTION

**P 1–1:** **Solution to MBA Students** (10 minutes)
[Using accounting information for decision making and control]

Together the two observations highlight the extremes in the trade-offs of using accounting information for decision and control. In the first case, there is more analysis of opportunity costs that are hard to capture with typical accounting information. In the second case, there is less intended interest in opportunity cost and greater emphasis on control.

**P 1–2:** **Solution to One Cost System Isn't Enough** (15 minutes)
[Economic Darwinism]

The first part of the quote describes the tension (and conflict) that arises when a single accounting system is used for multiple purposes. This part of the statement is an accurate description of practice. However, the quote has a couple of problems, including:

•While the quote describes the costs of using a single system ("a single system ... can't perform important managerial functions adequately"), the quote does not describe the benefits derived from using a single system (lower bookkeeping costs, a single audit, less confusion).

•Because the quote ignores the benefits of a single system, it ignores the concept of economic Darwinism. It does not address the question of how surviving (successful) companies can compete if a single system "can't perform important managerial functions adequately."

•Also, the quote assumes that managers are bound to their internal accounting systems, that no other alternative information sources are available. Often managers develop their own ad hoc, "off-line" information systems for decision making. These systems include PC-based spreadsheets, index cards, informal observation, and "walking around."

**P 1–3:** **Solution to U.S. and Japanese Tax Laws** (15 minutes)
[Influence of conflicting demands on cost systems]

The internal accounting system supports multiple uses, including financial reporting, taxes, contracting (debt and management compensation), internal decision making, and internal control. Because multiple purposes are served, trade-offs must be made among the competing demands. When more emphasis is placed on one purpose (taxes), less consideration can be given to other uses (internal decision making and control). By linking taxes to external reporting, Japanese firms' financial reports will be based on accounting procedures that give more weight to tax considerations. In the U.S., companies can keep two sets of books, one for taxes and the other for financial reporting. Thus, in the U.S., there is more of a decoupling of taxes and everything else. Except for the additional bookkeeping costs of producing the two separate sets of reports, tax considerations are predicted to have less influence on the choice of internal (and thus external) accounting procedures in the U.S. than in Japan.

The question is raised as to why firms use the same accounting procedures for internal reports as they do for external reports. Or for that matter, why do tax laws and external financial reporting considerations have any effect on internal accounting procedures? Why don't firms maintain multiple sets of accounts, one for each purpose (e.g., financial reporting, internal decision making, and internal control)? Clearly there are additional bookkeeping costs for maintaining multiple sets of accounts. But also, there are confusion costs and, in many instances, firms explicitly link senior executive compensation to externally reported financial statements. Such explicit linkage of executive pay to externally reported net income presumably exists to control agency costs between management and shareholders. Once senior management performance and rewards are linked to external reports, the internal reporting system will become linked to the external reports and basically less consideration will be given to choosing accounting procedures that aid in internal decision making and internal control.

In Japan, the firm's accounting systems are less likely to be used for internal uses (decision making and control) than in the U.S. Because they cannot rely as much on their accounting systems for internal uses (because more weight is placed on using accounting procedures to reduce taxes), Japanese managers are more likely to use non-accounting-based systems for internal decision making and control.

**P 1-4:** **Solution to Managers Need Accounting Information** (15 minutes)
[Alternative uses of accounting information]

Use of the word "need" in the quoted passage is pejorative. It implies an unlimited level of demand for information. However, rational managers apply a cost-benefit criterion to information and will only want accounting information if its benefits exceeds its cost. Accounting information provides benefits by improving decision making and controlling behavior in organizations. In most organizations, accounting information is very prevalent which implies that its benefits exceed its costs. Hence, successful managers will find it in their self-interest to learn how to use accounting information in these organizations.

Clearly, this statement is incorrect in those firms where accounting information has very limited usefulness (e.g., if the accounting information is often wrong or is not produced in a timely fashion). In these organizations, managers do not find the accounting information to have benefits in excess of its costs, will not use it, do not need to know how to use it, and definitely do not need it.

**P 1-5:** **Solution to Using Accounting for Planning** (15 minutes)
[Usefulness of historical costs]

a. Historical costs are of limited use in making planning decisions in a rapidly changing environment. With changing products, processes and prices, the historical costs are inadequate approximations of the opportunity costs of using resources.

Historical costs may, however, be useful for control purposes, as they provide information about the activities of managers and can be used as performance measures to evaluate managers.

b. The purpose of accounting systems is to provide information for planning purposes and control. Although historical costs are not generally appropriate for planning purposes, additional measures are costly to make. An accounting system should include additional measures if the benefits of improved decision making are greater than the costs of the additional information.

**P 1–6:** **Solution to Goals of a Corporation** (15 minutes)
[Alternative goals for an organization]

Finance and economics textbooks traditionally state that the goal of a profit organization is to maximize shareholder wealth. Managers are frequently presumed to act in the best interest of the shareholder, although recent finance literature recognizes that appropriate incentives are necessary to align manager interests with shareholder interests. The goal, however, remains the same: to maximize shareholder wealth. Finance textbooks, however, are not very clear as to how this is achieved. Most finance textbooks focus on financing decisions and not on the use of assets and dealing with customers.

Marketing's goal of satisfying customers recognizes that customers are the source of revenues for the organization, and therefore the means through which shareholder value is increased. However, customer satisfaction is only valuable insofar as it creates shareholder wealth. The further goal of marketing is to ensure that customer satisfaction is maximized without compromising the organization’s profitability.

**P 1–7:** **Solution to Budgeting** (15 minutes)
[Trade-off between decision making and control]

In this firm, the bonus is based on meeting the budget. Two incentives exist: sales people will under-forecast future sales and they have little incentive to sell more than the budget.

This firm tries to use the budget for two functions: decision making and control. In deciding on next year’s production plans, sales peoples’ forecasts of future sales are important. However, these same forecasts (after revision by supervisors) are used as part of the compensation scheme to motivate the sales people to achieve their goals. By using the budget (forecasts) as part of the control system, the firm gives up some of the budget's usefulness as a decision making tool to set production plans. While senior managers might recognize that the sales people's forecasts are low, they don't know exactly how low. This introduces more uncertainty into planning for next year's production.

**P 1-8:** **Solution to Golf Specialties** (20 minutes)
[Average versus variable cost of an incremental order]

a. The change in total cost if the 100 unit Kojo offer is accepted is:

$600 \times 3.10$ euros – $500 \times 3.50$ euros = 110 euros

Or, each head cover has variable cost of 1.10 euro. Since Kojo is willing to pay 2 euros per head cover or 200 euros for 100 covers, by accepting this order GS makes 90 euros a week. Therefore, GS should accept Kojo's offer if these are all the relevant facts.

b Given that the variable cost per head cover is 1.10 euros, the fixed cost per week is:

$AC = FC / Q + VC$

$3.10 = FC/600 + 1.10$ $3.50 = FC/500 + 1.10$

FC = 1,200 euros FC = 1,200 euros

c. GS should consider the following non-quantitative factors:
- What prevents Kojo from reselling the head covers back to dealers in Europe at prices below GS's current price of 4.25 euros?
- If GS sells the head covers to Kojo at 2 euros, what prevents GS's European customers from learning of this special deal and demand similar price concessions. In other words, why do we expect to be able to implement this price discrimination strategy?
- Will Kojo purchase other GS products and import them to Japan?
- What is Kojo's credit worthiness and will they pay for the head covers upon taking delivery?

**P 1–9:** **Solution to Parkview Hospital** (25 minutes)
[Changes in the environment cause accounting system changes]

a. Parkview's accounting system was probably adequate 10 years ago. It faced little competition and had little incentive to have detailed cost and revenue data at the clinical levels.

b. With increased pressure to reduce costs, Parkview management wants detailed cost and revenue data at the clinic level to help identify units with excess revenues or deficits. This would help guide their decisions as to how to respond to the $3.2 million shortfall. The accounting system doesn't provide as much help as management would like.

c. The question of changing the accounting system should be approached as a cost-benefit decision. What will such changes cost, how long will they take to implement, and what benefits are derived?

While it is tempting to say more accurate tracking of costs and benefits allows better decision making, changing the accounting system, including all the data processing changes that are likely necessary, usually is a very costly and time consuming process. Often special studies based on approximations of clinical department costs and revenues might prove to be faster and cheaper than waiting to revamp the accounting system.

Notice the change in competition in the health insurance market caused by Trans Insurance's entry prompted a series of changes in Parkview, including a re-examination of its accounting system.

**P 1–10:** **Solution to Montana Pen** (25 minutes)
[Incremental cost of outsourcing]

a. The average cost information given in the problem does not tell us what 400 clips cost. Like in the Vortec example from the chapter, the incremental cost of the 400 clips must be estimated from the following:

$$\frac{\text{Change in total cost}}{\text{Change in volume}} = \frac{\text{B185} \times 1200 - \text{B212.5} \times 800}{1{,}200 - 800} = \text{B130/clip}$$

At the current volume of 1,200 clips, the total cost is B222,000 (B185 × 1,200). If 400 clips are outsourced, reducing in-house volume to 800, the total cost falls to B170,000 (B212.5 × 800). Hence, total cost falls B52,000 (B222,000 - B170,000), or B130 per clip (B52,000 ÷ 400). Therefore, if 400 clips are outsourced to the Chinese company, Montana saves B130 per clip, but must pay the Chinese firm 136 per clip. Therefore, based solely on the cost data presented in the problem, do not outsource the gold clips.

b. There are a number of additional factors that must be considered besides just the costs:

   i. How does the quality of the Chinese clips compare to Montana's quality? If it is significantly higher, then it might be worth paying six Baht more per clip (approximately $0.10). What about delivery reliability? Is the Chinese firm more or less reliable than producing the clips in-house?

   ii. What alternative use can be made of the manufacturing capacity of the 400 clips freed up if they are outsourced? Is the Bangkok plant's manufacturing capacity constrained because there are not enough skilled goldsmiths or because of space or equipment? If so, by outsourcing the 400 clips to the Chinese, what other pen parts can these goldsmiths manufacture?

   iii. What long-term benefits are created by developing a business relation with this Chinese firm? For example, might this Chinese firm become a possible business partner or useful in opening a Chinese pen factory? Will Montana's management learn anything new about business dealings with Chinese firms from outsourcing these clips? Will purchasing these clips in China help Montana sell more pens in China?

# CHAPTER 2
## THE NATURE OF COSTS

**P 2-1:** **Solution to Darien Industries** (CMA adapted) (10 minutes)
[Relevant costs and benefits]

| | | |
|---|---|---|
| Current cafeteria income | | |
| Sales | $12,000 | |
| Variable costs (40% × 12,000) | (4,800) | |
| Fixed costs | (4,700) | |
| Operating income | | $2,500 |
| | | |
| Vending machine income | | |
| Sales (12,000 × 1.4) | $16,800 | |
| Darien's share of sales (.16 × $16,800) | | 2,688 |
| Increase in operating income | | $ 188 |

**P 2-2:** **Negative Opportunity Costs** (10 minutes)
[Opportunity cost]

Yes, when the most valuable alternative to a decision is a net cash outflow that would have occurred is now eliminated. The opportunity cost of that decision is negative (an opportunity benefit). For example, suppose you own a house with an in-ground swimming pool you no longer use or want. To dig up the pool and fill in the hole costs $3,000. You sell the house instead and the new owner wants the pool. By selling the house, you avoid removing the pool and you save $3,000. The decision to sell the house includes an opportunity benefit (a negative opportunity cost) of $3,000.

**P 2-3:** **Solution to NPR** (10 minutes)
[Opportunity cost of radio listeners]

The quoted passage ignores the opportunity cost of listeners' having to forego normal programming for on-air pledges. While such fundraising campaigns may have a low out-of-pocket cost to NPR, if they were to consider the listeners' opportunity cost, such campaigns may be quite costly.

**P 2–4:** **Solution to Silky Smooth Lotions** (15 minutes)
[Break even with multiple products]

Given that current production and sales are: 2,000, 4,000, and 1,000 cases of 4, 8, and 12 ounce bottles, construct of lotion *bundle* to consist of 2 cases of 4 ounce bottles, 4 cases of 8 ounce bottles, and 1 case of 12 ounce bottles. The following table calculates the breakeven number of lotion bundles to break even and hence the number of cases of each of the three products required to break even.

| **Per Case** | **4 ounce** | **8 ounce** | **12 ounce** | **Bundle** |
|---|---|---|---|---|
| Price | $36.00 | $66.00 | $72.00 | |
| Variable cost | $13.00 | $24.50 | $27.00 | |
| Contribution margin | $23.00 | $41.50 | $45.00 | |
| Current production | 2000 | 4000 | 1000 | |
| Cases per bundle | 2 | 4 | 1 | |
| Contribution margin per bundle | $46.00 | $166.00 | $45.00 | $257.00 |
| Fixed costs | | | | $771,000 |
| Number of bundles to break even | | | | 3000 |
| Number of cases to break even | 6000 | 12000 | 3000 | |

**P 2–5:** **Solution to J. P. Max Department Stores** (15 minutes)
[Opportunity cost of retail space]

| | Home Appliances | Televisions |
|---|---|---|
| Profits after fixed cost allocations | $64,000 | $82,000 |
| Allocated fixed costs | 7,000 | 8,400 |
| Profits before fixed cost allocations | 71,000 | 90,400 |
| Lease Payments | 72,000 | 86,400 |
| Forgone Profits | – $1,000 | $ 4,000 |

We would rent out the Home Appliance department, as lease rental receipts are more than the profits in the Home Appliance Department. On the other hand, profits generated by the Television Department are more than the lease rentals if leased out, so we continue running the TV Department. However, neither is being charged inventory holding costs, which could easily change the decision.

Also, one should examine externalities. What kind of merchandise is being sold in the leased store and will this increase or decrease overall traffic and hence sales in the other departments?

**P 2-6:** **Solution to Bidwell Company** (CMA adapted) (15 minutes)
[Simple break-even analysis]

a. Breakeven $= \dfrac{\text{Fixed Costs}}{\text{Contribution Margin}}$

$$= \frac{\$210,000}{(\$10 - \$7)} = 70,000 \text{ units}$$

b.
$$[10Q - 7Q - 210,000](1 - .4) = 90,000$$
$$(3Q - 210,000)\,(.6) = 90,000$$
$$3Q = 150,000 + 210,000$$
$$Q = 120,000$$

c. Breakeven $= \dfrac{\$241,500}{\$3/\text{unit}} = 80,500$ units

**P 2-7:** **Solution to Vintage Cellars** (15 minutes)
[Average versus marginal cost]

a. The following tabulates total, marginal and average cost.

| **Quantity** | **Average Cost** | **Total Cost** | **Marginal Cost** |
|---|---|---|---|
| 1 | $12,000 | $12,000 | |
| 2 | 10,000 | 20,000 | $8,000 |
| 3 | 8,600 | 25,800 | 5,800 |
| 4 | 7,700 | 30,800 | 5,000 |
| 5 | 7,100 | 35,500 | 4,700 |
| 6 | 7,100 | 42,600 | 7,100 |
| 7 | 7,350 | 51,450 | 8,850 |
| 8 | 7,850 | 62,800 | 11,350 |
| 9 | 8,600 | 77,400 | 14,600 |
| 10 | 9,600 | 96,000 | 18,600 |

b. Marginal cost intersects average cost at minimum average cost (MC=AC=$7,100). Or, at between 5 and 6 units AC = MC = $7,100.

c. At four units, the opportunity cost of producing and selling one more unit is $4,700. At four units, total cost is $30,800. At five units, total cost rises to $35,500. The incremental cost (i.e., the opportunity cost) of producing the fifth unit is $4,700.

d. Vintage Cellars maximizes profits ($) by producing and selling seven units.

| Quantity | Average Cost | Total Cost | Total Revenue | Profit |
|---|---|---|---|---|
| 1 | $12,000 | $12,000 | $9,000 | -$3,000 |
| 2 | 10,000 | 20,000 | 18,000 | -2,000 |
| 3 | 8,600 | 25,800 | 27,000 | 1,200 |
| 4 | 7,700 | 30,800 | 36,000 | 5,200 |
| 5 | 7,100 | 35,500 | 45,000 | 9,500 |
| 6 | 7,100 | 42,600 | 54,000 | 11,400 |
| 7 | 7,350 | 51,450 | 63,000 | 11,550 |
| 8 | 7,850 | 62,800 | 72,000 | 9,200 |
| 9 | 8,600 | 77,400 | 81,000 | 3,600 |
| 10 | 9,600 | 96,000 | 90,000 | -6,000 |

**P 2-8:** **Solution to Sunnybrook Farms** (CMA adapted) (15 minutes)
[Incremental costs and revenues of extending retail store hours]

| | |
|---|---|
| Annual Sunday incremental costs | $24,960 |
| ÷ 52 weeks | |
| Weekly Sunday incremental costs | $ 480 |
| | |
| Sunday sales to cover incremental costs | |
| 480 ÷ (.2) | $ 2,400 |
| | |
| Sunday sales to cover lost sales during | |
| the week 2,400 ÷ (1 – .6) | $ 6,000 |

*Check*:

| | |
|---|---|
| Sunday sales | $ 6,000 |
| Additional Sales due to Sunday | |
| ($6,000 × 40%) | $ 2,400 |
| Gross Margin on additional sales | |
| ($2,400 × 20%) | $ 480 |
| × 52 Weeks | $24,960 |

**P 2-9:** **Solution to Taylor Chemicals** (15 minutes)
[Relation between average, marginal, and total cost]

a. Marginal cost is the cost of the next unit. So, producing two cases costs an additional $400, whereas to go from producing two cases to producing three cases costs an additional $325, and so forth. So, to compute the total cost of producing say five cases you sum the marginal costs of 1, 2, …, 5 cases and add the fixed costs ($500 + $400 + $325 + $275 + $325 + $1000 = $2825). The following table computes average and total cost given fixed cost and marginal cost.

| Quantity | Marginal Cost | Fixed Cost | Total Cost | Average Cost |
|---|---|---|---|---|
| 1 | $500 | $1000 | $1500 | $1500.00 |
| 2 | 400 | 1000 | 1900 | 950.00 |
| 3 | 325 | 1000 | 2225 | 741.67 |
| 4 | 275 | 1000 | 2500 | 625.00 |
| 5 | 325 | 1000 | 2825 | 565.00 |
| 6 | 400 | 1000 | 3225 | 537.50 |
| 7 | 500 | 1000 | 3725 | 532.14 |
| 8 | 625 | 1000 | 4350 | 543.75 |
| 9 | 775 | 1000 | 5125 | 569.44 |
| 10 | 950 | 1000 | 6075 | 607.50 |

b. Average cost is minimized when seven cases are produced. At seven cases, average cost is $532.14.

c. Marginal cost always intersects average cost at minimum average cost. If marginal cost is above average cost, average cost is increasing. Likewise, when marginal cost is below average cost, average cost is falling. When marginal cost equals average cost, average cost is neither rising nor falling. This only occurs when average cost is at its lowest level (or at its maximum).

**P 2-10:** **Solution to Emrich Processing** (15 minutes)
[Negative opportunity costs]

Opportunity costs are usually positive. In this case, opportunity costs are negative (opportunity benefits) because the firm can avoid disposal costs if they accept the rush job.

The original $1,000 price paid for GX-100 is a sunk cost. The opportunity cost of GX-100 is -$400. That is, Emrich will <u>increase</u> its cash flows by $400 by accepting the rush order because it will avoid having to dispose of the remaining GX-100 by paying Environ the $400 disposal fee.

How to price the special order is another question. Just because the $400 disposal fee was built into the previous job does not mean it is irrelevant in pricing this job. Clearly, one factor to consider in pricing this job is the reservation price of the customer proposing the rush order. The $400 disposal fee enters the pricing decision in the following way: Emrich should be prepared to **pay** up to $399 less any out-of-pocket costs to get this contract.

**P 2–11:** **Solution to Gas Prices** (15 minutes)
["Price gouging" or increased opportunity cost?]

The opportunity cost of the oil in process was higher after the invasion and thus the oil companies were justified in raising prices as quickly as they did. For example, suppose the oil company had one barrel of oil purchased at $15. This barrel was refined and processed for another $5 of cost and then the refined products from the barrel sold for $21. Replacing that barrel requires the oil company to pay another $15 per barrel on top of the $15 per barrel it is already paying. Therefore, in order to replace the old barrel, the prices of the refined products must be raised as soon as the crude oil price rises.

However, accounting treats the *realized holding gain* on the old oil as an accounting profit, not as an opportunity cost. Therefore, the income statement of oil companies with large stocks of in-process crude will show accounting profits, unless they can somehow defer these profits. Switching to income-decreasing accounting methods and writing off obsolete equipment will help the oil companies avoid the political embarrassment of reporting the holding gains. In January 1990, the large oil companies received significant adverse media publicity when they reported large increases in fourth-quarter profits.

It is useful having discussed this problem to ask the following question: What happens to oil companies in the reverse situation when a large, unexpected price drop occurs? Suppose the oil company purchased old barrels for $15 and sold the refined products for $21. New barrels now can be purchased for $10. The company would like to keep selling refined products at $21, but competition from other oil companies will push the price of refined products down. Depending on how quickly the price of refined products fall, the oil companies will report smaller (maybe even negative) accounting earnings as their inventory of $15 oil gets refined and sold, but at lower prices.

**P 2–12:** **Solution to Penury Company** (15 minutes)
[Break-even analysis with multiple products]

a. Breakeven when products have separate fixed costs:

| | Line K | Line L |
|---|---|---|
| Fixed costs | $40,000 | $20,000 |
| Divided by contribution margin | $0.60 | $0.20 |
| Breakeven in units | 66,667 units | 100,000 units |
| Times sales price | $1.20 | $0.80 |
| Breakeven in sales revenue | $80,000 | $80,000 |

b. Cost sharing of facilities, functions, systems, and management. That is, the existence of economies of scope allows common resources to be shared. For example, a smaller purchasing department is required if K and L are produced in the same plant and share a single purchasing department than if they are produced separately with their own purchasing departments.

c. Breakeven when products have common fixed costs and are sold in bundles with equal proportions:

At breakeven we expect:

Contribution from K + Contribution from L = Fixed costs

$0.60 Q + $0.20 Q = $50,000

where Q = number of units sold of K = number of units sold of L

$$\begin{aligned} \$0.80\ Q &= \$50{,}000 \\ Q &= 62{,}500 \text{ units} \end{aligned}$$

| Product | Break-even Units | Price | Break-even Sales |
|---|---|---|---|
| K | 62,500 | $1.20 | $75,000 |
| L | 62,500 | $0.80 | $50,000 |

**P 2–13:** **Solution to Volume and Profits** (15 minutes)
[Cost-volume-profit]

a. False.

b. Write the equation for firm profits:

$$\text{Profits} = P \times Q - (FC - VC \times Q) = Q(P - VC) - FC$$

$$= Q(P - VC) - (FC \div Q)Q$$

Notice that average fixed costs per unit (FC÷Q) falls as Q increases, but with more volume, you have more fixed cost per unit such that (FC÷Q) × Q = FC. That is, the decline in average fixed cost per unit is exactly offset by having more units.

Profits will increase with volume even if the firm has no fixed costs, as long as price is greater than variable costs. Suppose price is $3 and variable cost is $1. If there are no fixed costs, profits increase $2 for every unit produced. Now suppose fixed cost is $50. Volume increases from 100 units to 101 units. Profits increase from $150 ($2 ×100 - $50) to $152 ($2 × 101 - $50). The change in profits ($2) is the contribution margin. It is true that average unit cost declines from $1.50 ([100 × $1 + $50]÷100) to $1.495 ([101 × $1 + $50]÷101). However, this has nothing to do with the increase in profits. The increase in profits is due solely to the fact that the contribution margin is positive.

Alternatively, suppose price is $3, variable cost is $3, and fixed cost is $50. Contribution margin in this case is zero. Doubling output from 100 to 200 causes average cost to fall from $3.50 ([100 × $3 + $50]÷100) to $3.25 ([200 × $3 + $50]÷200), but profits are still zero.

**P 2-14:** **Solution to American Cinema** (20 minutes)
[Breakeven analysis for an operating decision]

a. Both movies are expected to have the same ticket sales in weeks one and two, and lower sales in weeks three and four.

Let $Q_1$ be the number of tickets sold in the first two weeks, and $Q_2$ be the number of tickets sold in weeks three and four. Then, profits in the first two weeks, $\pi_1$, and in weeks three and four, $\pi_2$, are:

$$\pi_1 = .1(6.5Q_1) - \$2,000$$

$$\pi_2 = .2(6.5Q_2) - \$2,000$$

"I Do" should replace "Paris" if

$$\pi_1 > \pi_2, \text{ or}$$

$$.65Q_1 - 2,000 > 1.3Q_2 - 2,000, \text{ or}$$

$$Q_1 > 2Q_2.$$

In other words, they should keep "Paris" for four weeks unless they expect ticket sales in weeks one and two of "I Do" to be twice the expected ticket sales in weeks three and four of "Paris."

b. Taxes of 30 percent do not affect the answer in part (a).

c. With average concession profits of $2 per ticket sold,

$$\pi_1 = .65Q_1 + 2Q_1 - 2,000$$

$$\pi_2 = 1.30Q_2 + 2Q_2 - 2,000$$

$\pi_1 > \pi_2$ if

$$2.65Q_1 > 3.3Q_2$$

$$Q_1 > 1.245Q_2$$

Now, ticket sales in the first two weeks need only be about 25 percent higher than in weeks three and four to replace "Paris" with "I Do."

**P 2-15:** **Solution to Home Auto Parts** (20 minutes)
[Opportunity cost of retail display space]

a. The question involves computing the opportunity cost of the special promotions being considered. If the car wax is substituted, what is the forgone profit from the dropped promotion? And which special promotion is dropped? Answering this question involves calculating the contribution of each planned promotion. The opportunity cost of dropping a planned promotion is its forgone contribution: (retail price less unit cost) × volume. The table below calculates the expected contribution of each of the three planned promotions.

| Planned Promotion Displays For Next Week | | | |
|---|---|---|---|
| | End-of-Aisle | Front Door | Cash Register |
| Item | Texcan Oil | Wiper blades | Floor mats |
| Projected volume (week) | 5,000 | 200 | 70 |
| Sales price | 69¢/can | $9.99 | $22.99 |
| Unit cost | 62¢ | $7.99 | $17.49 |
| Contribution margin | 7¢ | $2.00 | $5.50 |
| Contribution (margin × volume) | $350 | $400 | $385 |

Texcan oil is the promotion yielding the lowest contribution and therefore is the one Armadillo must beat out. The contribution of Armadillo car wax is:

| | |
|---|---|
| Selling price | $2.90 |
| less: Unit cost | $2.50 |
| Contribution margin | $0.40 |
| × expected volume | 800 |
| Contribution | $ 320 |

Clearly, since the Armadillo car wax yields a lower contribution margin than all three of the existing planned promotions, management should not change their planned promotions and should reject the Armadillo offer.

b. With 50 free units of car wax, Armadillo's contribution is:

| | | | |
|---|---|---|---|
| Contribution from 50 free units (50 × $2.90) | | | $145 |
| Contribution from remaining 750 units: | | | |
| Selling price | $2.90 | | |
| less: Unit cost | $2.50 | | |
| Contribution margin | | $0.40 | |
| × expected volume | | 750 | 300 |
| Contribution | | | $445 |

With 50 free units of car wax, it is now profitable to replace the oil display area with the car wax. The opportunity cost of replacing the oil display is its forgone contribution ($350), whereas the benefits provided by the car wax are $445.

*Additional discussion points raised*

(i) This problem introduces the concept of the opportunity cost of retail shelf space. With the proliferation of consumer products, supermarkets' valuable scarce commodity is shelf space. Consumers often learn about a product for the first time by seeing it on the grocery shelf. To induce the store to stock an item, food companies often give the store a number of free cases. Such a giveaway compensates the store for allocating scarce shelf space to the item.

(ii) This problem also illustrates that retail stores track contribution margins and volumes very closely in deciding which items to stock and where to display them.

(iii) One of the simplifying assumptions made early in the problem was that the sale of the special display items did not affect the unit sales of competitive items in the store. Suppose that some of the Texcan oil sales came at the expense of other oil sales in the store. Discuss how this would alter the analysis.

**P 2–16:** **Solution to Measer** (20 minutes)
[Average versus variable cost]

"Beware of unit costs." If you focus solely on the unit cost numbers in the problem, you are likely to be misled.

In the long run, the firm should shut down because it cannot cover fixed costs. However, if the firm has already incurred or is liable for fixed factory and administration costs, then it should continue to operate if it can cover variable costs. Notice the assumption regarding timing. Fixed costs are *assumed* to have been incurred whereas variable costs are assumed not to have been incurred yet. Given these assumptions, the loss-minimizing rate of output is 11 million units:

| | Rate of Production and Sale (000's units) | | | |
|---|---|---|---|---|
| | 10,000 | 11,000 | 12,000 | 13,000 |
| Sales @ $4.50/unit | $45,000 | $49,500 | $54,000 | $58,500 |
| Total Costs | 58,000 | 62,400 | 67,000 | 71,600 |
| Profit (Loss) | ($13,000) | ($12,900) | ($13,000) | ($13,100) |

Notice, minimizing average unit costs is not the basis for choosing output levels. Average unit costs are minimized at 13 million units.

An alternative way to solve the problem is to calculate contribution margin, as below:

| | Output Levels | | | |
|---|---|---|---|---|
| | 10,000 | 11,000 | 12,000 | 13,000 |
| Variable Cost | $43,000 | $47,400 | $52,000 | $56,600 |
| Average Variable Cost/unit | $4.30 | $4.31 | $4.33 | $4.35 |
| Contribution margin/unit | $.20 | $.19 | $.17 | $.15 |
| Contribution margin (units × output level) | $2,000 | $2,090 | $2,040 | $1,950 |

The preceding table indicates that maximizing contribution margin (not contribution margin per unit) also gives the right answer. At 11 million units $2,090 is being generated towards covering fixed costs.

Minimizing average variable cost gives the wrong answer.

**P 2-17:** **Solution to Affording a Hybrid** (20 minutes)
[Breakeven analysis]

a. The $1,500 upfront payment is irrelevant since it applies to both alternatives. To find the breakeven mileage, *M*, set the monthly cost of both vehicles equal:

$$\$499 + M\left(\frac{\$3.00}{50}\right) = \$399 + M\left(\frac{\$3.00}{25}\right)$$

$\$100 \quad = \; M(.12 - .06)$

**M** $= \$100/.06 = 1{,}666.66$ miles per month

Miles per year = $1{,}666.66 \times 12 = 20{,}000$

b. $$\$499 + M\left(\frac{\$4.00}{50}\right) = 399 + M\left(\frac{\$4.00}{25}\right)$$

$\$100 = M(.16 - .08)$

$M = \$100/.08 = 1{,}250$ miles per month

Miles per year $= 1{,}250 \times 12 = 15{,}000$ miles per year

**P 2–18:** **Solution to Fast Photo** (20 minutes)
[Cost behavior]

Matt's intuition is correct regarding the behavior of fixed costs. As the table below shows, average fixed costs per unit falls from $6 per unit in Plant A to $4.62 in plant D. However, unlike the usual textbook assumption that variable costs per unit are constant, these plants exhibit increasing variable costs per unit. Plant A has average variable costs per roll of $3.90 and this rises to $5.42 per roll in plant D. The increase in variable costs per unit more than offsets the lower fixed costs per roll. Thus, profits fall as volume increases in plants B through D. One likely reason for the increasing variable cost per roll is higher labor costs due to overtime. If the high-volume plants add extra work shifts and if there are wage shift differentials between day and night work, average variable costs will increase. Finally, average variable costs per unit will increase with volume if plant congestion forces the firm to hire workers whose sole job is managing the congestion (i.e., searching for misplaced orders, expediting work flows, etc.)

| | Plant A | Plant B | Plant C | Plant D |
|---|---|---|---|---|
| Number of rolls processed | 50,000 | 55,000 | 60,000 | 65,000 |
| Variable costs (000s) | 195 | 242 | 298 | 352 |
| Fixed costs (000s) | 300 | 300 | 300 | 300 |
| Average fixed cost per unit | $6.00 | $5.45 | $5.00 | $4.62 |
| Average variable cost per unit | $3.90 | $4.40 | $4.97 | $5.42 |

**P 2-19:** **Solution to MedView** (20 minutes)
[Break-even Analysis]

a. The brochure gives the break-even point and the question asks us to calculate variable cost per unit. Or,

$$BE = \frac{\text{Fixed Cost}}{\text{Price} - \text{Variable Cost}}$$

Substituting in the known quantities yields:

$$45 = \frac{\$18{,}000}{\$475 - \text{Variable Cost}}$$

Solving for the unknown variable cost per unit gives

Variable cost = \$75/scan

b. The brochure is overlooking the additional fixed costs of office space and additional variable (or fixed) costs of the operator, utilities, maintenance, insurance and litigation, etc. Also overlooked is the required rate of return (cost of capital). Calculating the break-even point for the machine rental fee is very misleading.

**P 2–20:** **Solution to Manufacturing Cost Classification** (20 minutes)
[Period versus product costs]

| | Period Cost | Product Cost | Direct Labor | Direct Material | Over-head |
|---|---|---|---|---|---|
| Advertising expenses for DVD | x | | | | |
| Depreciation on PCs in marketing dept. | x | | | | |
| Fire insurance on corporate headquarters | x | | | | |
| Fire insurance on plant | | x | | | x |
| Leather carrying case for the DVD | | x | | x | |
| Motor drive (externally sourced) | | x | | x | |
| Overtime premium paid assembly workers | | x | | | x |
| Plant building maintenance department | | x | | | x |
| Plant security guards | | x | | | x |
| Plastic case for the DVD | | x | | x | |
| Property taxes paid on corporate office | x | | | | |
| Salaries of public relations staff | x | | | | |
| Salary of corporate controller | x | | | | |
| Wages of engineers in quality control dept. | | x | | | x |
| Wages paid assembly line employees | | x | x | | |
| Wages paid employees in finished goods warehouse | x | | | | |

**P 2–21:** **Solution to Australian Shipping** (20 minutes)
[Negative transportation costs]

a. Recommendation: The ship captain should be indifferent (at least financially) between using stone or wrought iron as ballast. The total cost (£550) is the same.

Stone as ballast

| | |
|---|---|
| Cost of purchasing and loading stone | £40 |
| Cost of unloading and disposing of stone | 15 |
| | £55 |
| Ton required | × 10 |
| Total cost | £550 |

Wrought iron as ballast

| | |
|---|---|
| Number of bars required: | |
| 10 tons of ballast × 2,000 pounds/ton | 20,000 pounds |
| Weight of bar | ÷ 20 pounds/bar |
| | 1,000 bars |
| | |
| Loss per bar (£1.20 – £0.90) | £0.30 |
| × number of bars | 1,000 |
| | £300 |
| Cost of loading bars (£15 ×10) | 150 |
| Cost of unloading bars (£10 ×10) | 100 |
| Total cost | £550 |

b. The price is lower in Sydney because the supply of wrought iron relative to demand is greater in Sydney because of wrought iron's use as ballast. In fact, in equilibrium, ships will continue to import wrought iron as ballast as long as the relative price of wrought iron in London and Sydney make it cheaper (net of loading and unloading costs) than stone.

**P 2-22:** **Solution to iGen3** (20 minutes)
[Cost-volume-profit and breakeven on a lease contract]

a and b. Breakeven number of impressions under Options A and B:

| | **Option A** | **Option B** |
|---|---|---|
| Monthly fixed lease cost | $10,000 | $0 |
| Labor/month | 5,000 | 5,000 |
| Total fixed cost/month | $15,000 | $5,000 |
| Variable lease cost/impression | $0.01 | $0.03 |
| Ink/impression | 0.02 | 0.02 |
| Total variable cost | $0.03 | $0.05 |
| Price/impression | $0.08 | $0.08 |
| Contribution margin/impression | $0.05 | $0.03 |
| Breakeven number of impressions | 300,000 | 166,667 |

c. The choice of Option A or B depends on the expected print volume ColorGrafix forecasts. Choosing among different cost structures should not be based on breakeven but rather which one results in lower total cost. Notice the two options result in equal cost at 500,000 impressions:

$$\begin{aligned} \$15{,}000 + \$0.03\ Q &= \$5{,}000 + \$0.05\ Q \\ \$10{,}000 &= \$0.02 \\ Q &= 500{,}000 \end{aligned}$$

Therefore, if ColorGrafix expects to produce more than 500,000 impressions it should choose Option A and if fewer than 500,000 impressions are expected ColorGrafix should choose Option B.

d. At 520,000 expected impressions, Option A costs $30,600 ($15,000 + .03 × 520,000), whereas Option B costs $31,000 ($5,000 + .05 × 520,000). Therefore, Option A costs $400 less than Option B. However, Option A generates much more operating leverage ($10,000/month), thereby increasing the expected costs of financial distress (and bankruptcy). Since ColorGrafix has substantial financial leverage, they should at least consider if it is worth spending an additional $400 per month and choose Option B to reduce the total amount of leverage (operating and financial) in the firm. Without knowing precisely the magnitude of the costs of financial distress, one can not say definitively if the $400 additional cost of Option B is worthwhile.

**P 2-23:** **Solution to Adapt, Inc.** (20 minutes)
[Cost-volume-profit and operating leverage]

a. NIAT = (PQ – VQ –F)(1-T) and (PQ – VQ) / PQ = 70%

Where:
NIAT = Net income after taxes
P = Price
Q= Quantity
V= variable cost per unit
F = Fixed cost
T= Tax rate

$$
\begin{aligned}
\$1.700 &= (\$6.200 - VQ - F)\,(1 - 0.4) \\
2.833 &= 6.200 - VQ - F \\
(PQ - VQ) / PQ &= 70\% \\
1 - VQ / PQ &= .70 \\
VQ / PQ &= .30 \\
VQ &= .30\ PQ = .30(6.200) = 1.860 \\
2.833 &= 6.200 - 1.860 - F \\
F &= 1.507
\end{aligned}
$$

b. Knowing DigiMem's fixed costs informs Adapt, Inc. about DigiMem's operating leverage. Knowing DigiMem's operating leverage helps Adapt design pricing strategies in terms of how DigiMem is likely to respond to price cuts. The higher DigiMem's operating leverage, the more sensitive DigiMem's cash flows are to downturns. If DigiMem has a lot of operating leverage, they will not be able to withstand a long price war. Also, knowing DigiMem's fixed costs is informative about how much capacity they have and hence what types of strategies they may be pursuing in the future.

**P 2-24:** **Solution to Exotic Roses** (25 minutes)
[Breakeven analysis]

a. Fixed costs total \$27,000 per year and variable costs are \$1.50 per plant. The breakeven number of potted roses is found by solving the following equation for Q:

Profits = \$15 Q - \$1.50 Q - \$27,000 = 0
Or Q = \$27,000 / (\$15 - \$1.50) = \$27,000 / \$13.50 = 2,000 plants

b. To make \$10,000 of profits before taxes per year, solve the following equation for Q:

Profits = \$15 Q - \$1.50 Q - \$27,000 = \$10,000

Or Q = \$37,000 / (\$15 - \$1.50) = \$37,000 / \$13.50 = 2,740.74 plants

c. To make \$10,000 of profits AFTER taxes per year, solve the following equation for Q:

Profits = [\$15 Q - \$1.50 Q - \$27,000] × (1 - 0.35) = \$10,000
= [\$15 Q - \$1.50 Q - \$27,000] = \$10,000 / 0.65 = \$15,384.62
Or Q = \$42,384.62 / \$13.50 = 3,139.60 plants

**P 2-25: Solution to Oppenheimer Visuals** (25 minutes)
[Choosing the optimum technology and "all costs are variable in the long run"]

a. The following table shows that Technology 2 yields the highest firm value:

| | | | Technology 1 | | Technology 2 | |
|---|---|---|---|---|---|---|
| Q | Price | Revenue | Total cost | Profit | Total cost | Profit |
| 60 | \$760 | \$45600 | \$46000 | \$-400 | \$40000 | \$5600 |
| 65 | 740 | 48100 | 47000 | 1100 | 42000 | 6100 |
| 70 | 720 | 50400 | 48000 | 2400 | 44000 | 6400 |
| 75 | 700 | 52500 | 49000 | 3500 | 46000 | 6500 |
| 80 | 680 | 54400 | 50000 | 4400 | 48000 | 6400 |
| 85 | 660 | 56100 | 51000 | 5100 | 50000 | 6100 |
| 90 | 640 | 57600 | 52000 | 5600 | 52000 | 5600 |
| 95 | 620 | 58900 | 53000 | 5900 | 54000 | 4900 |
| 100 | 600 | 60000 | 54000 | 6000 | 56000 | 4000 |
| 105 | 580 | 60900 | 55000 | 5900 | 58000 | 2900 |
| 110 | 560 | 61600 | 56000 | 5600 | 60000 | 1600 |

b. They should set the price at \$700 per panel and sell 75 panels per day.

c. The fixed cost of technology 2 of \$16,000 per day was chosen as part of the profit maximizing production technology. Oppenheimer could have chosen technology 1 and had a higher fixed cost and lower variable cost. But given the demand curve the firm faces, they chose technology 2. So, at the time they selected technology 2, the choice of fixed costs had not yet been determined and was hence "variable" at that point in time.

**P 2–26:** **Solution to Eastern University Parking** (25 minutes)
[Opportunity cost of land]

The University's analysis of parking ignores the opportunity cost of the land on which the surface space or parking building sits. The $12,000 cost of an enclosed parking space is the cost of the structure only. The $900 cost of the surface space is the cost of the paving only. These two numbers do not include the opportunity cost of the land which is being consumed by the parking. The land is assumed to be free. Surface spaces appear cheaper because they consume a lot more “free” land. A parking garage allows cars to be stacked on top of each other, thereby allowing less land to be consumed. The correct analysis would impute an opportunity cost to each potential parcel of land on campus, and then build this cost into both the analysis and parking fees. The differential cost of each parcel would take into account the additional walking time to the center of campus. Remote lots would have a lower opportunity cost of land and would provide less expensive parking spaces.

Another major problem with the University's analysis is that parking prices should be set to allocate a scarce resource to those who value it the highest. If there is an excess demand for parking (i.e., queues exist), then prices should be raised to manage the queue and thereby allocate the scarce resource. Basing prices solely on costs does not guarantee that any excess supply or demand is eliminated.

Other relevant considerations in the decision to build a parking garage include:

1. The analysis ignores the effect of poor/inconvenient parking on tuition revenues.
2. Snow removal costs are likely lower, but other maintenance costs are likely to be higher with a parking garage.

The most interesting aspect of this question is "Why have University officials systematically overlooked the opportunity cost of the land in their decision-making process?" One implication of past University officials’ failure to correctly analyze the parking situation is the "dumb-administrator" hypothesis. Under this scenario, one concludes that all past University presidents were ignorant of the concept of opportunity cost and therefore failed to assign the "right" cost to the land.

The way to understand why administrators will not build a parking garage is to ask what will happen if a garage is built <u>and priced</u> to recover cost. The cost of the covered space will be in excess of $1,200 per year. Those students, faculty, and staff with a high opportunity cost of their time (who tend to be those with higher incomes) will opt to pay the significantly higher parking fee for the garage. Lower-paid faculty will argue the inequity of allowing the "rich" the convenience of covered parking while the “poor” are relegated to surface lots. Arguments will undoubtedly be made by some constituents that parking spots should not be allocated using a price system which discriminates against the poor but rather parking should be allocated based on "merit" to be determined by a faculty committee. Presidents of universities have risen to their positions by developing a keen sense of how faculty, students, and staff will react to various proposals. An alternative to the "dumb-administrator" hypothesis is the "rational self-interested administrator" hypothesis. Under this hypothesis, the parking garage is not built because the administrators are unwilling to bear the internal political ramifications of such a decision.

Finally, taxes play an important role in the University's decision not to build a parking garage. If faculty are to pay the full cost of the garage, equilibrium wage rates will have to rise to make the faculty member as well off at Eastern University paying for parking than at another university where parking is cheaper. Because employees are unable to deduct parking fees from their taxes, the University will have to increase salaries by the amount of the parking fees plus the taxes on the fees to keep the faculty indifferent about staying or leaving the University. Therefore, a parking garage paid for by the faculty (which means paid by the University) causes the government to raise more in taxes. The question then comes down to: is the parking garage the best use of the University's resources?

**P 2-27:** **Solution to William Company** (CMA adapted) (25 minutes)
[Using Cost-volume-profit as a decision rule]

a.

| Model | Variable Cost per Box | Total Fixed Cost |
|---|---|---|
| Economy | $.43 | $ 8,000 |
| Regular | .35 | 11,000 |
| Difference | $.08 | $ 3,000 |

Volume at which both machines produce the same profit $= \dfrac{\text{Fixed cost differential}}{\text{Variable cost differential}}$

$= \dfrac{\$3,000}{\$.08}$

$=$ 37,500 boxes

b. A decision rule would have to include the Super Model:

| | Variable Cost per Box | Total Fixed Cost |
|---|---|---|
| Regular | $.35 | $11,000 |
| Super | .26 | 20,000 |
| | $.09 | $ 9,000 |

Volume at which Regular and Super produce the same profit $= \dfrac{\$9,000}{\$.09}$

$=$ 100,000 boxes

Therefore, the decision rule is as shown below.

| Anticipated Annual Sales Between | Use Model |
| --- | --- |
| 0–37,500 | Economy |
| 37,500–100,000 | Regular |
| 100,000 and above | Super |

The decision rule places volume well within the capacity of each model.

c. No, management cannot use theater capacity or average boxes sold because the number of seats per theater does not indicate the number of patrons attending, nor the popcorn-buying habits in different geographic locations. Each theater likely has a different average "boxes sold per seat" with significant variations. The decision rule does not take into account variations in demand that could affect model choice.

**P 2-28:** **Solution to Mastich Counters** (25 minutes)
[Opportunity cost to the firm of workers deferring vacation time]

At the core of this question is the opportunity cost of workers deferring vacation.

The new policy was implemented because management believed it was costing the firm too much money when workers left with accumulated vacation and were paid. However, these workers had given Mastich in effect a loan. By not taking their vacation time as accrued, they stayed in their jobs and worked, allowing Mastich to increase its output without hiring additional workers, and without reducing output or quality. Mastich was able to produce more and higher quality output with fewer workers. Suppose a worker is paid $20 per hour this year and $20.60 next year. By deferring one vacation hour one year, the worker receives $20.60 when the vacation hour is taken next year. As long as average worker salary increases are less than the firm's cost of capital, the firm is better off by workers accumulating vacation time. The firm receives a loan from its workers at less than the firm's cost of capital.

Under the new policy, and especially during the phase-in period, Mastich has difficulty meeting production schedules and quality standards as more workers are now on vacation at any given time. To overcome these problems, the size of the work force will have to increase to meet the same production/quality standards. If the size of the work force stays the same, but more vacation time is taken, output/quality will fall.

Manager A remarked that workers were refreshed after being forced to take vacation. This is certainly an unintended benefit. But it also is a comment about how some supervisors are managing their people. If workers are burned out, why aren't their supervisors detecting this and changing job assignments to prevent it? Moreover, how is burnout going to be resolved after the phase-in period is over and workers don't have excess accumulated vacation time?

The new policy reduces the workers' flexibility to accumulate vacation time, thereby reducing the attractiveness of Mastich as an employer. Everything else equal, workers will demand some offsetting form of compensation or else the quality of Mastich's work force will fall.

Many of the proposed benefits, namely reducing costs, appear illusory. The opportunity costs of the new policy are reduced output, schedule delays, and possible quality problems. If workers under the new policy were forfeiting a significant number of vacation hours, these lost hours "profit" the firm. But, as expected from rational workers, very few vacation hours are being forfeited (as mentioned by Manager C).

However, there is one very real benefit of the new policy – less fraud and embezzlement. One key indicator of fraud used by auditors is an employee who never takes a vacation. Forced vacations mean other people have to cover the person's job. During these periods, fraud and embezzlement often are discovered. Another benefit of this new policy is it reduces the time employees will spend lobbying their supervisors for extended vacations (in excess of three to four weeks). Finally, under the existing policy, employees tend to take longer average vacations (because workers have more accumulated vacation time). When a worker takes a long vacation, it is more likely the employee's department will hire a temporary or "float" person to fill in. With shorter vacations, the work of the person on vacation is performed by the remaining employees. Thus, the new policy reduces the slack (free time) of the work force and results in higher productivity.

**P 2-29: Solution to Optometry Practice** (25 minutes)
[Break-even analysis]

Hiring the optometrist generates two income streams, examination revenue and eyeglass and contact sales. Each exam is expected to produce the following additional revenue:

| | Frequency<br>(1) | Profits<br>(2) | Expected Profits<br>(1) × (2) |
|---|---|---|---|
| Eyeglasses | 60% | $90 | $54 |
| Contact lens | 20% | $65 | $13 |
| Expected Profits from sales per exam | | | $67 |

The break-even point is calculated as follows:

| | |
|---|---|
| Contribution margin per exam: | |
| Exam fee | $ 45 |
| Expected gross margin on sales | $ 67 |
| Contribution margin | $112 |

| | |
|---|---|
| Fixed costs: | |
| Optometrist | $63,000 |
| Occupancy costs | 1,200 |
| Equipment | 330 |
| Office staff | 23,000 |
| Total fixed costs | $87,530 |

$$\text{Break even volume of exams} = \frac{\text{Total fixed costs}}{\text{Contribution margin}}$$

$$= \frac{\$87,530}{\$112}$$

$$= 781.5 \text{ exams}$$

Break even volume as a fraction of capacity

$$= \frac{781.5 \text{ exams}}{2 \times 40 \times 48}$$

$$= 20.3\%$$

**P 2–30:** **Solution to JLE Electronics** (25 minutes)
[Maximize contribution margin per unit of scarce resource]

Notice that the new line has a maximum capacity of 25,200 minutes (21 ×20 × 60) which is less than the time required to process all four orders. The profit maximizing production schedule occurs when JLE selects those boards that have the largest contribution margin per minute of assembly time. The following table provides the calculations:

| | CUSTOMERS | | | |
|---|---|---|---|---|
| | **A** | **B** | **C** | **D** |
| Price | $38 | $42 | $45 | $50 |
| Variable cost per unit | 23 | 25 | 27 | 30 |
| Contribution margin | $15 | $17 | $18 | $20 |
| | | | | |
| Number of machine minutes | 3 | 4 | 5 | 6 |
| Contribution margin/minute | 5 | 4.25 | 3.6 | 3.33 |

Customers A, B, and C provide the highest contribution margins per minute and should be scheduled ahead of customer D.

| | CUSTOMERS | | | |
|---|---|---|---|---|
| | **A** | **B** | **C** | **D** |
| Number of boards requested | 2500 | 2300 | 1800 | 1400 |
| Number of boards scheduled to be produced in the next 21 days | 2500 | 2300 | 1700* | 0 |

* 1700 [25,200 – (2,500 × 3) – (2,300 × 40]/5

**P 2–31:** **Solution to News.com** (25 minutes)
[Breakeven and operating leverage increases risk]

a. and b. Breakeven number of hits:

| | **NetCom** | **Globalink** |
|---|---|---|
| Price | $0.05 | $0.05 |
| Variable cost | 0.01 | 0.02 |
| Contribution margin | $0.04 | $0.03 |
| Fixed cost | $3,000 | $2,000 |
| Breakeven number of hits | 75,000 | 66,667 |

c. The choice among ISPs depends on the expected number of hits. The two ISP's have the same cost at 100,000 hits per month:

$$\$3{,}000 + \$0.01Q = \$2{,}000 + \$0.02Q$$

$$Q = 100{,}000$$

If the number of hits exceeds 100,000 per month, NetCom is cheaper. If the number of hits is less than 100,000, Globalink is cheaper.

d. If demand fluctuates with general economy-wide factors, then the risk of News.com is not diversifiable and the variance (and covariance) of the two ISP's will affect News.com's risk. For example, the table below calculates News.com's profits if they use NetCom or Globalink and demand is either high or low. Notice that News.com has the same expected profits ($1,000 per month) from using either ISP. However, the variance of profits (and hence risk) is higher under Net.Com than under Globalink. Therefore, News.com should hire Globalink. Basically, with lower fixed costs, but higher variable costs per hit, News.com's profits don't fluctuate as much with Globalink as they do with Net.Com.

| | NetCom | NetCom | Globalink | Globalink |
|---|---|---|---|---|
| Hits | 50,000 | 150,000 | 50,000 | 150,000 |
| Revenue | $2,500 | $7,500 | $2,500 | $7,500 |
| Fixed Cost | 3,000 | 3,000 | 2,000 | 2,000 |
| Variable Cost | 500 | 1,500 | 1,000 | 3,000 |
| Profits | -$1,000 | $3,000 | -$500 | $2,500 |
| Expected profits | $1,000 | | $1,000 | |

**P 2–32:** **Solution to Kinsley & Sons** (25 minutes)
[Opportunity cost of cannibalized sales]

a. The decision to undertake the additional advertising and marketing campaign depends on how one considers the cannibalized sales from catalog. Additional web profits from the program will be $4 million. But half of these will be from existing catalog purchases. Thus, the net new profits are only $2 million. In this case, undertaking the project is not profitable as documented by the following calculations:

| | |
|---|---|
| Net new incremental web profits | $4.0 |
| Incremental catalog profits | 0.6 |
| Cost of ad campaign | (2.8) |
| Lost profits from catalog sales | (2.0) |
| Net Loss | ($0.2) |

However, if we do not undertake the marketing campaign, we have no assurance that our competitors will not pursue an aggressive web campaign for their web sites. Thus, we may lose the $2 million of catalog sales profits whether we undertake this campaign or not. If this is the case, we should undertake the campaign because we will lose the $2 million anyway. In this case, the calculation becomes:

| | |
|---|---|
| Net new incremental web profits | $4.0 |
| Incremental catalog profits | 0.6 |
| Cost of ad program | (2.8) |
| Net Gain | $1.8 |

b. The critical assumption involves whether the $2.0 million of lost catalog sales is an opportunity cost of this campaign. If we believe that our competitors will not expand their web marketing, and hence we will not lose these $2 million profits from catalog, then this $2 million **is** an opportunity cost of the web marketing campaign. On the other hand, if we expect our competitors to launch web marketing campaigns and this $2 million profits from catalog would have been lost whether or not we undertake the campaign, the $2 million is **not** an opportunity cost of our campaign.

**P 2-33:** **Solution to Littleton Imaging** (25 minutes)
[Breakeven analysis]

a. Breakeven:

| | |
|---|---:|
| Fee | $250 |
| Film | -55 |
| Lease | -45 |
| Contribution margin | $150 |
| | |
| Fixed costs per month: | |
| Office rent | $1,400 |
| Receptionist | 2,400 |
| 2 technicians | 6,400 |
| CAT scanner lease | 1,200 |
| Office furniture, telephone & equipment | 600 |
| Radiologist | 15,000 |
| Total | $27,000 |
| | |
| Breakeven (fixed cost/contribution margin) | 180 |

b. To calculate the number of sessions required to yield an after-tax profit of $5,000 (with a 40 percent tax rate), solve the following equation for Q (number of sessions):

$\$5,000 = (CM \times Q - FC) \times (1\text{-}T)$
$\$5,000 / 0.60 + FC = CM \times Q$

Or,

$Q = (\$5,000 / .060 + FC) / CM$
$Q = (\$8,333.33 + \$27,000) / \$150$
$Q = \$35,333.33 / \$150$
$Q = 235.56$ sessions

c. To calculate the breakeven price, given Dr. Gu expects to conduct 200 sessions per month, solve the following equation for F (fee per session):

$200 \times F = \$55 \times 200 + \$45 \times 200 + \$27,000$
$200 \times F = \$100 \times 200 + \$27,000$
$200 \times F = \$20,000 + \$27,000$
$F = \$47,000 / 200$
$F = \$235$

**P 2-34:** **Solution to Candice Company** (CMA adapted) (30 minutes)
[Break-even analysis of new technologies]

a. $\text{Break-even units} = \dfrac{\text{Total fixed costs}}{\text{Unit contribution margin}}$

| | Method A | | Method B | |
|---|---|---|---|---|
| Selling price | | $30.00 | | $30.00 |
| Variable costs: | | | | |
| Raw materials | $5.00 | | $5.60 | |
| Direct labor | 6.00 | | 7.20 | |
| Variable overhead | 3.00 | | 4.80 | |
| Variable selling | 2.00 | 16.00 | 2.00 | 19.60 |
| Contribution margin | | $14.00 | | $10.40 |
| | | | | |
| Traceable fixed manufacturing costs | | $2,440,000 | | $1,320,000 |
| Incremental selling expenses | | 500,000 | | 500,000 |
| Total fixed costs | | $2,940,000 | | $1,820,000 |
| | | | | |
| Divided by: | | | | |
| Contribution margin | | $ 14.00 | | $ 10.40 |
| Break-even units | | 210,000 | | 175,000 |

b. The choice of production methods depends on the level of expected sales. Candice Company would be indifferent between the two manufacturing methods at the volume (x) for which total costs are equal.

$$\$16x + \$2,940,000 = \$19.60x + \$1,820,000$$

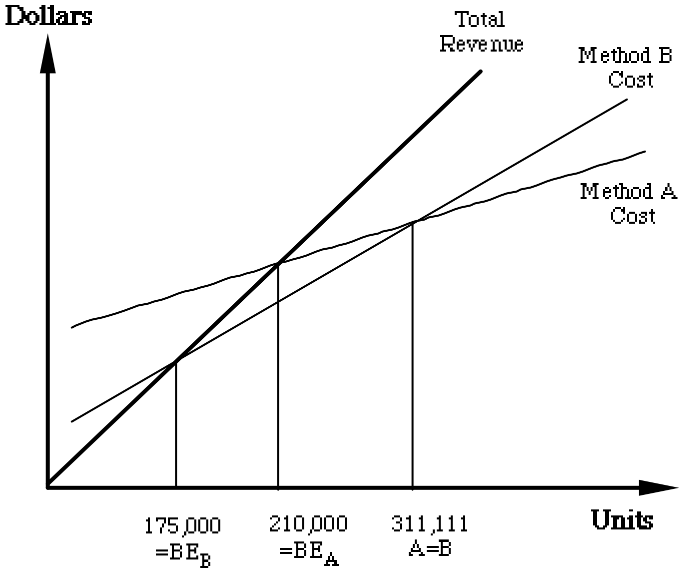
$$\$3.60x = \$1,120,000$$

$$x = 311,111 \text{ units}$$

In a world of certainty, if management expects to produce fewer than 311,111 units it would choose method B. Above 311,111 units they would prefer method A. The figure below illustrates this situation. The two break-even points for the two manufacturing methods occur at 210,000 and 175,000 units. However, it is the point where the two cost curves intersect (311,111 units) that is relevant. Method B has lower total costs up to 311,111 units and then method A has lower costs beyond this volume.

With uncertainty, the problem becomes more complicated because the two methods affect operating leverage differently. Operating leverage affects risk, cost of capital, and expected tax payments (to the extent that marginal tax rates vary with profits). Basically, the production method with the lower break-even volume has the lower systematic risk and thus the lower discount rate.[1]

**Candice Company**
**Comparing Cost Curves for Methods A & B**
**and their Breakeven Points**




**P 2–35:** **Solution to Mat Machinery** (30 minutes)
[Determining the best alternative use of a special order]

Contribution of each alternative:

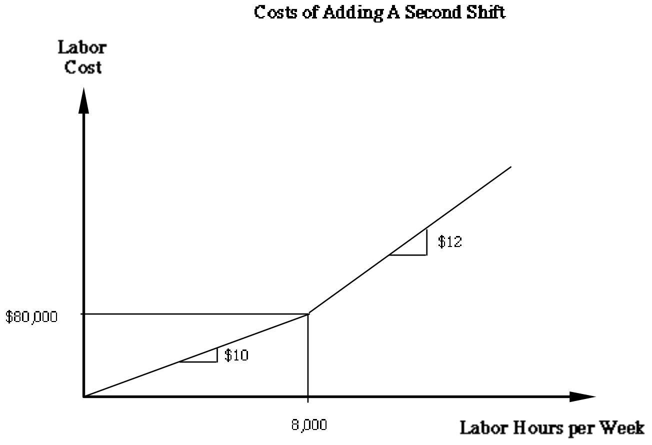
| | | | Sell to Raytell Corp. | | Sell as a Standard Model | | Sell As Is |
|---|---|---|---|---|---|---|---|
| | Sales price | | $68,000 | | $64,500 | | $55,000 |
| | Less discount | | -- | | 1,290 | | -- |
| | Net sales price | | $68,000 | | $63,210 | | $55,000 |
| Less | Additional costs | | | | | | |
| | Materials | $5,000 | | $6,500 | | — | |
| | Labor | 6,000 | | 2,000 | | — | |
| | Overhead (50% DL) | 3,000 | 14,000 | 1,000 | 9,500 | | — |
| | | | $54,000 | | $53,710 | | $55,000 |
| Less | Commissions | | 1,360 | | 632 | | 550 |
| | Contribution | | $52,640 | | $53,078 | | $54,450 |

1 P. Lederer and V. Singhal, "Effect of Cost Structure and Demand Risk in Justification of New Technologies," *Journal of Manufacturing and Operations Management* 1 (1988), pp. 339-371.

Therefore, the "sell as is" for $55,000 is the best alternative. Notice that fixed factory overhead does not enter the analysis, as these costs are not relevant to any of the alternatives.

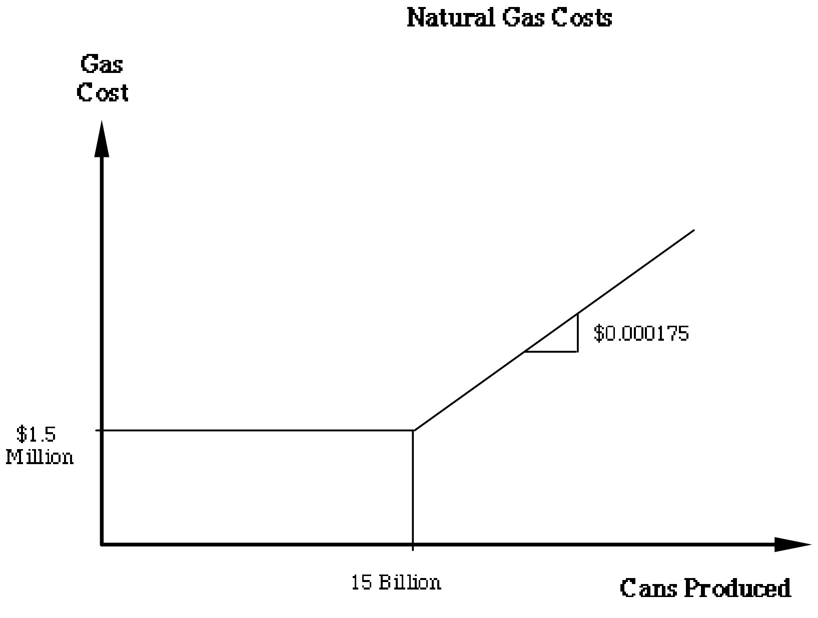
**P 2-36:** **Solution to Cost Behavior Patterns** (30 minutes)
[Graphing cost behavior patterns]

a.

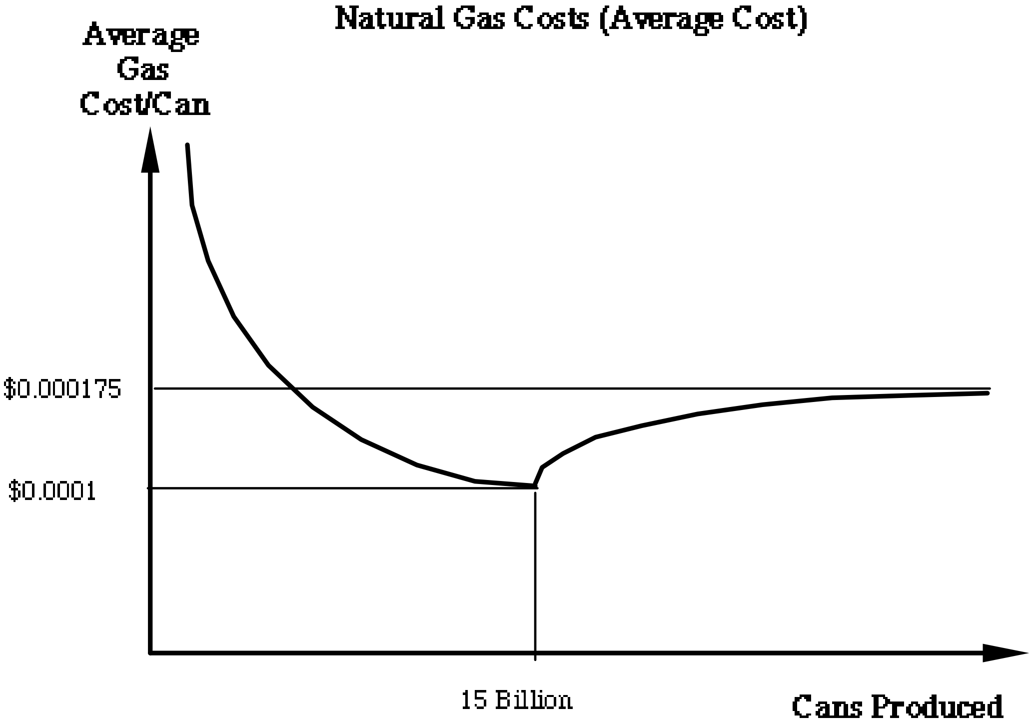



b.

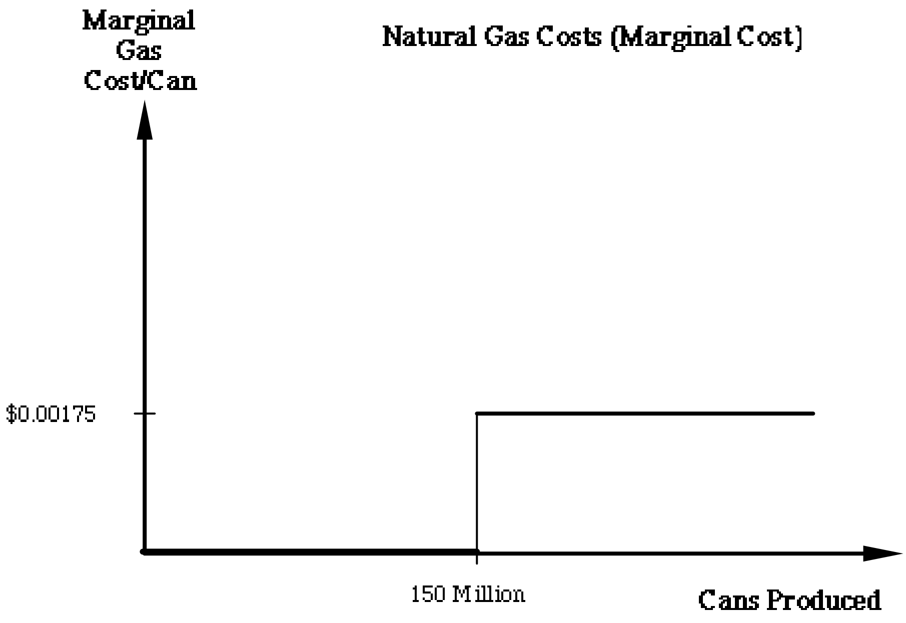
| | | |
|---|---|---|
| 1000 cans | = | ten cubic feet of gas |
| 100 cans | = | one cubic foot of gas |
| 1 can | = | 0.01 cu.ft |
| Marginal cost/can | = | 0.01cu.ft/can × $0.175/cu.ft = $0.00175 |



c. The question does not specify whether to plot marginal gas cost per can or average gas cost per can. Therefore, there are two possible answers.




Marginal gas cost per can is:



**P 2-37:** **Solution to Royal Holland Line** (30 minutes)
[Break-even analysis]

a. Before the break-even point can be calculated, the variable cost per passenger is computed as:

$$\text{Variable cost per passenger} = \frac{\$324,000}{1,200}$$

$$= \$270$$

$$\text{Contribution margin per passenger} = \$1,620 - \$270$$

$$= \$1,350$$

$$\text{Break-even number of passengers} = \frac{\text{Fixed cost}}{\text{Contribution margin}}$$

$$= \frac{\$607,500}{1,350}$$

$$= 450 \text{ passengers}$$

b. The cost of the ship itself is not included. The weekly opportunity cost of the Mediterranean cruise is not using the ship elsewhere. One alternative use is to sell the ship and invest the proceeds. Since no other information is provided regarding alternative uses of the ship and assuming there are no capital gains taxes on the sale proceeds, the weekly opportunity cost of the ship is:

| | |
|---|---:|
| Sales proceeds | $371,250,000 |
| × Interest rate | 10% |
| | $37,125,000 |
| ÷ number of weeks/year | 50 |
| Weekly opportunity cost | $ 742,500 |

c. The revised break-even including the cost of the ship:

$$\text{Total fixed costs} = \$607,500 + 742,500$$
$$= \$1,350,000$$

$$\text{Break-even} = \frac{\$1,350,000}{1,350} = 1,000 \text{ passengers}$$

d. Let C = contribution margin from additional sales

$$900 = \frac{1,350,000}{1,350 + C}$$

$$900(1,350 + C) = 1,350,000$$

$$900C = 1,350,000 - 1,350 \times 900$$

$$C = \frac{1,350,000}{900} - 1,350$$

$$C = \$150$$

$$\text{Additional purchases per passenger} = \frac{\$150}{.5} = \$300.$$

**P 2–38: Solution to Roberts Machining** (30 minutes)
[Describing the opportunity set and determining opportunity costs]

a. The opportunity set consists of:

1. Use die to produce #1160 racks and then scrap the die.
2. Use die to produce #1160 racks, but do not scrap the die.
3. Do not produce #1160 racks. Scrap the die immediately.
4. Sell the die to Easton.
5. Do not produce and do not scrap die.

b. Cash flows of each alternative (assuming GTE does not sue Roberts for breaching contract and ignoring discounting):

1. Use die to produce #1160 racks and then scrap the die

| | |
|---|---|
| Accounting profit | $358,000 |
| Add back cost of die | 49,000 |
| Scrap | 6,800 |
| Net cash flow | $413,800 |

2. Use die to produce #1160 racks, but do not scrap the die

| | |
|---|---|
| Accounting profit | $358,000 |
| Add back cost of die | 49,000 |
| Net cash flow | $407,000 |

3. Do not produce #1160 racks. Scrap the die immediately

| | |
|---|---|
| Net cash flow | $6,800 |

4. Sell the die to Easton

| | |
|---|---|
| Payment from Easton | $588,000 |
| Less lost future profits | -192,000 |
| Net cash flow | $396,000 |

5. Do not produce and do not scrap die

| | |
|---|---|
| Net cash flow | $0 |

c. Opportunity cost of each alternative:

| | |
|---|---|
| 1. Use die to produce #1160 racks and then scrap the die | $407,000 |
| 2. Use die to produce #1160 racks, but do not scrap the die | $413,800 |
| 3. Do not produce $1160 racks. Scrap the die immediately | $413,800 |
| 4. Sell the die to Easton | $413,800 |
| 5. Do not produce and do not scrap die | $413,800 |

d. Roberts should reject Easton's offer and produce the #1160 rack as specified in its contract. This alternative has the lowest opportunity cost (or equivalently, it has the greatest net cash flow).

**P 2-39:** **Solution to Doral Rentals** (30 minutes)
[All costs are variable in the long run, breakeven, and profit maximization]

a. The fraction of sprayers Amos has to rent each week to breakeven:

| | |
|---|---|
| Weekly lease cost per sprayer | $27.00 |
| | |
| Rental price | $38.00 |
| Cleaning cost | 2.00 |
| Contribution margin per rental | $36.00 |
| | |
| Fraction of rentals per week to break even ($27/$36) | 75% |

Suppose Doral leases 10 units and rents 75% of them each week. Then he has:

| | |
|---|---|
| Rental income: (75% × 10 × $38) | $285.00 |
| Less: | |
| Lease cost (10 × $27) | (270.00) |
| Cleaning cost on rented sprayers (75% × 10 × $2) | (15.00) |
| Profit | $0.00 |

b. No, Amos is ignoring the opportunity cost of his time spent leasing and renting the sprayers. He could be spending this time marketing his other rentals. He should also consider the additional rentals of his other items (punch bowls) from customers coming into his store to rent sprayers as a potential benefit of the sprayers.

c. With fixed costs of advertising and labor, the breakeven number of rentals is:

| | | |
|---|---|---|
| Fixed costs per week (advertising and labor) | | $65.00 |
| | | |
| Rental price per sprayer | $38.00 | |
| Less: cleaning cost | 2.00 | |
| Contribution margin per sprayer rented | $36.00 | |
| Likelihood of rental | × 0.90 | |
| Expected cash flow from each sprayer leased | | $32.40 |
| Less: lease cost per sprayer | | ($27.00) |
| Expected contribution margin per rental | | $5.40 |
| Breakeven number of rentals per month ($65/$5.40) | | 12.04 |

d. Amos wants to maximize profits, so

Profits $= P \times Q - V \times Q - FC$

$= (69 - Q)Q - 29Q - \$65$

$= 69Q - Q^2 - 29Q - 65$

$= 40Q - Q^2 - 65$

Taking the derivative and setting it to zero to find the maximum profits :

$40 - 2Q = 0$

Or, $Q^* = 20$ sprayers

An alternative way to solve for the maximum profits is by using a table and searching for the maximum profits:

| Number of Sprayers | Price | Revenue | Lease Cost | Cleaning Cost | Fixed Cost | Total Cost | Profit |
|---|---|---|---|---|---|---|---|
| 10 | $59 | $590 | $270 | $20 | $65 | $355 | $235 |
| 15 | 54 | 810 | 405 | 30 | 65 | 500 | 310 |
| 16 | 53 | 848 | 432 | 32 | 65 | 529 | 319 |
| 17 | 52 | 884 | 459 | 34 | 65 | 558 | 326 |
| 18 | 51 | 918 | 486 | 36 | 65 | 587 | 331 |
| 19 | 50 | 950 | 513 | 38 | 65 | 616 | 334 |
| 20 | 49 | 980 | 540 | 40 | 65 | 645 | 335 |
| 21 | 48 | 1008 | 567 | 42 | 65 | 674 | 334 |
| 22 | 47 | 1034 | 594 | 44 | 65 | 703 | 331 |
| 23 | 46 | 1058 | 621 | 46 | 65 | 732 | 326 |
| 24 | 45 | 1080 | 648 | 48 | 65 | 761 | 319 |
| 25 | 44 | 1100 | 675 | 50 | 65 | 790 | 310 |

The profit maximizing number of sprayers is 20.

**P 2-40:** **Solution to Fuller Aerosols** (30 minutes)
[Breakeven and production planning with capacity constraints]

a. Breakeven volumes

**Fuller Aerosols**
**Breakeven Volumes**

| | AA143 | AC747 | CD887 | FX881 | HF324 | KY662 |
|---|---|---|---|---|---|---|
| Fixed cost | $900 | $240 | $560 | $600 | $1,800 | $600 |
| Price | $37.00 | $54.00 | $62.00 | $21.00 | $34.00 | $42.00 |
| Variable cost | 28.00 | 50.00 | 48.00 | 17.00 | 28.00 | 40.00 |
| Contribution margin | $9.00 | $4.00 | $14.00 | $4.00 | $6.00 | $2.00 |
| | | | | | | |
| Breakeven volume | 100 | 60 | 40 | 150 | 300 | 300 |

b. With 70 hours (or 4200 minutes) of capacity per week, all the products can be manufactured.

**Fuller Aerosols**
**Minutes on the Fill Line to Produce All Products**

| | AA143 | AC747 | CD887 | FX881 | HF324 | KY662 | Total Minutes |
|---|---|---|---|---|---|---|---|
| Fill time per case (minutes) | 3 | 4 | 5 | 2 | 3 | 4 | |
| Cases ordered | 300 | 100 | 50 | 200 | 400 | 200 | |
| Minutes | 900 | 400 | 250 | 400 | 1200 | 800 | 3950 |

An aerosol product should only be produced if its contribution margin times the number of units sold exceeds its fixed costs.

**Fuller Aerosols**
**Breakeven Volumes**

| | AA143 | AC747 | CD887 | FX881 | HF324 | KY662 |
|---|---|---|---|---|---|---|
| Contribution margin | $9.00 | $4.00 | $14.00 | $4.00 | $6.00 | $2.00 |
| Cases ordered | 300 | 100 | 50 | 200 | 400 | 200 |
| Contribution | $2,700 | $400 | $700 | $800 | $2400 | $400 |
| Fixed cost | 900 | 240 | 560 | 600 | 1,800 | 600 |
| Profit (loss) | $1,800 | $160 | $140 | $200 | $600 | -$200 |

c. Given a capacity constraint on the aerosol fill line, products should be produced that maximize the contribution margin per minute of fill time. The following table lists the order in which the products should be produced and the quantity of each produced. Products AA143, CD887, FX881, and HF324 are produced to meet demand. After producing these four products to meet demand this leaves 250 minutes of fill line time to produce 62 cases out of the 100 ordered AC747. Making 62 cases of AC747 generates contribution of $248 (62 x $4) which just barely covers its fixed costs of $240. And KY662 is not produced because it has the lowest contribution margin per minute of fill time and even if meeting all orders, it does not cover fixed costs.

**Fuller Aerosols**
**Production Schedule with Only 3,000 Minutes (50 hours × 60 minutes/hour) of Fill Line Time**

| | AA143 | AC747 | CD887 | FX881 | HF324 | KY662 | Minutes Available |
|---|---|---|---|---|---|---|---|
| Fill time per case (minutes) | 3 | 4 | 5 | 2 | 3 | 4 | |
| Cases ordered | 300 | 100 | 50 | 200 | 400 | 200 | |
| Minutes | 900 | 400 | 250 | 400 | 1200 | 800 | |
| Contribution margin | $9.00 | $4.00 | $14.00 | $4.00 | $6.00 | $2.00 | |
| Contribution margin/min | $3.00 | $1.00 | $2.80 | $2.00 | $2.00 | $0.50 | |
| Most to least profitable Product per minute | 1 | 5 | 2 | 3 | 3 | 6 | |
| Total minutes available | | | | | | | 3,000 |
| Minutes used to meet demand for AA143 | 900 | | | | | | 2,100 |
| Minutes used to meet demand for CD887 | | | 250 | | | | 1,850 |
| Minutes used to meet demand for FX881 and HF324 | | | | 400 | 1200 | | 250 |
| Minutes used to meet demand for AC747 | | 250 | | | | | 0 |
| Cases manufactured | 300 | 62.5 | 50 | 200 | 400 | 0 | |

**P 2-41:** **Solution to Happy Feet** (30 minutes)
[Breakeven and operating leverage]

a. Breakeven sales is calculated using the following formula:

Profits = 0 = Revenues – cost of goods sold – fixed costs

0 = R – 0.5R - $63,000 - .03R

0.47 = $63,000

R = $134,042.55

b. Dr. Zang should probably accept the revised lease agreement. The following table shows that she actually makes less money ($750 per month) at her expected sales level of $150,000 per month if she accepts the revised rental agreement of $1,000 per month plus 12.5 percent of sales. However, the revised lease agreement reduces her risk of bankruptcy.

| | **$13,333 + 3% Lease** | **$1,000 + 12.5% Lease** |
|---|---|---|
| Revenues | $150,000 | $150,000 |
| Cost of goods sold | 75,000 | 75,000 |
| Fixed rent | 13,333 | 1,000 |
| Lease fee as % of sales | 4,500 | 18,750 |
| Interest on bank loan | 11,667 | 10,500 |
| Other costs | 38,000 | 38,000 |
| Profits | $7,500 | $6,750 |

Note that depreciation on the store improvements are excluded from the calculation of profits since we are really interested in looking at cash flows from the business. Besides, depreciation is the same under both lease agreements, and hence does not affect the decision.

The slightly lower profit of $750 per month is a fairly low price to pay to lower the venture's operating leverage by making the landlord a pseudo partner in Happy Feet. The following table illustrates the effect on profits if revenues fluctuate between Dr. Zang's $80,000 and $220,000 estimates.

| | $13,333 + 3% Lease | | $1,000 + 12.5% Lease | |
|---|---|---|---|---|
| Revenues | $80,000 | $220,000 | $80,000 | $220,000 |
| Cost of goods sold | 40,000 | 110,000 | 40,000 | 110,000 |
| Fixed rent | 13,333 | 13,333 | 1,000 | 1,000 |
| Lease fee % of sales | 2,400 | 6,600 | 10,000 | 27,500 |
| Interest on bank loan | 11,667 | 11,667 | 10,500 | 10,500 |
| Other costs | 38,000 | 38,000 | 38,000 | 38,000 |
| Profits | -$25,400 | $40,400 | -$19,500 | $33,000 |

Here we see that if sales are only $80,000, the revised lease results in a smaller loss (-$19,500) than under the original lease (-$25,400). If sales are $220,000, the store generates $7,400 more under the original lease than the revised lease. But given Dr. Zang's limited working capital, the roughly $5,000 smaller loss when sales are low could be important, especially if there are a number of months of low sales until the store becomes established. Moreover, if the sales are substantially above Dr. Zang's estimates, the lease can be renegotiated in three years.

**P 2-42:** **Solution to Digital Convert** (30 minutes)
[Operating leverage and the cost of financial distress]

a. Profits are maximized at a wholesale price of $1,240 and a quantity of 20 units as calculated in the following table:

| Quantity | Price | Variable Cost | Fixed Cost | Profit |
|---|---|---|---|---|
| 19 | 1,278 | 480 | 0 | 15,162 |
| 20 | 1,240 | 480 | 0 | 15,200 |
| 21 | 1,202 | 480 | 0 | 15,162 |
| 22 | 1,164 | 480 | 0 | 15,048 |
| 23 | 1,126 | 480 | 0 | 14,858 |
| 24 | 1,088 | 480 | 0 | 14,592 |
| 25 | 1,050 | 480 | 0 | 14,250 |
| 26 | 1,012 | 480 | 0 | 13,832 |

Maximum profits $15,200

b. If DC adopts the new technology, profits are maximized at a wholesale price of $1,050 and a quantity of 25 units as calculated in the following table:

| Quantity | Price | Variable Cost | Fixed Cost | Profit |
|---|---|---|---|---|
| 19 | 1,278 | 100 | 7,000 | 15,382 |
| 20 | 1,240 | 100 | 7,000 | 15,800 |
| 21 | 1,202 | 100 | 7,000 | 16,142 |
| 22 | 1,164 | 100 | 7,000 | 16,408 |
| 23 | 1,126 | 100 | 7,000 | 16,598 |
| 24 | 1,088 | 100 | 7,000 | 16,712 |
| 25 | 1,050 | 100 | 7,000 | 16,750 |
| 26 | 1,012 | 100 | 7,000 | 16,712 |

Maximum profits $16,750

c. The following table shows that adopting the new sensor manufacturing technology does not maximize DC's total profits after considering the expected cost of financial distress. Adopting the new technology lowers the value of DC by $12,800. In other words, DC should stay with its current manufacturing technology.

| | |
|---|---|
| Monthly profits from the new technology | $16,750 |
| Monthly profits from the existing technology | 15,200 |
| Incremental profits from the new technology | $1,550 |
| Number of months the new technology must be leased | ×24 |
| Incremental profits over the next 24 months | $37,200 |
| | |
| Cost of financial distress | $500,000 |
| Increase in likelihood of financial distress over 24 months | ×10% |
| Increase in expected cost of financial distress | $50,000 |
| | |
| Expected total profits (loss) of new technology | ($12,800) |

**P 2-43:** **Solution to APC Electronics** (35 minutes)
[Accounting versus opportunity cost]

a. The hourly cost of operating each of the four lines is calculate in the following table:

| | LINE I | LINE II | LINE III | LINE IV |
|---|---|---|---|---|
| Equipment depreciation | $840,000 | $1,300,000 | $480,000 | $950,000 |
| Occupancy costs | 213,000 | 261,000 | 189,000 | 237,000 |
| Total annual line costs | $1,053,000 | $1,561,000 | $669,000 | $1,187,000 |
| Expected hours of operations | 1,800 | 2,200 | 1,600 | 2,000 |
| Operating cost per hour | $585.00 | $709.55 | $418.13 | $593.50 |

b. If APC accepts this special order from Healthtronics, APC will record cost of goods sold of:

| | |
|---|---|
| Set-up labor* | $160 |
| Assembly labor** | 3,192 |
| Line cost*** | 17,550 |
| Total cost | $20,902 |

*4 ×$40
** 3 × 14 × $28 + 3 x 16 × $42
*** 30 × $585

Even though line costs are fixed costs, they are still product costs and hence charged to inventory and then cost of goods sold when they are shipped.

c. APC's out of pocket costs for this special order consist of the set-up labor ($160) plus the assembly labor ($3,192) or $3,352.

d. The opportunity cost of the Healthtonics special order:

| **Healthtonics:** | | **Total** |
|---|---|---|
| Set-up labor | | |
| Hours | 4 | |
| Cost per hour | $40 | $160 |
| Assembly labor | | |
| Number of technicians | 3 | |
| Hours during the day | 14 | |
| Cost per hour | 28 | 1,176 |
| Number of technicians | 3 | |
| Hours during the evening | 16 | |
| Cost per hour | $42 | 2,016 |
| **SonarTech:** | | |
| Tear-down time | | |
| Hours | 2 | |
| Cost per hour | $40 | 80 |
| Set-up labor | | |
| Hours | 6 | |
| Cost per hour | $40 | 240 |
| Overtime costs | | |
| Number of technicians | 4 | |
| Hours | 14 | |
| Overtime rate ($14/hour) | $14 | 784 |
| Additional Freight | | 2,300 |
| Total cost | | $6,756 |

**P 2-44:** **Solution to Amy's Boards** (35 minutes)
[Break-even analysis — short-run versus long-run]

The major goals of this problem are to demonstrate how fixed costs first become fixed and second to illustrate the relation between fixed costs and capacity. Before the snow boards are purchased in part (a), they are a variable cost. (In the long run, all costs are variable.) However, once purchased, the boards are a fixed cost. The number of boards purchased determines the shop's total capacity, which is fixed, until she either buys more boards or sells used boards.

a. Number of boards to break-even:

| | |
|---|---|
| Fixed Costs | |
| Store rent (net of sublet, \$7,200 - \$1,600) | \$ 5,600 |
| Salaries, advertising, office expense | 26,000 |
| | \$31,600 |
| Contribution margin per board per year: | |
| Revenue per week | \$75 |
| Refurbishing cost | -7 |
| Contribution margin per board per week | \$68 |
| ×number of weeks | 20 |
| Seasonal contribution margin from 100% rental | \$1,360 |
| × likelihood of rental | 80% |
| Expected seasonal contribution margin per board | \$1,088 |
| Net cost per board (\$550 – \$250) | 300 |
| Net contribution per board per year | \$ 788 |
| Break-even number of boards (\$31,600 ÷ \$788) | 40.10 |

b. Expected profit with 50 boards:

| | |
|---|---|
| Expected seasonal contribution margin per board (from part a) | \$ 1,088 |
| × number of boards | 50 |
| Expected contribution margin | \$54,400 |
| Less: | |
| Cost of boards (\$300 × 50) | (15,000) |
| Fixed costs | (31,600) |
| Expected profit | \$ 7,800 |

c. Break-even number of rentals with 50 boards:

Total fixed costs

| | |
|---|---|
| Store rent | $ 5,600 |
| Salaries, advertising, and office expense | 26,000 |
| Boards and boots (net of resale, $300 × 50) | 15,000 |
| | $46,600 |

| | |
|---|---|
| Contribution margin per board per week | $68 |
| Break-even number of rentals $\frac{\$46,600}{\$68}$ | 685.29 |
| Total possible number of rentals (50 boards × 20 weeks) | 1,000 |
| Break-even fraction of boards rented each week | 68.5% |

d. In the long run, all costs are variable. However, once purchased, the boards are a fixed cost. The reason for the difference is Amy has about ten more boards than the break-even number calculated in part (a). In part (a), before the boards are purchased, they are a variable cost. She can buy any number of boards she wants and pay a proportionately higher cost for them and rent them all 80 percent of the time. Therefore the cost of the boards is a variable cost with respect to the number of rentals. It is subtracted from the revenue in calculating the contribution margin per board. Once you buy the boards, their cost becomes fixed. Instead of being included in calculating contribution margin, it is included in the fixed cost (numerator of the breakeven volume).

**P 2-45:** **Solution to Blue Sage Mountain** (35 minutes)
[Costs and pricing decisions-Appendix A]

a. Table of prices, quantities, revenues, costs, and profits:

| Quantity | Price | Total Revenue | Total Cost | Total Profit |
|---|---|---|---|---|
| 100 | $510 | $51,000 | $79,000 | -$28,000 |
| 200 | 490 | 98,000 | 88,000 | 10,000 |
| 300 | 470 | 141,000 | 97,000 | 44,000 |
| 400 | 450 | 180,000 | 106,000 | 74,000 |
| 500 | 430 | 215,000 | 115,000 | 100,000 |
| 600 | 410 | 246,000 | 124,000 | 122,000 |
| 700 | 390 | 273,000 | 133,000 | 140,000 |
| 800 | 370 | 296,000 | 142,000 | 154,000 |
| 900 | 350 | 315,000 | 151,000 | 164,000 |
| 1,000 | 330 | 330,000 | 160,000 | 170,000 |
| 1,100 | 310 | 341,000 | 169,000 | 172,000 |
| 1,200 | 290 | 348,000 | 178,000 | 170,000 |
| 1,300 | 270 | 351,000 | 187,000 | 164,000 |
| 1,400 | 250 | 350,000 | 196,000 | 154,000 |
| 1,500 | 230 | 345,000 | 205,000 | 140,000 |
| 1,600 | 210 | 336,000 | 214,000 | 122,000 |
| 1,700 | 190 | 323,000 | 223,000 | 100,000 |
| 1,800 | 170 | 306,000 | 232,000 | 74,000 |
| 1,900 | 150 | 285,000 | 241,000 | 44,000 |
| 2,000 | 130 | 260,000 | 250,000 | 10,000 |

b. Profits are maximized when the price is set at $310 and 1,100 boards are sold.

c. If fixed costs fall from $70,000 to $50,000, prices should not be changed because a price of $310 and 1,100 boards continue to maximize profits as illustrated below:

| Quantity | Price | Total Revenue | Total Cost | Total Profit |
|---|---|---|---|---|
| 100 | $510 | $51,000 | $59,000 | -$8,000 |
| 200 | 490 | 98,000 | 68,000 | 30,000 |
| 300 | 470 | 141,000 | 77,000 | 64,000 |
| 400 | 450 | 180,000 | 86,000 | 94,000 |
| 500 | 430 | 215,000 | 95,000 | 120,000 |
| 600 | 410 | 246,000 | 104,000 | 142,000 |
| 700 | 390 | 273,000 | 113,000 | 160,000 |
| 800 | 370 | 296,000 | 122,000 | 174,000 |
| 900 | 350 | 315,000 | 131,000 | 184,000 |
| 1,000 | 330 | 330,000 | 140,000 | 190,000 |
| 1,100 | 310 | 341,000 | 149,000 | 192,000 |
| 1,200 | 290 | 348,000 | 158,000 | 190,000 |
| 1,300 | 270 | 351,000 | 167,000 | 184,000 |
| 1,400 | 250 | 350,000 | 176,000 | 174,000 |
| 1,500 | 230 | 345,000 | 185,000 | 160,000 |
| 1,600 | 210 | 336,000 | 194,000 | 142,000 |
| 1,700 | 190 | 323,000 | 203,000 | 120,000 |
| 1,800 | 170 | 306,000 | 212,000 | 94,000 |
| 1,900 | 150 | 285,000 | 221,000 | 64,000 |
| 2,000 | 130 | 260,000 | 230,000 | 30,000 |

d. If variable costs fall from $90 to $50 per board, prices should be lowered to $290 per board to maximize profits as illustrated below:

| Quantity | Price | Total Revenue | Total Cost | Total Profit |
|---|---|---|---|---|
| 100 | $510 | $51,000 | $75,000 | -$24,000 |
| 200 | 490 | 98,000 | 80,000 | 18,000 |
| 300 | 470 | 141,000 | 85,000 | 56,000 |
| 400 | 450 | 180,000 | 90,000 | 90,000 |
| 500 | 430 | 215,000 | 95,000 | 120,000 |
| 600 | 410 | 246,000 | 100,000 | 146,000 |
| 700 | 390 | 273,000 | 105,000 | 168,000 |
| 800 | 370 | 296,000 | 110,000 | 186,000 |
| 900 | 350 | 315,000 | 115,000 | 200,000 |
| 1,000 | 330 | 330,000 | 120,000 | 210,000 |
| 1,100 | 310 | 341,000 | 125,000 | 216,000 |
| 1,200 | 290 | 348,000 | 130,000 | 218,000 |
| 1,300 | 270 | 351,000 | 135,000 | 216,000 |
| 1,400 | 250 | 350,000 | 140,000 | 210,000 |
| 1,500 | 230 | 345,000 | 145,000 | 200,000 |
| 1,600 | 210 | 336,000 | 150,000 | 186,000 |
| 1,700 | 190 | 323,000 | 155,000 | 168,000 |
| 1,800 | 170 | 306,000 | 160,000 | 146,000 |
| 1,900 | 150 | 285,000 | 165,000 | 120,000 |
| 2,000 | 130 | 260,000 | 170,000 | 90,000 |

**P 2–46:** **Solution to Gold Mountain Ski Resort** (45 minutes)
[Analyze reasonableness of an investment using breakeven]

a. Recommendation: Reject immediately.

Given the fixed and variable cost structure provided by the client, I calculate that breakeven volume of the venture is 82 percent of the chair lift's annual capacity (see analysis below).

Each daily pass generates $58 of contribution margin. With total fixed cost of $12.4 million ($8.3 million of financing cost plus $4.1 million of operating cost), they must sell 213,793 daily passes to break even. This number of passes requires 427,586 lifts. But their triple-person chair lift, if operating full, can only produce 518,400 lifts per year. It is likely that during weekends and holidays there will be long lift lines, uncharacteristic of a high-end ski resort, further reducing demand.

Early in the morning and late afternoons and at the beginning and end of the season, they are unlikely to have sufficient demand to operate the lift at the 82 percent of capacity necessary to breakeven, let alone generate a profit.

| | |
|---|---|
| Number of skiers per chair | 3 |
| Chairs per hour | 180 |
| Hours per day | 8 |
| Daily pass | $60 |
| | |
| Annual fixed cost of the ski resort | |
| Financing costs | $ 8,300,000 |
| Operating costs | $ 4,100,000 |
| | $12,400,000 |
| Variable costs per skier-day | |
| Additional cost per 100 skier-days | $ 200 |
| Skier days | ÷100 |
| | $ 2.00 |
| | |
| Contribution margin per skier-day | $58.00 |
| | |
| Breakeven number of skier days | |
| Fixed cost | $12,400,000 |
| ÷ Contribution margin | $58.00 |
| Breakeven skier days | 213,793 |
| Chair lifts to breakeven | |
| Breakeven skier days | 213,793 |
| Number of ski runs per skier-day | 2 |
| Chair lifts to breakeven | 427,586 |

| | |
|---|---|
| Chair lift Capacity | |
| Hours per day | 8 |
| Skiers lifted per hour | 540 |
| Skier-lifts per day | 4,320 |
| × Number of ski days/season | 120 |
| Ski runs per season | 518,400 |
| Breakeven lifts as a percentage of lift capacity | |
| Chair lifts to breakeven | 427,586 |
| Capacity of lift | 518,400 |
| | 82% |

b. Based on the revised facts, I would change my recommendation to, Gather additional information.

With the four-person chair lift, the number of daily passes to break even rises slightly (see below). However, the capacity of the chair lift increases more, thereby reducing the breakeven capacity to 62 percent. The resort has more capacity at peak times. However, while this additional capacity reduces lift lines at peak load periods, it also causes the slopes to be more congested, making the ski resort less attractive. I suggest we gather more data from competitive high-end resorts regarding the number of skiers per run per hour at peak times.

| | |
|---|---|
| Total fixed cost | $ 12,475,000 |
| Contribution margin | ÷ $58 |
| Breakeven number of skiers | 215,086 |
| | |
| Chair lifts to breakeven | |
| Breakeven skier days | 215,086 |
| Number of ski runs per skier-day | 2 |
| Chair lifts to breakeven | 430,172 |
| Chair lift Capacity | |
| Hours per day | 8 |
| Skiers lifted per hour | 720 |
| Skier-lifts per day | 5,760 |
| × Number of ski days/season | 120 |
| Ski runs per season | 691,200 |
| Breakeven lifts as a percentage of lift capacity | |
| Chair lifts to breakeven | 430,172 |
| Capacity of lift | 691,200 |
| | 62% |

**Case 2–1:** **Solution to Old Turkey Mash** (50 minutes)
[Period versus Product Costs]

a. This question involves whether the costs incurred in the aging process (oak barrels and warehousing costs) are period costs (and written off) or product costs (and capitalized as part of the inventory value). The table below shows the effect on income of capitalizing all the warehousing costs and then writing them off when the whiskey is sold.

| | Base Year | Year 1 | Year 2 | Year 3 |
|---|---|---|---|---|
| Revenues | $6,000,000 | $6,000,000 | $6,000,000 | $6,000,000 |
| less: | | | | |
| Cost of Goods Sold: | | | | |
| bbls distilled @ $100/bbl | $1,000,000 | $1,000,000 | $1,000,000 | $1,000,000 |
| Oak barrels | 750,000 | 750,000 | 750,000 | 750,000 |
| Warehouse rental | 1,000,000 | 1,000,000 | 1,000,000 | 1,000,000 |
| Warehouse direct costs | 2,500,000 | 2,500,000 | 2,500,000 | 2,500,000 |
| Net Income before taxes | $ 750,000 | $ 750,000 | $ 750,000 | $ 750,000 |
| Income taxes (30%) | 225,000 | 225,000 | 225,000 | 225,000 |
| Net Income after taxes | $ 525,000 | $ 525,000 | $ 525,000 | $ 525,000 |
| | | | | |
| Increase in income from capitalizing aging costs | $000 | $203,000 | $504,000 | $903,000 |

Since all the additional expansion costs are now being capitalized into inventory, profits are higher by the amount of the capitalized costs less the increase in taxes.

b. The present financial statements based on treating aging cost as period costs show an operating loss. This loss more closely represents the operating cash flows of the firm. Unless the bank is dumb, the bank will want to see a statement of cash flows in addition to the income statement. If the firm computes net income with the aging costs treated as product costs, net income is higher. But is the banker really fooled?

If the firm is able to sell the additional production as it emerges from the aging process, then the following income statements will result for years 3 to 10:

| | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 |
|---|---|---|---|---|---|
| Revenues | $6,000,000 | $6,000,000 | $6,000,000 | $7,200,000 | $8,400,000 |
| less: | | | | | |
| Cost of Goods Sold: | | | | | |
| (gallons sold × $2.50) | 1,000,000 | 1,000,000 | 1,000,000 | 1,200,000 | 1,400,000 |
| Oak barrels | 1,200,000 | 1,350,000 | 1,500,000 | 1,500,000 | 1,500,000 |
| Warehouse rental | 1,240,000 | 1,400,000 | 1,600,000 | 1,760,000 | 1,880,000 |
| Warehouse direct costs | 3,100,000 | 3,500,000 | 4,000,000 | 4,400,000 | 4,700,000 |
| Net Income before taxes | (540,000) | (1,250,000) | (2,100,000) | (1,660,000) | (1,080,000) |
| Income taxes (30%) | 162,000 | 375,000 | 630,000 | 498,000 | 324,000 |
| Net Income after taxes | ($ 378,000) | ($ 875,000) | ($1,470,000) | ($1,162,000) | ($ 756,000) |

| | Year 8 | Year 9 | Year 10 |
|---|---|---|---|
| Revenues | $9,600,000 | $10,800,000 | $12,000,000 |
| less: | | | |
| Cost of Goods Sold: | | | |
| (gallons sold × $2.50) | 1,600,000 | 1,800,000 | 2,000,000 |
| Oak barrels | 1,500,000 | 1,500,000 | 1,500,000 |
| Warehouse rental | 1,960,000 | 2,000,000 | 2,000,000 |
| Warehouse direct costs | 4,900,000 | 5,000,000 | 5,000,000 |
| Net Income before taxes | (360,000) | 500,000 | 1,500,000 |
| Income taxes (30%) | 108,000 | (150,000) | (450,000) |
| Net Income after taxes | ($ 252,000) | $ 350,000 | $1,050,000 |

Notice that by year 10, the firm's profits are twice what the old base profits were. Ultimately, the decision by the banker to continue lending to Old Turkey will depend on the banker's expectation that the additional production will be sold, not on how the accounting profits are recognized on the books.

The decision to report aging costs as product costs depends on the following questions:

- Will taxes be affected? If the treatment of aging costs is changed for reporting purposes, will the IRS require the firm to use the same method for taxes? If so, this will increase the firm's tax liability and further increase the cash drain the firm faces. Therefore, expert tax advice is needed.
- Will the bank be fooled by the positive income numbers even though a cash drain is occurring? The bank's decision to continue to lend to the firm depends on its assessment of the firm's ultimate ability to sell the increased quantities produced at the same or higher prices. Independent of how the firm reports its current earnings, the wisdom of the decision to double production depends on whether the overseas markets for the product exist.
- The bank may in fact want the firm to treat aging costs as product costs and thereby increase reported profits to satisfy bank regulatory reviews. Regulators look closely at outstanding loans and the documentation provided by the borrowers to their banks. Submitting income statements with reported losses may cause the regulators to question this loan, thereby imposing costs on the bank.

**Advice**: First, find out if the firm can continue to write off aging costs as period expenses for taxes while capitalizing these costs for financial reporting purposes. If the tax rules are such that the firm can keep separate books, then take both sets of income statements and the cash flow statements to the bank and find out which set of statements they feel more accurately reflects the firm's financial condition.

**Case 2-2: Solution to Mowerson Division** (CMA adapted) (60 minutes)
[Opportunity cost of make/buy decisions]

In this problem, specific identification of opportunity costs is required.

a. Joseph Wright should have analyzed the costs and savings that Mowerson would realize for a period greater than one year (2007). For instance, Wright should have considered the fact that Mowerson expects production volume to steadily increase over the next three years. Under these circumstances, the difference between Mowerson's standard cost for manufacturing PCBs and Tri-Star's price for PCBs becomes increasingly important. A decision of this type is dependent on events in the future, i.e., differing income streams, production plans, and production capabilities. Furthermore, this is a long-term decision, which means that more than one year should be considered. Once Mowerson dismisses the assembly technicians, it would not be able to rehire them immediately. By incorporating more than 2007 costs and revenues, Mowerson should also use discounted cash flow techniques to recognize the time value of money.

b.

| | (i) Appropriate/Inappropriate | | (ii) Correct/Incorrect |
|---|---|---|---|
| 1. | Appropriate. Mowerson will no longer have to pay these wages. | 1. | Correct. This is the cost associated with the 40 technicians who will no longer work at Mowerson. |
| 2. | Inappropriate. The Assembly Supervisor will continue to be employed by Mowerson for two years. | 2. | Incorrect. Cost will continue to be incurred by Mowerson and only the amount should be included in Wright's analysis, that is salary less the benefits provided by the supervisor. |
| 3. | Appropriate but only to the extent of the outside rental space. The cost associated with the main plant floor space is inappropriate because Mowerson is still using this space. | 3. | Incorrect. Only the amount related to the outside rental space (1,000 × $9.50 = $9,500) should be included. The cost associated with the floor space in the main plant will continue. |
| 4. | Inappropriate. Although the purchasing clerk is on temporary assignment to a special project, the clerk's employment at Mowerson will continue. | 4. | Incorrect. There will be no savings associated with the purchasing clerk, except for any value added by the clerk to the special project. |
| 5. | Appropriate. Mowerson will realize this savings from the reduction in purchase orders issued. | 5. | Correct based on the information provided. |
| 6. | Inappropriate. Mowerson has included the cost of incoming freight in direct material cost and Tri-Star has included the cost of delivery in its price. Therefore, any differential in freight expense is accounted for in Item 7. | 6. | Incorrect. Any savings or additional costs associated with freight expense will be included in Item 7. |
| 7. | Appropriate. Any differential between the in-house cost to manufacture and the purchase cost should be accounted for in Wright's analysis. | 7. | Incorrect. The correct amount should be $2,975,000 [($60.00–30.25) × 100,000]. The only relevant manufacturing costs are direct material ($24.00) and variable overhead ($6.25) as fixed overhead will continue to be incurred irrespective of the decision and direct labor costs have already been considered as a savings in Item 1. |
| 8. | Appropriate. The junior engineer represents an addition to the staff. | 8. | Correct based on the information provided. |
| 9. | Appropriate. The quality control inspector represents an addition to the staff. | 9. | Correct based on the information provided. |

| | |
|---|---|
| 10. Appropriate. The increase in the safety stock represents additional cost to Mowerson. | 10. Incorrect. Mowerson currently maintains a safety stock of 1,800 boards so a more correct amount is $4,800 as calculated below. However, the correct safety stock level really cannot be determined without knowing the consequences of a stockout, i.e., the cost of a stockout must be compared to the additional storage cost. |

| Percentage of Time Tri-Star Deliveries Will be Late | Probability (1) | Safety Stock of PCBs (2) | Expected Value (1) × (2) |
|---|---|---|---|
| 4% | .30 | 2,500 | 750 |
| 6% | .40 | 4,000 | 1,600 |
| 8% | .25 | 6,000 | 1,500 |
| 10% | .05 | 7,000 | 350 |

| | |
|---|---|
| New safety stock level | 4,200 |
| Current level | 1,800 |
| Increase in safety stock | 2,400 |
| Cost per unit | $2 |
| Additional cost | $4,800 |

c. In evaluating its manufacturing decision, Mowerson should consider information about Tri-Star's:

- financial stability
- credit rating
- reputation for product quality and ability to meet quoted deliveries
- potential price increases in the future
- capacity levels
- competition, i.e., other potential sources of supply besides Tri-Star.

**Case 2–3: Solution to Puttmaster** (60 minutes)
[Opportunity cost of lost sales]

The profit-maximizing number of infomercials requires trading off the additional sales of Puttmasters sold via infomercials against the cost of the infomercials and the cost of the lost sales from retail outlets. Each Puttmaster sold via the infomercial yields the following contribution margin:

| | |
|---|---|
| Selling price | $69.95 |
| Shipping and handling fee | 15.95 |
| Total revenue | $85.90 |
| Less: | |
| Manufacturing cost | 9.55 |
| Shipping | 5.80 |
| Answering fee | 2.00 |
| Contribution margin | $68.55 |

Innovative Sports' contribution margin for each unit sold to the distributor is:

| | |
|---|---|
| Selling price | $30.85 |
| Less: | |
| Manufacturing cost | 9.55 |
| Contribution margin | $21.30 |

Since every 10 Puttmasters sold via infomercials reduces retail store sales by two units, 10 infomercials cause $42.60 (2 × $21.30) of lost contribution margin from retail sales. Therefore, each infomercial sale has an opportunity cost of $4.26 ($42.60 ÷ 10). Hence, the net contribution margin of each infomercial sale is:

| | |
|---|---|
| Contribution margin | $68.55 |
| Less: | |
| Contribution margin (retail sale) | 4.26 |
| Net contribution margin | $64.29 |

To breakeven on each infomercial, Innovative Sports must sell 13,143 Puttmasters ($845,000 ÷ $64.29).

The following table calculates the expected number of Puttmasters to be sold from repeated showings of the infomercial assuming that each showing generates 90 percent of unit sales as the previous showing.

| Showing Number | Units Sold |
|---|---|
| 1 | 22,000 |
| 2 | 19,800 |
| 3 | 17,820 |
| 4 | 16,038 |
| 5 | 14,434 |
| 6 | 12,990 |

Innovative Sports will want to continue to purchase infomercial TV spots as long as each 30-minute spot continues to produce total contribution margin in excess of the infomercial's cost ($845,000) after taking into account the affect of the infomercial on reducing retail sales. From the above table, we see that five infomercials produce sales in excess of the 13,143 breakeven point. Therefore, the profit-maximizing number of infomercials is five.

The following table confirms this conclusion.

| Infomercial Number | Units Sold | Total Contribution | Cost of Infomercial | Profit from Infomercial | Cumulative Profit |
|---|---|---|---|---|---|
| 1 | 22,000 | $1,414,380 | $845,000 | $569,380 | $569,380 |
| 2 | 19,800 | 1,272,942 | 845,000 | 427,942 | 997,322 |
| 3 | 17,820 | 1,145,648 | 845,000 | 300,648 | 1,297,970 |
| 4 | 16,038 | 1,031,083 | 845,000 | 186,083 | 1,484,053 |
| 5 | 14,434 | 927,975 | 845,000 | 82,975 | 1,567,028 |
| 6 | 12,991 | 835,177 | 845,000 | -9,823 | 1,557,205 |
| 7 | 11,692 | 751,660 | 845,000 | -93,340 | 1,463,864 |
| 8 | 10,523 | 676,494 | 845,000 | -168,506 | 1,295,358 |
| 9 | 9,470 | 608,844 | 845,000 | -236,156 | 1,059,202 |

Cumulative profits reach a maximum at five infomercials.

# CHAPTER 3
## OPPORTUNITY COST OF CAPITAL AND CAPITAL BUDGETING

**P 3–1:** **Solution to IRR Problem** (5 minutes)
[Simple IRR calculation]

$$0 = (\$50{,}000) + 8{,}330 \times \text{Annuity Factor (IRR = ?, t = 7)}$$
$$6.002 = \text{Annuity Factor (IRR = ?, t = 7)}$$
$$\text{IRR} = 4\%$$

**P 3–2:** **Solution to Accelerated Depreciation** (10 minutes)
[Depreciation tax shields]

As long as the firm has positive taxable income and tax rates remain constant, accelerated depreciation is preferable to the straight-line method. The accelerated depreciation method allows for earlier writeoffs of the original cost. Since larger and earlier writeoffs shield more income from taxes in earlier time periods, the present value of the tax shield from depreciation is greater under the accelerated method.

**P 3–3:** **Solution to Jasper, Inc.** (10 minutes)
[Internal rate of return]

a. The internal rate of return is the discount rate that equates the present values of the inflows to the outflows. Or, for project A:

$$0 = -\$300{,}000 + \$100{,}300 \text{ x Annuity Factor } (IRR_a = ?, t = 5)$$
$$\$300{,}000 = \$100{,}300 \times \text{Annuity Factor } (IRR_a = ?, t = 5)$$
$$2.991 = \text{Annuity Factor } (IRR_a = ?, t = 5)$$

Looking in the present value of an annuity table, $IRR_a = 20\%$.

Project B:

$$0 = -\$150{,}000 + \$55{,}783 \times \text{Annuity Factor } (IRR_b = ?, t = 5)$$
$$\$150{,}000 = \$55{,}783 \times \text{Annuity Factor } (IRR_b = ?, t = 5)$$
$$2.689 = \text{Annuity Factor } (IRR_b = ?, t = 5)$$

Looking in the annuity tables, $IRR_b = 25\%$.

b. Both projects have IRRs greater than the required rate of return. Using the IRRs as a measure then, we should take alternative B since it has the highest net present value.

| | A | B |
|---|---|---|
| Annual cash flows | $100,300 | $55,783 |
| NPV @ 16% | 328,382 | 182,634 |
| Less: initial outlay | 300,000 | 150,000 |
| NPV | $28,382 | $32,634 |

**P 3–4:** **Solution to Just One, Inc.** (10 minutes)
[IRR vs. NPV]

The original IRR ranking is misleading because the scale of each project is different. While Q has the higher IRR, it is a smaller project and yields fewer dollars of net present value.

**P 3–5:** **Solution to Equity Corp.** (10 minutes)
[Determining relevant cash flows for valuing an investment]

The consulting fees are a sunk cost and are not used in this decision. Let's look at the cash flows.

| | |
|---|---|
| PV operating revenues (after tax) | $90,000 |
| PV operating expense (after tax) | ($20,000) |
| PV tax savings from depreciation .4 × $87,500 | $35,000 |
| Cost of machine | ($100,000) |
| Net present value | $ 5,000 |

Equity Corporation should install the equipment.

**P 3–6:** **Solution to Declining Market, Inc.** (10 minutes)
[When to discontinue a product line]

There are two things wrong. First, depreciation shields some income from tax. This shield must be taken into account in the contribution equation. A better equation is:

$$(1 - \tau)(\text{sales} - \text{variable cost}) + \tau \times \text{depreciation}$$

Second, one should compare the present value of the contribution to earnings to the price the company can get for selling the equipment.

**P 3–7:** **Solution to Northern Sun, Inc.** (15 minutes)
[Net present value and payback]

a. Note: all cash inflows and outflows are at the end of the year.

| Net Cash Inflow (Outflow) | Year | Discount Factor @ 10% | Present Value |
|---|---|---|---|
| $(355) | 1 | .909 | ($323) |
| 55 | 2 | .826 | 45 |
| 190 | 3 | .751 | 143 |
| 240 | 4 | .683 | 164 |
| 190 | 5 | .621 | 118 |
| Net Present Value | | | $147 |

b.

| Year | Inflow | Cumulative Inflow | Investment to be Recovered |
|---|---|---|---|
| 1 | 0 | 0 | 355 |
| 2 | 55 | 55 | 300 |
| 3 | 190 | 245 | 110 |
| 4 | 240 | 485 | – |
| 5 | 190 | 675 | – |

3 years + (110 ÷ 240) = 3.46 years

**P 3–8:** **Solution to Ab Landlord** (15 minutes)
[Valuing rental problem with inflation]

a. Ab Landlord needs to weigh the purchase offer against the present value of the net cash flows from his current operation. Mr. Landlord expects the net cash flow in real dollars to remain constant at $200,000/year. Since we have the cash flow in real dollars, we can use the real interest rate of 5% to calculate the present value.

$$
\begin{aligned}
PV &= \$200{,}000 \times \text{Annuity Factor } (i = .05,\ t = 10) \\
&= \$200{,}000 \times 7.722 \\
&= \$1{,}544{,}000
\end{aligned}
$$

Since the present value of the current operation is greater than the purchase offer, Mr. Landlord should keep the property.

b. In this case, the net cash flows remain constant in nominal dollars.

$$\begin{aligned} PV &= \$200{,}000 \times \text{Annuity Factor } (i = .16, t = 10) \\ &= \$200{,}000 \times 4.833 \\ &= \$966{,}600 \end{aligned}$$

If rent control is imposed, then Mr. Landlord should sell the building now for $1,500,000.

**P 3–9:** **Solution to Lottery** (15 minutes)
[Present value and future value of annuity]

a. The minimum lump sum you should take is the present value of the cash payments.

$$\begin{aligned} PV &= \$100{,}000 \times \text{Annuity Factor } (i = .10, t = 10) \\ &= \$100{,}000 \times 6.145 \\ &= \$614{,}500 \end{aligned}$$

b. This question is essentially (a) in reverse. You are looking for the future value of the cash payments. Looking in the future value in arrears table, the annuity factor is 15.937.

$$\begin{aligned} FV &= \$100{,}000 \times 15.937 \\ &= \$1{,}593{,}700 \end{aligned}$$

c. This is similar to (a). This time, t = 7.

$$\begin{aligned} PV &= \$100{,}000 \times \text{Annuity Factor } (i = .10, t = 7) \\ &= \$100{,}000 \times 4.868 \\ &= \$486{,}800 \end{aligned}$$

d. To convert an end-of-year payment schedule to a beginning-of-year schedule, we need only multiply by 1 + r. The minimum payment is $614,500 × 1.10 = $675,900.

**P 3–10:** **Solution to Mr. Jones's Retirement** (15 minutes)
[Saving for retirement]

This problem must be broken into two parts to solve. First, the present value of the retirement annuity must be calculated.

$$\begin{aligned} PV &= \$30{,}000 \times \text{Annuity Factor } (r = .04,\ t = 15) \\ &= \$30{,}000 \times 11.118 \\ &= \$333{,}540 \end{aligned}$$

Now we need to calculate the annual savings required that will grow to this retirement amount using the future value of an annuity table.

$$\begin{aligned} \$333{,}540 &= \text{Payment} \times \text{Future Annuity Factor } (r = .04,\ t = 20) \\ &= \text{Payment} \times 29.778 \\ \$11{,}200 &= \text{Payment} \end{aligned}$$

**P 3–11:** **Solution to NPV vs. Payback** (15 minutes)
[NPV and payback]

The investment generates cash flows of $1,200 in its first five years. The worst NPV would be generated when the entire $1,200 is received at the end of the fifth year. In that case the NPV is:

$$NPV = -1{,}200 + \frac{1{,}200}{(1.2)^5}$$

$$= -1{,}200 + 482$$

$$= -\$718$$

**P 3–12:** **Solution to Simple Investment** (15 minutes)
[Net present value]

$$\begin{aligned} \text{NPV of investment} &= -\$1{,}000 + \$300 \text{ (PV of an annuity for 5 yrs. @ 14\%)} \\ &\quad + \frac{140}{.14} \text{ (PV of \$1 received in 5 yrs. at 14\%)} \\ &= -\$1{,}000 + \$300(3.433) + \$1{,}000(.519) \\ &= -\$1{,}000 + \$1{,}030 + \$519 \\ &= \$549 \end{aligned}$$

**P 3–13:** **Solution to Demand for DVD Players** (15 minutes)
[Competitive Pricing]

Let the price be p. In a competitive industry the NPV of a new plant will tend to be zero.

$$NPV = -\$40{,}000{,}000 + \frac{(p - \$20) \times 100{,}000}{.10} = 0$$

so

$p - \$20 = \$40$
$p = \$60$

The price is \$60.

**P 3–14:** **Solution to Clean Tooth** (15 minutes)
[Evaluating a divestiture]

PV = \$50,000 × PV of annuity for 10 yrs. @ r

PV depends on r.

Point of indifference: \$250,000 = \$50,000 × PV of annuity for 10 yrs. @ r

$$\text{PV of annuity @ r\% for 10 yrs.} = \frac{\$250{,}000}{\$50{,}000} = 5.000$$

PV of annuity for 10 yrs. @ 14% = 5.216
PV of annuity for 10 yrs. @ 16% = 4.833

| | |
|---|---|
| If market rate of interest > 15% | Keep |
| If market rate of interest < 15% | Sell |

**P 3–15:** **Solution to New Car** (15 minutes)
[Computing effective interest rates]

Let A = annuity factor

\$50,000 = \$2,233.33 × A

A = 22.39 ⇒ i = 2% month ⇒ 24% annual rate compounded monthly

Or,

$(1.02)^{12} - 1 = 26.8\%$ = annual rate compounded annually.

**P 3–16:** **Solution to National Taxpayers Union** (15 minutes)
[Relation between interest rates and inflation]

If nominal interest rates are determined in a competitive market, then

$$r_n = (1 + r_R)(1 + I) - 1$$

where

$r_n$ = the nominal interest rate in year t

$r_R$ = real rate of interest

I = expected rate of inflation in year t.

Since the interest rate on Treasury bills is determined in a competitive market, the observed rate of interest on Treasury bills incorporates inflation. As the rate of inflation increases, the nominal rate of return increases. Thus, the real rate of return is unaffected by inflation. The author of the letter ignores this link between the rate of inflation and nominal interest rates.

The author also ignores the fact that the real value of the $1,000 annual savings depends on the rate of inflation. If the real value of $1,000 was saved every year, the present value of the amount available for retirement would be unaffected by inflation.

Present Value of Amount Available for Retirement $= \sum_{t=1}^{45} \frac{\$1,000(1+I_t)}{(1+r_R)(1+I_t)} = \sum_{t=1}^{45} \frac{\$1,000}{(1+r_R)^t}$

**P 3–17:** **Solution to Federal Dam Project** (15 minutes)
[Present value of a government subsidy]

Assume the farmer values the dam at the construction cost, or $300 per acre.

Subsidy = $30,000 – PV (payments)

*For 10 percent:*

PV (payments) $= \left(\frac{1}{1.1}\right)^5 \sum_{t=1}^{30} \frac{\$1,000}{(1.1)^t}$

$= (.6209)(9.427)(\$1,000)$
$= \$5,853.22$

Subsidy = $24,146.78

**P 3–18:** **Solution to South American Mining** (20 minutes)
[IRR of an additional investment]

a. The IRR is calculated by looking at the incremental differences (000s).

| | **Period 0** | **Period 1** | **Period 2** |
|---|---|---|---|
| Current situation | –\$8 | \$ 0 | \$10 |
| Additional expenditure | –\$9 | \$10 | \$ 0 |
| Difference | –\$1 | \$10 | –\$10 |

Let X = 1 ÷ (1 + IRR).
Using the equation,

$$0 = -\$1 + \$10X - \$10X^2$$

IRR can be calculated using the quadratic formula.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

where: $a = -\$10$
$b = \$10$
$c = -\$1$

$$x = \frac{-\$10 \pm \$7.746}{-\$20}$$

Or, $x_1 = .8873$ and

$x_2 = .1127$

Since, $x = \dfrac{1}{1+irr}$

then $irr = \dfrac{1}{x} - 1$

And, $irr_1 = \dfrac{1}{.8873} - 1 = .127$

$irr_2 = \dfrac{1}{.1127} - 1 = 7.87$

The IRRs are 12.7 percent and 787 percent.

b. The bond rate of 15 percent lies between the two IRRs, making the additional outlay a positive NPV project. The company should invest the extra $1 million.

**P 3–19: Solution to House Mortgage** (20 minutes)
[Simple discounting]

a. The present value of a mortgage equals the period payment times the annuity factor

$200,000 = Payment x Annuity Factor (r = .10, n = 30)

$$\text{Payment} = \frac{\$200,000}{9.427}$$

Payment = $21,216

b. After one year: Principal = $21,216 × Annuity Factor (r = .10, n = 29)
= $21,216 × 9.370 = $198,793

After ten years: Principal = $21,216 × Annuity Factor (r = .10, n = 20)
= $21,216 × 8.514 = $180,633

c. The remaining principal after year 4 is

Principal = $21,216 × Annuity Factor (r = .10, n = 26)
= $21,216 × 9.161 = $194,360

If the house is remortgaged at 8 percent, the payments are

$194,360 = Payment × Annuity Factor (r=.08, n=30)
Payment = $194,360 ÷ 11.258
Payment = $17,264

The difference between the two payments is $3,952 ($21,216 – $17,264). The present value of the incremental difference over five years is

PV of Savings = $3,952 × Annuity Factor (r = .06, n = 5)
= $3,952 × 4.212 = $16,646

**P 3–20:** **Solution to Flower City Grocery** (20 minutes)
[Replacement problem without taxes]

**Old Machine**

| | |
|---|---|
| <u>Outflow</u> | |
| Repair | (\$ 1,000) |
| <u>Inflow</u> | |
| PV of Profits @ \$5,000 per year for 5 years, r = .09 (3.890) | <u>\$19,450</u> |
| Net Present Value of keeping old machine | <u>\$18,450</u> |

**New Machine**

| | |
|---|---|
| <u>Outflow</u> | |
| Purchase | (\$ 5,000) |
| <u>Inflow</u> | |
| Sale of old machine | <u>\$25,285</u> |
| \$500 Why or why not? r for 5 years, r =.09 (3.890) | |
| Net Present Value of purchasing new machine | <u>\$20,785</u> |
| $NPV_{new} - NPV_{old}$ | <u>\$ 2,335</u> |

Purchasing the new machine is the better choice.

**P 3–21:** **Solution to Toledo Stadium** (20 minutes)
[Simple capital budget]

a. Another way of asking this question is: Does this project have a positive NPV?

| | | |
|---|---|---|
| Annual Cash Flows: | | |
| Maintenance | \$(250,000) | |
| Cash Inflows: | | |
| Lease payments | 650,000 | |
| Concerts | 600,000 | |
| Other sports events | <u>50,000</u> | |
| Annual Net Cash Flows | \$1,050,000 | |
| × Annuity Factor | <u>9.818</u> | |
| Less: Original Outlay | | \$10,308,900 |
| Net Present Value | | <u>12,000,000</u> |
| | | <u>\$(1,691,100)</u> |

The city should not build the stadium.

b. In this case, we need to look at which choice costs the city more. The present value of the lost revenues is

$$
\begin{aligned}
PV &= (\$350{,}000) \times \text{Annuity Factor } (r = .08,\ t = 10) \\
&= (2{,}348{,}500)
\end{aligned}
$$

The negative present value of the lost revenues is greater than the negative present value of the stadium. It is now in the interest of the city to build the stadium.

**P 3–22: Solution to PQR Coal** (20 minutes)
[Modify or sell obsolete equipment]

The firm has two choices:

(A) Sell the old equipment for $500,000 and purchase new equipment for $800,000. Operating costs are unchanged.
(B) Refurbish the old equipment for $250,000 and incur an additional $20,000 per year operating expense for ten years.

We need to examine the present value of each alternative in order to determine which alternative is the better choice.
Choice (A) is simple. The additional cost to the firm is:

$$\$500{,}000 - \$800{,}000 = (\$300{,}000)$$

Choice (B) is a bit more complicated. PQR Coal will incur costs of $250,000 to adapt the machinery and $20,000 per year increase in operating costs.

$$
\begin{aligned}
PV_B &= (\$250{,}000) + (20{,}000) \times \text{Annuity Factor } (r = .10,\ t = 10) \\
&= (\$250{,}000) + (20{,}000) \times 6.145 \\
&= (\$372{,}900)
\end{aligned}
$$

Ms. Big is right. Choice (A) is the correct choice because it has the smallest present value of cash outlays.

**P 3–23: Solution to Student Loan Program** (20 minutes)
[Calculating the government's subsidy]

a.

$$
\begin{aligned}
PV &= \text{Payment x Annuity Factor } (r = .04,\ t = 10) \\
\$10{,}000 &= \text{Payment x } 8.111 \\
\$1{,}233 &= \text{Payment}
\end{aligned}
$$

b.

$$\begin{aligned} PV &= \text{Payment x Annuity Factor } (r = .06, t = 10) \\ &= \$1{,}233 \times 7.360 \\ &= \$9{,}075 \end{aligned}$$

c. Yes, the NDSL recipients are receiving a subsidy. Recall that five years have passed since the student received the $10,000 loan. The present value of the annual loan repayments ($1,233) amounts to:

$$\begin{aligned} \text{Present value of repayments} &= \$9{,}075 \times PV(r = .06, t = 5) \\ &= \$9{,}075 \times .747 \\ &= \$6{,}779 \\ \text{Present value of subsidy} &= \$10{,}000 - \$6{,}779 \\ &= \$3{,}221 \end{aligned}$$

**P 3–24:** **Solution to Geico** (20 minutes)
[Valuing land]

Yes. The land should be considered as part of the cost of the expansion project. Just because the land will not be sold does not mean it is "free" to this project. Accepting this expansion project restricts the firm's future use of the land. It cannot be sold or used for some other expansion.

The forgone receipts that could have been received from investing the proceeds of selling the land should be included in the cost of the expansion project. If the land were sold for $820,000 and the proceeds invested in U.S. government bonds paying 8% then $65,600 ($820,000 × 8%) is the annual opportunity cost of using this land in this investment project.

**P 3–25:** **Solution to Cost-Saving Device** (20 minutes)
[Solving for cash flows]

Depreciation = $59,400÷3

Let C = Annual pretax cost savings

$$\begin{aligned} NPV &= -\$59{,}400 + \$19{,}800(.34)(\text{PV of an annuity for 3 years @ 10\%} \\ &\quad + C(.66)(\text{PV of an annuity for 5 years @ 10\%}) = 0 \\ &= -\$59{,}400 + \$19{,}800(.34)(2.487) + C(.66)3.791 \\ &= -\$59{,}400 + \$16{,}742 + 2.502C \end{aligned}$$

$$C = \frac{\$42{,}658}{2.502} = \$17{,}050$$

**P 3–26:** **Solution to Depreciation Tax Shield** (20 minutes)
[Depreciation tax shield, real and nominal interest rates]

Depreciation per year $= \dfrac{\$100}{5}$ = \$20, so tax shield per year = \$20 × .40 = \$8 million

The tax shield is nominal. Nominal interest rate = (1 + real rate)(1 + inflation) -1
= $(1.05)^2$ - 1 = .1025

PV of tax shield = \$8 × (Present Value of annuity for 5 years @ 10.25%)
= \$30,134 million.

**P 3–27:** **Solution to Housing Markets** (20 minutes)
[Valuing real estate]

a. The question is, how much is the assumable mortgage on your house worth?

PV of annuity at 8% = 11.258
PV of annuity at 15% = 6.566

$\dfrac{\$120,000}{11.258}$ = Annual mortgage payment @ 8% = 10,659 x 6.566
= \$69,987 PV of payments

| | |
|---|---|
| Gain on loan: | \$120,000 |
| | – 69,987 |
| | \$ 50,013 |
| + sale price of identical house | 150,000 |
| Price of house | \$200,013 |

b. Difference in property taxes is \$1,000/year for perpetuity.

PV $= \dfrac{\$1,000}{.15} =$ \$6,667

Third home should sell for \$156,667.

**P 3–28:** **Solution to Mortgage Department** (20 minutes)
[Market rates of interest and usury laws]

a. $$\text{Payments} = \frac{\$50{,}000}{\text{Annuity }(30, .10)} = \frac{\$50{,}000}{9.427} = \$5{,}303.91$$

b. $50,000 – ($5,304 × 8.055) = $50,000 – 42,724 = $7,276

c. How many points the bank has to charge to eliminate the loss of part (b) is:

$$\frac{\$7,276}{\$50,000} \times 100 = 14.55$$

**P 3–29:** **Solution to Electric Generator** (20 minutes)
[Present value of alternative energy sources]

a. Investment: $140,000

Annual Savings = ($42,000 – $22,000) = $20,000

NPV = –$140,000 + (6.145) ($20,000)
= –$17,100

The generator should not be purchased because it has a negative net present value.

b. The NPV of using the generator for both electric power and heating evaluated:

Total investment: $140,000 + $40,000 = $180,000

Total Annual Savings: ($42,000 + $21,000) – ($22,000 + $10,000) = $31,000

NPV = –$180,000 + (6.145) ($31,000)

= $10,495.

The generator should be purchased and used for both electrical generation and heating.

**P 3–30:** **Solution to Watson's Bay** (25 minutes)
[Capital Budgeting]

| | Pre-tax Cash Flow | After-tax Cash Flow | Present Value Factor | | Present Value |
|---|---|---|---|---|---|
| Machine Cost | | $100,000 | 1 | | $(100,000) |
| Operating cash flows | | | | | |
| 3,000 @ $15(1–.33) | | $ 30,150 | 2.589 | | $ 78,058 |
| Depreciation shield | | | | | |
| Year 1 | $33,330(.33) | $10,999 | .833 | $ 9,162 | |
| 2 | 44,450(.33) | 14,669 | .694 | 10,180 | |
| 3 | 14,810(.33) | 4,887 | .579 | 2,830 | |
| 4 | 7,410(.33) | 2,445 | .482 | 1,178 | 23,350 |
| Salvage | $10,000(.67) | $ 6,700 | .482 | | 3,229 |
| Net Present Value | | | | | $ 4,637 |

Since the project has a positive net present value, accept the project.

**P 3–31:** **Solution to Linda Lion Co.** (30 minutes)
[Capital Budgeting and Inflation]

a.

| Year | Cash Flow Before Taxes | Cash Flow After Taxes | Depreciation | Tax Rate × Depreciation | Total Cash Flow | Present Value of Cash Flow |
|---|---|---|---|---|---|---|
| 0 | ($1,000) | ($1,000) | | | ($1,000) | ($1,000) |
| 1 | 400 | 240 | $250 | $100 | 340 | 294 |
| 2 | 420 | 252 | 250 | 100 | 352 | 264 |
| 3 | 441 | 265 | 250 | 100 | 365 | 237 |
| 4 | 463 | 278 | 250 | 100 | 378 | 212 |
| | | | | Net Present Value | | $ 7 |

Accept the investment.

The discount rate in the above calculation is 15.5 percent. That rate is obtained as follows:

$$(1 + \text{inflation rate}) \times (1 + \text{real rate}) -1 = (1.05)(1.1)-1=.155$$

b.

| Year | Cash Flow Before Taxes | Cash Flow After Taxes | Depreciation | Tax Rate × Depreciation | Total Cash Flow | Present Value of Cash Flow |
|---|---|---|---|---|---|---|
| 0 | ($1,000) | ($1,000) | | | ($1,000) | ($1,000) |
| 1 | 400 | 240 | $250 | $100 | 340 | 269 |
| 2 | 460 | 276 | 250 | 100 | 376 | 235 |
| 3 | 529 | 317 | 250 | 100 | 417 | 206 |
| 4 | 608 | 365 | 250 | 100 | 465 | 182 |
| | | | | Net Present Value | | ($ 108) |

Reject the investment.

The discount rate in the above calculation is 26.5 percent. That rate is obtained as follows:

(1 + inflation rate) × (1 + real rate) -1 = (1.15)(1.1)-1=.265

The answers differ for two reasons:

(i) The present value of the depreciation shield is less with higher inflation
PV of annuity of $100 for 4 years @ 15.5% = $283
PV of annuity of $100 for 4 years @ 26.5% = 230
Difference $ 53

(ii) The year –1 cash flow is higher by a present value of $18 in part (a) (the $400 wasn't adjusted to go along with the changed inflation rate). That increases the later years' cash flows also. The net effect is an annuity in advance of 18 for four years at a real rate of 10%.
18(3.487) $ 63
Total Difference $116

**P 3–32:** **Solution to Dakota Mining** (30 minutes)
[Multiple internal rates of return]

a. Let x = 1÷(1+ IRR)

IRR = $-4.4 + 27.7x - 25x^2$

$$x = \frac{-27.7 \pm \sqrt{27.2^2 - 4x25x4.4}}{-50}$$

$$= \frac{-27.7 \pm \sqrt{767.29 - 440}}{-50}$$

$$= \frac{-27.7 \pm 18.1}{-50}$$

$$= 0.192 \quad \text{or} \quad 0.916$$

$$\text{IRR} = -1 + 1/x$$

$$= -1 + 5.21 \quad \text{or} \quad -1 + 1.09$$

$$= 4.21 \text{ or } 0.09$$

There are multiple internal rates of return in this case, so we have to know whether the NPV curve cuts the axis from above or below. One way is to calculate the NPV using 8 percent.

$$\text{NPV } (r = 8\%) = -4.4 + \frac{27.7}{(1.08)} - \frac{25}{(1.08)^2}$$

$$= -4.4 + 25.6 - 21.4$$

$$= -0.2$$

So the curve cuts the axis from below and NPV is negative for market rates below 9 percent. The project should not be accepted.

b. For a market rate of return of 14 percent the NPV function is positive, so we should accept the project.

**P 3–33: Solution to Overland Steel** (30 minutes)
[Evaluating pollution fines and shut down]

| | |
|---|---|
| PV of Annuity 30 year 14% | 7.003 |
| PV of $1 in 30 years 14% | 0.020 |

*Alternatives*

(1) Keep running and pay fine:

| | | | |
|---|---|---|---|
| NPV | (–$365,000 + $450,000) × 7.003 | | $595,255 |
| | + Salvage 0.020 × 2,000,000 | | 40,000 |
| | | NPV | $635,255 |

(2) Pollution devices installed:

| | | | |
|---|---|---|---|
| NPV | (\$450,000 + 25,000) × 7.003 | | \$3,326,425 |
| | + Salvage 0.020 × 2,000,000 | | 40,000 |
| | | | \$3,366,425 |
| | – initial outlay | | 2,750,000 |
| | | NPV | \$ 616,425 |

(3) Sell it:

| | | |
|---|---|---|
| Purchase Price | | \$1,000,000 |
| Demolition Costs | | – 650,000 |
| | NPV | \$ 350,000 |

Alternative (1) is best if all the costs the company incurs are confined to the fine and there are no adverse publicity costs, lawsuits, or reduction in firm brand-name capital.

**P 3-34: Solution to Black Feather Indian Nation** (30 minutes)
[Estimating demand using opportunity cost for NPV analysis]

a. A discounted net present value calculation is proposed to compare the initial investment to the future cash flows from gasoline sales. A cost-volume-profit (breakeven) analysis is inappropriate because this is a multi-year investment project. For example, at a contribution margin of \$0.05 per gallon and an investment of \$4 million, 80 million gallons of gas must be sold to breakeven. There are two problems with using a breakeven point of 80 million gallons. First, it ignores fixed and variable operating costs of each station (insurance, building maintenance, labor, and utilities). Second, it ignores the time value of money. The Indian Nation is not indifferent between selling the 80 million gallons in the first year or over ten years.

b. Data requirements to calculate the annual cash flows include:

(i) The Nation's cost of capital. This number is needed to discount the future cash flows.

(ii) To estimate the potential customer demand, the following data are necessary:

- The number of licensed vehicles in each of the five bordering towns.
- The average number of miles driven by a licensed vehicle.
- The average number of miles from each city to the closest Nation gas station, and the average gasoline mileage of the vehicles in each city. These data are used to calculate how much gasoline an average customer must spend to get to the Nation's closest gas station.
- The distribution of income of the vehicle owners in each of the five cities. Dividing each income level by 2,000 hours per year (40 hours

per week × 50 weeks per year) is an estimate of that potential customer's opportunity cost of their time to drive one hour to get gasoline from the Nation. Only those drivers with fairly low opportunity cost of time will drive the extra miles to save \$0.50 per gallon. If the average fill-up is 15 gallons, the potential savings is \$7.50 (\$0.50 × 15 gallons).

(iii) Operating costs of each station must be estimated including both fixed and variable costs. This data can be gathered from trade associations or interviews of existing stations.

(iv) Profits from other sales such as oil, cigarettes, pop, and so forth. This data can be gathered from trade associations or interviews of existing stations.

**P 3–35: Solution to Scottie Corporation** (40 minutes)
[Capital Budgeting and Opportunity Cost]

a.

Annual cash flows

| | | |
|---|---|---|
| Sales | \$20,000(.6) | \$12,000 |
| Operating costs | – 5,000(.6) | –3,000 |
| Depreciation | 7,000(.4) | 2,800 |
| Total annual cash flows | | \$11,800 |

| | | |
|---|---|---|
| Present value of annual cash flows | 3.791(11,800) | \$44,734 |
| Original investment | | 35,000 |
| **Net Present Value** | | \$ 9,734 |

Given the project has a positive net present value, Scottie should accept the project.

b. (i)
Annual cash flows of rental

| | | |
|---|---|---|
| Rent | \$3,000(.6) | \$1,800 |
| Depreciation | \$2,000(.4) | 800 |
| Total annual cash flows | | \$2,600 |

| | | |
|---|---|---|
| Present value of annual cash flows | 3.791(\$2,600) | \$ 9,857 |
| Investment | | 10,000 |
| **Net Present Value of Renting** | | (\$ 143) |

Renting the warehouse space out has a negative net present value. Therefore, the space would not be rented and the alternative to the casting project is just to stay as is without renting the space. As a consequence there is no change in either the casting's cash flows or in the alternative cash flows and the casting's NPV is unchanged.

(ii) The opportunity cost is the cost of the next best alternative use. Since the next best alternative use of the space (to using it for the castings) is to leave it idle, the annual rent is not an opportunity cost.

**P 3–36:** **Solution to Punch Press** (40 minutes)
[Modify an existing machine or purchase a new one]

*Old Machine*

$$\text{Depreciation} = \frac{\$16{,}200+\$1{,}800}{3} = \$6{,}000/\text{year}$$

$$\text{NPV} = -\$16{,}200 + \frac{\$10{,}000(1-.4)+\$6{,}000\times.4}{1.1} + \frac{\$8{,}000(1-.4)+\$6{,}000\times.4}{1.1^2}$$

$$+\frac{\$6{,}000\times.4+\$8{,}000(1-.4)}{1.1^3} = \$2{,}796.24$$

*New Machine*

$$\text{Depreciation} = \frac{\$28{,}200}{3} = \$9{,}400$$

$$\text{Capital gain} = \$2{,}600 - \$1{,}800 = \$800$$

$$\text{NPV} = -\$28{,}200+\$2{,}600+\frac{\$18{,}000\times.6+\$9{,}400\times.4+\$800\times.4}{1.1}$$

$$+\frac{\$9{,}400\times.4+\$14{,}000\times.6}{1.1^2}+\frac{\$9{,}400\times.4+\$14{,}000\times.6}{1.1^3}$$

$$= \$\underline{\underline{6{,}531.03}}$$

Purchase the new punch press because it has a greater positive net present value.

**P 3–37:** **Solution to Apex Company** (40 minutes)
[Evaluating alternative machines]

a. We want to find the *after tax* present value of the two streams of cash flows and pick the one with the lowest present value of costs.

First, calculate the depreciation tax shield on each tool.

Tool A:

$$40\ \% \times \Sigma \frac{D(t)}{(1+r)^t} = \$46{,}000\left[\frac{12}{78(1+r)} + \frac{11}{78(1+r)^2} + \frac{10}{78(1+r)^3} + ... + \frac{1}{78(1+r)^{12}}\right] \times 40\%$$

$$= \frac{\$46{,}000}{78}\left[\frac{12}{1+r} + \frac{11}{(1+r)^2} + \frac{10}{(1+r)^3} + \ ...\ \frac{1}{(1+r)^{12}}\right] \times\ 40\%$$

$$= \frac{\$46{,}000}{78}[7{,}536\ +\ 7.139\ +\ ...\ 926]\ \times\ 40\%$$

$$= \frac{\$46{,}000}{78}\ \times\ 55.77\ \times\ 40\% = \$32{,}890\ \times\ 40\%\ =\ \underline{\underline{\$13{,}156}}$$

Tool B:

$$\text{Depreciation tax shield} = \frac{\$41{,}000}{78} \times\ 55.77\ \times\ 40\%\ =\ \underline{\underline{\$10{,}439}}$$

Next, calculate the present value of the cost of operating each tool.

For A: (1 – 40%) x\$26,000 × PV of annuity for 12 years @ 8%

= \$15,600 × 7.536 = \$117,562

For B: \$32,000 × (1 – 40%) × 7.536 = \$144,691

Finally, calculate the present value of the salvage values for each tool.

For A: $\frac{S}{(1+i)^{12}}$ = \$6,000 × .397 = \$2,382

For B: \$4,500 × .397 = \$1,787

| | Tool A | Tool B |
|---|---|---|
| Investment | –$52,000 | –$41,000 |
| Cost of operations | –117,562 | –144,691 |
| Tax shield from depreciation | +13,156 | +10,439 |
| Salvage | +2,382 | 1,787 |
| | –$154,024 | –$173,465 |

Choose Tool A because the net present value of its costs are lower.

b. One way to answer this part is that excluding depreciation the difference is $22,158 in favor of Tool A. Even if we allowed full depreciation for Tool B now, and none for Tool A, we only add to Tool B $41,000 × .4 = $16,400 and thus A is still preferred.

**P 3–38:** **Solution to Eastern Educational Services** (50 minutes)
[Capital budget or a replacement machine]

a. 1. *Initial Outlay*:

Old Machine Depreciation: $\dfrac{\$100,000 - \$20,000}{10} =$ $8,000/yr.

| | |
|---|---|
| | × 6 yrs. |
| Accumulated Depreciation | 48,000 |
| Book Value | 52,000 |
| Taxable Gain on Sale | $ 8,000 |
| Taxes on $8,000 | $ 3,200 |

Incremental Outlays:

| | |
|---|---|
| Purchase price | $140,000 |
| less: trade-in | (60,000) |
| + Tax on sale | 3,200 |
| net incremental outlay | $ 83,200 |

2. *Incremental Cost Savings*:

| | | |
|---|---|---|
| Variable production costs: $3 × 10,000 | | $30,000 |
| Incremental fixed costs | | 6,000 |
| Property taxes | ($100,000 – 140,000) × .05 | (2,000) |
| | Annual savings before taxes | 34,000 |
| | less: taxes (40%) | (13,600)* |
| Plus: | Increased tax shelter | 6,800† |
| | | $27,200 |

† $6,800 = 40% × change in depreciation expense

$$= 40\% \times \frac{\$140,000 - \$40,000}{4} - \$8,000$$

3. *Net Present Value @ 12%*

| | | |
|---|---|---|
| Annual savings: | $27,200 × 3.037 | $82,606.40 |
| Salvage value: | $20,000 × .636 | 12,720.00 |
| Present value of cash flows | | $95,326.40 |
| less: initial outlay | | –83,200.00 |
| NPV | | $12,126.40 |

b. (i) Less likely (1)
(ii) More likely (2)

* The preceding analysis looked at the *incremental* cash flows. An alternative equivalent solution method focuses on total cash flows.

There are four mutually exclusive alternatives:

| | | **New Machine** | |
|---|---|---|---|
| | | Not Buy | Buy |
| **Present** | Keep | I | III |
| **Machine** | Sell | II | IV |

| | I | II | III | IV |
|---|---|---|---|---|
| Contribution margin | $50,000 | | $80,000 | $80,000 |
| – FC | (10,000) | | (4,000) | (4,000) |
| – Property Taxes 5% | (5,000) | | (12,000) | (7,000) |
| × (1 – .4) | 21,000 | | 38,400 | 41,400 |
| + T × $D_t$ | 3,200 | | 13,200 | 10,000 |
| Annual Cash flows | $24,200 | $0 | $51,600 | $51,400 |
| PV of annuity × 3.037 | 73,495 | 0 | 156,709 | 156,102 |
| + Salvage | $20,000 | | $60,000 | $40,000 |
| PV of Salvage × .636 | 12,720 | 0 | 38,160 | 25,440 |
| Initial outlay | 0 | | –140,000 | –140,000 |
| less: Sale | 0 | $60,000 | 0 | $60,000 |
| + Tax on sale | 0 | –3,200 | 0 | –3,200 |
| Initial investment | $0 | $56,800 | –$140,000 | –$83,200 |
| NPV | $86,215 | $56,800 | $54,869 | $98,342 |

Of the four mutually exclusive alternatives IV has the highest NPV. The above solution is consistent with this.

$$NPV_{IV} – NPV_{I} = \$12,126.$$

# CHAPTER 4
## ORGANIZATIONAL ARCHITECTURE

**P 4-1:** **Solution to Empowerment** (10 minutes)
[Empowerment versus control]

In contrast to the argument, "for empowerment to work, managers should not let go of all control." If a manager gives a worker both decision control and decision management rights over a decision, the agency problems will be substantial. Managers must maintain some level of decision control (for example, monitoring). Workers can still be empowered by being given greater decision management rights (initiation and implementation rights).

**P 4-2:** **Solution to Pay for Performance** (10 minutes)
[Dysfunctional behavior with pay for performance]

The number of arrests would go up. However, the plan would likely have several undesirable effects. First, it would encourage the police to make arrests even if the reasons for the arrest are questionable. Second, it would encourage police to work on crimes where arrests are easy to make, rather than working on more serious crimes where it is more difficult to make numerous arrests. Third, the plan would not encourage cooperation or teamwork (since the bonus is based on individual arrests).

**P 4-3:** **Solution to Course Packets** (10 minutes)
[Opportunistic behavior and associated costs]

a. Finance faculty and those teaching large classes and/or those with large course packets are more likely to distribute class material electronically and those with smaller classes and smaller course packets will photocopy the material.

b. This is inefficient to the extent that most students download and then print the material on their personal printers. It is cheaper for one high-speed copier to make all the copies rather than having each student making copies on a more expensive and slower printers. If most students just download the materials, but do print only a fraction of the material, then all the faculty should be be distributing the material electronically.

**P 4-4:** **Solution to Allied Van Lines** (15 minutes)
[Agency costs and monitoring]

Long-haul truckers are much more difficult to monitor because they spend considerable time on the road by themselves. The only observable behavior is whether they make timely deliveries. Truck failures and wasted time on the road can lead to untimely deliveries. If the company owns the truck, the truck driver can blame the company for poor maintenance. If the truck driver owns the truck, then the trucker is responsible for truck maintenance and failure.

Inner-city truckers are easier to observe, and the company can perform maintenance of trucks daily.

**P 4-5:** **Solution to Voluntary Financial Disclosure** (15 minutes)
[Monitoring role of external financial reports]

The advantage of issuing financial statements voluntarily is reducing the monitoring costs of potential investors. If investors have more information about a company, they will bear less risk and be more willing to invest in the company.

The disadvantage of issuing financial statements is revealing proprietary information that may be of benefit to competitors. Firms may be reluctant to issue financial statements if they are performing poorly. Investors, however, will infer they are doing poorly if only the successful companies are issuing financial statements to distinguish themselves from poorly performing companies.

**P 4-6:** **Solution to University Physician Compensation** (15 minutes)
[Revenue sharing and compensation schemes]

The major problem with the compensation scheme is that physicians only pay 30 percent of the net cost of expenses once revenues exceed the stated salary target. Thus, if the doctor values some expenditure at more than 30 percent of the cost, but its value to the practice is less than its cost, the doctor will still make the expenditure. For example, suppose the physician has revenues in excess of the salary target and expenses and is considering taking a trip to a medical conference in Hawaii. The cost of the conference is $5,000. The value of the conference to the doctor is $4,500. Clearly, the trip would not be taken if the doctor had to pay the full cost. But since she only bears 30 percent of the cost (or $1,500) but values the trip at $4,500 she will take the trip.

The current salary target formula is dysfunctional. The hospital has to be careful about schemes that reimburse physicians for expenses that can be pure perks. For example, a doctor can take a trip to Hawaii for which she receives private benefits and the hospital no benefits. However, differentiating between "acceptable" and "unacceptable" expenses requires a costly monitoring system. One alternative is to charge the doctors a fixed rental fee for using the clinic. Such fixed fees do not affect marginal decisions.

**P 4–7:** **Solution to Desert Storm Mail Deliveries** (15 minutes)
[Inconsistent performance measures lead to adverse decisions]

In a letter from Capt. O'Connor, he describes the problem as improper performance measures. "Since Air Force planes will cube out (fill up) before they weigh out (load restrictions), what's the easiest way to both fill planes and empty warehouses? Send the packages, of course, and continue to store letters. January 10 packages were being shipped prior to December 15 letters. There's a cost of getting both packages and letters late. The performance measure should have been based on the number of pieces delivered or a combination of volume and pieces, taking aging into consideration. Correspondence should be considered a perishable commodity. (This is true for me, as I am still paying some bills out here.)"

**P 4-8:** **Solution to American InterConnect I** (15 minutes)
[Dysfunctional behavior from performance evaluation]

This question describes an actual company's procedure for measuring employee satisfaction. They wanted to include employee satisfaction as a performance criterion to get people to work towards creating a better workplace. However, all employees' performance was measured by their own self-reported satisfaction surveys. It should come as no surprise that all employees usually said they were very satisfied with their job. The only time this does not occur is when the group does not expect to receive any bonus because overall targets are not met or when they are so mad at their managers that they decide to punish them by reporting very low employee satisfaction.

Another problem with this scheme is that it discourages managers from setting tight targets and providing frank feedback to employees. To improve employee satisfaction managers will propose higher than optimum pay increases for their direct reports. These incentives are mitigated to the extent other targets are also adversely affected, such as earnings. However, at the margin, managers will substitute some earnings for more employee satisfaction.

This question raises the more general issue of why pay for employee satisfaction?

**P 4-9:** **Solution to Raises** (15 minutes)
[Pay and incentives]

Economic theory predicts that simply raising the pay of workers by 20 percent will not alter their effort choices (ignoring some potential "income effects"). Increasing the level of pay does not change the marginal costs and benefits of exerting effort. This, however, does not mean that money does not motivate people. The question is what would happen if the increase in pay were tied to increased effort? If the workers would be willing to exert more effort for more pay, then money could be said to motivate the workers.

**P 4-10:** **Solution to Decentralization** (15 minutes)
[Decentralization and control]

In classic market exchange, traders own the resources and bear the full wealth effects of their actions (there are no agency problems). In firms, decision makers act on the behalf of others and do not necessarily have strong incentives to maximize value. Hence decentralizing decision rights to employees will not always improve efficiency, even if these employees have better knowledge to make the decisions.

**P 4-11:** **Solution to Vanderschmidt's** (15 minutes)
[Specific knowledge and organizational architecture]

Joop does not have the same level of specific knowledge to run the company as his father. Rather the specific knowledge is likely to be held by other people throughout the company. Given this distribution of knowledge, Joop will probably have to decentralize decision rights. Decentralizing decision rights will require associated changes in the performance-evaluation and reward systems (so that the three legs of the stool balance). Joop will probably want to increase the emphasis on performance-based pay to motivate the newly empowered workers to make decisions that are in the best interest of the company.

**P 4-12:** **Solution to Sales Commissions** (15 minutes)
[Disincentives of sales commissions]

Given that she has decision rights over pricing and is evaluated and paid on sales, she will set prices to maximize sales, not profits. In fact, she will set price where marginal revenue equals her marginal cost, which does not include the marginal cost of the furniture.

**P 4-13:** **Solution to Formula 409** (15 minutes)
[Changing incentive systems]

"About half of my people left the company — and, I might add, they were the best half, my racehorses. They were replaced by recruits from large companies, and gradually, 409 became a little version of a big company — a bureaucratic mess where nobody thought much about case sales. I didn't want to run a company like that, so I sold it for a bundle and went back to being an entrepreneur and having fun." (Source: Wilson Harrell, "Inspire Action: What Really Motivates Your People to Excel?" Success, September 1995.)

**P 4-14:** **Solution to Pratt & Whitney** (15 minutes)
[Changing all three legs of the stool]

Broadening job descriptions changed decision rights assignments. Workers were assigned the task of redesigning the compensation package to base pay on training not seniority.

Performance measures were based on cost cutting and other targets. Also, performance measures tracked training.

Performance rewards were changed to pay based on meeting targets and training.

**P 4-15:** **Solution to Theory X-Theory Y** (20 minutes)
[Applying the framework]

There are certain aspects of both Theory X and Theory Y that are consistent with the basic assumptions underlying our framework. Other parts are inconsistent. We assume that workers are self-interested and tend to prefer leisure to work. On the other hand, there are also parts of each job that people enjoy. Nowhere have we assumed that people are incapable of self-direction and assuming responsibility. If this were literally true, why assume subordinates possess these traits but not their supervisors?

It is certainly the case that the more enjoyable work can be made, the less you have to pay people. Enjoyable jobs do not have to pay as much as unpleasant jobs to attract and retain individuals to these jobs. However, not all jobs can be made enjoyable (garbage collectors, or jobs that entail firing people).

Coercion, punishment, and rewards are useful controls but must be coupled with performance measures and decision rights. Theory Y is trying to motivate behavior by assigning "enjoyable" decision rights to people. This won't work unless coupled with performance measures and rewards.

**P 4-16:** **Solution to American InterConnect II** (20 minutes)
[Dysfunctional behavior from performance evaluation]

This question describes an actual company's procedure for awarding bonuses to new product development teams. Although AI is trying to provide incentives for product developers to increase firm revenues by developing new products the market wants, the system isn't working. The people assigned to new product development now are not the same ones who helped design the products the market is currently buying. Thus, the existing system is just adding noise to the product developers' bonuses. It is increasing the variance and hence the risk of their compensation. Employees resent this. Also, in assigning people to development teams, it will be more difficult to get people to serve on teams for groups that have current products that are not selling well in the market (not meeting their revenue target).

The problem arises because the accounting system cannot track current revenues back to product developers who helped design the product.

While revenue-based compensation plans are common in practice, they can induce dysfunctional incentives. In particular, if the employees receiving bonuses based on revenues have the decision rights to set prices, they will set prices that maximize total revenue which is not the same price that maximizes profits. The revenue-maximizing price occurs where the last unit sold generates no additional revenue. The profit maximizing price is where marginal revenue equals marginal cost.

**P 4-17:** **Solution to Private Country Clubs** (20 minutes)
[Agency costs from free riders]

This question illustrates that ownership structure affects the magnitude of agency problems.

The quote is both right and wrong in some sense. The restaurant operation manager (being self-interested) has incentives to shirk. Each member only owns $1/N^{th}$ of the restaurant operation and since monitoring is costly, members have an incentive to free-ride (shirk on monitoring). Therefore, country club food quality (holding prices constant) will tend to be lower than pure restaurants owned by individuals with alienable ownership shares. Individual owners capture the wealth consequences of their actions.

Clubs where members can resell memberships have more incentive to monitor restaurant quality than in clubs where the club resells the membership. Prospective members realize food quality is lower and discount the membership price they are willing to pay. The above statement is true in this sense.

Members would prefer higher-quality food for a given price, but agency problems--shirking by restaurant workers and free-riding by members -- reduce quality from what results in privately-owned restaurants.

NOTE: Franchising out the food operation creates a local monopoly situation because of the tie-in sale between golf/swimming and food/drink. Members are willing to pay a higher price to avoid traveling to a restaurant after golf.

**P 4-18:** **Solution to Tipping** (20 minutes)
[Knowledge and incentives]

When a customer comes into a restaurant in the U.S. they have an implicit contract with the waiter to tip for good service. A customer might honor this contract for two reasons. First, the person might value being fair and not want to shirk on the implicit agreement (economics allows for people to care about fairness). Second, the customer will realize that if he shirks on the tip the next time he comes back to the restaurant the waiter will shirk on service. Tips are likely to be higher at restaurants in residential neighborhoods because the second effect (the repeat-customer effect) is likely to be large. Many customers who will not return will frequent restaurants on interstate highways. These customers have large incentives to shirk on the tip unless they care significantly about fairness to the waiter.

**P 4-19:** **Solution to White's Department Store** (20 minutes)
[Dysfunctional behavior with pay for performance]

This behavior is likely to be caused by the compensation plan. Presumably, the employees are paid sales commissions. In this case, they have incentives to hide sale items if they think they can convince customers to purchase more expensive products. They also have limited incentives to exert effort on activities other than personal selling. For example, individual salespeople have incentives to freeride on the efforts of others in designing displays to attract customers. The situation might be improved by changing the compensation scheme to emphasize elements other than personal sales.

**P 4-20:** **Solution to Coase Farm** (25 minutes)
[Markets versus firms]

a. Because Taggart cannot be held liable for its environmental damages, it chooses the number of tracks with the highest net present value (two, yielding an NPV of $12 million.). Coase anticipates Taggart's choice and chooses to use one field, the highest value use of the farm when Taggart builds two tracks. This yields an NPV of $7 million.

b. Because Taggart must pay Coase for any damages, Coase should plant soybeans on two fields to yield an NPV of $18 million. Taggart responds by building one track, yielding an NPV of $1 million ($9 million for operating the track less $8 million environmental damages it pays to Coase.) Coase gets $10 million from operating the farm plus $8 million damages from Taggart.

c. The investments that the merged firm make is to build one track and grow soybeans on one field, yielding a combined NPV of $20 million ($9 million from the track and $11 million from the field.) This is higher than the combined payoffs of $19 million under either setting 'a' or setting 'b'.

d. First, the decision rights regarding the number of tracks to build and the number of fields to use must be centralized in the hands of someone who is in charge of maximizing firm-wide value instead of allowing the railroad division manager to choose the number of tracks and the farm division manager to choose the number of fields. Second, the railroad should become a profit center because it no longer has decision rights over investment (number of tracks to build) and the farm should become a cost center because it no longer has decision rights over how much soybeans to plant. Finally, employee compensation in the railroad and farm divisions should be tied to profits and costs, respectively, consistent with their allocation of decision rights.

**P 4-21:** **Solution to Rothwell Inc.** (30 minutes)
[Compensation schemes and sales incentives]

a. The high sales/low profits situation experienced by Rothwell is partially explained by an incongruence in Corporate and District objectives created by its compensation plan. Given the structure of the bonus plan, districts increase their bonus by generating large revenues at the expense of firm profits. Particular weaknesses in Rothwell's bonus plan are noted below:

- Quotas and bonus points are measured in terms of revenue within each product line. A district can earn bonus points while making minimal profits for the firm. Selling one unit at full price, for example, would earn the same bonus credit as selling two units at half price. But selling two units at half price is a lot easier than selling one unit at full price.

- The use of sales revenues for both bonus qualification and bonus calculation, together with the practice of sharing sales across districts, also promotes suboptimal behavior. Managers short of making quota in a product line can organize sales transfers with managers exceeding quota in that line. This can be done in such a way that both districts benefit. This sort of collusion would lead to high bonus payouts relative to overall sales volume and reduce firm profits.

- The existing compensation plan does not address cost of sales. Districts are rewarded equally for equal dollar sales, even if one sale cost the district substantially more.

b. An alternative compensation plan is as follows:

- Continue the balanced selling program by basing bonus qualification on meeting quota in each product line. Define quotas in terms of units sold, rather than sales revenue.

- Use contribution margin of products sold as the base of bonus point calculation. By combining bonus qualification on units sold and bonus points on contribution margin, districts would no longer be rewarded for chopping price to sell additional units (as in the two-for-one situation described above).

- Continue to weight Pride Level product lines more heavily in bonus point calculation so that sales efforts are commensurate with long-term firm strategy.

- Identify budget items that are discretionary at the district level (entertainment, travel, etc.). Measure performance against these budgets and award or deduct bonus points accordingly. Factoring discretionary expenditures and contribution margin into the bonus point calculation gives district managers incentive to reduce cost of sales.

In summary, the improvements outlined above suggest that organizing district sales offices as profit centers rather than as cost centers better aligns district performance measurement and rewards with corporate objectives. Establishing district sales offices as profit centers is further supported by the fact that districts possess most decision rights (on both the revenue and expense sides) and should be evaluated accordingly.

**P 4-22:** **Solution to Gong-Fen** (30 minutes)
[Free-rider problems]

The current system generates influence costs as well as creating incentives for families to have additional babies since each child gets half a portion. "Since a child just over three obviously could not eat an adult's share, it was desirable to have more children. The system functioned as a positive disincentive to birth control."

However, the most serious incentive issues are likely the free-rider problems:

"(The performance and compensation system) was a constant source of resentment among the villagers — in addition to being a massive discouragement to efficiency. Every day, the peasants would screw up their eyes to watch how the others were working in case they themselves were being taken advantage of. No one wanted to work harder than others who earned the same number of work points. Women felt bitter about men who sometimes did the same kind of job as they, but earned two points more. There were constant arguments." (Source: J. Chang, *Wild Swans: Three Daughters of China* (Anchor Books: New York, 1991, p. 415)).

**P 4-23:** **Solution to International Computer Company** (35 minutes)
[Capital budgeting and dysfunctional incentives from errors in the design of the performance measurement system]

This problem illustrates that not properly assigning design rights in the firm can lead to value-decreasing actions. The leasing division is not assigned the property rights to the leased equipment when it is returned to the firm. The returned equipment is "free" to the service department and the international division. Since the leasing department does not receive any financial benefits when the equipment is returned, it must recover the entire cost of the equipment in the original lease terms, which causes it to set a higher annual lease payment than if it factored in the present value of the salvage value of the equipment.

a. The fixed annual lease payment (ignoring the salvage value of the network) is computed as:

Let L = the four fixed annual lease payments received at the beginning of each year.

Then, the following equation must hold:

$$L + \frac{L}{1.08} + \frac{L}{1.08^2} + \frac{L}{1.08^3} = 1.25\left[\$39{,}000 + \frac{\#3{,}000}{1.08} + \frac{\$4{,}000}{1.08^2} + \frac{\$5{,}000}{1.08^3}\right]$$

The left-hand-side of this equation is the present value of the annual lease payments and the right-hand-side is the present value of 125 percent of the costs charged to the leasing division. Solving the above equation yields:

$$3.577L = \$61{,}470$$

$$L = \$17{,}185$$

Therefore, to recover 125 percent of its costs, the annual lease payment is $17,185.

b. Increased competition has put pressure on the leasing department's profit margins and markups. Just because the markups are falling, some to as low as 10 percent, does not mean that ICC should stop leasing the equipment.

One problem that is causing the leasing department to lose business is that they are trying to recover 125 percent of all their costs, excluding the salvage value of the leased equipment when it comes off lease. Therefore, while the leasing division is showing a 25 percent profit margin, the firm as a whole is making more money on the lease and these additional profits are showing up as profits in the field service organization and the international division who get the returned equipment for free. The leasing department is in a sense subsidizing the other two departments.

If the leasing department sold the returned equipment to the field service organization or the international division, they could set a much lower lease price. In this case the annual lease price is:

$$L + \frac{L}{1.08} + \frac{L}{1.08^2} + \frac{L}{1.08^3} = 1.25\left[\$39{,}000 + \frac{\$3{,}000}{1.08} + \frac{\$4{,}000}{1.08^2} + \frac{\$5{,}000}{1.08^3}\right] - \frac{\$30{,}000 \times 36.667\%}{1.08^4}$$

$$3.577L = \$61{,}470 - \$11{,}000 \times .7350$$

$$L = \$14{,}925$$

Now, the leasing division can lower the annual lease payment by $2,260 to $14,925 per year and still recover 125% of its costs.

Notice that if the lease payment is $14,925, the leasing division's markup over costs is about 8 1/2% ignoring the salvage value on the equipment. That is, solving for the markup in the following equation:

$$3.577 \times \$14,925 = M\% \left[ \$39,000 + \frac{\$3,000}{1.08} + \frac{\$4,000}{1.08^2} + \frac{\$5,000}{1.08^3} \right]$$

$$M = \frac{\$53,387}{\$49,176} = 1.086$$

The preceding calculations demonstrate that the leasing division can lower its markup to about 8 percent if they do not receive the salvage value of the returned equipment. The firm is still making a 25 percent markup including the value of the returned equipment.

Clearly, ICC should not abandon the lease market. Instead, they should change the way decision rights are partitioned and give the decision rights regarding the returned leased equipment to the leasing department to determine how this equipment is best used. Also, the performance evaluation of the leasing department should be changed to give this department the revenues from the used equipment.

## P 4-24: Solution to Repro Corporation (40 minutes)

[Internal competition and incentives]

a. Since a large portion of the compensation of the two sale forces (Products and Service) is comprised of the commission bonus, the two sales forces will be placed in direct head-to-head competition for customers. Firms which opt to purchase equipment from Products are lost sales potential for Service, and firms which contract for an FM through the Service division are lost sales for the Products division. As a result, the two sales divisions within Repro will be competing with each other as well as with external competitors for business.

The internal competition from the Service division will be especially unacceptable to the Products division. Having been in business for an extended period of time, Products has been able to generate extensive contacts with potential customers. Since both Products and Service are part of the same corporation, two possible scenarios will result:

(i) Service will be given access to Products' customer database which the Products' sales force has worked hard to create.

(ii) Products will prevent Service from accessing its customer database.

Under the first scenario, Products' sales force will raise the "fairness" issue and under the second scenario, the Service division will be forced to duplicate the efforts of the Products sales force in identifying potential customers.

Note: The preceding answer is written with the view that internal competition is "bad" (reduces firm value). Internal competition can be "good" if the reduction in agency costs is greater than the costs of duplicated effort.

b. Under the assumption that the two sales forces will remain independent, Repro must encourage the two divisions to work together in identifying potential customers. If Products' sales force identifies a potential customer in the market for office equipment solutions, and that customer's need can better be served by an FM solution (assuming that higher profits also can be gained by Repro under FM), then the Products' sales force must be encouraged to communicate this business opportunity to Service's sales force. On the other hand, in situations where the Service sales force identifies a new customer and decides that the customer's need can be better satisfied by the purchase of hardware, they must in turn be encouraged to contact Products' sales force.

An incentive system must exist to encourage mutual cooperation between the two divisions. The bonus scheme should be redesigned to include a "finder's fee" for both sales forces. If a Products salesperson identifies a potential FM customer that leads to a successful transaction and vice versa for the Service salesperson, that salesperson should be awarded a bonus. This type of bonus scheme will help to ensure that the externality associated with head-to-head competition between the two divisions is internalized, thus discouraging dysfunctional head-to-head competition and encouraging cooperation. In addition, the management (upper and lower) will be encouraged by company headquarters to maintain close contacts in regions where both divisions are located. This is advantageous to the company as a whole and will encourage greater interaction between divisions, providing an opportunity to work out possible problems at the local level.

Note: To be fully effective, the finder's fee must be set at a level such that the members of both sales forces are made indifferent between selling their own division's product and contacting the other division's sales force.

Additionally, regional field division managers will likely end up working together in headquarters as their careers advance. This field interaction will serve as a teaching and learning opportunity for the managers.

In essence, the introduction of the Service division without a corresponding change in the compensation system results in a suboptimal situation. The organization's architecture is a "three-legged stool" comprised of *performance evaluation systems, decision rights allocation systems,* and *reward/punishment systems*. A change in any one of these legs of the system must be accompanied by a change in the other legs to maintain stability.

Instead of having two separate sales forces, one for Product and one for Service, an alternative arrangement would be to have a single sales force that sells both. This raises the question of to whom does this organization report? Who evaluates them and sets their compensation? Having a single sales force likely results in Products and Service being merged into a single division.

**Case 4-1:** **Solution to Christian Children's Fund** (45 minutes)
[Gaming performance metrics and insuring the 3 legs of the stool are balanced]

The AIMES system illustrates a key point: "What you measure is what you get." By adopting the ten metrics, CCF will focus the organization on these ten outcome measures. There are reasons for and against using the AIMES metrics. These are discussed below.

Strengths:

- The AIMES project forced CCF to think about what their mission is and how best to achieve that mission. In terms of Figure 1-3, it forced CCF to better link their strategy to at least one part of their organizational architecture (performance evaluation).
- Program directors use the AIMES data as a tool to monitor and manage their programs.
- The ten metrics make project managers more focused and better able to concentrate resources in areas that make a measurable difference in children's health.
- CCF uses the information to make program and resource allocation decisions.
- The family card has promoted better nutrition via appropriate feeding and child care practices because there is now more direct contact between CCF staff and volunteers and families.
- CCF is now more accountable to their donors.

Weaknesses:

- While the AIMES project better linked CCF's strategy to one piece of its organizational architecture, it did not address the other two legs of the stool (decision rights assignment and performance rewards). AIMES, by only attacking one leg of the stool might cause the three legs to become unbalanced.
- Because the ten metrics are in fact used to assess program effectiveness and to allocate resources, this creates incentives for the community managers who oversee the collection of the data via the family cards to game the system. This gaming can be outright fraud by giving individual families better scores than they actually achieved. CCF, in describing the AIMES system does not mention the internal audit procedures used to insure the accuracy of the reported data. Some of the metrics such as "access to safe water," "practice of safe sanitation," "families know how to manage diarrhea or respiratory infection," inherently require the local staff to make subjective evaluations. Knowing that future funding or their performance is being judged based on these subjective evaluations creates incentives for CCF's data collectors to bias their subjective evaluations.

- CCF does not report the aggregate AIMES data on their web site or in their annual reports. Requests for these data were declined. Hence, CCF's claim that AIMES makes CCF more accountable to its donors is incorrect.
- The chapter's discussion of organizational architecture argues that performance measures and compensation schemes should be linked to the decision rights assigned to the managers. In CCF's case, program managers have decision rights to design programs that improve children's welfare. Certainly, the ten AIMES metrics capture many important aspects of children's welfare. But, an individual program manager's impact on any of these metrics is very small relative to factors a CCF manager cannot control. For example, suppose an earthquake or civil war occurs. Despite the local manager's best efforts, all ten indicators will likely fall. The CCF manager cannot control most of the external factors driving these ten metrics. This exposes the local manager to enormous risk. Decreases in metrics will cause the local manager (who has more knowledge of the local conditions) to argue that events outside of his/her control caused the decline. But these same managers are less likely to explain improvements in the metrics are not the result of their effort. Hence, CCF senior managers will spend a lot of time sorting out the real causes of changes in the metrics. (Chapter 5 on responsibility accounting expands on this discussion.)

**Case 4–2:** **Solution to Woodhaven Service** (50 minutes)
[Incentives]

a. (i) Dr. Weisbrotten's approach is fundamentally contrary to the suggestions of the chapter. Basically, by introducing Weisbrotten, Harold seeks to alter the preferences of his employees. While it is possible to lower agency costs by convincing agents that working harder on the job is desirable in itself, the text is pessimistic about such a strategy. Normally self-interested people's preferences are not easily altered. However, the firm can reduce the agency problem, if not goal incongruence, by structuring agents' incentives that when agents maximize their incentive-based payoffs, the principal's utility (or wealth) is also maximized. In other words, the agent's and the principal's goals become congruent through the agent's incentive scheme, not by a change in the agent's preferences.

(ii) The idea of hiring harder-working mechanics appears to have some merit as a means of reducing agency costs in that it eliminates conflicting interests of agents and principals by limiting the set of agents to those who already have the same goals as the principal. However, there is something naive about this notion. Is there such a condition as "hardworkingness?" Is this condition common enough in the population that Harold can expect to find mechanics out of work who possess it? Furthermore, how would one go about testing for hardworkingness? Mechanics looking for work are not likely to be the most hard working.

b. Harold thinks that Woodhaven's lack of bottom-line success in repairs is due to his mechanics' lack of productivity. He also believes that incentive-based compensation for the mechanics will help this problem. Two kinds of plans are suggested, commission and flat rate. The commission plan is designed to boost profits by boosting revenues. Assuming that the price of each service is above the marginal cost of performing that service, offering mechanics a percentage of revenues should work to increase profits. The flat rate is designed to boost profits by cutting costs. Whereas revenues from labor charges are always derived from standard rather than actual times, paying mechanics by the hour makes the labor costs incurred depend upon the actual time they spend on the job. Given more demand than capacity, and given the likely propensity of workers to prefer leisure over toil, the mechanics may very well be spending too long on each job. If they were paid only for the "just right" amount of time, subsidized leisure would disappear, giving mechanics an incentive to lower labor costs.

However, nothing occurs in a vacuum, and changing compensation schemes could be expected to have other effects as well. Most importantly, both compensation plans induce behavior that is divergent from Harold's desires. If he paid mechanics a percentage of the sales they generate, many mechanics would likely generate revenue that should not be generated. Suddenly, Woodhaven would "specialize" in $2,000 engine rebuilds, whether the staff had the technical knowledge for this kind of repair or not. In a worst-case scenario, mechanics would simply cheat customers by selling expensive services that were not necessary and might not even be performed. If mechanics are paid a standard number of hours for a job, they will simply work faster. So fast, indeed, that a drop in quality is likely.

Since Woodhaven is a neighborhood shop, it is likely that many customers know one another. This would cause the rapid and easy transfer of information about any problems among Woodhaven's client base. Because of Woodhaven's small size and lack of recognition outside of the neighborhood, it would probably be difficult to continually replace alienated clientele. We may, therefore, conclude that the relative cost of cheating and/or lowering quality would be unusually high for Woodhaven Service. One would be inclined to reject any plan that would not tightly control acts that might alienate the present customers.

(i) Intuitively, one can see that Honest Jack's plan would generate more dysfunctional behavior than Harold's. By paying a minimum salary of $300, Harold's commission plan would likely reduce the quantity of unnecessary services performed. First, since it is easier to meet one's financial obligations with $300 than with nothing, the mechanics would feel less of a "need" to cheat the customers. Also, since an average volume of business would earn each mechanic the same amount of money under either plan, the marginal benefit from each additional sale would be less under Harold's commission plan than under Jack's.

(ii) Placing an upper bound upon potential weekly earnings would further diminish mechanics' incentive to cheat customers. It is likely that there would be diminishing marginal returns for cheating customers due to factors such as the increasing probability of getting caught, guilt feelings, or simply lack of capacity to perform further repairs. At some point, it would no longer be profitable for the mechanic to cheat. If this point occurs at a figure below the dollar figure that is set as the upper bound, then the quantity of dysfunctional behavior is the same with or without the upper bound. However, if the point at which cheating is no longer profitable is above the upper-bound dollar figure that is set, the upper bound will actually reduce the quantity of cheating. Since the upper bound, in all cases, either reduces cheating or does not change it, we would expect the upper bound to tend to lessen cheating.

c. This question is related to the celebrated 1992 case in which Sears auto repair departments were accused of overcharging customers for unnecessary work. For Woodhaven Service, the cost of cheating would be very high. Indeed, one would suspect that very little cheating would be profitable for Harold, a fact that would heavily influence any decision on incentive-based compensation. However, if Harold owned the mall franchise described above, the price of cheating would be much lower. Location, brand recognition, and other factors would all make cheating cheaper. Promotion would bring in new customers to replace alienated ones. Mall shoppers would likely give the shop a try and would be unlikely to discuss their auto service experience with a large proportion of the shop's potential market. It would appear that Harold at the mall would reap all the same benefits as Harold in the neighborhood, but without the costs of cheating. We would therefore think it far more likely that Harold would install one of the incentive compensation plans described above at the mall than at Woodhaven Service. It is difficult to assess how being manager at a company-owned store would affect Harold's outlook. We need more information on the compensation plan used for such managers. On the one hand, increasing sales would be less beneficial for an employee than an owner. Lower rewards would indicate less desire to use an incentive compensation plan. On the other hand, differences in the cost of cheating for the owner and the manager are unclear. Losing your franchise may be more expensive than losing your job, but losing your job is more expensive than a letter of reprimand from the parent company.

d. Another way to reduce the risk of dysfunctional behavior by mechanics is to strip them of their decision rights. Since the approval of a supervisor would be needed to perform some or all services, the mechanics would find their ability to cheat severely curtailed. However, this increased control comes with a cost. Skilled supervision would be required and knowledge would have to be transferred to the person who now has the decision rights. Indeed, the person with the decision rights would likely have to duplicate much of the mechanic's diagnostic work to confirm the mechanic's conclusions regarding service requirements.

In the case of Woodhaven Service, the cost of separating knowledge and decision rights should be low. Due to the small size of the facility, there is simply not that much to supervise. After 20 years, Harold should know enough about cars and repairs to be able to decide whether or not a major service is warranted and whether it would be best to do it in-house. However, in the mall shop, there is a lot more to watch and a lot less reason to care. Therefore, it would seem that the collocation of knowledge and decision rights makes more sense at the mall than at Woodhaven.

e. There are many approaches Woodhaven could take to better itself financially. One that leaps out: Raise prices. Demand is so strong that it outstrips supply, indicating that the price of regular service is too low. Furthermore, the profitability of gasoline operations suggests loyal customers who are willing to pay a premium for what is essentially a commodity item. Obviously, there is something at Woodhaven that the customers like and that Harold is not charging them for in the service end of his business.

# CHAPTER 5
## RESPONSIBILITY ACCOUNTING AND TRANSFER PRICING

**P 5–1:** **Solution to Canadian Subsidiary** (10 minutes)
[Problems with ROI]

Subsidiary net income is after payments to the debtholders and hence the calculation of return on net investment (which is equivalent to return on equity) is on a return-on-equity basis. Calculate net investment and residual income to equity in each year:

| | 2009 | 2010 | 2011 |
|---|---|---|---|
| Net income | $14.0 | $14.3 | $14.4 |
| ÷ ROI | 20% | 22% | 24% |
| Net investment = (A–L) = Net income ÷ ROI | $70.0 | $65.0 | $60.0 |
| L = Assets – net investment | $55.0 | $65.0 | $75.0 |
| | | | |
| Subsidiary Net income | $14.0 | $14.3 | $14.4 |
| less: Cost of capital on net investment | (7.0) | (6.5) | (6.0) |
| Residual income | $ 7.0 | $ 7.8 | $ 8.4 |

The calculation shows that residual income, like ROI, is rising. The subsidiary has been leveraging up — adding debt to its capital structure and reducing net investment.

Therefore, the improving ROI is the result of financing changes, not operating performance.

**P 5–2:** **Solution to Phipps Electronics** (15 minutes)
[International transfer pricing and taxes]

| | Transfer Pricing Methods | |
|---|---|---|
| | Full Cost | Variable Cost |
| Low Country Taxes: | | |
| Transfer Price | $1,000 | $ 700 |
| -Cost | (1,000) | (1,000) |
| Taxable Income | 0 | (300) |
| Income Taxes (or refund) (30%) | 0 | ($ 90) |
| High Country Taxes: | | |
| Sales Price | $1,200 | $1,200 |
| -Transfer Price | (1,000) | (700) |
| Taxable Income | $ 200 | $ 500 |
| Income Taxes (40%) | $ 80 | $200 |
| Import Duty (15% × transfer price) | 150 | 105 |
| Taxes in High Country | $230 | $305 |
| Total Taxes | $230 | $215 |

Assuming Phipps has positive taxable income in Low Country against which to offset the loss of transferring the boards at variable cost, then the variable cost transfer pricing method minimizes the combined tax liability.

**P 5–3:** **Solution to Sunder Properties** (15 minutes)
[ROA creates under investment problems]

a. To calculate Sunder Properties' ROA, the question arises as to whether the calculation should include or exclude interest. Since ROA is a measure of the return on total assets, not the return to equity investors, interest should be excluded from the calculation of the numerator. (Or equivalently, interest should be added back to Net income before taxes.) Below is the calculation of ROA.

| | | |
|---|---|---|
| Revenues | | $86.50 |
| Expenses | | |
| With interest | 72.30 | |
| Interest | (2.60) | |
| Expenses (excluding interest) | | 69.70 |
| Net income before taxes | | 16.80 |
| Divided by total assets | | $64.00 |
| ROA | | 26.25% |

b. ROA Valley View:

| | | |
|---|---|---|
| Revenues | | $16.60 |
| Expenses | | |
| including interest | 13.30 | |
| interest | (.71) | |
| Expenses (excluding interest) | | (12.59) |
| Net income before taxes | | 4.01 |
| ÷ Total assets | | $20.0 |
| ROA | | 20.05% |

Because the ROA of the new project (20.05%) is less than the firm's ROA (26.25%), Sunder's ROA will fall if the new project is accepted. Hence, management is expected to reject the new project.

c. The shareholders of Brighton Holdings will want the managers of Sunder Properties to purchase Valley View if it has a positive residual income.

| | | |
|---|---|---|
| Net income before taxes (excluding interest) | | $4.01 |
| Total Assets | $20.00 | |
| WACC | 15% | 3.00 |
| Residual income | | $1.01 |

Since residual income is positive, the shareholders will want to see the apartment complex be purchased.

Alternatively, since Valley View has a return on investment of 20.05% that exceeds Sunder's weighted-average cost of capital of 15%, Valley View is a profitable acquisition.

d. Compensating the managers of Sunder Properties based on ROA gives them incentives to under-invest. We see in part (b) managers in Sunder reject the apartment complex because it lowers their overall average ROA, even though the apartment has a return in excess of its cost of capital (i.e., residual income is positive in part (c)). One suggestion is that Brighton Holdings compensate Sunder Properties' management based on residual income, not ROA. By making this change, Sunder does not have the incentive to reject positive residual income projects.

**P 5–4:** **Solution to Economic Earnings** (15 minutes)
[Understanding the role of the capital charge and depreciation in EVA]

Weaknesses:

•Like all accounting-based metrics, EE is short-run focused. Actions taken today that increase future cash flows do not show up in accounting-based performance measures until those cash flows are realized. If managers taking those actions have horizons shorter than when the cash flows are realized, then they have less incentive to take the actions.

• Adding back depreciation creates an over-investment problem. The user is only charged for interest on the capital, not its decline in value. It's like a bank only charging you interest and not principle.

• EE double counts interest. Interest is deducted, as is a charge for all the capital. This double counts interest.

Strengths:

• Like other accounting-based performance measures, EE is reasonably inexpensive and objective to compute. The accounting numbers are already being computed for taxes and external reporting and are audited.

• Unlike stock price, accounting-based measures can be used to measure the performance of sub-units of the organization. In other words, accounting measures can be disagregated.

**P 5-5:** **Solution to Discretionary Cost Centers** (20 minutes)
[Responsibility centers]

a. Discretionary cost centers are the same as cost centers. The fact that outputs and inputs are not well specified is a red herring. Whenever there are joint or common costs, outputs and inputs are not well specified. Just because the output is intangible in the form of a consulting report or market research study does not make its value any more or less difficult to assess than if the output is tangible, like an auto fender. If a plant makes several different types of auto fenders one can have just as much difficulty relating inputs to outputs for a given fender if different types of fenders share the same production resources (e.g., the same machines). The value to the firm of a particular fender is likely just as difficult to measure as the value to the firm of a particular market research study.

Profit centers differ from cost centers based on the decision rights assigned to the managers. Again, in this regard, cost centers and discretionary cost centers have no apparent differences. Both are given a fixed budget.

b. Based on the previous discussion, we should expect no significant changes from the relabeling of "cost centers" to "discretionary cost centers." While the term "discretionary" has a certain appealing descriptive flavor, merely changing terminology will have no significant effects. The name change does not alter the basic organizational structure. The partitioning of decision rights, the performance measurement system, and the reward and punishment system have not changed.

This problem illustrates a lesson: "Beware of jargon." Merely relabeling something or wrapping a concept with new terminology does not solve the problem of how large the cost center's budget should be or how to control the cost center. Jargon may focus people's attention on a particular problem, but such attention is likely to be short-lived.

**P 5–6:** **Solution to Metal Press** (20 minutes)
[ROA under historical-cost and inflation-adjusted depreciation]

a. Book value and depreciation expense:

| | Historical Cost | Price-adjusted Historical Cost |
|---|---|---|
| Original cost | $522,000 | $522,000 |
| Change in price index | | 1.19 |
| Depreciable cost | 522,000 | 621,180 |
| Annual depreciation expense (÷12) | 43,500 | 51,765 |
| Accumulated depreciation (× 7) | 304,500 | 362,355 |
| Book value | $217,500 | $258,825 |

b. ROAs will fall because of two reasons:
  (i) larger depreciation expense being subtracted from income reduces the numerator, and
  (ii) larger asset values in the denominator.

c. Division managers have greater incentive to replace obsolete equipment under the price-level-adjusted method than under historical cost because the differential between the book value of the old equipment and the new equipment is smaller. Hence, the historical cost incentive to keep older equipment is reduced.

**P 5–7:** **Solution to ICB, Intl.** (20 minutes)
[Summary of key transfer pricing issues]

The following points summarize the important issues in transfer pricing:

- Transfer pricing does not merely shift profits from one division to another, it affects overall firm profits by affecting the quantity of units transferred.

- A transfer price of full cost plus profit causes the buying division to buy fewer units than if the transfer price were lower.

- The ideal transfer price should be the resources forgone from making the transfer (opportunity cost).

- Allowing manufacturing to make a profit means that the marketing divisions will buy and hence sell fewer units than if the transfer prices were set at opportunity cost, unless manufacturing can also sell at a profit outside.

- If manufacturing has long-run excess capacity, it should transfer the conditioner at variable cost. If manufacturing does not have excess capacity, the transfer price should be at what it can sell the conditioner for in its next best use (market price).

- If the corporate controller intervenes in this case, then future transfer pricing disputes will land on her desk. Her intervention in this case will likely change the process by which transfer prices are set. The current decentralized negotiation process will tend to become more centralized in the controller's office.

**P 5-8:** **Solution to Shop and Save** (25 minutes)
[Transfer pricing using percentage of final selling price]

a. Advantages:

- No gaming over the transfer price. It is objectively set by central management. The Bakery cannot game the system by substituting variable costs for fixed costs if a variable cost transfer pricing method was used for instance.
- The transfer pricing policy is simple and easy to understand.
- The Bakery has an incentive to produce efficiently since it cannot pass inefficiencies on to the stores through higher transfer prices if they were using a cost-based transfer price.

Disadvantages:

- The optimum, firm-value maximizing transfer price is opportunity cost. With excess capacity, marginal (or variable) cost is the opportunity cost. There is no guarantee that 60 percent of the retail price is marginal cost. Moreover, it is unlikely that marginal cost is always 60 percent of the price across all fresh baked goods (breads, rolls, cakes, and pies).
- The current pricing policy does not utilize any of the specialized knowledge of the local stores nor of the Bakery in determining the transfer price.
- Decision rights over the transfer pricing of the baked goods are set centrally, but the Bakery is evaluated as a profit center. Hence, the performance evaluation and reward structure of the Bakery does not match the Bakery's decision rights assignment.

b. They can continue to use the 60 percent of retail price as the transfer price of current bakery items but allow the stores and bakery to negotiate the transfer price of new bakery items. In this way the stores that have specialized knowledge of what consumers want and the stores that have specialized knowledge of recipes and current trends in baked goods can assemble this knowledge and negotiate over the transfer price.

Another suggestion is to allow the stores to purchase some fresh baked goods from local bakeries. This forces the bakery to become more competitive in terms of specialty baked goods at competitive prices.

Finally, S&S should prepare a market study of the wholesale prices of fresh baked goods in the region. If the wholesale price of most fresh baked goods is roughly 60 percent of the retail price, then the internal transfer price of 60 percent of the retail price is roughly the market price and hence is probably a good approximation of opportunity cost.

Other solutions include: decentralize the pricing decision to the Bakery/grocery stores or make the Bakery a cost center. However, before implementing either of these suggestions, one needs to ask: "Is the current system broken?"

**P 5–9:** **Solution to Microelectronics** (25 minutes)
[Simple transfer pricing]

a. As long as the Phone Division is evaluated as a profit center and Microelectronics does not intervene somehow, the Phone Division will not purchase the circuit boards from the Circuit Board division because the Phone Division will lose money on each phone:

| | | |
|---|---|---|
| Selling price of phones | | $400 |
| Transfer price of boards (market) | $200 | |
| Other costs to complete phone | 250 | 450 |
| Incremental cash flow (loss) to Phone Division | | $(50) |

b. Yes. Firm profits are higher *assuming the excess capacity of 5,000 boards per month has no other use*.

| | | |
|---|---|---|
| Selling price of phones | | $400 |
| Incremental (variable) cost per board | $130 | |
| Other costs to complete phone | 250 | 380 |
| Incremental cash flow (loss) | | $ 20 |

c. The transfer price must be set in such a way as to induce the two parties to make the transfer. In essence, the transfer price must give incentives to the Circuit Board Division to want to make the transfer and give incentives to the Phones Division to buy. In other words, the following two constraints must be satisfied:

Circuit Board Division: TP > $130 (variable cost)

Phones Division TP < $150 (selling price - costs to complete)

where: TP = transfer price

Therefore, any transfer price between \$130 and \$150 will induce the two divisions to make the transfer. However, \$130 is best as it induces transfer even if the phone price declines \$19.

d. There are three important assumptions.

(i) If the Circuit Board Division currently has 5,000 units of excess capacity (33 percent), why is it selling circuit boards externally at \$200. Might it not be better to lower the price of the circuit boards to say \$190 (depending on the price elasticity of demand) and use up the excess capacity this way rather than by producing boards for the Phones Division at the internal transfer price? That is, the decision to transfer the boards internally assumes the opportunity cost of the excess capacity is zero.

(ii) The answer in part (c) assumes that any price between \$130 and \$150 is equally useful. This assumes the Phones Division will not adjust its selling price (and thus number of phones sold) based on its marginal costs (including the transfer price).

(iii) Variable costs per board (\$130) and per phone (\$250) do not change with volume.

Other assumptions include:

- There is a market for another 3,000 phones/month
- After including fixed costs, the divisions are profitable.
- Derived demand from additional phones does not drive down prices for circuit boards.
- Creating an exception to the rule in this case does not lead to future transfer pricing disputes.

**P 5–10:** **Solution to US Copiers** (25 minutes)
[Transfer pricing and divisional interdependencies]

a. Two reasons why US Copiers manufactures both copiers and toner cartridges are: synergies in demand and/or production. Selling toner cartridges is a way to charge higher prices to consumers who use (and hence value) the copier more intensively than users who use the copier less intensively. It allows them to engage in a form of price discrimination. To the extent that most users of SCD copiers buy US Copiers' toner cartridges at prices above marginal cost, US Copiers earns economic profits. Production synergies involve transaction cost savings from integrating the design of the cartridges and the copiers. It is likely that one firm can design both the cartridge and the copier at a lower cost than two separate firms trying to coordinate their design teams. Alternatively, since cartridges and copiers are highly specialized to each other, two separate firms have incentives to behave opportunistically in transferring the cartridges for inclusion in the copier. A single firm is likely to be better at controlling such opportunism than two separate firms.

b. You should consider the following issues:

(i) As long as TD can add capacity and produce cartridges at long-run marginal cost (LRMC) below price, then the correct transfer price should be LRMC.

(ii) Charging SCD market price of $35 will cause SCD to set a higher price on its copiers than if a transfer price less than $35 is charged. Thus, a lower transfer price causes more copiers to be sold and eventually more replacement toner cartridges to be sold.

(iii) Neither SCD nor TD should have the sole decision-making authority to price their own products. Rather, copiers and cartridges must be priced jointly. For example, when buying copiers, consumers consider both the copier's and replacement toner prices. In setting the price of the copier, the SCD manager should consider the future stream of replacement toner sales. And the TD manager should consider the effect of toner prices on copier sales. However, focusing only on their own profits causes each divisional manager to ignore the effect of their pricing decision on the other manager's cash flows. Hence, decentralizing the copier and toner cartridge prices to the respective managers is likely a bad idea.

**P 5–11:** **Solution to Cogen** (25 minutes)
[Full-cost versus variable cost transfer pricing]

a. If the transfer price is set at variable cost ($150,000), the Generator Division will buy seven turbines (see table) as this level maximizes the division's profits.

| Quantity | Price (000) | Revenue | Generator's Variable Cost | Var. Cost Transfer Price | Total Cost | Generator's Profits |
|---|---|---|---|---|---|---|
| 1 | $1,000 | $1,000 | $200 | $150 | $1750 | ($750) |
| 2 | 950 | $1,900 | 400 | 300 | 2100 | (200) |
| 3 | 900 | $2,700 | 600 | 450 | 2450 | 250 |
| 4 | 850 | $3,400 | 800 | 600 | 2800 | 600 |
| 5 | 800 | $4,000 | 1000 | 750 | 3150 | 850 |
| 6 | 750 | $4,500 | 1200 | 900 | 3500 | 1,000 |
| 7 | 700 | $4,900 | 1400 | 1050 | 3850 | 1,050 |
| 8 | 650 | $5,200 | 1600 | 1200 | 4200 | 1,000 |

b. The (average) full cost (000s) of a turbine is

| | | | | |
|---|---|---|---|---|
| Full cost | = | VC | + | FC ÷ 20 |
| | = | \$150 | + | \$1800 ÷ 20 |
| | = | \$240 | | |

c. If the transfer price is set at full cost (\$240,000), Generator will buy six turbines:

| Quantity | Price (000) | Revenue | Generator's Variable Cost | Avg. Cost Transfer Price | Total Cost | Generator's Profits |
|---|---|---|---|---|---|---|
| 1 | \$1,000 | \$1,000 | \$200 | \$240 | \$1840 | (\$840) |
| 2 | 950 | \$1,900 | 400 | 480 | 2280 | (380) |
| 3 | 900 | \$2,700 | 600 | 720 | 2720 | (20) |
| 4 | 850 | \$3,400 | 800 | 960 | 3160 | 240 |
| 5 | 800 | \$4,000 | 1000 | 1200 | 3600 | 400 |
| 6 | 750 | \$4,500 | 1200 | 1440 | 4040 | 460 |
| 7 | 700 | \$4,900 | 1400 | 1680 | 4480 | 420 |
| 8 | 650 | \$5,200 | 1600 | 1920 | 4920 | 280 |

d. Conventional wisdom argues that variable-cost transfer pricing yields the firm-profit maximizing solution. This is certainly the case as long as variable cost is reasonably easily observed and not subject to gaming. However, the Turbine Division has incentive to reclassify what are in reality fixed costs as variable costs and to convert activities that are now a fixed cost into a variable cost (by replacing contracts written in terms of fixed cash flows with contracts written so the cash outflows vary with units produced). Thus, full-cost transfer prices, being less subject to managerial discretion, might be preferred to variable-cost transfer prices, even though full-cost transfer prices result in fewer units being transferred and hence slightly lower overall profits.

**P 5-12:** **Solution to University Lab Testing** (30 minutes)
[Optimum transfer pricing schemes]

a. With excess capacity, performing one more test of Q796 does not prevent Lab Testing from performing a test for an outsider. Hence, the opportunity cost of one more test for an inside user is the variable cost of \$22.05. Therefore, the University Hospital profit maximizing transfer price is \$22.05 when Lab Testing has excess capacity. When an inside department is deciding to perform one Q796 test, the opportunity cost to the Hospital is \$22.05.

b. If Lab Testing is reimbursed \$22.05 for performing one more test, Joanna Wu incurs the variable cost of \$22.05 and reports zero profits on this test. Notice, that the fixed costs of \$25.93 do not affect the INCREMENTAL profits she generates because these fixed costs are FIXED, and by doing one more Q796 test, she only incurs the variable cost.

c. With no excess capacity, by performing one Q796 test, Joanna Wu forgoes doing an outside test (that is performed by another firm in the community). Thus, the opportunity cost to both the University Hospital and Lab Testing is $68.90, the revenue foregone from an outside health care provider. Thus, when Lab Testing has no excess capacity, the optimum transfer price (opportunity cost) is $68.90.

d. If Lab Testing is reimbursed $68.90 for performing one more test, Joanna Wu incurs the variable cost of $22.05 and reports profits of $46.85 on this test. Notice, that the fixed costs of $25.93 do not affect the INCREMENTAL profits she generates because these fixed costs are FIXED, and by doing one more Q796 test, she only incurs the variable cost.

e. The ideal transfer pricing policy is opportunity cost. Using this principle, if Lab Testing has excess capacity, the transfer price for one Q796 test is $22.05. Without excess capacity, the transfer price should be $68.90. But implementing this ideal transfer pricing scheme requires knowledge of whether Lab Testing has excess capacity at the time a test is performed. Joanna Wu has this specialized knowledge that varies over time, and possibly even within the same day. If Wu is given the decision rights to state whether excess capacity exists within her department with respect to Q796 tests, she has incentives to claim that no excess capacity exists in order to get the higher transfer price of $68.90. Even if she honestly reports whether she has excess capacity, it is very costly to communicate this information to physicians in real time so they can decide whether to order one more test or not. The administrative cost of implementing this two-tier transfer price is very expensive, not to mention the incentive problems of Wu mis-reporting the capacity of her lab. If her lab performs several hundred different tests, then the costs of implementing the ideal, two-tier transfer price for all her tests is exorbitant. An alternative transfer pricing scheme is to implement a full cost transfer price and charge internal users $47.98. While $47.98 is above variable cost of $22.05, it is still below the market price of $68.90. For each additional lab test, Wu generates $25.93 of profits (her fixed costs). Thus, full cost transfer pricing is a good compromise when one considers the costs of implementing and administering the transfer pricing policy. Another advantage of full cost transfer pricing is that it eliminates any incentives of Wu to convert fixed costs into variable costs. The disadvantages of full cost are that physicians will order too few tests when the price is $47.98 versus $22.05, and Wu has less incentive to be efficient as any cost increases get passed through to the University Hospital clinical units when the full cost gets recalculated based on the higher costs.

**P 5-13: Solution to Beckett Automotive Group** (30 minutes)
[Synergies and transfer pricing within an auto dealership]

a. By offering both new and used cars as well as service, Beckett is offering the customer convenience. Offering a bundled product consisting of a new car, trading in a used car, and service provides the customers one-stop shopping that lowers their transaction cost. When buying a new car, customers usually have a used car they no longer want. They could sell this car themselves privately through local ads, but this is a big inconvenience. Besides, there is a tax advantage to trading the old car. Sales tax is paid on the difference between the new and used car prices. If the used car is sold privately, the buyer pays more sales tax on the new car.

b. The current system gives the decision rights to negotiate the price of the trade-in to the Pre-owned Car manager. While this manager has the specialized knowledge of what the trade-in is worth, the manager does not have the incentive to take into account the potential lost profit on the new car if the customer rejects the trade-in price and walks away. For example, suppose the New Car sales person has talked the new car buyer into purchasing a car at a high price (and hence a large profit for Beckett). In this case, the Pre-Owned Car manager should be willing to take a lower profit on the trade-in. But this manager is not compensated for any part of the new car profits. In fact, if the new car purchase has a large enough profit built into the price, the Pre-Owned car manager should be willing to take a loss on the trade-in. This will only happen if the New Car sales person can talk the Pre-Owned Car manager into the deal, or if the New Car sales person goes to her manager, who goes to the owner of Beckett to convince the Pre-owned Car manager to take the deal. But this takes time, and the new car buyer may walk away.

Likewise, the New Car sales manager will not take into account the potential profit that Pre-owned Cars will make on the trade in when negotiating the price of the new car. If the New Car sales person knows that Pre-Owned Cars will make a large profit on the trade in, then New Cars should be willing to take a lower price on the new car to seal the total deal. The current system where each division is only rewarded on their own profits creates incentives for each manager to behave myopically.

c. One solution is to base part of the Pre-owned Car manager's bonus on the New Car department's profits. Suppose the Pre-owned Car manager's bonus was based on say 70 percent of the profits in Pre-owned Cars and 30 percent of New Car profits. Then the Pre-owned car manager has some incentive to take a lower profit on the trade in if it means making the new car sale.

Beckett could install a transfer price scheme whereby New Cars profit is calculated as the difference between the selling price of the new car and its cost PLUS the difference between the Kelly Blue Book wholesale value of the trade in and the trade in allowance given to the customer buying the new car and trading in her old car. In this way, New Cars gets rewarded for both the sale of the new car and the estimated profit on the trade in. Pre Owned Cars' profit is the difference between the price they receive when it sells the trade and the Kelly Blue Book wholesale price.

Another solution is to reorganize the firm so that both New and Pre-owned cars report to a single manager. In this way the profits from both the new car sale and the trade-in are captured within the same division.

**P 5–14: Solution to Assembly and Parts Departments** (30 minutes)
[Opportunity cost of holding inventory and incentives to overproduce]

The major problem in the existing system is that it ignores the opportunity cost of inventory. Both the assembly and parts departments have incentives to carry inventory stocks that are too large. Large lot sizes reduce part departments' average costs and reduce the probability of shortages of that part by assembly. On the other hand, assembly would like to receive a continuous stream of just the right parts from the parts department. The existing performance evaluation system does not measure or charge anyone for the opportunity cost of holding excessively large inventories.

The current system of cost centers and centrally-determined production quotas is obviously inherited from earlier times when the production process was far less complicated and a central planning organization could schedule and control all production. One weakness of the present system is that cost center managers are given two (often conflicting) objectives: first, meet the quota, and second, reduce cost. If the quota cannot be achieved, what is more important, additional output or cost? One way to solve this problem is to make each part and assembly department a profit center.

Applying an inventory holding cost will induce assembly departments to reduce their inventory of parts. If the holding cost is also applied to parts departments, they too have incentives to reduce their inventories. The disadvantage is that these inventory holding costs have to be backed out of the accounting reports for external financial and tax reporting. The fact that few firms formally incorporate inventory holding costs into their product costs suggests that the costs of doing so likely outweigh the benefits.

Moreover, if assembly can order parts a week in advance, thereby forcing parts departments to keep their large lots in inventory until assembly takes delivery, parts departments will reduce lot sizes and inventories.

A transfer price scheme should be installed and assembly departments should be free to purchase parts outside the firm. Without this competitive force, parts departments' incentives are to maximize output by producing in very large lots. This is not necessarily the same as maximizing profits since inventory holding costs are ignored. Transfer prices will also force assembly departments to bear the cost of their schedule changes. Transfer prices should also be extended to manufactured goods. That is, make manufacturing a profit center.

Another possibility is to reorganize. If a particular parts department produces parts for primarily one assembly department, combine these two departments into an integrated parts-assembly department.

**P 5-15:** **Solution to U.S. Pump Systems** (30 minutes)
[Nonsensical transfer prices]

The major "glitch" in this problem is how the Valve Division can continue to sell its products to outsiders at a price of $60 when the Installation Division has received a price quote of $35 for ostensibly an equivalent product. Something is "fishy" here. Before getting embroiled in a debate over how the transfer price should be set or adjusted, senior management should examine the economics of the situation. Strategically, can or should the firm continue to manufacture valves at a variable cost of $30 when an external market supplier is selling them at $35? How long can we expect the Valve Division to be able to sell valves to outside customers at $60 when another supplier is quoting U.S. Pumps a price of $35?

Questions that must be explored are: Is the outside $35 valve a perfect substitute for the Valve Division's product in terms of technical specifications, durability, quality, and delivery schedules? Is the $35 price a long-run equilibrium price or a short-run promotional price? What competitive advantage does the outside supplier have in being able to supply valves at $35 each?

In essence, put aside the more narrow accounting issues of setting the transfer price until the far more important strategic issues are resolved.

Once the strategic issues are addressed, and assuming U.S. Pump Systems decides it is economical for them to continue to produce inside, then the issue is convincing Valve Division management that it is in their interest to sell the valves internally at $35 each.

At $35 per valve, the company and the Valve Division will benefit. If the valves are not sold and assuming the outside customers continue to buy from the Valve Division at $60 (a shaky assumption at best)[1], the Valve Division gross margin will fall to $330,000:

**Valve Division**
**Operating Statement**
**Pro Forma**
**Not Selling to Installation Division at $35**

| | To Outside |
|---|---|
| Sales (20,000@ $60) | $1,200,000 |
| Variable costs @ $30 | (600,000) |
| Fixed costs | (270,000) |
| Gross margin | $ 330,000 |

If, on the other hand, Valve Division meets the external price and sells to the Installation Division at $35, they will make a $5 contribution margin on each valve and their total margin is $100,000 ($5 × 20,000) higher than if they don't sell inside.

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1 Why would the outside supplier want to sell their valves to Installation Division for $35 if they can sell them to the Valve Division's customers at a price between $35 and $60?

**Valve Division**
**Operating Statement**
**Pro Forma**
**Selling to Installation Division at $35**

| | | To Installation Division | | To Outside | Total |
|---|---|---|---|---|---|
| Sales | 20,000@ $35 | $700,000 | 20,000@ $60 | $1,200,000 | $1,900,000 |
| Variable costs @ $30 | | (600,000) | | (600,000) | (1,200,000) |
| Fixed costs | | (135,000) | | (135,000) | (270,000) |
| Gross margin (loss) | | ($ 35,000) | | $ 465,000 | $ 430,000 |

The reason the Installation Division is showing a loss is because the fixed costs are being allocated to the inside sales. Since these fixed costs will be incurred regardless of the decision to sell internally or not, they are irrelevant to the decision.

**P 5-16:** **Solution to CJ Equity Partners** (30 minutes)
[Investment incentives and EVA, ROA, earnings]

a. The following table computes the performance of each operating company using residual income after taxes (or EVA).

| | **Jasco Tools** | **Miller Bottling** | **JanSan** |
|---|---|---|---|
| Total assets | $20.1 | $31.2 | $16.3 |
| After tax weighted-average cost of capital | 0.14 | 0.12 | 0.10 |
| After tax capital charge | $2.814 | $3.744 | $1.630 |
| **Residual income** | | | |
| Revenues | $38.600 | $42.900 | $21.200 |
| Operating expenses | (33.600) | (36.800) | (18.200) |
| CM Equity management fee | (0.200) | (0.200) | (0.200) |
| Net operating profit before capital charge and taxes | $4.800 | $5.900 | $2.800 |
| Income taxes (40%) | (1.920) | (2.360) | (1.120) |
| Net income before capital charge | $2.880 | $3.540 | $1.680 |
| Capital charge | (2.814) | (3.744) | (1.630) |
| Residual income | $0.066 | $(0.204) | $0.050 |

b. Memo explaining the choice of performance measure:

Residual income is used to measure the performance of each of the operating companies because it provides the professional managers incentive to operate their company profitably, which includes using their assets efficiently. Each operating company is charged for the total assets in the company times each company's risk adjusted, after tax cost of capital. This represents the opportunity cost to investors of assets invested in the company. Each operating company is charged for taxes to give them incentives to make tax-efficient decisions. Note: interest expense is not included in the calculation of residual income to avoid double counting the cost of debt financed assets. Using residual income gives each operating company's professional manager incentives to use assets efficiently. Any asset (or project) that is not returning the company's weighted-average cost of capital reduces firm value. The CJ Equity management fee is included as an expense because each operating company imposes costs on CJ Equity in the form of oversight and tax preparation.

The problem with the current performance measure (net income after taxes) is it creates an over investment problem. Using net income after taxes only charges the professional managers for the cost of assets financed with debt. Equity financed assets are "free." ROA is not used as a performance measure because it creates incentives to under invest in positive NPV projects.

Note: Some students might prepare a performance measure based on ROA, such as:

| | **Jasco Tools** | **Miller Bottling** | **JanSan** |
|---|---|---|---|
| Total assets | $20.10 | $31.20 | $16.30 |
| After tax weighted-average cost of capital | 14% | 12% | 10% |
| | | | |
| **Return on Assets (ROA)** | | | |
| Revenues | $38.60 | $42.90 | $21.20 |
| Operating expenses | (33.60) | (36.80) | (18.20) |
| CM Equity management fee | (0.20) | (0.20) | (0.20) |
| Net Operating profit before taxes | $4.80 | $5.90 | $2.80 |
| Income taxes (40%) | -1.92 | -2.36 | -1.12 |
| Net Income after taxes | $2.88 | $3.54 | $1.68 |
| ROA | 14.33% | 11.35% | 10.31% |

If students compute ROA, they should not deduct interest expense in calculating net income. ROA is a measure of return on total assets. Deducting interest expense to arrive at net income produces a return to the equity holders (i.e., after paying the debt holders). Hence, dividing net income (after deducting interest expense) by total assets produces inconsistent measures in the numerator and denominator. As noted before, residual income (or EVA) has the advantage over ROA of not creating an underinvestment problem.

**P 5-17:** **Solution to Sunstar Appliances** (35 minutes)
[The dysfunctional incentives created by minimizing average cost]

a. Product managers are evaluated and paid based on minimizing average unit costs. The following table computes the minimum average unit cost and total profits for model CVP-6907.

| Quantity | Total Mfg. Cost | Average Mfg. Cost | Price | Revenue | Total Cost† | Profits |
|---|---|---|---|---|---|---|
| 100 | 1,450 | 14.50 | 120 | 12,000 | 2,450 | 9,550 |
| 105 | 1,496 | 14.25 | 116 | 12,180 | 2,546 | 9,634 |
| 110 | 1,545 | 14.05 | 112 | 12,320 | 2,645 | 9,675 |
| 115 | 1,596 | 13.88 | 108 | 12,420 | 2,746 | 9,674 |
| 120 | 1,650 | 13.75 | 104 | 12,480 | 2,850 | 9,630 |
| 125 | 1,706 | 13.65 | 100 | 12,500 | 2,956 | 9,544 |
| 130 | 1,765 | 13.58 | 96 | 12,480 | 3,065 | 9,415 |
| 135 | 1,826 | 13.53 | 92 | 12,420 | 3,176 | 9,244 |
| 140 | 1,890 | 13.50 | 88 | 12,320 | 3,290 | 9,030 |
| 145 | 1,956 | 13.49 | 84 | 12,180 | 3,406 | 8,774 |
| 150 | 2,025 | 13.50 | 80 | 12,000 | 3,525 | 8,475 |

†Total cost equals total manufacturing cost plus variable selling and distribution cost.

From the above table we see that the product manager would like to produce 145 toasters per day as this quantity yields the lowest average cost per unit of $13.49.

b. Sunstar's performance evaluation system has a number of advantages. It causes product managers to search out cost savings by negotiating lower prices with vendors and finding more efficient production techniques. However, it produces two dysfunctional behaviors.

First, it causes the product manager to produce more than the profit maximizing quantity of toasters. From the above table, we see that the profit maximizing quantity is 110 toasters per day. However, the unit cost minimizing output level is 145 toasters. So the product managers will be devising ways to produce more than forecasted sales. Year-end inventory is likely higher than expected. There is likely to be large number of toasters in transit to the distribution center at the end of the year and a large number of toasters still in the plant, either waiting for final inspection or packaging. Product managers will constantly be pushing for lower selling prices to increase the number they can manufacture.

The second incentive problem created by evaluating product managers based on minimizing average unit costs involves insuring product quality. Product managers can reduce costs by using thinner sheet metal and less expensive, lower-quality components.

c. Product managers should be evaluated based on the total cost of manufacturing a prespecified number of units each month. Instead of minimizing average cost, they should be evaluated based on the total cost for a fixed number of units. Alternatively, they can be given a fixed dollar amount and then evaluated on maximizing the number of units they manufacture for this fixed budget. In either case, Sunstar must closely monitor quality through an independent quality assurance department or by penalizing the product manager for units that are returned because they fail.

Suggesting that the product manager be evaluated as a profit center is not quite right because the product manager currently does not have the decision rights over pricing and distribution costs. Without these decision rights, the product manager's performance measure (profits) and decision rights (production methods) are not consistent.

**P 5-18:** **Solution to Stale-Mart** (35 minutes)
[Perverse incentives from accelerated depreciation on ROI]

a. Calculation of ROI and residual income:

| | **(Millions of dollars)** | |
|---|---|---|
| | **Broadway** (Actual) | **Horse Falls** (Forecast) |
| Operating income before depreciation | $1.050 | $3.300 |
| Depreciation | 0.210 | 1.425 |
| Net income | $0.840 | $1.875 |
| Investment: | | |
| Inventories and receivables | $2.10 | $2.90 |
| Fixed assets | 0.90 | 4.60 |
| Total investment | $3.00 | $7.50 |
| ROI | 28% | 25% |
| Net income | $0.840 | $1.875 |
| Less: Cost of capital (20%) | (.600) | 1.500 |
| Residual income | $0.240 | $0.375 |

b. I expect Ms. Chris to reject the proposal and keep the Broadway store open. She will do this to maximize her bonus compensation, not necessarily because of her emotional attachment to the Broadway store. From the calculations in part (a), the Broadway store has a higher ROI (28 percent) than the Horse Falls store (25 percent). Her bonus is based on ROI and opening the Horse Falls store lowers her average ROI across the eight stores.

c. Her decision to keep the Broadway store open will change if residual income is used to measure performance. Residual income of the Horse Falls store is higher than the residual income of the Broadway store.

Stale-Mart's loss of market share and poor stock price performance is likely due to their unwillingness to open new stores in growing areas of cities and closing stores in declining areas of cities. The demographics of cities change over time and once profitable locations stagnate as affluent shoppers move residences to newer areas. Retailers must move with their customer base.

Stale-Mart does not appear to be doing this. The performance evaluation and reward systems encourage district managers to keep old stores open beyond the store's prime. Once the leasehold improvements have been mostly depreciated the store's accounting ROI then looks very good.

Stale-Mart has several options to correct this problem:

i. Remove the decision rights to open new stores from the district managers and give it to corporate managers who are compensated on share price appreciation. The problem with this option is that the district managers likely have better-specialized knowledge of their local markets than the corporate staff.

ii. Change the performance evaluation system of the district managers. Calculate the performance of each district manager based on operating income before depreciation. But then you have to control their incentive to over-invest in leasehold improvements. Alternatively, calculate depreciation on the straight-line method using longer lives. This reduces the penalty for opening new stores.

iii. Base bonuses on residual income, not ROI. If incentive plans are based on maximizing ROI, this creates incentives to under-invest or divest of projects that earn above their cost of capital but below the division's average ROI. Residual income does not suffer from this problem.

**P 5–19:** **Solution to R&D Inc** (35 minutes)
[Capitalizing versus expensing R&D in calculating EVA]

a. EVA if R&D is written off is:

| | | |
|---|---|---|
| Earnings before R&D expenditures | | $21.5 |
| R&D expenditures | | 6.0 |
| Earnings after expensing R&D | | $15.5 |
| Total invested capital (excluding R&D assets) | $100.0 | |
| Weighted average cost of capital | 14% | |
| Capital cost | | ($14.0) |
| EVA | | $ 1.5 |

b. R&D is capitalized and amortized over a three-year life:

The following table calculates the capitalization and amortization of R&D:

| Year | Beginning R&D Book Value | R&D Expenditures | R&D Amortization | Ending R&D Bookvalue |
|---|---|---|---|---|
| 1 | $0.0 | $6.0 | $2.0 | $4.0 |
| 2 | 4.0 | 6.0 | 4.0 | 6.0 |
| 3 | 6.0 | 6.0 | 6.0 | 6.0 |
| 4 | 6.0 | 6.0 | 6.0 | 6.0 |
| 5 | 6.0 | 6.0 | 6.0 | 6.0 |
| 6 | 6.0 | 6.0 | 6.0 | 6.0 |
| 7 | 6.0 | 6.0 | 6.0 | 6.0 |

Notice that after the second year, R&D Inc. is adding new R&D assets of $6.0 million and writing off R&D amortization of $6.0 million per year. The only difference is that the invested capital is larger by $6.0 million of R&D assets.

| | | |
|---|---|---|
| Earnings before R&D expenditures | | $21.50 |
| Amortization of R&D assets | | 6.00 |
| Earnings after R&D amortization | | $15.50 |
| Total invested capital (including R&D assets) | $106.00 | |
| Weighted average cost of capital | 14% | |
| Capital cost | | ($14.84) |
| EVA | | $ 0.66 |

c. Since the firm is spending a constant amount on R&D each year, capitalizing versus expensing R&D produce the same earnings after capitalization/amortization. Both methods charge earnings for $6 million. The only differential effect capitalization/amortization has is on the capital charge (14% × $6 million). Under expensing R&D, by cutting R&D by $1 gives the manager immediate savings of $1 and thus $1 of higher EVA. Under R&D capitalization/amortization, cutting R&D by $1 translates into lower amortization this year (and the next 2 years) of $0.33 plus $0.14 of lower capital cost, or a total savings this year of $0.48. Therefore, capitalization/amortization reduces the incentives of managers to cut R&D.

**P 5-20:** **Solution to Flat Images** (40 minutes)
[Other than variable cost transfer pricing reduces firm-wide profits]

a. At a transfer price of $4,800, Marketing will purchase 100 screens from Manufacturing and will make a profit of $50,000. See below:

**Marketing Division Profit Maximizing Decision Given a Transfer Price of $4,800**

| No. of Screens | Selling Price | Revenue | Marketing's Own Cost | Transfer Cost | Profit |
|---|---|---|---|---|---|
| 50 | $8000 | $400,000 | $160,000 | $240,000 | $0 |
| 75 | 7500 | 562,500 | 165,000 | 360,000 | 37,500 |
| 100 | 7000 | 700,000 | 170,000 | 480,000 | 50,000 |
| 125 | 6500 | 812,500 | 175,000 | 600,000 | 37,500 |
| 150 | 6000 | 900,000 | 180,000 | 720,000 | 0 |
| 175 | 5500 | 962,500 | 185,000 | 840,000 | -62,500 |
| 200 | 5000 | 1,000,000 | 190,000 | 960,000 | -150,000 |
| 225 | 4500 | 1,012,500 | 195,000 | 1,080,000 | -262,500 |
| 250 | 4000 | 1,000,000 | 200,000 | 1,200,000 | -400,000 |
| 275 | 3500 | 962,500 | 205,000 | 1,320,000 | -562,500 |

b. At a transfer price of $4,800 per screen, Manufacturing makes a profit of:

| | |
|---|---|
| Revenue from transfer (100 x $4,800) | $480,000 |
| Variable cost (100 x $800) | (80,000) |
| Fixed cost | (300,000) |
| Manufacturing's profit | $100,000 |

c. At a transfer price of $4,800, Flat Images is generating profit of:

| | |
|---|---|
| Revenue from external sale (100 x $7,000) | $700,000 |
| Variable cost (100 x $1,000) | (100,000) |
| Fixed cost ($150,000 + $300,000) | (450,000) |
| Manufacturing's profit | $150,000 |

d. To maximize firm-wide profits Flat Image should manufacture and sell screens 200 screens. See below:

| No. of Screens | Selling Price | Revenue | Total Cost | Profit |
|---|---|---|---|---|
| 50 | $8000 | $ 400,000 | $500,000 | -$100,000 |
| 75 | 7500 | 562,500 | 525,000 | 37,500 |
| 100 | 7000 | 700,000 | 550,000 | 150,000 |
| 125 | 6500 | 812,500 | 575,000 | 237,500 |
| 150 | 6000 | 900,000 | 600,000 | 300,000 |
| 175 | 5500 | 962,500 | 625,000 | 337,500 |
| 200 | 5000 | 1,000,000 | 650,000 | 350,000 |
| 225 | 4500 | 1,012,500 | 675,000 | 337,500 |
| 250 | 4000 | 1,000,000 | 700,000 | 300,000 |
| 275 | 3500 | 962,500 | 725,000 | 237,500 |

e. The answers to (c) and (d) differ because the transfer price of $4,800 is above Manufacturing's variable cost of $800. So Marketing buys only 100 screens from Manufacturing, which is less than the 200 screens that maximizes firm-wide profits. This is an example of the double-marginalization problem.

f. Flat Images should set the transfer price at Manufacturing's variable cost of $800 to maximize firm-wide profits. At this transfer price, Marketing will purchase 200 screens per month.

| No. of Screens | Revenue | Marketing's Own Cost | Transfer Cost (@$800) | Total Cost | Profit |
|---|---|---|---|---|---|
| 50 | $400,000 | $160,000 | $40,000 | $200,000 | $200,000 |
| 75 | 562,500 | 165,000 | 60,000 | 225,000 | 337,500 |
| 100 | 700,000 | 170,000 | 80,000 | 250,000 | 350,000 |
| 125 | 812,500 | 175,000 | 100,000 | 275,000 | 537,500 |
| 150 | 900,000 | 180,000 | 120,000 | 300,000 | 600,000 |
| 175 | 962,500 | 185,000 | 140,000 | 325,000 | 637,500 |
| 200 | 1,000,000 | 190,000 | 160,000 | 350,000 | 650,000 |
| 225 | 1,012,500 | 195,000 | 180,000 | 375,000 | 637,500 |
| 250 | 1,000,000 | 200,000 | 200,000 | 400,000 | 600,000 |
| 275 | 962,500 | 205,000 | 220,000 | 425,000 | 537,500 |

**P 5-21:** **Solution to Premier Brands** (40 minutes)
[Over and under investment incentives from ROA and RONA]

a. The following table calculates the RONA of the two proposed acquisitions and also how Guttman's total RONA changes if either brand is acquired. Here we see that Brand 1 lowers her combined RONA and so will be rejected while Brand 2 raises her RONA and will be accepted. However, since both brands yield RONAs in excess of Premier's WACC, both should be accepted. This example illustrates that RONA (and ROA) create underinvestment incentives.

| | Current Operations | Brand 1 | Brand 2 | Current & Brand 1 | Current & Brand 2 |
|---|---|---|---|---|---|
| Net income | $708 | $67 | $228 | $775 | $936 |
| Total assets | 6500 | 604 | 2044 | 7104 | 8544 |
| Current liabilities | 1300 | 82 | 498 | 1382 | 1798 |
| Net assets | 5200 | 522 | 1546 | 5722 | 6746 |
| RONA | 13.62% | 12.84% | 14.75% | 13.54% | 13.87% |

b. If Premier's WACC is 15.22 percent instead of 12.43 percent, Guttman's decisions do not change. The bonus calculation is based on actual RONA achieved. Premier's WACC does not enter into the bonus calculation. If the bonus was based on residual income (or EVA) the WACC becomes the hurdle rate that each acquisition must achieve.

c. As sole owner of Premier, I would want to acquire both brands as each one has a positive NPV. Again, this highlights that RONA (and ROA) can lead to an under investment problem.

d. As sole owner of Premier, I would acquire neither brand as each one has a negative NPV. In this situation RONA (and ROA) can lead to an over investment problem.

e. RONA, unlike ROA gives managers incentives to increase current liabilities, since this lowers net assets and raises RONA. In effect, RONA, unlike ROA, gives managers incentives to increase the amount of total assets financed by short term liabilities. Managers will do this by delaying payment to their trade creditors. However, since increasing the time to pay their creditors imposes costs on their suppliers, rational suppliers will look for means to recoup this cost by raising the price, reducing service, and so forth. In other words, there is no "free lunch."

**P 5-22:** **Solution to Hochstedt** (40 minutes)
[ROI, Residual income and foreign exchange rates]

a. The following is a performance report for the U.S. subsidiary:

| Hochstedt<br>U.S. Subsidiary<br>ROI and Residual Income<br>Current Year (millions) | | | |
|---|---|---|---|
| | Dollars | Euros (Current rate: 1.57) | Euros (Historic rate: 1.40) |
| U.S. sales | $14 | 21.98† | |
| U.S. expenses | $8 | 12.56† | |
| German imports | | 6.20 | |
| Profits (Marks) | | 3.22 | |
| U.S. investment | $6 | 9.42 | 8.40 |
| Capital charge (35%) | | 3.30 | 2.94 |
| ROI | | 34% | 38% |
| Residual income (loss) | | (0.08) | 0.28 |

†Current U.S. sales and expenses are converted to German marks using the current exchange rate of 1.57 euros = $1.

The preceding performance report is expressed in marks, the domestic currency of the German managers. The third column translates all U.S. dollars into marks using the current rate of 1.57 euros = $1. Using the current rate for all translations, the U.S. subsidiary shows a 34 percent ROI and a negative residual income of 0.08 million. The fourth column translates current flows at the current rate but the current investment amount at the historic rate. Using the historical rate when the investment was made results in an ROI of 38 percent and a positive residual income of 0.28 million.

b. Issues to be addressed by management in designing a performance report:

1. Are the reports to be used for decision management or control? If corporate management wants the report to help them run the business (i.e., decision management), then a report of the form above is useful. If the reports are used to measure, evaluate, and reward subsidiary management performance (i.e., control), the above reports may not be appropriate (see #2 below).
2. Should the subsidiaries be evaluated as cost centers, profit centers, or investment centers? The case does not indicate what decision rights the local managers have and therefore, one cannot decide the exact format of the performance report without knowing how decision rights are partitioned. For example, if the foreign managers have decision rights

over the amount of investment in their subsidiary, then they should be evaluated as investment centers; if they don't have control over the investments, they should be evaluated as profit centers. Therefore, if the reports are used for performance evaluation and reward/punishment, matching the performance measure to the decision rights partitioning is critical.

3. Which exchange rate should be used to translate the investment in U.S. dollars back into marks, the current rate (1.57) or the historical rate (1.40)? While some accounting systems require the foreign investments to be translated at the rate in effect when the investment was made, the opportunity cost of the investment is the current exchange rate. Therefore, the third column that shows a negative residual income of 0.08 million euros is the most appropriate for measuring the opportunity cost of the firm's investment. This exchange rate is best for decision making. However, it may not be the best for control. Use of the current exchange rate imposes the risk of exchange rate fluctuations onto the manager. Being risk averse, managers will try to hedge this risk on their own, although it is probably cheaper to hedge at the corporate level.
4. How is the transfer price of the 6.2 million euros of imports from the parent determined? Does this represent the opportunity cost of the firm of making the transfer?
5. Should ROI or residual income be the performance measure? ROI has intuitive appeal but creates incentives to drop positive NPV projects that are below the average ROI for the subsidiary. Residual income does not have this dysfunctional incentive. But residual income does not allow relative comparisons of small and large subsidiaries.
6. Should a single cost of capital apply to all foreign subsidiaries or are there differences in risk among the subsidiaries that would necessitate different costs of capital?

**P 5-23:** **Solution to Savannah Products** (40 minutes)
[EVA and transfer pricing]

a. The following table calculates the EVA ($ billions) for the two divisions.

| | Forest Division | Lumber Division | Total |
|---|---|---|---|
| Revenues: | | | |
| Inside | $1.600* | | |
| Outside | 0.900 | $7.600 | |
| Total revenues | $2.500 | $7.600 | |
| Expenses | | | |
| Timber purchases | | 1.600* | |
| Operating expenses | 2.000 | 3.500 | |
| Net Income | $0.500 | $2.500 | |
| | | | |
| Weighted average cost of capital | 15% | 20% | |
| Total assets | 2.200 | 2.700 | |
| Cost of capital invested | $0.330 | $0.540 | |
| | | | |
| EVA | $0.170 | $1.960 | $2.130 |

*(800 million ÷ 1 billion board feet) × $2 billion (Forest Division operating expenses)

b. The Lumber Division appears to be the more profitable of the two divisions.

c. Lumber appears more profitable because it is not paying the opportunity cost of timber. The Forest Division can sell its timber externally at $4.50 per board foot, and in fact sold 20 percent of its timber that way. The Lumber Division is only paying $2.00 per board foot ($1.60 billion ÷ 800 million board feet). Thus, Lumber's profitability is being increased by $2.50 per board foot due to the cost-based transfer-pricing scheme employed.

d. Savannah should consider going to a market-based transfer price to better assess the opportunity cost of the timber transferred. Also, this will give Lumber the incentive to buy one more board foot of timber as long as it can sell it for at least $4.50 net of its variable costs. Using market price to transfer timber produces the following EVA calculations, which show that Lumber is actually reducing firm value.

| | Forest Division | Lumber Division | Total |
|---|---|---|---|
| Revenues: | | | |
| Inside | $3.600* | | |
| Outside | 0.900 | $7.600 | |
| Total revenues | $4.500 | $7.600 | |
| Expenses | | | |
| Timber purchases | | 3.600* | |
| Operating expenses | 2.000 | 3.500 | |
| Net Income | $2.500 | $0.500 | |
| | | | |
| Weighted average cost of capital | 15% | 20% | |
| Total assets | 2.200 | 2.700 | |
| Cost of capital invested | $0.330 | $0.540 | |
| | | | |
| EVA | $2.170 | ($0.040) | $2.130 |

* 800,000 × $4.50

However, if Savannah uses a market-based transfer price, it will have to adjust the compensation plan to avoid giving Forest Division managers a wind-fall gain and the Lumber Division a wind-fall loss.

**P 5-24:** **Solution to Transfer Pricing Company** (40 minutes)
[Full cost transfer pricing can be second best]

a. The following table calculates the profit maximizing price-quantity combination that corporate would set:

| **Quantity** | **Price** | **Variable Cost ($15+$5)** | **Profit** |
|---|---|---|---|
| 4 | $420 | $20 | $1,600 |
| 5 | 400 | 20 | 1,900 |
| 6 | 380 | 20 | 2,160 |
| 7 | 360 | 20 | 2,380 |
| 8 | 340 | 20 | 2,560 |
| 9 | 320 | 20 | 2,700 |
| 10 | 300 | 20 | 2,800 |
| 11 | 280 | 20 | 2,860 |
| 12 | 260 | 20 | 2,880 |
| 13 | 240 | 20 | 2,860 |

b. The following table shows that Intermediate will select a transfer price of $270 to maximize its profits.

| Transfer Price | Quantity Purchased | Intermed Revenue | Intermed Variable Cost | Intermed Profits |
|---|---|---|---|---|
| $220 | 7 | $1,540 | $105 | $1,435 |
| 230 | 7 | 1,610 | 105 | 1,505 |
| 240 | 6 | 1,440 | 90 | 1,350 |
| 250 | 6 | 1,500 | 90 | 1,410 |
| 260 | 6 | 1,560 | 90 | 1,470 |
| 270 | 6 | 1,620 | 90 | 1,530 |
| 280 | 5 | 1,400 | 75 | 1,325 |
| 290 | 5 | 1,450 | 75 | 1,375 |

c. At a transfer price of $48, Final maximizes profits by purchasing 11 units of intermed as documented in the following table:

| Quantity Transferred | Selling Price | Final's Variable Cost | Transfer Price | Final's Profit |
|---|---|---|---|---|
| 4 | $420 | $5 | $48 | $1,468 |
| 5 | 400 | 5 | 48 | 1,735 |
| 6 | 380 | 5 | 48 | 1,962 |
| 7 | 360 | 5 | 48 | 2,149 |
| 8 | 340 | 5 | 48 | 2,296 |
| 9 | 320 | 5 | 48 | 2,403 |
| 10 | 300 | 5 | 48 | 2,470 |
| 11 | 280 | 5 | 48 | 2,497 |
| 12 | 260 | 5 | 48 | 2,484 |
| 13 | 240 | 5 | 48 | 2,431 |

d. For every unit of intermediate produced and transferred to Final, Intermediate's profits rise by the amount of allocated fixed costs. Because these costs are fixed, producing more units of intermediate and selling them to Final causes Intermediate's profits to rise by $33 ($48 - $15). Since Final will purchase 11 units, Final's profits increase by 11 × $33, or $363.

e. Corporate should set the transfer price at full cost of $48 because this results in higher firm-wide profits than if Intermediate sets the transfer price at $270. If corporate knew Intermediate's variable cost is $15 per unit, and corporate sets the transfer price at $15, Final would purchase 12 units. Using Intermediate's full cost of $48 causes Final to purchase 11 units, one fewer than the firm-value-maximizing amount. While slightly less than the firm-value-maximizing transfer (11 vs. 12), full cost transfer pricing is far better than letting Intermediate set the transfer price at $270 where only six units are transferred. The following table shows that firm profits are larger at a transfer price of $48 than a transfer price of $270. And at a transfer price of $48, firm profits are only $20 below the firm-value maximizing transfer price of $15 ($2,860 vs. $2,880).

**Transfer price = $48**

| | | |
|---|---|---|
| Intermediate's profits | | |
| Margin ($48 - $15) | $33 | |
| Units transferred | 11 | |
| Profits | | $363 |
| Final's profits | | |
| Margin ($280 - $48 - $5) | $227 | |
| Units transferred | 11 | |
| Profits | | $2,497 |
| Total firm-wide profits | | $2,860 |

**Transfer price = $270**

| | | |
|---|---|---|
| Intermediate's profits | | |
| Margin ($270 - $15) | $255 | |
| Units transferred | 6 | |
| Profits | | $1,530 |
| Final's profits | | |
| Margin ($380 - $270 - $5) | $105 | |
| Units transferred | 6 | |
| Profits | | $630 |
| Total firm-wide profits | | $2,160 |

**Transfer price = $15**

| | | |
|---|---|---|
| Intermediate's profits | | |
| Margin ($15 - $15) | $0 | |
| Units transferred | 12 | |
| Profits | | $0 |
| Final's profits | | |
| Margin ($260 - $15 - $5) | $240 | |
| Units transferred | 12 | |
| Profits | | $2,880 |
| Total firm-wide profits | | $2,880 |

**P 5–25:** **Solution to XBT Keyboards** (45 minutes)
[Incentives to convert fixed costs to variable costs with variable cost transfer pricing]

This problem illustrates that managers who are receiving variable cost transfer prices have incentives to convert fixed costs into variable costs.

a. The current incremental cost of manufacturing 2.5 million keys internally are:

| | Per Key |
|---|---|
| Materials ($3.00/50) | $0.06 |
| Direct Labor – keys ($4.00/50) | 0.08 |
| Variable overhead ($\frac{\$8}{\$16*} \times \$4.00/50$) | 0.04 |
| Injection molding ($10.00/50) | 0.20 |
| Average unit cost per key | $0.38 |

*$16 = sum of direct labor of keys and assembly ($4 + $12)

Therefore, if the keys are outsourced, instead of produced internally, the firm's cash flows fall by $0.01 ($0.39 - $0.38) per key.

b. Ms. Litle will purchase the keys from the outside vendor in order to maximize division profits and her own compensation, even though the average incremental cost per unit ($0.38) is lower than the vendor's price ($0.39). The reason Litle takes this firm-value decreasing action is to convert a fixed cost (injection molding lease), which is not part of the variable cost transfer price she receives for keyboards included with XBT PCs, into a variable cost.

c. XBT Keyboard Division's pro forma income statement if manufacturing of all keys remains internal is:

**XBT Keyboard Division**
**Pro Forma Income**
(all keys fabricated internally)

| | | |
|---|---|---|
| Revenue: | | |
| External sales (150,000 @ $100) | $15,000,000 | |
| Internal transfers (50,000 @ $60 × 1.2) | 3,600,000 | $18,600,000 |
| Costs: | | |
| Variable costs (200,000 @ $60) | $12,000,000 | |
| Fixed Costs: | | |
| Key Injection molding (4 × $500,000) | 2,000,000 | |
| Fixed overhead (200,000 @ $18) | 3,600,000 | $17,600,000 |
| Divisional Profits | | $ 1,000,000 |

If the outside vendor is used to manufacture the keys for units transferred for use with the XBT PC, the Keyboard Division profits are:

**XBT Keyboard Division**
**Pro Forma Income**
(2.5 million keys purchased outside)

---

| | | |
|---|---|---|
| Revenue: | | |
| External sales (150,000 @ $100) | $15,000,000 | |
| Internal transfers (50,000 @ $70.50* × 1.2) | 4,230,000 | $19,230,000 |
| | | |
| Costs: | | |
| Variable Costs: | | |
| External sales (150,000 @ $60) | $9,000,000 | |
| Internal transfers (50,000 @ $70.50) | 3,525,000 | |
| Fixed Costs: | | |
| Key Injection molding (3 × $500,000) | 1,500,000 | |
| Fixed overhead (200,000 @ $18) | 3,600,000 | $17,625,000 |
| Divisional Profits | | $ 1,605,000 |

*Variable cost per keyboard with purchased keys:

| | |
|---|---|
| Base | $11.00 |
| Key sockets | 13.00 |
| Connectors & cables | 9.00 |
| Direct labor – assembly | 12.00 |
| Variable overhead ($\frac{\$8}{\$16} \times \$12$) | 6.00 |
| Keys ($0.39 × 50) | 19.50 |
| | $70.50 |

Keyboard Division profits increase by $605,000 if 2.5 million keys are out-sourced. This $605,000 can be decomposed as follows:

| | |
|---|---|
| Increase in divisional profits | $605,000 |
| Composed of: | |
| Additional revenue from internal transfers on Injection molding ($500,000 × 1.2) | $600,000 |
| Additional revenue from mark-up on higher cost of vendor keys ([$0.39 – 0.38] × 2,500,000 × 20%) | 5,000 |
| | $605,000 |

From this analysis, most of the additional divisional profits arise from converting a fixed cost ($500,000) into a variable cost, which increases the transfer price. But, an additional $5,000 arises because the division gets a 20 percent mark-up on the increased cost of keys supplied by the outside vendor.

As a large shareholder, in possession of all the facts, the firm would be better off by $25,000 (the extra cost of the purchased keys) if the external purchase was not made, assuming there are no other benefits from outside purchase.

d. Probably no major change in the accounting or organizational systems is warranted. Litle's performance measure is higher when she cancels the lease and purchases the keys outside. If she is earning an above-market wage for her ability, other parts of her compensation can be adjusted. The only additional cash flow cost to XBT is the 1¢ additional cost per key on $2.5 million or $25,000 (before taxes). However, there are some offsetting benefits XBT receives for this $25,000. First, an external vendor now exists that can be used to benchmark the Keyboard Division's internal cost and quality. Long-run variable cost for a keyboard is closer to $70.50 than the $60.00 because the $60.00 does not include the cost of injection molding which is variable in the long run. Therefore, the PC Division is being charged too little for keyboards at $60 and therefore might be underpricing its PCs.

**P 5-26:** **Solution to Infantino Saab** (45 minutes)
[Calculating EVA and transfer pricing]

a. The residual incomes of the three departments are calculated in the following table:

| | **New Cars** | **Pre-owned Cars** | **Parts & Service** | **Total** |
|---|---|---|---|---|
| % of land | 50% | 40% | 10% | 100% |
| % of building | 30% | 10% | 60% | 100% |
| | | | | |
| Allocated land cost | $450,000 | $360,000 | $90,000 | $900,000 |
| Allocated building cost | 3,600,000 | 1,200,000 | 7,200,000 | 12,000,000 |
| Other net assets | 2,500,000 | 6,700,000 | 1,300,000 | 10,500,000 |
| Total department assets | $6,550,000 | $8,260,000 | $8,590,000 | $23,400,000 |
| Capital charge (16%) | $1,048,000 | $1,321,600 | $1,374,400 | $3,744,000 |
| Department Income | $600,000 | $1,725,000 | $1,813,000 | $4,138,000 |
| | | | | |
| Residual Income | $(448,000) | $403,400 | $438,600 | $394,000 |

b. It appears as though the new car department is losing money and the pre-owned and parts and service departments are making money. But this ignores the synergies/interdependencies among the departments (see part c).

c. The new car department appears to be losing money because most of the profit from transactions involving trade-ins gets assigned to the pre-owned car department when the trade-in allowance is used as the transfer price. Using the example in the problem, the new car department only makes $500 on the new car and the pre-owned car department makes $2,800 on the used car. But the used car department cannot make this profit unless the new car department sells a new car and takes a used car in trade, usually at a substantial discount from market. Infantino Saab is selling a joint product consisting of new cars and a resale market for new car buyers' used cars. New cars could show a profit if Infantino would give the new car department some of the profits made from selling the used car. For example, suppose the used car taken in trade has a fair market value of $9,200. The new car department gave the new car buyer $8,000 for his used car. The new car department should receive $1,200 of profit from this trade-in and when the used car department sells the used car for $10,800 it would show a profit of $1,600. That is, instead of using the trade-in allowance as the transfer price of the used car, the transfer price should be the fair market value of the used car. Also, the profits in the parts and service departments are due partially to the sales of cars made by the new and pre-owned car departments. Customers tend to bring their cars needing service back to the dealerships where they are purchased. There is no simple, obvious way to allocate the profits of the service department back to the new and used car department. Moreover, some new and used car customers choose where to purchase or not purchase their cars based on their past dealings with the service department. Providing high quality car service often generates new and used car sales.

Another problem in the way Infantino Saab is calculating residual income is the cost assigned to the land. Infantino owns twenty acres of land in what has become a very valuable commercial area. The land was purchased 40 years ago for $900,000. Certainly, the value of the land has appreciated. Yet, the cost assigned to the three departments for their use of the land is only $144,000 (16% × $900,000). Suppose this land is now worth $5 million. Ms. Infantino is forgoing $800,000 (16% × $5 million) of income if she were to sell the land and invest it in similarly risky assets returning 16 percent a year. Viewed this way, she actually lost $406,000 ($800,000 – $394,000) before taxes by operating the dealership.

**P 5-27:** **Solution to Wujo** (45 minutes)
[Transfer pricing tradeoffs between incentives and taxes]

a. With a zero transfer price the profit maximizing price is €235 and WUK reports a profit of €12.225 million.

| Price | Quantity (000) | Revenue | Variable cost | Fixed Cost | Transfer cost | Profit |
|---|---|---|---|---|---|---|
| 270 | 130 | 35,100,000 | 9,100,000 | 15,000,000 | 0 | 11,000,000 |
| 265 | 135 | 35,775,000 | 9,450,000 | 15,000,000 | 0 | 11,325,000 |
| 260 | 140 | 36,400,000 | 9,800,000 | 15,000,000 | 0 | 11,600,000 |
| 255 | 145 | 36,975,000 | 10,150,000 | 15,000,000 | 0 | 11,825,000 |
| 250 | 150 | 37,500,000 | 10,500,000 | 15,000,000 | 0 | 12,000,000 |
| 245 | 155 | 37,975,000 | 10,850,000 | 15,000,000 | 0 | 12,125,000 |
| 240 | 160 | 38,400,000 | 11,200,000 | 15,000,000 | 0 | 12,200,000 |
| **235** | **165** | **38,775,000** | **11,550,000** | **15,000,000** | **0** | **12,225,000** |
| 230 | 170 | 39,100,000 | 11,900,000 | 15,000,000 | 0 | 12,200,000 |
| 225 | 175 | 39,375,000 | 12,250,000 | 15,000,000 | 0 | 12,125,000 |

b. With a transfer price of €50 per unit, the profit maximizing price is €260 and WUK reports a profit of €4.60 million.

| Price | Quantity (000) | Revenue | Variable cost | Fixed cost | Transfer cost | Profit |
|---|---|---|---|---|---|---|
| 270 | 130 | 35,100,000 | 9,100,000 | 15,000,000 | 6,500,000 | 4,500,000 |
| 265 | 135 | 35,775,000 | 9,450,000 | 15,000,000 | 6,750,000 | 4,575,000 |
| **260** | **140** | **36,400,000** | **9,800,000** | **15,000,000** | **7,000,000** | **4,600,000** |
| 255 | 145 | 36,975,000 | 10,150,000 | 15,000,000 | 7,250,000 | 4,575,000 |
| 250 | 150 | 37,500,000 | 10,500,000 | 15,000,000 | 7,500,000 | 4,500,000 |
| 245 | 155 | 37,975,000 | 10,850,000 | 15,000,000 | 7,750,000 | 4,375,000 |
| 240 | 160 | 38,400,000 | 11,200,000 | 15,000,000 | 8,000,000 | 4,200,000 |
| 235 | 165 | 38,775,000 | 11,550,000 | 15,000,000 | 8,250,000 | 3,975,000 |
| 230 | 170 | 39,100,000 | 11,900,000 | 15,000,000 | 8,500,000 | 3,700,000 |
| 225 | 175 | 39,375,000 | 12,250,000 | 15,000,000 | 8,750,000 | 3,375,000 |

c. Ignoring income taxes, the value maximizing transfer price is zero. A zero transfer price induces WUK to set a lower price (€235) and sell more units (165,000), than if the transfer price is €50. The WUK managers will treat the €50 transfer price as a variable cost. They will take this variable higher cost into effect when determining their profit maximizing price. The €50 royalty effectively shifts up WUK's marginal cost curve causing them to sell fewer units at a higher price. But this royalty is not a real marginal cost to the firm. In effect, by charging a royalty of anything greater than zero results in the double marginalization problem discussed by economists.

d. The following table demonstrates that overall firm value is maximized (on an after tax basis) by charging WUK a royalty of €50 for each unit of EzPhoto sold.

| | Transfer Price | |
|---|---|---|
| | Zero | 50 |
| WUK profit before taxes | €12.225 | €4.600 |
| U.K. tax rate | 0.330 | 0.330 |
| WUK U.K. taxes | €4.034 | €1.518 |
| | | |
| Wujo's profit before taxes | €0.000 | €7.000 |
| Wujo's PRC tax rate | 0.150 | 0.150 |
| Wujo PRC taxes | €0.000 | €1.050 |

| | Zero | 50 | Difference |
|---|---|---|---|
| Total revenue | €38.775 | €36.400 | €2.375 |
| Variable cost | 11.550 | 9.800 | 1.750 |
| Operating margin | €27.225 | €26.600 | €0.625 |
| WUK U.K. taxes | 4.034 | 1.518 | 2.516 |
| Wujo PRC taxes | 0.000 | 1.050 | -1.050 |
| Fixed costs | 15.000 | 15.000 | 0.000 |
| Consolidated profits | €8.191 | €9.032 | -€0.841 |

Even though WUK sells 25,000 (165,000 – 140,000) fewer units of EzPhoto at a €50 transfer price, the combined taxes paid to the PRC and the U.K. are substantially lower. With a zero transfer price, its U.K. tax bill is €4.034 million. At a €50 transfer price, profits are shifted out of the high tax U.K. jurisdiction to the lower tax PRC jurisdiction, and the total tax liability (PRC plus U.K.) is only €2.568 million. The lower total taxes paid with a €50 transfer price more than makes up for the lower operating margin (€625,000) that results from WUK setting a higher price and selling fewer units. In fact, the combined net cash flows are higher by €841,000 with a €50 royalty. This example illustrates how tax considerations often "trump" internal incentives when it comes to setting transfer prices.

e. Clearly, if Wujo can set two different transfer prices, it would charge WUK a zero royalty internally to induce WUK to sell the profit maximizing number of EzPhotos, but the use the €50 transfer price on its PRC and U.K. tax returns. The following table calculates the combined cash flows after taxes.

| | Wujo-PRC | WUK | Total |
|---|---|---|---|
| Profits before taxes | | €12,225,000 | €12,225,000 |
| Units sold | 165,000 | 165,000 | |
| Transfer price | €50 | €50 | |
| Transfer revenue/cost | €8,250,000 | €8,250,000 | |
| Income before tax | €8,250,000 | €3,975,000 | |
| Tax rate | 0.15 | 0.33 | |
| Income taxes | €1,237,500 | €1,311,750 | €2,549,250 |
| Cash flow after taxes | | | €9,675,750 |

With a €50 transfer price used for both internal use and taxes, the total revenue is €4.6 million and a total tax liability of €2.568 million or net cash flows after taxes of €2.032 million. Clearly, Wujo would really like to use to separate transfer prices, a zero transfer price internally to motivate WUK to sell more units, and a €50 transfer price on its PRC and U.K. tax returns because this leads to much higher net cash flows after taxes (€7,643,750)

f. If the U.K. tax authorities audit WUK and find that WUK is using a €0 transfer price for internal purposes such as performance evaluation, they would challenge the use of the €50 transfer price used for taxes on the basis that the €50 transfer price being used for taxes serves no legitimate business purpose other than to minimize taxes. The only way WUK can justify its use of €50 as the transfer price for taxes is if they can show that this is normal business practice in the industry and that other software companies are using such a royalty rate in arms length transactions.

## P 5-28: **Solution to Serviflow** (55 minutes)

[Double marginalization of transfer pricing]

a. Firm-wide profits are maximized by setting the price of NGM4010 at $510 and selling 49 units per week as calculated in the table below.

| **Quantity Sold** | **Price Paid By external customer** | **Total Revenues** | **Supply Div total cost** | **Mktg Div total cost** | **Servilow Total profit** |
|---|---|---|---|---|---|
| 20.0 | $800 | $16,000 | $120 | $280 | $15,600.00 |
| 22.0 | 780 | 17,160 | 132 | 308 | 16,720.00 |
| 24.5 | 755 | 18,498 | 147 | 343 | 18,007.50 |
| 26.0 | 740 | 19,240 | 156 | 364 | 18,720.00 |
| 30.0 | 700 | 21,000 | 180 | 420 | 20,400.00 |
| 40.0 | 600 | 24,000 | 240 | 560 | 23,200.00 |
| 45.0 | 550 | 24,750 | 270 | 630 | 23,850.00 |
| 49.0 | 510 | 24,990 | 294 | 686 | 24,010.00 |
| 50.0 | 500 | 25,000 | 300 | 700 | 24,000.00 |
| 60.0 | 400 | 24,000 | 360 | 840 | 22,800.00 |

Instead of computing firm-wide profits from the table, since we know profits are maximized where marginal revenues equal marginal costs we can solve for the profit maximizing quantity using the following equations:

$$\text{Revenue} = (1{,}000 - 10Q)Q$$
$$= 1{,}000Q - 10Q^2$$
$$MR = 1{,}000 - 20Q = MC = 20$$
$$20Q = 980$$
$$Q = 49$$

b. At a price of \$510 and a weekly quantity of 49 units, Serviflow generates \$24,010 of profits [\$510 × 49 – 49(\$6+\$14)].

c. If the Supply Division knows NGMD's demand curve for NGM4010 then it will set the transfer price at \$496 units and NGMD will purchase and sell 24.5 units per week.

| Transfer Price | Units purchased Weekly by NGMD | Supply Div total cost | Supply Div Profit |
|---|---|---|---|
| \$480 | 25.30 | \$151.80 | \$11,992.20 |
| 490 | 24.80 | 148.80 | 12,003.20 |
| 491 | 24.75 | 148.50 | 12,003.75 |
| 492 | 24.70 | 148.20 | 12,004.20 |
| 493 | 24.65 | 147.90 | 12,004.55 |
| 494 | 24.60 | 147.60 | 12,004.80 |
| 495 | 24.55 | 147.30 | 12,004.95 |
| 496 | 24.50 | 147.00 | 12,005.00 |
| 497 | 24.45 | 146.70 | 12,004.95 |
| 498 | 24.40 | 146.40 | 12,004.80 |
| 499 | 24.35 | 146.10 | 12,004.55 |
| 500 | 24.30 | 145.80 | 12,004.20 |

As in part (a), Supply maximizes its profits where

$$
\begin{aligned}
&MR = MC \\
&\text{Revenue} = (986 - 20Q)Q = 986Q - 20Q^2 \\
&MR = 986 - 40Q = MC = 6 \\
&40Q = 980 \\
&\quad Q = 24.5
\end{aligned}
$$

d. At a transfer price of \$496 and 24.5 units transferred per week, NGMD and the Supply Division make the following profits:

| | **NGMD** |
|---|---|
| Revenues (24.5 × \$755) | \$18,497.50 |
| Transfer cost (24.5 × 496) | (12,152.00) |
| Variable cost (24.5 × \$14) | (343.00) |
| NGMD profits | \$6,002.50 |
| | |
| Supply Division profits | 12,005.00 |
| Total firm profits | \$18,007.50 |

e. If corporate headquarters has all the information and sets the output decision to sell 49 units Serviflow generates weekly profits of \$24,010. Giving the Supply Division the decision rights to set the transfer price, total firm profits are only

$18,007.50 per week or about 25 percent lower. The reason is that the Supply Division will set the transfer price to maximize its profits and then NGMD takes this transfer price as given to maximize its profits. The quantity of units that maximizes the Supply Division's profits results in too few units being transferred. Only 24.5 units are transferred if Supply Division sets the transfer price, whereas 49 units are transferred if corporate knows all the relevant information. When each division maximizes its profits, firm-wide profits are lower and this is called the Double Marginalization Problem.

f. Corporate should set the transfer price at the Supply Division's variable cost of $6. NGMD would then select

$$T = 986 – 20Q$$
$$\$6 = 986 - 20Q$$
$$20Q = 480$$
$Q = 49$, which is the firm-wide profit maximizing quantity.

g. If Supply Division's variable cost of $6 per unit is the transfer price, the Supply division does not make any money supplying NGM4010. In fact, if all of the Supply Division's output is sold to other Serviflow divisions at Supply Division's variable cost, the Supply Division reports a loss equal to its fixed costs. Evaluated as a profit center, the Supply Division appears to be losing money. To avoid losing money or to reduce the loss, the Supply Division will figure out ways to convert its fixed costs into variable costs, even if the total cost of production rises. In this way, the higher variable costs are passed on to marketing divisions.

**Case 5–1:** **Solution to Swan Systems** (50 minutes)
[Comparing ROI and residual income and the effects of cost allocations]

This question is designed to do three things. First, it illustrates that choosing the best/worst performer depends on the performance measurement system. Equally plausible performance measurement systems can give conflicting and contradictory rankings. Second, it illustrates the similarities and differences between ROI and residual income. Third, it demonstrates that corporate cost allocations can affect relative performance measures.

a. The table below presents the various measures of divisional performance:

**Swan Systems**
**Summary of Performance Measures**
**Last Fiscal Year**
(Dutch Guilders)

| | Australia | Netherlands | U.S. |
|---|---|---|---|
| BEFORE CORPORATE OVERHEAD ALLOCATIONS: | | | |
| ROI[a] | 15.0% | 11.3% | 13.0% |
| Residual income[b] | 5.60 | 6.40 | 6.52 |
| AFTER CORPORATE OVERHEAD ALLOCATIONS: | | | |
| Sales | 50 | 55 | 75 |
| Divisional expenses | (38) | (33) | (58) |
| Allocated corporate overhead | (4) | (4) | (6) |
| Net income | 8 | 18 | 11 |
| ROI[c] | 10.0% | 9.2% | 8.4% |
| Residual income[d] | 1.6 | 2.4 | 0.5 |

[a] Net income divided by divisional net assets
[b] Divisional net income less cost of capital times divisional net assets
[c] Net income (after corporate overhead allocations) divided by divisional net assets
[d] Divisional net income (after corporate overhead) less cost of capital times divisional net assets

b. The first thing to notice is that the relative performance evaluation of each division depends on the measure of performance selected. For example, the table below summarizes the relative ranking of each division on each performance measure. In terms of ROI (before corporate overhead allocation), Australia is the best, but on residual income, it is the worst. Therefore, the evaluation of a division depends on what exactly one wishes to include in the performance measure.

| Swan Systems<br>Relative Rank of Each Division based on Various Performance Measures<br>Last Fiscal Year<br>(1=best, 3=worst) | | | |
|---|---|---|---|
| | Australia | Netherlands | U.S. |
| BEFORE CORPORATE OVERHEAD ALLOCATIONS: | | | |
| Net income | 3 | 1 | 2 |
| ROI | 1 | 3 | 2 |
| Residual income | 3 | 2 | 1 |
| AFTER CORPORATE OVERHEAD ALLOCATIONS: | | | |
| Net income | 3 | 1 | 2 |
| ROI | 1 | 2 | 3 |
| Residual income | 2 | 1 | 3 |

While returns on investment and residual income are closely related, they differ in one important aspect. ROI is a scale-free measure whereas residual income is not scale free. The Australia division is smaller than the other two. It has a higher ROI but a smaller residual income. If divisions expand by taking the largest positive net present value investments first, then smaller divisions should have larger ROIs than larger divisions, and over time the smaller division's ROI will tend to fall towards the firm's cost of capital. One problem with rewarding managers purely on the basis of ROI is that it creates incentives to turn down positive NPV projects that are below the division's average ROI.

A number of problems limit the usefulness of ROI and residual income. ROI and residual income are short-term measures of performance. They exclude the future cash flows from existing investments. Another problem with both ROI and residual income is how the net investment is financed and whether divisional net income includes or excludes interest expense on debt. If the divisions have different proportions of debt-financed assets and interest expense is included in division net income, then relative profitability is distorted. Historical cost accounting can also distort ROIs and residual incomes if market values differ dramatically from book value (recorded at historical cost).

The question as to whether corporate overhead should or should not be allocated depends in part on whether the firm incurs opportunity costs that can be approximated by the corporate cost allocations. The case indicates that a portion of corporate office expense is incurred to support the divisions and these costs roughly vary with divisional sales. Therefore, to the extent one has "faith" in the ability of the corporate overhead allocation to approximate the true underlying opportunity costs, then the performance measures based on corporate cost allocations are likely more accurate than those without the allocations.

c. To evaluate the three divisions, all three are earning ROIs in excess of their cost of capital. All three have positive residual income. Which is the best and which is the worst cannot be determined from this limited set of data. Australia certainly has the highest ROI, but is this due to their not yet expanding into other positive but smaller ROI markets? Or is it due to superior management skills? The use of budgets at the beginning of the year provides a benchmark to gauge performance at the end of the year. (See Chapter 6.)

**Case 5-2:** **Solution to Celtex** (50 minutes)
[Transfer pricing dispute]

a. Cash flows:

| | | Per Gal. |
|---|---|---|
| Buy Q47 Outside: | | |
| Out-of-pocket costs of Celtex to Meas | | $3.00 |
| | | |
| Buy Q47 Inside: | | |
| Out-of-pocket costs of Organic Chemical (80% of $1) | $.80 | |
| Out-of-pocket costs of Synchem | 1.75 | |
| Out-of-pocket costs of Celtex | | $2.55 |
| | | |
| Net Cash Outflow of buying from Meas | | $ .45 |

If Juris ends up buying from Meas, the net cash flow of Celtex is lower by $.45 for every gallon of Q47 purchased. Because there is excess capacity in the industry, the opportunity cost of capacity is zero. Fixed overhead costs will be incurred regardless of the decision to produce Q47.

(b) While it seems obvious that Debra Donak should somehow intervene and prevent this loss from occurring, the old maxim, "If it ain't broke, don't fix it" should be applied.

Celtex has been a successful chemical company. Its decentralized, senior management hands-off policy seems to be working. If Donak intervenes in the current dispute, she will be asked to intervene in future disputes. This will begin to unravel Celtex's decentralization policy. Once Donak assumes the decision rights over pricing and external sourcing from her managers, internal managers will alter their behavior and ask Donak to intervene more often in the future.

The question is: are the cash flows forgone if Juris buys from Meas larger than the cash flows from weakening the high degree of decentralization? The current Synchem-Consumer Products ruckus appears inconsequential. This is a new start-up product for Consumer Products and is unlikely to be a large volume of business for Synchem. If this were a large cash flow item, Horigan would likely be acting differently towards his bid.

The real issue here is not the transfer pricing question and forcing or not forcing Horigan to lower his bid, but rather Horigan's competence as a manager. Either Horigan knows what he is doing by bidding $3.20 or he doesn't. Maybe he doesn't want the business at anything less than $3.20 because he anticipates an upturn. If Horigan is not qualified to operate Synchem, Donak should replace him instead of intervening in the transfer pricing dispute that will likely undermine Celtex's apparently successful decentralization policy. By intervening in this case, Donak changes the way decision rights are assigned in terms of setting transfer prices.

**Case 5-3:** **Solution to Executive Inns** (55 minutes)
[Depreciation as a commitment device and residual income]

a. Sarah will propose the expansion to Kathy because the net cash flows in years 1 - 10 are positive and she is not charged for the costs of the expansion. Thus, her compensation will increase.

b. Residual income is computed as:

Expected Net Cash Flows - Depreciation - 12% × Average Book Value of Investment

Using 12 percent as the cost of capital, the following table computes Ms. Adams' annual expected residual income. She will use her expected cash flows, not the cash flow estimates she submits to justify the project because she wants an unbiased estimate of the effect of the decision to accept the project on her expected compensation.

| Year | Expected Cash Flows | Straight Line Depreciation | End of Year Book Value | Average Book Value | Operating Profit After Depreciation | Residual Income |
|---|---|---|---|---|---|---|
| 0 | -$10 | | $10 | | | |
| 1 | 2 | $1.0 | 9.0 | $9.5 | $1.00 | -$0.14 |
| 2 | 1.9 | 1.0 | 8.0 | 8.5 | 0.90 | -0.12 |
| 3 | 1.8 | 1.0 | 7.0 | 7.5 | 0.80 | -0.10 |
| 4 | 1.7 | 1.0 | 6.0 | 6.5 | 0.70 | -0.08 |
| 5 | 1.6 | 1.0 | 5.0 | 5.5 | 0.60 | -0.06 |
| 6 | 1.5 | 1.0 | 4.0 | 4.5 | 0.50 | -0.04 |
| 7 | 1.4 | 1.0 | 3.0 | 3.5 | 0.40 | -0.02 |
| 8 | 1.3 | 1.0 | 2.0 | 2.5 | 0.30 | 0.00 |
| 9 | 1.2 | 1.0 | 1.0 | 1.5 | 0.20 | 0.02 |
| 10 | 1.1 | 1.0 | 0.0 | 0.5 | 0.10 | 0.04 |

c. Sarah will not propose the expansion because the residual income is now negative in each of the first five years, before she expects to leave the firm.

d. If evaluated based on profits after depreciation, Sarah will now take the expansion project because net income is positive in each year.

e. She changes her decision in part (d) because she does not have to pay for the cost of capital invested in the project.

**Case 5-4: Solution to Royal Resort and Casino** (60 minutes)
[Synergies and transfer pricing]

a. Answering this question requires an understanding of the various niche strategies employed by the three separate firms and RRC. RRC caters to an upscale, high-income customer who wants luxurious surroundings, plush complimentary rooms, good food, and top-name entertainment. They want the convenience of "one-stop shopping" with all amenities in one location. By bundling gaming, lodging, and entertainment together, RRC lowers customers' transaction costs, much like supermarkets and shopping centers. The high income RRC customer has a high opportunity cost of time and doesn't want to waste time or have the weather-related inconvenience traveling to restaurants and shows. But this bundling niche strategy does not come for free – RRC must somehow provide incentives to its divisional managers to exploit the synergies.

Big Horseshoe Slots & Casino, Nell's Lounge and Grill, and the Sunnyside Motel are separately owned, thus providing the owners with incentives to maximize their individual firms' values. Loses in the marketplace quickly discipline inefficient owners. And neighboring business owners are unlikely to subsidize their unprofitable neighbors. The three separate businesses have fewer synergies among them, catering to a lower-income clientele that values less the one-stop services at RRC. If any synergies exist across the three separate firms such as parking or joint advertising, they can probably be captured via negotiations among the three owners.

Firms decentralize decision making authority in order to make better use of local knowledge. Firms are subdivided into divisions to solve free-rider problems by more closely tying pay to individual effort. To reduce the free-rider problem, the performance of each division is calculated as though the division was a free-standing firm. But this is a myth and it raises the central conundrum: If each division is truly free-standing in the sense that it has no synergies with other divisions, divest it. There is no reason the division should be under one corporate umbrella, shielded from the discipline of the market, and potentially subsidized by other divisions. However, if synergies exist, how should they be allocated, assigned, or accounted for in order that each decentralized division has incentive not to forego firm-value enhancing actions in the pursuit of myopic division profits? As illustrated in the context of the Royal Resort and Casino, an accounting system usually can not economically capture and report all the synergies.

b. One such interdependency is junkets. Entertainment and Hotel operations might appear to be unprofitable if they are not compensated for the complimentary food and lodging for the big gamblers. But how should such compensation across divisions be determined? Answering this question involves setting a transfer price the Hotel division receives and the Gaming division pays when one complimentary room is used for a junket guest.

As an example of another interdependency, consider a customer staying at another hotel who comes to RRC to see a show. Suppose this guest drops $50 in RRC slot machines, a synergy exists between Entertainment and Gaming. In designing a transfer price scheme, how much of this $50 should be credited to the Entertainment division because their show got this customer in the door? Gaming would prefer Entertainment set low prices for its shows to insure a large crowd of potential gamblers. It is probably prohibitively expensive to design and implement a transfer pricing system that perfectly captures this $50 transaction. Or, consider those gamblers, not staying at RRC who prefer to gamble at RRC. They think they are lucky at RRC, or prefer the atmosphere. These people stay to see shows and have meals. For these customers, some amount of their show and restaurant receipts should be transferred to Gaming to compensate Gaming for getting them to RRC. But again, estimating the magnitude of these transfers can be costly. Simply ignoring them does not create incentives for the division heads to take into account the consequences of their actions on the other divisions' performance.

c. A number of mechanisms can be used to better capture synergies among divisions. These include:

- use transfer prices,
- award division managers shares in the firm,
- tie divisional pay to firm-wide performance,
- create groups and link pay to group-level performance,
- link divisional pay to other divisions' performance,
- measure performance both objectively and subjectively,
- use cost allocations to get divisional managers to cooperate,
- reorganize.

Each of these is briefly discussed below.

d. Transfer pricing is a common method used to capture interdependencies among units. However, it has limitations as the following discussion illustrates. Suppose a room at RRC can be rented for $150 per night; it costs $25 to clean it and provide fresh linens. If Hotel does NOT have an empty room, the Hotel division foregoes $150 by providing a complimentary room to a Gaming junket guest. (The $25 cost of cleaning is incurred whether or not the guest is paying for the room.) By turning away a customer willing to pay for the room that is being provided complimentary to a junket guest, Gaming should pay Hotel the foregone room rental of $150. Had the room remained empty, the only cost the junket guest imposes on the Hotel division is the $25 cleaning cost. Therefore, the transfer price should be either $25 (had the room been empty) or $150 (if the room could have been rented). If Hotel, because it has the knowledge of whether or not they turned away a paying guest, has the authority to set the transfer price after each junket guest leaves, Hotel has incentives to lie about whether the room was rentable. Knowing that it will almost always be charged $150 for rooms, Gaming will tend not to invite gamblers unless they are expected to lose at least $150 per day. If Hotel has some empty rooms, it is best for Gaming to offer free lodging as long as the guest loses at least $25 to cover the cleaning cost.

The preceding transfer pricing rule does not capture the complexities of most real-world situations. Suppose the hotel is at capacity 40 percent of the time. Then, one possible transfer price is $75 (0.40 x $150 + 0.60 x $25). However, this transfer price does not take into account the variation in occupancy rates between weekdays and weekends, holidays, conventions, seasons, and the quality of the entertainment playing at RRC on that day. It can become very time consuming to develop a menu of transfer prices that incorporates most realities and yet not be dependent on privately-held information by one division.

Giving shares of the firm to divisional managers creates incentives for them to take actions to capture synergies across divisions. But additional company stock causes divisional managers to hold undiversifiable portfolios thereby increasing the amount of risk they bear. Moreover, small divisions, by definition, have little affect on firm-wide value and hence giving them stock creates little incentive to overcome the free-rider problem. Determining the optimum amount of stock to award divisional managers is tricky, but likely depends on the relative size of the division, the magnitude of the synergies, and the risk aversion of the managers.

To avoid the under-diversification problem associated with awarding company stock to divisional managers, some companies link pay to firm-wide accounting-based earnings rather than stock. In the long run, stock and earnings are about equally risky. But over short time periods, accounting earnings impose less risk on managers than does common stock. Stock returns are sensitive to market-wide factors such as interest rates, tax policy, foreign currency fluctuations, and so forth.[2] Firm-wide accounting earnings reduce risk, but still have free-rider problems.

To reduce free-rider problems, firms like Fiat with numerous profit and investment centers combine divisions with significant synergies into groups headed by a group-level manager. By tying the group-level manager's pay to group-level performance, this manager has incentive to capture the synergies among divisions in his or her group. By not paying any divisional manager a bonus unless the group makes its target or by linking divisional managers' pay directly to group performance reduces the divisional managers' myopic behavior. However, adding group-level structures also has downsides. Another costly layer of management is created resulting in centralization of some decision making authority. This reduces the ability of divisions to respond quickly to unexpected events. While group-level structures better capture interactions among divisions within each group, they do not capture synergies among groups unless a super group-level structure is imposed on top of the group structure.

Instead of adding groups, divisional managers with significant synergies can link their pay to each other's performance. For example, if two divisions have

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[2] See R. Sloan, "Accounting Earnings and Top Executive Compensation," *Journal of Accounting and Economics*(Jan./April/July 1993), pp. 55-100.

joint costs or joint benefits, each divisional manager's pay can be based on say 70 percent of own division performance and 30 percent of the other division's performance. Determining the "right" percentages is tricky. Eastman Chemical tried and abandoned this approach. When three or four divisions interact, the system becomes overly complicated.

Another method companies often use to give divisional managers incentives to cooperate to capture interdependencies is to combine both objective and subjective performance measures. For example, divisional EVA is an objective performance measure. Also rewarding managers through extra pay, non-pecuniary compensation, and promotions based on them being a "team" player as perceived by their superior is a subjective metric. "360˚ peer review" systems or basing some fraction of a manager's bonus on the subjective evaluation of those who interact with the manager creates incentives to cooperate to capture synergies. Unfortunately, such systems also create incentives for managers to lobby for higher ratings from those providing the subjective evaluations.

Another often overlooked method for inducing cooperation among divisions is allocating corporate-level advertising and overhead. While some accountants argue that allocating corporate overhead is a tax on profitable divisions that can distort profitability, such allocations also have desirable incentive properties. For example suppose there are five divisions each with its own performance metric such as EVA. Corporate overhead is $100 million. If this overhead is allocated to the divisions based on the percentage of that division's EVA to firm-wide EVA, then the divisions have incentives to cooperate. If one division's EVA goes up so does the amount of overhead allocated to that division and the other divisions' allocated corporate overhead goes down. Each division manager has incentive to increase the other divisions' EVA so each manager's own overhead goes down and EVA after allocated overhead increases. This type of allocation does not insulate each division's cost allocation from the other divisions' performance. In fact, if the synergies among divisions arise mainly from shared benefits such as brand-name capital, corporate overhead can be allocated based on divisional revenues instead of division profits or EVA. Chapters 7 and 8 discuss the incentive effects of cost allocations in greater detail.

Finally, if the synergies between two divisions become large, these two divisions can be combined into one EVA or profit center controlled by a single manager. However, as with all other possible "remedies," reorganizing also has costs. In particular, local managers of the merged divisions no longer have profit responsibility for their organization.

# CHAPTER 6
## BUDGETING

**P 6-1: Solution to G. Bennett Stewart on Management Incentives** (15 minutes)
[Costs and benefits of budgeting]

The quote fails to recognize that budgeting systems have survived and thus in general must be yielding benefits at least as large as their costs. While Stewart's analysis of budgeting systems offers insights into the dysfunctional aspects of budgeting, it does not address the question of the benefits such systems provide that allow these systems to survive.

Mr. Stewart’s criticism of budgets focuses on their decision control role. When used as performance measures and linked to bonuses, budgets cause gaming. There is no question that such gaming exists. The important questions are: What is the magnitude of the gaming? If budgets are not used to measure performance, what is and does it result in better or worse incentives?

**P 6–2: Solution to Investment Banks** (15 minutes)
[Zero-based budgeting]

a. Zero-based Budgeting (ZBB) is a form of budgeting in which each and every line item request in every budget must be justified by demonstrating that the benefits from requesting this amount of money exceed the amount requested. ZBB differs from the more typical case of incremental budgeting, in which only the increment over last year’s budget on each line item is justified. Presumably, ZBB better roots out inefficiencies in the firm by forcing each manager to demonstrate each year that each and every expenditure proposed is in the best interest of the firm. However, ZBB is more time consuming and thus more costly to operate than incremental budgeting. Moreover, ZBB tends to deteriorate into an incremental-type budgeting system whereby each year managers pull out last year’s justifications and make incremental changes to last year’s plan.

b. All budgeting systems separate decision management from decision control. Managers who propose next year's budgets do not have the decision control rights to approve (ratify) such requests. Those with the decision monitoring rights must have the specific knowledge to exercise the ratification rights. While ZBB is more costly to operate than incremental budgeting, it is more useful in the sense that it transfers more specific knowledge about each line item comprising the budget. In organizations that experience high turnover among the people with the decision monitoring rights, the benefits of ZBB are higher than in firms with more stable management.

Managers tend to be promoted vertically within organizations. Having been in lower-level positions, they have a great deal of specific knowledge about their subordinates’ budgets. Therefore, the benefits of ZBB (the value of the specific knowledge transferred) are lower in organizations with little external turnover of senior management positions.

Given the high external turnover in Cabots, Cabots is more likely to be using ZBB than Rogers Petersen.

**P 6–3:** **Solution to Ice Storm** (15 minutes)
[Assigning responsibility and controllability of expenses]

a. The cover memo for the second statement is:

> As you can see from the enclosed operating statement for this year, our operating profits excluding the ice storm exceeded budget by $107,000 thus achieving 105 percent of our budgeted profit. This better-than-projected profit results from revenues being 1 percent higher than anticipated, and occupancy costs 3 percent lower than expected. However, labor and materials exceeded budget.
>
> Taking into account the ice storm damage costs of $653,000 our total profits were $546,000 below budget.

b. There are two issues raised by this problem: agenda setting and controllability. How financial analyses are presented affects agendas. The second statement, which separates the storm costs from normal operations, focuses the discussion on the ice storm and whether the costs of the ice storm are measured properly. That is, how were the costs of the ice storm computed? Dye's superiors might conclude that the reason for M&P's favorable operating performance (before the ice storm costs are considered) is because Dye charged some normal operating costs to the ice storm to improve "operating profits before the ice storm." While the second statement tries to remove the costs of the ice storm from Dye's performance evaluation, the second statement also exposes Dye to charges that Dye did not do enough to reduce the costs of possible storms (e.g., removing tree limbs from around the greenhouses).

The second issue involves whether the manager should be held responsible for the ice storm. While the manager cannot prevent such storms, Dye can reduce the adverse consequences of such events. The second statement, which separates out the ice storm, tries to make the case that the manager should not be held accountable for the ice storm. The extent to which this ploy works depends on whether Dye's boss focuses on the ice storm and blames Dye for not doing enough prevention.

**P 6–4:** **Solution to Budget Lapsing versus Line-Item Budgets** (15 minutes)
[Budgeting]

a. Budget lapsing refers to preventing the manager from carrying over to the next fiscal period any unspent budget funds from this fiscal period. Line-item budgeting refers to restricting the manager's ability to shift unspent funds from one line item to another line item *within the same fiscal period.* Thus, budget lapsing restricts manager's decision rights across time, whereas line-item budgets restrict managers' decisions rights within a fiscal year.

b. Budget lapsing occurs in most organizations, probably to reduce the horizon problem of managers who build up large balances that are spent before they change jobs. It also is used to control manager's risk aversion. If it is optimum to spend $X on a certain activity, it is not optimum to have the manager save a portion of $X because she is risk averse.

c. Line-item budgets restrict managers' decision rights. You would expect to observe such restrictions where the agency costs of manager's discretion is high or where alternative monitoring devices such as incentive schemes and competition from other firms is low. Government agencies and certain non-profit organizations face little external competition and are unable to effectively employ incentive compensation schemes. Thus, these organizations are more likely to use line-item budgets.

**P 6-5:** **Solution to DMP Consultants** (15 minutes)
[Advantages and disadvantages of participative (bottom-up) budgeting]

The memo should contain the following points:

- Participative budgets help assemble specialized knowledge from lower levels of the firm. But if these budget estimates are then used for determining employees' compensation, this creates strong incentives for employees to lie, to sandbag the numbers, and to bias their information so it makes it easier for them to meet their sales quotas.
- Are our firm's sales compensation and budgeting systems broken? Remember, "If it ain't broke, don't fix it."
- DMP is suggesting a "one size fits all approach." But each firm must tailor its budgeting systems to its own unique organizational structure which best enables it to achieve its corporate strategy. Some firms will have top-down budgets and others will have bottom-up budgets.
- Top-down budgets are good for decision control, but bad for decision management. Bottom-up budgets are good for decision management, but compromise decision control (compensation). Participative budgets that are also used for decision control create distorted information.
- Only changing the budgeting system results in changing one leg of the three-legged stool. If participative budgeting is adopted, other parts of the firm's organizational architecture will have to be examined and perhaps modified.

**P 6-6: Solution to Federal Insurance** (15 minutes)
[Zero-based budgeting]

Federal will use zero-based budgeting because its senior management team is new, from outside of Federal, and not familiar with the detailed operations of Federal. Hence, zero-based budgeting will provide them with substantially more detailed information about the various divisions and administrative departments of Federal than traditional incremental budgeting.

**P 6-7: Solution to Golf World** (20 minutes)
[Agency costs and flexible budgets change incentives]

a. Almost all of the difference between actual operating profits and the static budget for April is due to the reduced cart rentals from 6,000 to 4,000. When the variances are calculated based on the flexible budget, Grimes operation shows only a $1,100 unfavorable variance. Labor and gas and oil were over budget. The $200 unfavorable variance in labor is probably insignificant and the $900 gas & oil difference is likely a timing difference between when the gas and oil are purchased and when they are actually used.

b. The major advantage of the controller's flexible budget scheme is that it separates those items Grimes can control from those he can't control. The flexible budget (and hence the variances) are adjusted for volume effects which presumably are out of Grimes' control. But are they? Herein lies the disadvantage of the controller's scheme. By removing volume effects from Grimes' variances, he has <u>no</u> incentive to worry about cart rentals. If in fact the only variances for which he is responsible are the operating costs, he can show favorable variances by reducing the quality of his services. The carts will not be cleaned as well, they will break down more on the course, and he will not choose the cart fleet to maximize his profit center's profits but rather to minimize costs.

Also, Grimes has specialized knowledge of the customers' demand curves for carts. If he is held responsible for revenues (i.e., the controller's proposal is rejected), Grimes has more incentive to implement pricing policies that maximize profits. If volume effects are "flexed out" of Grimes' budget, he has no incentive to offer special prices in order to price discriminate.

c. An agency problem exists between Sandy Green and Golf World under the present organizational structure. Green receives the benefits of closing the courses to golf carts (this reduces the maintenance her crews have to conduct) but she does not bear the full costs of this action (the reduced revenues from golf carts). By shutting a course because of wetness, Green keeps that course looking good and does not have to repair cart damage. In time, this translates to lower maintenance costs and higher golf course profits. But this decision imposes a negative externality on Grimes and the golf cart profit center.

One way to internalize this externality is to include as part of Green's operating statement the difference between Grimes' actual and static budget operating profits.

Some students are tempted to convert Golf Carts to a cost center from a profit center. This question involves who should have the decision rights to set the cart price. If Grimes can best set the price it should be a profit center, otherwise it should be a cost center. Who should set the price depends on who has the specialized knowledge and who has the comparative advantage in acquiring the knowledge. If Golf Carts becomes a cost center, Grimes will have no incentive to acquire the knowledge to set the profit-maximizing cart price.

**P 6-8:** **Solution to Coating Department** (20 minutes)
[Identifying fixed and variable costs for a flexible budget]

a. The first step in identifying the flexible budget is determining which accounts are fixed and which are variable. Given the data in the problem, one way to identify fixed and variable costs is to compute the unit cost per year (total cost ÷ coating hours) and see if the unit cost is relatively constant over the wide volume swings observed in 2009 - 2011. The following table takes the total cost data and divides them by machine hours.

| | **2009** | **2010** | **2011** |
|---|---|---|---|
| Coating materials | \$4.11 | \$4.10 | \$4.12 |
| Engineering support | \$2.24 | \$4.08 | \$2.06 |
| Maintenance | \$2.87 | \$4.28 | \$2.38 |
| Occupancy costs (square footage) | \$2.20 | \$3.44 | \$1.78 |
| Operator labor | \$9.26 | \$9.33 | \$9.69 |
| Supervision | \$3.72 | \$5.65 | \$3.25 |
| Utilities | \$1.03 | \$1.05 | \$1.06 |

From this table, we see that coating materials, operator labor, and utilities have fairly constant unit costs indicating that these items are probably variable costs. Fixed costs include engineering support, maintenance, occupancy costs, and supervision. Based on the preceding analysis, we can now estimate fixed and variable costs for 2012 by separating costs into fixed and variable components as in the next table.

| | 2009 | 2010 | 2011 | Average | Random Walk |
|---|---|---|---|---|---|
| Variable costs: | | | | | |
| Coating material | $4.11 | $4.10 | $4.12 | $ 4.11 | $ 4.12 |
| Operator labor | 9.26 | 9.33 | 9.69 | 9.43 | 9.69 |
| Utilities | 1.03 | 1.05 | 1.06 | 1.05 | 1.06 |
| Total variable cost | | | | $14.59 | $14.87 |
| | | | | | |
| Fixed costs: | | | | | |
| Engineering support | $27,962 | $34,295 | $31,300 | $ 31,186 | $ 31,300 |
| Maintenance | 35,850 | 35,930 | 36,200 | 35,993 | 36,200 |
| Occupancy costs | 27,502 | 28,904 | 27,105 | 27,837 | 27,105 |
| Supervision | 46,500 | 47,430 | 49,327 | 47,752 | 49,327 |
| Total fixed cost | | | | $142,768 | $143,932 |

In estimating 2012's costs, given we do not have specific data on expected relative price changes, we can either take an average of the last three years' data for each cost category, or we can assume that 2012 will look most like 2011. This last assumption is called a random walk model: our best estimate of the future is the most recent observation of the past. Therefore, we have two flexible budgets:

Expected costs = $142,768 + $14.59 per machine hour

Expected costs = $143,932 + $14.87 per machine hour

b. The following table calculates the coating department's cost per machine hour for 2012 using both an average of the annual costs and a random walk.

| | Average | Random Walk |
|---|---|---|
| Variable cost per machine hour | $ 14.59 | $ 14.87 |
| Times: Expected 2012 machine hours | 16,000 | 16,000 |
| Total variable costs | $233,333 | $237,920 |
| Plus: Fixed cost | 142,768 | 143,932 |
| Budgeted costs | $376,102 | $381,852 |
| Expected 2012 machine hours | 16,000 | 16,000 |
| Cost per hour in coating department | $ 23.51 | $ 23.87 |

**P 6–9:** **Solution to Marketing Plan** (20 minutes)
[Long-run versus short-run budgets]

Approve the advertising campaign, but only the first year of the plan. Approving the plan in general and specifically authorizing the one-year budget gives Jensen the flexibility to move ahead on the program. There is no compelling case for granting a three-year budget for this advertising campaign, while there are some reasons not to approve all three years now. The disadvantages of granting a three-year budget include:

a. New information will become available over the next three years regarding the company's other products, profitability, competition, etc. By approving all three years now, senior management gives up decision monitoring rights over the next three years. This makes it more difficult to assemble and take advantage of new information when it becomes available.

b. Jensen can have the project approved for the first year. This is a tentative approval for the entire three years, but senior managers reserve the decision rights to review and monitor performance over the three years. If she is given a three-year budget, there is less monitoring of results than if three one-year budgets are approved.

c. Three one-year budgets will require Jensen to make a presentation each year of the results to date and projected benefits of continuing the program. Thus, three one-year budgets are more likely to force Jensen and senior managers to communicate more information about the ad campaign, its results, and other related aspects of the business.

d. Setting a single three-year budget that does not lapse at the end of each year sets a precedent in the firm. Other managers will request similar treatment. Annual budgets that lapse are a mechanism to control agency problems. Allowing exceptions to annual budget lapsing will reduce monitoring and likely increase agency problems.

e. Setting a single three-year budget produces different incentive effects for Jensen than three one-year budgets. Presumably, Jensen will exert more effort at the end of each of the three years preparing for the budget review than if there is just one review at the end of three years. But this of course depends on how the *performance evaluation and reward systems* operate in conjunction with the budget review process.

**P 6-10:** **Solution to Potter-Bowen** (20 minutes)
[Top-down budgeting and incentives]

PB's sales budgeting system is essentially a top-down approach. Senior management forecasts total sales and unit prices at the firm-wide level and distributes this plan to the divisions, and then to the regions, and finally to the individual salespeople. The total projected sales cascades down through the sales force based on historical sales patterns. This budgeting procedure does not provide for the assembling of knowledge from lower levels in the firm, namely the sales force. They are not asked how many 6103s each can sell. They are told how many they will sell. It is not a bottom-up budgeting process. Thus, the first point to note is the budget system does not assemble knowledge from lower levels of the organization.

While the budgeting system does not assemble specialized knowledge from lower levels of PB, it does solve the problem of salespeople under-forecasting sales to more easily meet their sales quotas. Budgeting systems entail trade-offs between decision management and decision control. PB uses the budget to set sales quotas to motivate and compensate its sales force. While PB's system does not emphasize decision management, it reduces many of the problems with decision control.

PB's budgeting and compensation systems will lead to some dysfunctional behavior. Growing regions and sales territories within a region will find it easier to meet their targets and thus receive a greater bonus than shrinking territories. Therefore, it will be difficult for PB to keep its best salespeople in declining territories. Salespeople will tend to gravitate to those territories expected to have above average growth.

Salespeople have incentives to maximize dollar sales, not profits. Therefore, individual salespeople have incentives to offer price discounts to generate sales.

Another problem with the PB systems is that it ratchets up the budget based on past performance. Salespeople knowing this will tend to withhold sales if they are below 90 percent or above 150 percent. If sales are below 90 percent or above 150 percent, additional sales will just increase their next year's target without providing any current year bonus. Thus salespeople will try to defer these sales into the next fiscal year.

Having such wide break points (ten percentage points) causes salespeople at the end of the year to withhold sales if the sale does not put them into the next category. For example, suppose a salesperson had achieved 134 percent of his/her target for the year and it is December 14. The person will try to delay recording sales between the 14th and the 31st until the next budget period unless these sales push the person into the 140–150 percent category.

**P 6–11:** **Solution to Feder Purchasing Department** (20 minutes)
[Solving for fixed and variable cost given the flexible budget]

| | |
|---|---|
| Actual spending | $1,175,000 |
| Unfavorable variance | – 41,400 |
| Flexible budget @ 9,300 units | $1,133,600 |

First, write down the flexible budgets for the beginning and end of February. There are two equations in two unknowns (FC and VC). Subtract one equation from the other to get one equation in one unknown (VC). Then solve for the other unknown (FC).

$$
\begin{array}{rcll}
\$1{,}133{,}600 & = & FC + VC \times 9{,}300 & \text{(End of February flexible budget)} \\
\underline{1{,}076{,}400} & = & \underline{FC} + \underline{VC \times 8{,}200} & \text{(Beginning of February flexible budget)} \\
57{,}200 & = & 1{,}100\ VC & \\
VC & = & \$52 & \\
 & & & \\
FC & = & \$1{,}133{,}600 - \$52 \times 9{,}300 & \\
 & = & \$650{,}000 &
\end{array}
$$

**P 6–12:** **Solution to Access.Com** (20 minutes)
[Budget ratcheting]

a. If actual sales exceed budgeted sales in the year, next year's target is raised. However, if actual sales fall short of budget, next year's budget does not fall much. Looking at A. C. Chen's data reveals that 90 percent of Chen's good performance is added to the current budget whereas only 10 percent of any shortfalls are subtracted.

2004: $1.614 = 1.470 + a\,(1.630 - 1.470)$ => $a = 0.90$
2005: $1.785 = 1.614 + a\,(1.804 - 1.614)$ => $a = 0.90$
2006: $1.775 = 1.785 + b\,(1.685 - 1.785)$ => $b = -0.10$

b. Advantages of ratcheting:

- Budget ratcheting is simple and inexpensive to implement. No costly market research or long-run planning staffs are required.
- Ratcheting is objective and generates minimum influence costs.

Disadvantages of ratcheting:

- Being a top-down approach, it does not assemble knowledge.
- It produces dysfunctional incentives when performance is above budget – sales people have a disincentive to make additional sales since additional sales raise next year's target.
- Ratcheting does not control for variation in growth across different markets. This leads to a self selection in the work force. Good sales people will tend to quit if they are in low growth markets and bad sales people will stay in growing markets.

**P 6–13:** **Solution to Videx** (20 minutes)
[Budget Ratcheting]

a. Videx is ratcheting Martha Rameriz's budget. When she exceeds her budget, next year's budget is increased by 80 percent of the difference. The budget in year 8 will be set at $907,000, calculated as: 80% × ($908,000 - $901,000) + $901,000 = $906,600, which rounds up to $907,000. Notice that in setting the budget, Videx is rounding up all calculations to even thousands.

b. When Rameriz falls short of budget, the budget for next year is the same as the budget for the current year. If her sales in year 7 are $900,000, her budget for year 8 remains at $901,000.

**P 6-14:** **Solution to New York Fashions** (25 minutes)
[Flexible budgets]

a. Budgeted profits for August if revenues are $80,000:

**New York Fashions-Crystal Lakes Store**
Flexible Budget at $80,000 Revenues
August

| Expense | Fixed | Variable | |
|---|---|---|---|
| Revenues | | | $80,000 |
| Cost of goods sold | | $36,000 | (36,000) |
| Management | $7,000 | 800 | (7,800) |
| Sales persons | 2,000 | 6,400 | (8,400) |
| Rent | 12,000 | 4,000 | (16,000) |
| Utilities | 900 | | (900) |
| Other | 1,500 | | (1,500) |
| Budgeted net income | | | $9,400 |

b. Performance report for August.

| Expense | Flexible Budget | Actual Results | Variance |
|---|---|---|---|
| Revenues | $80,000 | $80,000 | |
| Cost of goods sold | (36,000) | (38,000) | $2,000 U |
| Management | (7,800) | (7,600) | 200 F |
| Sales persons | (8,400) | (9,800) | 1,400 U |
| Rent | (16,000) | (16,000) | |
| Utilities | (900) | (875) | 25 F |
| Other | (1,500) | (1,400) | 100F |
| Budgeted net income | $9,400 | $6,325 | 3,075 U |

c. The Crystal Lakes store under performed the flexible budget. Cost of goods sold exceeded budget by $2,000 and sales person expense exceeded budget by $1,400. Actual net income was $3,075 less than the flexible budget's net income.

d. Flexible budgets do not hold managers accountable for volume changes, whereas static budgets do. Hence, managers have less incentives to increase revenues (in the case of retail stores) if they are paid based on flexible budget variances.

**P 6-15:** **Solution to International Telecon** (25 minutes)
[Budget lapsing]

a. The payroll data does not exhibit any strong seasonal time-series pattern within the year. Payroll rises slightly in October and November in all three years, but December is lower in two of the three years. And the increase in the last three months is not large relative to other swings during the year. Since payroll does not exhibit any strong upsurge at the end of the year, it is unlikely that IT has a major seasonal component in the last quarter of its fiscal year that would cause supplies to rise.

However, there is a very large and persistent rise in the last three months in each of the last three years for supplies. This pattern is consistent with risk-averse cost center managers holding back some of their supplies budget during the year and then spending the remaining supplies budget in the last three months, especially in December. It is highly likely that IT requires any unspent supplies budget to be forfeited (budget lapsing). Large unspent funds in one year probably reduce the next year's supply budget.

b. Budgets that lapse cause cost center managers to do wasteful things at the end of the year to spend any remaining funds. Wasteful activities include making purchases at higher than normal prices, paying for rush deliveries, and buying items valued by the firm at less than their cost.

Budget lapsing is a frequently used policy in most firms to control managers' over-retention of funds. If budgets did not lapse, managers about to retire or move to a new assignment could use the accumulated funds in ways that enhance their careers, but not the value of the firm. Budget lapsing also forces managers to spend the funds assigned to them rather than saving them for a "rainy day." If it is firm-value-maximizing to spend, say, $800,000 on advertising this year, the manager assigned these decision rights to spend $800,000 on advertising should spend these funds and not save them.

It is important to note the difference in incentives between cost and profit center managers regarding their supplies expenditures. Profit center managers do not have the same "use it or lose it" mentality, because any unspent supplies increase profits. If the profit center manager budgets $100,000 for supplies but only spends $85,000, the $15,000 unspent budget causes the profit center's profits to be higher by that amount. Cost center managers, on the other hand, have less incentive to reduce supplies spending. Savings are not directly rewarded, unless the manager's performance is evaluated by comparing actual supplies spending to budgeted supplies spending.

One way to reduce the spending on supplies is to change the cost center manager's performance evaluation system. By placing more emphasis on showing favorable budget variances (actual spending less than budget), cost center managers have incentives to return unspent supplies budgets. The problem with this scheme is that it also creates strong incentives for managers to inflate the supplies budget estimate at the beginning of the year so they can underspend by larger amounts.

Another solution to reducing wasteful end-of-year supplies expenditures is to allow managers to carry over small amounts of unspent budgets to the next fiscal year and not to reduce next year's budget by the amount of any unspent funds. For example, IT could allow 20 percent of the budget not spent in any one year to be carried over to the next year. Also, the cumulative carryover from all previous years cannot exceed (say) 40 percent of the current year's budget. The reason for this last constraint is to prevent successive year carryovers from accumulating to a very large amount.

The benefits of allowing budget carryovers are the eliminated wasted expenditures made at the end of the year. The cost of the carryover policy is when managers leave their position and make wasteful expenditures. Also, the policy as outlined above requires additional (costly) monitoring and bookkeeping activities to track the amount of carryover budget.

But the most likely reason firms lapse budgets is to prevent risk averse managers from under-spending and hence not achieving their program goals.

**P 6–16:** **Solution to Adrian Power** (30 minutes)
[Flexible budgeting]

a. The first step is to convert the total variable costs into variable costs per unit of output and then to use these per-unit amounts to construct the flexible budget.

**Adrian Power**
**Planned Level of Production for January**

| | Variable Costs per unit | Actual Costs Incurred | Flexible Budget @ 15,400 | Variance |
|---|---|---|---|---|
| Direct materials | $10.00 | $142,400 | $154,000 | $11,600F |
| Direct labor | 16.00 | 259,800 | 246,400 | 13,400U |
| Indirect labor | 1.50 | 27,900 | 23,100 | 4,800U |
| Indirect materials | 0.75 | 12,200 | 11,550 | 650U |
| Maintenance | 0.45 | 9,800 | 6,930 | 2,870U |
| Supervision | | 28,000 | 24,700 | 3,300U |
| Other costs | | 83,500 | 83,500 | 0 |
| Total | | $563,600 | $550,180 | $13,420U |

b. The dollar magnitude of the variances is large enough to warrant investigation. Production levels exceeded budget by 10 percent (15,400 versus 14,000 units). There was a very favorable materials variance of $11,600 but all the other variances (except other costs) were unfavorable. It appears that in the process of securing a larger supply of materials to meet the increased production schedules, lower-quality materials were procured, causing the plant to use more direct and indirect labor, indirect materials, maintenance, and supervision. The unfavorable variances exceed the favorable material variance by $13,420.

## P 6–17: **Solution to Panarude Airfreight** (30 minutes)

[Budget lapsing]

a. Under the new budgeting scheme, budgets now lapse quarterly, as opposed to annually. In this regime, profit and cost center managers will ensure that unspent funds are spent at the end of each quarter as opposed to the end of the year. This occurs for two reasons: (i) future budgets are reduced by favorable quarterly variances and (ii) managers lose the benefits from any current unspent funds in the quarter. In this sense, the new budgeting scheme has not really eliminated the hoarding and spending behavior observed under the previous scheme, it has only caused it to occur earlier in the fiscal year.

b. The quarterly lapsing of budgets is likely inferior to annual lapsing for a couple of reasons.

   (i) Instead of end-of-year spending, there is now end-of-quarter spending. The present value of this end-of-quarter spending is higher because the extra dollars that would have been spent in November and December are now spent in March and June. This causes the firm to lose interest on these funds.

   (ii) The increased monitoring of quarterly budgets by the centralized budget office and the additional time operating managers spend at the end of each quarter are not costless. Managers and the accounting personnel could be spending this time in other activities. Thus, the quarterly lapsing of budgets generates additional opportunity costs.

   (iii) The new scheme imposes far more control on the operating managers. They have less flexibility to alter the timing of their spending throughout the year as circumstances change. This is another example of trading off decision management for decision control.

   Unless the firm requires extremely tight monitoring of expenditures on a quarterly basis, the new budgeting scheme will likely generate costs in excess of the benefits.

**P 6-18:** **Solution to Veriplex** (30 minutes)
[Budgetary incentives to shift costs to new start-up product]

a. Analysis of budget variances (euros):

| | Actual | Budget | Variance % |
|---|---|---|---|
| Existing gauges | 6.39 | 6.60 | 0.21 F |
| VTrap | 1.30 | 0.92 | 0.38 U |
| Total | 7.69 | 7.52 | 0.17 U |

b. This problem is based on an actual large European multinational company's experience, and occurs in other firms as well. The Gauge Department is evaluated as a cost center. Because senior managers are so interested in this project, the Gauge Department manager knows they will tolerate a larger unfavorable budget overrun in the new gauge line than in the existing line. Thus, the gauge manager has incentive to shift costs to new products, thereby making the existing products look better.

For example, suppose there are two equally skilled machinists, but one has been with the company longer and receives a higher salary. By assigning the older machinist to the new gauges, the new gauge line bears more cost than the old gauges. Or, if an existing machine, used for both new and old gauges, is refurbished and most of the cost can be justified as caused by the new gauges, again the old gauges benefit and the new gauges are charged the cost.

The gauge manager can easily argue the new gauge costs are over budget because of all the engineering change orders and tinkering with the production process. That is, the new gauge cost overruns are outside the Gauge Department's control. The gauge manager has asymmetric information with respect to his/her superiors to monitor the costs of the new gauge program. Given the start-up nature of the program, there is little history to benchmark the new gauge program. Thus, it is harder to monitor these expenditures by senior managers and consequently it is easier for the gauge manager to shift costs from the existing gauges to the new gauges.

Other possible reasons for the pattern include:

i. The Gauge Department actually diverted real resources from the old gauge line to the new line, and this is what caused the budget pattern. Senior management was so focused on the new line that the gauge manager shifted real production resources from the old to the new lines. The problem with this is that if real resources were shifted from the old gauges, how was the Gauge Department able to meet the production quotas for both lines?

ii. Learning curve effects not built into the budget cause the existing products to be over-budgeted and new products to be under-budgeted.

iii. Since the budget next year is based in part on current spending, new products will have overruns in early years as a way to build in slack for later years.

**P 6-19:** **Solution to Madigan Modems** (30 minutes)
[Static versus flexible budget]

a. Static budget variance:

| | Actual | Budget | Variance |
|---|---|---|---|
| Total production cost | \$1,114,800 | \$1,120,000 | \$5,200 F |

b. Flexible budget variance:

| | Actual | Budget | Variance |
|---|---|---|---|
| Variable costs (@\$160[1] /unit) | \$ 631,800 | \$ 624,000[3] | \$ 7,800 U |
| Fixed costs | 483,000[2] | 480,000 | 3,000 U |
| Total production cost | \$1,114,800 | \$1,104,000 | \$10,800 U |

[1] \$640,000 ÷ 4,000 units
[2] \$1,114,800 - \$631,800
[3] 3,900 units × \$160

c. Memo based on static budget: The production manager did well. He/she was under budgeted expenditures by \$5,200.

d. Memo based on flexible budget: The production manager performed poorly. Given the actual volume of 3,900 units, variable costs were \$7,800 over budget. Fixed costs were \$3,000 over budget.

e. In this production setting, the flexible budget probably better reflects the production manager's performance. Since the decision to deviate from budgeted volume of 4,000 units is not likely under the control of the production manager, then the flexible budget holds the manager responsible for the variable costs per unit produced and all the fixed costs. If the production manager is evaluated on the static budget, he/she has an incentive to produce fewer units than budgeted to save the variable costs.

**P 6-20:** **Solution to Webb & Drye** (30 minutes)
[Line-item budgets]

At the heart of the dispute between Malone and Piccaretto is the issue of whether or not the IT Department has a line-item budget. Line-item budgets hold managers responsible for not just keeping their actual total spending in line with the total budget, but in addition the manager is held responsible for keeping spending on each line item in check with the budget for that line item. Managers with line-item budgets do not have decision rights to shift spending from one line item to another line item without seeking prior approval from higher level managers. Line-item budgets impose tighter controls on managers and also assemble knowledge held by higher level managers before any decision is reached to shift monies across line items.

The ultimate issue of whether a department has a line-item budget involves who has the specific knowledge to make the substitutions. If a lower level manager with the budget has all the relevant specific knowledge to transfer funds across the line items, then line-item budgets are not necessary and impose unnecessary delays in adapting to changed circumstances. Line-item budgets reduce the incentives of lower level managers to search for and implement cost savings because these savings may not be available to offset higher spending in other areas of the budget. If higher level managers have some of the specific knowledge needed to decide whether substitutions across line items are useful, then line item budgets help assemble this knowledge with the decision rights.

In the WD case, Malone has some specific knowledge of the consequences of Piccaretto's decision to substitute staff salaries for more antivirus software. Malone has knowledge of the various users of IT services. For example, Malone obviously knew of the complaints from attorneys handling the large class action lawsuit. By not consulting Malone before she made these decisions, Piccaretto did not have all the specific knowledge relevant for making this substitution.

Malone erred in not fully informing Piccaretto when she was hired that the IT department had a line-item budget and that Piccaretto did not have the decision rights to shift funds across line items without first seeking Malone's permission.

Malone should clarify the budgeting procedures and institute written policies that Piccaretto (and any other managers) has a line-item budget and that prior approval from Malone is required if Piccaretto wants to shift funds across line items.

**P 6-21:** **Solution to Spa Ariana** (30 minutes)
[Breakeven analysis and flexible vs. static budgets]

a. The breakeven point is found by dividing fixed costs by contribution margin. Or, 339.5 treatments per month = \$14,600 / (\$100 – 57)

b. April's budget based on 550 treatments is:

**Flexible Budget for April**
(Number of treatments = 550)

| | Variable cost | Fixed Cost | Total |
|---|---|---|---|
| Revenue | | | $55,000 |
| Therapist | $22,000 | | (22,000) |
| Supplies/laundry | 2,200 | | (2,200) |
| Management | | $5,500 | (5,500) |
| Utilities | | 1,600 | (1,600) |
| Rent | 3,850 | 6,000 | (9,850) |
| Repairs/upkeep/ cleaning | 3,300 | 1,500 | (4,800) |
| Total cost | $31,350 | $14,600 | ($45,950) |
| Budgeted Profit | | | $ 9,050 |

c. The performance report for April based on a static budget of 550 treatments:

**Performance Report for April Based on 550 Treatments**

| | Budget | Actual | Variance | |
|---|---|---|---|---|
| Revenue | $55,000 | $53,000 | ($2,000) | U |
| Therapist | (22,000) | (21,280) | (720) | F |
| Supplies/laundry | (2,200) | (1,795) | (405) | F |
| Management | (5,500) | (5,125) | (375) | F |
| Utilities | (1,600) | (1,725) | 125 | U |
| Rent | (9,850) | (9,710) | (140) | F |
| Repairs/upkeep/ cleaning | (4,800) | (5,080) | 280 | U |
| Total cost | ($45,950) | ($44,715) | ($1,235) | F |
| Budgeted Profit | $ 9,050 | $ 8,285 | ($ 765) | U |

d. The performance report for April based on a flexible budget of 530 treatments:

**Performance Report for April Based on 530 Treatments**

| | Variable Cost | Fixed Cost | Flex. Budget | Actual | Variance | |
|---|---|---|---|---|---|---|
| Revenue | | | $53,000 | $53,000 | $0 | |
| Therapist | $21,200 | 0 | ($21,200) | ($21,280) | 80 | U |
| Supplies/ laundry | 2,120 | 0 | (2,120) | (1,795) | (325) | F |
| Management | 0 | 5,500 | (5,500) | (5,125) | (375) | F |
| Utilities | 0 | 1,600 | (1,600) | (1,725) | 125 | U |
| Rent | 3,710 | 6,000 | (9,710) | (9,710) | 0 | |
| Repairs/ upkeep/ cleaning | 3,180 | 1,500 | (4,680) | (5,080) | 400 | U |
| Total cost | $30,210 | $14,600 | ($44,810) | ($44,715) | ($95) | F |
| Budgeted Profit | | | $8,190 | $8,285 | $95 | F |

e. It depends. For *decision management* purposes, the report in part (c) is better. The owners had expected 550 treatments. At this volume the Spa should have generated profits of $9,050. Instead, it had profits of $8,285, or $765 less than expected. The primary cause of this unfavorable profit variance was 20 fewer treatments. Since each treatment generates contribution margin of $43, 20 fewer treatments results in $860 of less profit. To help the owners understand what went wrong and to help correct the problem, the static budget, which was based on the owner's prior expectation, is most useful. For *decision control* purposes (i.e., to evaluate and reward the manager of the Spa), the flexible budget report is better if the manager has no control over the number of treatments. In this case, if the manager can only control costs, the flexible budget report does not hold the manager accountable for volume fluctuations. If the manager can affect the volume via advertising and operating policies, then for decision control purposes, the static budget provides better incentive alignment between the owners and the manager.

f. The cost structure of the Spa does not include any return of the owners' initial $450,000 investment. Suppose the Spa is in business for 10 years, or 120 months. Then, just to return their initial investment (ignoring any interest on this investment), the Spa must generate $450,000/120, or $3,750 per month (before taxes and interest). This raises the breakeven point to ($14,600+3,750)/$43, or 426.7 treatments. Even though the $450,000 is a sunk cost (except to the extent that the owners can sell the remaining term of their lease to a new owner), the owners invested this money expecting to earn a return on their investment.

**P 6-22:** **Solution to Picture Maker** (35 minutes)
[Deriving a flexible budget]

a. Since the budget variance = Actual – Budget, rearranging gives

Budget = Actual – Variance, or:

| | Actual Results | Variance from Budget | Budget |
|---|---|---|---|
| Revenue | $360 | $108 U | $468 |
| Expenses: | | | |
| Paper | $65 | $13 F | $78 |
| Chemicals | 28 | 2 U | 26 |
| Maintenance | 90 | 10 F | 100 |
| Equipment lease | 120 | 0 | 120 |
| Store rent | 80 | 0 | 80 |
| Total expenses | $383 | $21 F | $404 |
| Net income (loss) | $(23) | ($87) | $64 |

b. Since actual revenues were $360, and each print cost $0.18, then $360 ÷ $0.18 = 2,000.

c. The budget in part (a) reports revenues of $468. With each print generating revenues of $0.18, the budget in part (a) is based on 2,600 prints ($468 ÷ $0.18). Using the 2,600 prints amount, the budgeted cost of paper ($78), and the budgeted cost of chemicals ($26) we can calculate the budgeted variable cost of paper to be $0.03 per print ($78 ÷ 2,600) and the budgeted variable of chemicals to be $0.01 per print ($26 ÷ 2,600). The flexible budget based on 2,000 prints is:

| | Budget Based on 2,000 Prints | |
|---|---|---|
| Revenue | | $360 |
| Expenses: | | |
| Paper ($0.03) | $60 | |
| Chemicals ($0.01) | 20 | |
| Maintenance | 100 | |
| Equipment lease | 120 | |
| Store rent | 80 | |
| Total expenses | | $380 |
| Net income (loss) | | ($20) |

**P 6–23: Solution to City Hospital Nursing** (35 minutes)
[Line item budgets, specialized knowledge, and control]

a. The major type of specialized knowledge Jones acquires in preparing the schedule is the working preferences of her staff. Next month one nurse wants to work only weekends, another wants nights because the kids are home from school, etc.

b. Given the set of constraints on Maxine Jones' staffing decisions (i.e., she has fewer decision rights than her counterparts in private hospitals), she is less able to take advantage of her specific knowledge of nurse preferences. This has a number of consequences:

- The average quality of nursing services will be lower or nursing costs will be higher since Jones is less able to substitute among alternatives. Jones can't substitute two nurse practitioners and a part-time registered nurse for two full-time registered nurses, for example. Since Jones is more constrained than her private counterparts in substituting among nursing types to meet schedule requests, she will not be able to compete as effectively and this will cause nursing costs to rise or nursing quality to fall, or some combination of the two.
- There will be more turnover of nurses at City Hospital.
- There will be more forced bed closings in City Hospital than other hospitals. Since Jones is less able to compete with private hospitals for nurses and will have more turnover, she will violate minimum staffing levels more frequently. These violations will cause beds to close, as new patients will be prevented from being admitted to an understaffed unit.
- Since Maxine Jones has less flexibility in using the specialized knowledge she acquires of nursing schedule preferences, she will acquire less of this specialized knowledge. She will appear to become an "uncaring" government bureaucrat.

c. City Hospital is operated under a line-item budget in which each type of nurse is a separate line item. Maxine Jones is unable to substitute across nursing types. Line-item budgets are very common in government-owned and-operated enterprises. They provide much more control than budgets where the supervisor can freely substitute among nurse types. They transfer the decision rights to substitute among line items to higher levels in the organization.

Given the adverse consequences of such systems as identified in part (b), the interesting question is why do such systems exist? What benefits are achieved? In a private hospital, presumably there is closer monitoring by the board of directors and hospital administration than in the City Hospital. There are probably fewer demands placed on private hospitals than city hospitals. Private hospitals have more freedom to decide the niche they wish to fill. The City Hospital has less freedom to deny patient access. If a private hospital fails to cover its expenses, the discipline of the marketplace will close it down. There is much less market discipline in the City Hospital. Governments are loath to deny health services. Since the City Hospital has less incentive to be run efficiently, agency problems are likely greater. And one way to reduce agency problems is to limit the decision rights of agents. While Maxine Jones has less discretion to change staffing mix, she has much less ability to impose agency costs on the city by overstaffing the unit or by giving good work schedules to her friends.

**P 6–24:** **Solution to Madden International** (35 minutes)
[Sharing of specialized knowledge via intensive budgeting and financial reviews]

a. (i) Strengths:

- constant interaction and communication among all the managers
- generates collection of specific knowledge about markets, products, industry
- encourages value-maximization
- stimulates sharing of specialized knowledge across managers
- forces managers to plan for short & long-run
- better decision making — helps separate the effects of unforeseen/uncontrollable costs
- encourages local risk taking which is diversifiable at the corporate level
- uniformity of procedures for evaluation across the firm (facilitates knowledge transfers)
- not being evaluated based on the budget reduces the incentives to "shade" estimates

(ii) Weaknesses:

- very time consuming for senior and corporate management
- compensation is very subjective, not tied to meeting objective performance criteria
- five-year plans have little value in rapidly changing world (except they force managers to think ahead)
- comparability across subsidiaries difficult

b. Given the complexity of the markets in which Madden operates and the rate of change in these markets, Madden's success and value depend critically on the generation, collection, and dissemination of specialized knowledge. A very formal, structured budget system forces managers to communicate frequently. In the setting of the budget and in financial review committees, this specialized knowledge is communicated.

To illustrate the preceding point, consider the following analogy. Elementary schools hold school dances for 11 and 12 year olds. Usually, the boys would be on one side of the room and the girls on the other. To get the boys and girls to dance, the boys would be placed in one line and the girls in a second line and then the two lines would be paired up and dance partners assigned.

In many ways, the very formal, highly structured budget scheme is like requiring pre-teenage children to line up at a dance. It is a way to force people in different functional areas such as marketing, manufacturing, and R&D to share their specialized knowledge with different parts of the subsidiary and corporate headquarters. Normally, marketing people would only talk to marketing people, finance people to finance people, and so forth. Because the world is changing so rapidly, cross-functional meetings must be more frequent. Without such an elaborate system, meetings would be less frequent and there would be less communication between marketing, manufacturing, and R&D people.

In order to encourage people to share knowledge, very little weight should be placed on using budgets as a performance evaluation scheme. In Madden's situation, to maximize the value of the budget system for decision management (i.e., sharing specialized knowledge), very little weight is placed on using budgets for decision control (i.e., performance evaluation).

Also, the high uncertainty in the environment makes it difficult to attribute the "success" of a new innovation to a given manager's actions.

**P 6-25:** **Solution to Brehm Vineyards** (35 minutes)
[Flexible budgeting, breakeven, and performance evaluation]

a. Flexible budget at 8,000 units:

| | **Fixed Cost** | **Variable Cost** | **Total Cost** | |
|---|---|---|---|---|
| Revenue | | | | $960,000 |
| Grape costs | $240,000 | $2.10 | $256,800 | |
| Labor | 75,000 | 2.15 | 92,200 | |
| Packaging | | 14.00 | 112,000 | |
| Selling and administrative costs | 36,000 | | 36,000 | |
| Utilities | 4,000 | 0.75 | 10,000 | |
| Total cost | $355,000 | $19.00 | | (507,000) |
| Net income before tax | | | | $453,000 |

b. Breakeven volume = FC ÷ contribution margin:

BE = $355,000 ÷ ($120 - $19) = 3,515 cases

c. Volume needed to generate profits of $300,000 after taxes:

After tax profit = $300,000 = [$120 × Q -$19 x Q - $355,000] × (1-0.40)

$300,000 ÷ .0.60 + $355,000 = $101 × Q

Q = 8465.3 cases

d. Performance report based on 6,000 cases:

| | Fixed Cost | Variable Cost | Budgeted Cost | Budget | Actual | Variance |
|---|---|---|---|---|---|---|
| Revenue | | | | $720,000 | $840,000 | $120,000F |
| Grape costs | $240,000 | $2.10 | $252,600 | | 260,000 | 7,400U |
| Labor | 75,000 | 2.15 | 87,900 | | 98,000 | 10,100U |
| Packaging | | 14.00 | 84,000 | | 83,000 | -1,000F |
| Selling & admin | 36,000 | | 36,000 | | 39,000 | 3,000U |
| Utilities | 4,000 | 0.75 | 8,500 | | 8,800 | 300U |
| Total cost | $355,000 | $19.00 | | $469,000 | 488,800 | 19,800U |
| Net income | | | | $251,000 | $351,200 | $100,200F |

e. In a normal year Brehm expects net income of $453,000. Bad weather cut actual net income to $351,200, or about 22 percent. However, Brehm generated $100,200 more income than budgeted at 6,000 actual cases. This favorable net income variance was due to $120,000 favorable revenue variance resulting from a $20 per case increase in the wholesale price. All expense categories report unfavorable variances (except $1,000 favorable packaging variance). The total cost variance was $19,800 unfavorable with Labor ($10,100 unfavorable) and Grape Costs ($7,400 unfavorable) being the major reasons. The higher than budgeted revenues of $120,000 were offset by about $20,000 of unfavorable cost variances.

One's evaluation of management depends on whether you believe management was responsible for negotiating the higher than normal price of $140 versus the price of $120 that exists during normal production of 8,000 cases. Managers could not do anything about the weather other than to mitigate the weather's adverse effects. The only way to assess whether managers successfully mitigated the effects of the bad weather is to benchmark Brehm's juice yield against other white pinot growers in the same region.

Bad weather drove production down to 6,000 cases. If we assume that management is responsible primarily for budgeted costs and nature determines quantity, and the market determines the wholesale price, then one must conclude that management did a less than stellar job of controlling costs. On the surface, costs exceeded budget by about $20,000, or about 4 percent.

## P 6-26: **Solution to Republic Insurance** (40 minutes)
[Soviet-style incentive schemes]

a. The following table computes how total compensation varies with the budgeted sales numbers:

| Actual sales, S | Reported Budget, B | S-B | B-S | Comp. if S>B | Comp. if S<B | Change |
|---|---|---|---|---|---|---|
| 100 | 75 | 25 | (25) | $28,000 | | |
| 100 | 90 | 10 | (10) | $29,200 | | $1,200 |
| 100 | 99 | 1 | (1) | $29,920 | | $ 720 |
| 100 | 100 | 0 | 0 | $30,000 | $30,000 | $ 80 |
| 100 | 101 | (1) | 1 | | $29,700 | ($ 300) |
| 100 | 102 | (2) | 2 | | $29,400 | ($ 300) |
| 100 | 110 | (10) | 10 | | $27,000 | ($2,400) |
| 100 | 120 | (20) | 20 | | $24,000 | ($3,000) |

The salesperson expecting to sell 100 policies will maximize his or her compensation at the end of the year by reporting truthfully that they will sell 100 policies.

b. One advantage of the compensation plan is that it does induce truthful reporting of expected sales. Another advantage is that it rewards the salesperson for selling more policies. That is, once the budget is set. Each additional policy sold either pays $20 (if S>B) or $400 if (S<B).

To better examine the compensation plan, rewrite the equations:

| | | |
|---|---|---|
| Total compensation | =$20,000 + $80B + $20S | if $S \geq B$ |
| | $20,000 - $300B + $400S | if $S < B$ |

You can see from these equations that once the budget has been set at some fixed B, the salesperson has an incentive to sell additional policies, even if they cause S > B. One might question the very large change in the bonus per policy sold at the point where B = S. Suppose the budget is set at 100 policies. Selling up to 100 policies, the salesperson receives $400 per extra policy. After selling more than 100 policies, each additional policy is worth only $20. Does the marginal disutility of selling an additional policy after 100 policies decrease so steeply? Moreover, such a large difference will cause salespeople above their targets to "sell" their extra policy sales to salespeople below their targets. Alternatively, salespeople above their budget will try to delay the sale into the next year.

There is an $80 penalty for under forecasting but a $300 penalty for over forecasting. Again, it is not clear why the two penalties should be so different. This could bias a risk-averse salesperson to bias their forecasts down.

**P 6-27:** **Solution to Old Rosebud Farms** (40 minutes)
[Flexible budgets and performance evaluation]

In terms of the static budget presented in the problem, the management of Rosebud Farms had less volume (boarding days) than expected. Revenues were $167,900 under the static budget. Likewise, expenses were under budget by $12,468 for variable expenses and $11,000 for fixed expenses. Based on the favorable expense variances in

Table 1, one is tempted to conclude that volume fell, but operations were fine given the reduced volume. However, the $12,468 under-budget variable expenses is misleading because it is based on a much higher volume of boarding days than were actually achieved. Therefore, one must look at variable-expense variances using a flexible budget analysis per the following:

Old Rosebud Farms
Flexible Budget Income Statement
Year Ended 12/31

| | Budget Formula (per mare per day) | Actual | Flexible Budget | Variance |
|---|---|---|---|---|
| Number of mares | | 52 | 52 | 0 |
| Number of boarding days | | 18,980 | 18,980 | 0 |
| Price | $25 | $ 20 | $ 25 | $ 5U |
| Revenues | | $379,600 | $474,500 | $94,900U |
| Less variable expenses: | | | | |
| Feed & supplies | 5.00 | 104,390 | 94,900 | 9,490U |
| Veterinary fees | 3.00 | 58,838 | 56,940 | 1,898U |
| Blacksmith fees | .30 | 6,074 | 5,694 | 380U |
| Contribution margin | $16.70 | $210,298 | $316,966 | $106,668U |
| Less fixed expenses: | | | | |
| Depreciation & insurance | | 56,000 | 56,000 | 0 |
| Utilities | | 12,000 | 14,000 | 2,000F |
| Repairs & maintenance | | 10,000 | 11,000 | 1,000F |
| Labor | | 88,000 | 96,000 | 8,000F |
| Net income | | $44,298 | $139,966 | $95,668U |

Now all of the variable expense categories are showing unfavorable variances. Instead of showing an unfavorable net income variance of $144,432 using a static budget as in Table 1, a flexible budget analysis shows an unfavorable net income variance of $95,668. Part of this difference is due to the variable expenses being higher than they should have been given the actual number of boarding days.

Also, an analysis of revenues reveals that not only was the number of boarding days less than forecasted, the price actually realized per boarding day turned out to be $20 per day instead of the budgeted $25 per day. Therefore, the static budget unfavorable revenue variance of $167,900 can be decomposed into an unfavorable price variance of $94,900 and an unfavorable quantity variance of $73,000 per below. (Chapter 12 describes price and quantity variances in more detail).

| | |
|---|---|
| Actual price (379,600/18,980) | $20 |
| Price variance [($25-20) × 18,980] | $ 94,900U |
| Quantity variance [(18,980-21,900) × $25] | 73,000U |
| Actual revenue less static budget ($379,600 - 547,500) | $167,900U |

U (F) denotes unfavorable (favorable) variance.

**P 6-28:** **Solution to Troika Toys** (40 minutes)
[Flexible budgeting and performance evaluation]

The following table reports both actual and budgeted performance on the Troika Toys account:

**Variance Report**
**Troika Toys**

| | Actual Amounts | Flexible Budget | Variance |
|---|---|---|---|
| Revenue (220 hours @ $120) | $26,400 | $26,400 | 0 |
| Design Labor | 10,320 | 9,900 | 420U |
| Artwork | 4,350 | 4,120 | 230U |
| Office and Occupancy Costs | 1,690 | 1,320 | 370U |
| Total Costs | $16,360 | $15,340 | $1,020U |
| Profits | $ 10,040 | $11,060 | $1,020U |

**Memo to Executive Committee**

Ms. Bent generated more billable hours (220) than were initially budgeted (150 to 200) because of superior performance and customer acceptance. However, the profits on this project were $1,020 below what they should have been had she stayed within the budget. She used more expensive designers ($420), more artwork ($230), and more office and occupancy costs ($370) than budgeted. While she over-ran on costs, the variance is only 3 percent of total revenues.

In summary, the cost variances are relatively small. Ms. Bent generated actual profits of $10,040 which (even after the higher costs) are substantially above the initial mid-point of expected profits (175 hours) which were projected to be $8,450 when the contract was signed.

**P 6–29:** **Solution to Cellular First** (40 minutes)
[Static versus Flexible Budgets]

a. The following table calculates the budget variance using a static budget based on eight salespeople and no overtime.

| | Static Budget | Actual | Static Budget Variance |
|---|---|---|---|
| Salespeople | 8 | 9 | |
| Hours per person per month | 160 | 160 | |
| Hours per sale | 2 | 2 | |
| Average salary per person | $1,500 | $1,500 | |
| Average commission/sale | $20 | $20 | |
| Overtime wage per hour | $12 | $12 | |
| | | | |
| Straight hours | 1,280[1] | 1,440[2] | |
| Overtime hours | 0 | 140 | |
| Hours | 1,280 | 1,580 | |
| | | | |
| Sales | 640[3] | 725 | |
| | | | |
| Revenue | $51,200 | $58,000 | $(6,800) |
| Salaries | | | |
| Straight hours | $12,000 | $13,500 | 1,500 |
| Overtime | 0 | 1,680 | 1,680 |
| | 12,000 | 15,180 | 3,180 |
| Commissions | 12,800 | 14,500 | 1,700 |
| Profits | $26,400 | $28,320 | $(1,920) |

() denote favorable variances

[1] 8 sales people × 160 hours per sales person
[2] 9 sales people × 160 hours per sales person
[3] budgeted hours ÷ 2 hours per sale

b. The following table calculates the budget variance using a flexible budget based on nine salespeople who sell 725 new accounts.

| | Flexible Budget (9 salespeople, sales of 725) | Actual | Flexible Budget Variance |
|---|---|---|---|
| Expected hours given sales[1] | 1,450 | | |
| Expected straight hours[2] | 1,440 | | |
| Expected overtime | 10 | | |
| Revenue | $58,000 | $58,000 | $ 0 |
| Salaries | | | |
| Straight hours[3] | $13,500 | $13,500 | 0 |
| Overtime | 120 | 1,680 | 1,560 |
| | $13,620 | $15,180 | 1,560 |
| Commissions | 14,500 | 14,500 | 0 |
| Profits | $29,880 | $28,320 | $1,560 |

() denote favorable variances

[1] 725 sales × 2 hours per sale
[2] 9 salespeople × 160 hours per salesperson
[3] 9 salespeople @ $1500 each

c. The static budget in part a is used when the manager has control over and hence is held responsible for volume changes, as in the case of a profit center. Flexible budgets as in part b are more likely used when the manager does not have control over and hence is not held responsible for volume changes, as in the case of some cost centers. A flexible budget adjusts for volume changes and therefore, does not hold the manager accountable for volume changes.

**P 6–30:** **Solution to Magee Inc.** (60 minutes)
[Tight versus loose budgets]

This problem illustrates the type of analysis required in setting quotas when bonuses and managerial effort depend on the quota. Unlike the situation discussed in the chapter, in this case the sales manager does not have the specialized knowledge of the future sales level. There is no problem with the manager distorting the quota estimate as the quota is chosen by senior management. The quota is only being set to affect the manager's incentives to work hard.

The point of this problem is to illustrate that in some cases it is optimum to set tight quotas and in other cases a medium-tight or even a loose quota maximizes firm value.

Thus, one cannot always conclude that tight or loose quotas are always best. It depends on the relative costs and benefits.

In this problem, data are provided that allow us to know what the manager will do (i.e., choose high/low effort). If an easy quota is set, the expected benefit to the firm is the total contribution margin generated by the salesperson. Central management wants the sales manager to exert the high effort level as long as the additional expected gross margin exceeds the extra bonus paid.

The manager will exert high effort if the expected payoffs exceed the disutility of the extra effort. The disutility of the additional effort is $1,500 and let Δ Prob x $10,000 be the expected payoff. Equating these two:

$\$1,500 = \Delta \text{ Prob} \times \$10,000,$

Solve for Δ Prob:

$\Delta \text{ Prob} = \$1,500/\$10,000 = 15\%.$

The probability of making the quota has to increase by 15 percent.

Both the loose quota and medium quota meet the criteria that the probability of making the quota increases by 15 percent. The following table calculates the payoffs to the manager of taking the high effort action under each quota scenario and the expected gross margin under each quota:

| | Various Levels of Quota Tightness | | |
|---|---|---|---|
| | Easy Quota | Medium Quota | Tight Quota |
| Expected Payoffs to Manager: Effort Level | | | |
| High | $9,000 | $6,000 | $3,000 |
| Low | 6,000 | 4,000 | 2,500 |
| Difference in expected payoffs | $3,000 | $2,000 | $500 |
| Disutility to employee of selecting high effort | -1,500 | -1,500 | -1,500 |
| Gain to employee of selecting high effort | $1,500 | $500 | -$1,000 |
| Effort level exerted | **High** | **High** | **Low** |
| Expected cost to the firm of manager exerting the utility maximizing effort | $9,000 | $6,000 | $2,500 |
| Expected gross margin of: | | | |
| achieving quota | $45,000 | $42,000 | $18,250 |
| not achieving quota | 2,000 | 16,000 | 32,250 |
| Expected gross margin | $47,000 | $58,000 | $50,500 |
| less: expected bonus to manager | $9,000 | $6,000 | $2,500 |
| Expected net payoff to firm of setting quota | **$38,000** | **$52,000** | **$48,000** |

We can see that it is in the best interest of the sales manager to exert high effort under both the loose and medium quotas.

When the manager chooses the high effort action, the expected cost (expected bonus) to the firm of the medium quota is only $6,000 (.6 × $10,000) whereas the expected cost of loose quota is $9,000. Given the numbers in the example, central management should set the *medium-tight* quota over the *tight* quota because this maximizes total profits after paying the bonus.

However, it is easy to show by making small adjustments to the gross margin numbers that in some cases it is best to set an easy quota or a tight quota.

**P 6–31:** **Solution to James Marketing Campaign** (70 minutes)
[Differences in risk sharing lead to agency costs]

This problem is designed to illustrate that differences in risk sharing between agent and principal will cause the agent to take actions which maximize the agent's utility but not the principal's utility. In particular, since the agent does not share proportionally in the losses, the agent more readily accepts projects where losses are more likely as long as they also promise greater gains.

a. The following table derives the firm profit-maximizing level of spending on the campaign. As can be seen from the table, the firm will want the Buffalo manager to spend $10,000 on the campaign, which will yield expected net profit of $315,000 (net of the manager's expected bonus).

| (All Figures in 000s) | | | | | |
|---|---|---|---|---|---|
| Amount of Spending | Probability of Success (S) | Net Profit from Spending if Successful | Manager's Bonus if Successful | Manager's Bonus if Not Successful | Expected Net Profit after Bonus and Salary |
| **$10** | **.20** | **1390** | **$139.0** | **$9.0** | **$315.00** |
| $25 | .21 | 1375 | 137.5 | 7.5 | 313.20 |
| $40 | .22 | 1360 | 136.0 | 6.0 | 311.40 |
| $55 | .23 | 1345 | 134.5 | 4.5 | 309.60 |
| $70 | .24 | 1330 | 133.0 | 3.0 | 307.80 |
| $85 | .25 | 1315 | 131.5 | 1.5 | 306.00 |
| $100 | .26 | 1300 | 130.0 | 0.0 | 304.20 |
| $115 | .27 | 1285 | 128.5 | 0.0 | 301.31 |
| $130 | .28 | 1270 | 127.0 | 0.0 | 298.44 |
| $145 | .29 | 1255 | 125.5 | 0.0 | 295.61 |

b. Based on the following set of calculations, the manager will choose to spend more on the project than profit-maximizing shareholders. The manager will seek to spend $145,000 on the project thereby reducing the expected profits of the firm from $315,000 to $295,610.

| Amount of Spending (000s) | Probability of Success (S) | (All Figures in 000s) Manager's Bonus if Successful | Manager's Bonus if Not Successful | Expected Bonus |
|---|---|---|---|---|
| $10 | .20 | $139.00 | $9.00 | $35.00 |
| $25 | .21 | 137.50 | 7.50 | 34.80 |
| $40 | .22 | 136.00 | 6.00 | 34.60 |
| $55 | .23 | 134.50 | 4.50 | 34.40 |
| $70 | .24 | 133.00 | 3.00 | 34.20 |
| $85 | .25 | 131.50 | 1.50 | 34.00 |
| $100 | .26 | 130.00 | 0.00 | 33.80 |
| $115 | .27 | 128.50 | 0.00 | 34.70 |
| $130 | .28 | 127.00 | 0.00 | 35.56 |
| **$145** | **.29** | **125.50** | **0.00** | **36.40** |

c. For increases in advertising, the manager's bonus falls for both success and unsuccessful outcomes. However, the expected bonus rises because more weight is being placed on the successful payoff which is worth a lot more than the unsuccessful outcome. Therefore, even though the bonus falls for successful and unsuccessful outcomes as advertising is increased, the expected bonus rises.

The two levels in parts a and b above differ because the manager views risk differently than the firm. In particular, the manager's bonus is bounded from below at zero. Therefore, if the manager spends a lot on marketing but is unsuccessful, the manager's bonus does not fall below $0. The manager is gambling with the shareholders' money, not the manager's bonus. This result does not depend on the manager being risk averse. Both the owner and manager value dollars.

**Case 6-1: Solution to Artisans Shirtcraft** (50 minutes)
[Preparing a budget and analyzing organizational issues]

a. Annual and monthly income statements:

Budgeted Production and Sales Quantities

Forty percent of all sales occur between September and December and sales are divided equally in these months. Given annual sales of 192,000, budgeted monthly sales quantities are budgeted at:

| | Sept. - Dec. 2010 | Jan. - Aug. 2011 |
|---|---|---|
| % of Sales | 40% | 60% |
| # of Months | ÷4 | ÷ 8 |
| % per month | 10% | 7.5% |
| Annual Sales | × 192,000 | × 192,000 |
| Sales per Month | 19,200 | 14,440 |
| Revenue ($23/unit) | $441,600 | $332,120 |

Since inventories are expected to be negligible, everything produced during a period is assumed sold during that period. Therefore, monthly purchase quantities are equal to monthly production quantities, which are equal to monthly sales quantities.

Purchasing Department Budgeted Costs

The costs for which Purchasing is responsible are direct materials costs of $7 per shirt and departmental overhead costs of $150,000. At 192,000 shirts produced during the year, the annual budgeted costs for Purchasing would be:

$$192{,}000 \times \$7 + \$150{,}000 = \$1{,}494{,}000$$

As stated in the problem, overhead costs are incurred uniformly over the year. Therefore, for any given month during the year, budgeted overhead would be $150,000/12= $12,500. Purchasing's budgeted monthly costs are:

| | Sept. - Dec. 2010 | Jan .- Aug. 2011 |
|---|---|---|
| Shirts Purchased | 19,200 | 14,400 |
| × Cost per Shirt | $7 | $7 |
| Materials Cost | $134,400 | $100,800 |
| + Monthly Overhead | 12,500 | 12,500 |
| Monthly Budget | $146,900 | $113,300 |

Production Department Budgeted Costs

As was the case with Purchasing, Production's costs consist of fixed overhead costs and variable direct costs. For the Production Department, however, these variable direct costs consist not of materials costs, but solely of labor costs. At one-half hour of labor per shirt and fixed overhead of $240,000, Production's annual budgeted cost is:

$$.5 \times \$6 \times 192{,}000 + \$240{,}000 = \$816{,}000$$

Budgeted overhead would be charged to Production at a rate of $240,000/12 = $20,000 per month. Direct labor would be assigned at a rate of $6 per hour × 1/2 hour per shirt = $3 per shirt. Budgeted monthly costs are:

| | Sept. - Dec. 2010 | Jan. - Aug. 2011 |
|---|---|---|
| Shirts Produced | 19,200 | 14,400 |
| × Cost per Shirt | $ 3 | $ 3 |
| Materials Cost | $57,600 | $43,200 |
| + Monthly Overhead | 20,000 | 20,000 |
| Monthly Budget | $77,600 | $63,200 |

Budgeted Income Statement for Artisans Shirtcraft

Budgeted revenue for the firm is equal to the budgeted number of shirts times the budgeted price per shirt:

$$192,000 \times \$23 = \$4,416,000.$$

Shirtcraft's budgeted Cost of Goods Sold would be made up of all costs assigned to individual shirts. Cost of Goods Sold consists of both direct costs and indirect costs. Clearly, both the price paid by Purchasing for raw materials and the cost of direct labor provided by Production should be assigned to the individual shirts. As stated previously, budgeted direct materials costs and direct labor costs per shirt are $7 and $3 respectively. The direct costs assigned to budgeted Cost of Goods Sold, therefore is ($7 + $3) × 192,000 = $1,920,000.

Overhead costs that are incurred in the creation of the finished product must also be included in calculating budgeted Cost of Goods Sold. The question states that indirect costs incurred both through the process of buying raw materials and as a consequence of the production of finished goods will be part of corporate Cost of Goods Sold. These costs are budgeted for the year at $150,000 and $240,000 respectively. Since there are no inventory issues, Shirtcraft's budgeted Cost of Goods Sold for the year is simply:

$$\$1,920,000 + \$150,000 + \$240,000 = \$2,310,000$$

Administrative expenses consist of Sales and Administration overhead plus expected bonus pay:

$$\$750,000 + \$75,000 \times 3 = \$975,000$$

Given budgeted interest expenses of $550,000 and expected taxes of 40 percent, Shirtcraft's budgeted annual and monthly income statements are:

| | Sept. - Dec. 2010 | Jan. - Aug. 2011 | 12 months ending 8/31/11 |
|---|---|---|---|
| Revenue | $441,600 | $331,200 | $4,416,000 |
| Shirts purchased | 146,900 | 113,300 | 1,494,000 |
| Production costs | 77,600 | 63,200 | 816,000 |
| Cost of goods sold | $224,500 | $176,500 | $2,310,000 |
| Sales & administration | 81,250 | 81,250 | 975,000 |
| Interest | 45,833 | 45,833 | 550,000 |
| Pretax income | $90,017 | $27,617 | $581,000 |
| Taxes (40%) | 36,007 | 11,047 | 232,400 |
| Net income | $54,010 | $16,570 | $348,600 |

b. Growth has produced two fundamental changes in Shirtcraft:

1. Lenders have been added as stakeholders. Unable to finance its growth internally, Shirtcraft has relied on debt. This reliance increases the bankers' power to influence Shirtcraft's business decisions. The bankers can now push the Montgomery sisters to align the company's interests with those of its lenders.

2. A separation between ownership and management has begun to develop. As the company grows larger and responsibilities become more specialized, the sisters will continue to relinquish control of portions of the business to professional managers. Agency problems increase and systematic methods of addressing issues such as goal incongruence, monitoring and internal knowledge transfer need to be developed.

Responsibilities become more specialized, presumably, to link decision rights with specific knowledge. As this decentralization occurs at Shirtcraft, control systems are developed to align the interests of managers, owners and creditors and facilitate communication of specialized knowledge between these major stakeholders. Shirtcraft uses budgeting and cost centers to try to meet these aims.

Shirtcraft's budget is the foundation of the company's financial controls. It provides a standard against which a department's performance can be measured and around which incentives can be based. Also, by establishing how much can be spent on what sort of activity, the budget exercises formal control over each department and thereby partitions decision rights.

The budget is also useful as a means of sharing specialized knowledge among the major stakeholders. Information that is important for the company as a whole may reside in a specific part of the company. For example, some knowledge of the company's anticipated cost structure is necessary for determining how much should be sold at what price. Through the process of negotiations and consensus forging that are undertaken to make Shirtcraft's budget, a mechanism exists, at least on an annual basis, to transfer this information between involved parties.

**Case 6-2:** **Solution to Scion Corp.** (75 minutes)
[Selecting the next year’s budget target]

This case allows the instructor to introduce the concept of standard costs earlier in the course instead of having to wait until the detailed discussion of standard costing in Chapter 9. Introducing standard costs here completes the topic of budgeting for a manufacturing plant. Since standard costs are really part of the budgeting process, deferring all discussion of standard costs until Chapter 9 is a bit disjointed.

The issue to be addressed involves the different incentives created by the two methods of arriving at the budget targets for the next year. Adjusting last year's budget by the productivity improvement factor generates a different set of incentives than using the same productivity improvement factor (PIF) to adjust last year's actuals. The two alternatives are discussed below:

*Advantages & disadvantages applying to both schemes*

Advantages:

- The budgeted direct labor times are developed over several years and should be fairly accurate.
- Both systems drive costs down over time.

Disadvantages:

- An across-the-board PIF does not take advantage of individual managers’ specialized knowledge of how to reduce costs. By applying an across-the-board-reduction, both schemes can cause discretionary costs to be reduced to a point that the plant has no resources to respond to emergencies. Another problem common to both is that one way to meet the PIF target and reduce labor input is by reducing product quality.

*Adjusting-the-budget scheme*

Advantages:

- It is simple and it allows managers in downstream departments who use parts from department A303 to know with more certainty the long-run budgeted costs of parts from department A303.
- Managers have the incentive to try to reduce actual costs below this year’s budget without the fear of having next year’s budget further reduced by this year’s cost savings.

Disadvantages:

- Department managers, knowing that next year's PIF will further reduce the standard direct labor hours per unit, will hold back some of their improvement this year. That is, if the PIF is 5 percent, but a particular manager knows how to save 8 percent next year, he/she will implement a program to save 5 percent next year and "save" the remaining 3 percent savings until the following year.
- Any inefficiencies or inaccuracies in the budget are carried forward into next year's budget.

*Adjusting-the-actual scheme*

Advantages:

- Next year's budget is based on the more recent operating results and thus next year's budget is more accurate (assuming current operating performance is a better indication of actual operating performance than last year's budget).

Disadvantages:

- If managers are having an outstanding year in terms of meeting the cost reduction targets, they have incentive to hold back some of the savings so that next year's budget isn't reduced even further. For example, if the budget is 2.5 direct labor hours per batch, but the manager can get it down to 2.4 hours this year, he/she has incentive to just meet the target of 2.5 hours this year, and not implement the other .1 hour savings until next year when the budget is reduced again. The decision to save productivity improvements or take advantage of them this year depends on whether the rewards for exceeding this year's target are bigger than the penalties for not meeting next year's targets.
- If the manager's results are poor (below budget), incentives exist to further reduce performance thereby generating a very easy target for next year. For example, the budget for direct labor - salaried is 2.5 hours. Suppose there is a major labor dispute outside the control of the manager that causes this number to rise to 2.8 hours. The manager has little incentive to try to reduce this back to, say, 2.7 hours by the end of the year. Adjusting 2.8 hours using the PIF gives a "looser" budget for next year than adjusting 2.7 hours using the same PIF.
- Use of actuals to set next year's budget results in a more variable budget number over time. Downstream users of the budgeted costs will have more difficulty projecting long-term costs.

**Case 6-3: Solution to LaserFlo** (90 minutes)
[Budgeted fixed and variable cost changes with volume]

This case provides the following topics to be raised and discussed:

* how changes in volume affect average unit costs
* how accounting costs can be used to support price discrimination
* how budgets form part of the internal contracting process
* how managers deal with other people in the organization surrounding budget negotiations
* mutual monitoring
* evaluating joint products of sales and tie-in service

One interesting aspect of this case is using the annuity factor to calculate the present value of service profits as part of the product's total profits. This illustrates the joint products of sales and service.

Another interesting aspect of this case involves price discrimination.

a. Table 1 calculates the cost of the projected five year profits of an AP2000 using first the \$35.05 and then the \$38.25 service cost.

Profits per AP2000 from service are lower by about \$350 per year or about \$1,100 over five years (discounted) due to the higher service cost. Based on placements of 120 units this year, the AP2000 program is projected to have five-year profits this year that are lower by about \$130,000.

b Field Service's hourly cost increased from \$35.05 to \$38.25 for two reasons: (i) variable costs per hour went up, primarily due to the shift to a higher fraction of more expensive Tech2s, and (ii) average fixed costs per unit went up because fewer hours are being worked.

The first step is to calculate the fixed and variable costs for 2010. Table 2 provides the details of the computation. In 2010 the variable cost per hour was \$29.63 and the fixed cost per hour was \$5.42.

Table 3 calculates the hourly service rates and fixed and variable costs per hour in 2010 and 2011. From Table 3 we see that, while total technician hours fell 13.0 percent, variable costs only fell 4.8 percent. Fixed costs also fell, but by less than the decrease in hours. Thus the service rate per hour increased because although the numerator (fixed plus variable cost) fell, the denominator (hours) fell more, causing the ratio (cost per hour) to rise.

It is also instructive to decompose the overall rate change into its components:

| | | |
|---|---|---|
| 2011 total hourly rate | | $38.25 |
| 2010 total hourly rate | | 35.05 |
| Increase | | $ 3.20 |
| | | |
| 2011 variable cost | $32.44 | |
| 2010 variable cost | 29.63 | |
| Variable cost increase | | $2.81 |
| | | |
| 2011 fixed cost | $5.81 | |
| 2010 fixed cost | 5.42 | |
| Fixed cost change | | $0.39 |
| Total rate increase | | $3.20 |

Most of the increase is caused by variable costs not dropping as much as volume. The reason for this is the shift from lower-cost Tech1s to higher-cost Tech2s.

c. Table 4 calculates what the cost of servicing the AP2000 would have been in 2011 had the reorganization not occurred. If the number of Tech1s and 2s remained at their 2010 level into 2011, the hourly rate would have been $36.54, but there would have been more service per AP2000. As can be seen, the annual service cost savings from the reorganization for an AP2000 is $144 per year. While the savings are positive, it is not very large, only about 3 percent of the 2010 staffing cost.

d. What can or should Marti Meyers do about the service cost increase? First, list the various options:

1. Do nothing and absorb the cost increase by showing lower profits.
2. Raise the service price of $85 and hope the profits from the lost sales are smaller than the additional service profits from the higher price.
3. Try to get Phil Hansen to change his budget for next year in such a way that Meyers is charged less per hour than $38.25.
4. Go to her boss and raise the issue. This might involve charges that Field Service is "fat" or mismanaged. This option would seek to bring pressure from higher level managers to review Field Service's budget and reduce the rate.
5. Try to change the organizational structure. Several possibilities include:
    a. Set the cost for technicians at the corporate level, not based on Hansen's budget.
    b. Make Hansen a profit center and let Meyers purchase service outside.
6. Lower the selling price of the AP2000 and raise the servicing price.

Before evaluating the five options, notice that the issue in LaserFlo is a transfer price dispute. Marketing's performance evaluation is based in part on the transfer price they are charged for field service. Field Service is a monopoly supplier of service. As a cost center, Field Service has to deliver service at the budgeted cost, next year at $38.25. They have an incentive to pad this figure in their budget so they have room to beat it. Marketing, being a profit center, "pays" the Field Service costs. Thus, Marketing (Marti Meyers) has an incentive to monitor these charges. And this is what she is doing now. Hansen does not report directly to Meyers. But by creating this transfer pricing scheme and treating Marketing as a profit center, the company gives Meyers an incentive to monitor these charges. This case illustrates how accounting, performance evaluation systems, and decision rights partitioning are so intertwined.

Evaluate the six options.

1. Do nothing. This option looks pretty good, especially if Meyers lacks power in the organization to lower the Field Service charge. Meyers profits are lower by about $130,000 with the higher cost. This is about 1 percent of total AP2000 sales in the first year, and the impact on Meyers is actually less. The $130,000 profit reduction is based on five years of service profits discounted. In the first year only, the profit loss is $41,472 ($346 × 120). If Meyers is not expecting to be in the job for long, she does not bear all the profit loss.

   Since Meyers is head of all of Marketing, and all six programs are charged for maintenance, her total evaluation will be affected by the higher service costs. She ultimately is charged all of the Field Service costs. Assuming 780,000 service hours next year at a higher cost of $38.25 per hour, the total impact on Marketing profits is almost $2.5 million, if the service cost is raised from $35.05 to $38.25. Thus, while the impact on the AP2000 program is small, the overall effect on Marketing is large.

   However, it is important to recognize that the total cost of service actually falls between 2010 and 2011:

**Field Service Costs (millions)**

| | 2010 | 2011 |
|---|---|---|
| Fixed Cost | $26.6 | $25.3 |
| Variable Cost | 4.9 | 4.5 |
| Total operating budget | $31.5 | $29.8 |

   While Meyers (and Marketing) would be better off if the rate had stayed at $35.05, she is still better off across all six programs because Marketing is charged about $1.7 million fewer dollars in 2011 than in 2010.

2. Raise the price of service. Depending on the price elasticity of the demand curve, this may be better than option 1. However, she should review the prices on all the other programs' maintenance contracts. Part

of the reason why service costs have risen is due to the higher fraction of Tech 2s needed to service the more complicated printers. This suggests that marginal costs have risen and that a price increase to the customer of above $85 per hour is warranted, not just on the AP2000 but for all the printers.

3. Try to convince Hansen to lower his cost estimates. If Hansen has built slack into his budget, then threatening a big fight with corporate over his budget might induce him to cut back on the budgeted cost estimate.

4. Go to corporate with charges of "slack." Such charges are sure to set off a "fire storm" within LaserFlo. The question is: can Meyers win such a fight. Hansen has the detailed specialized knowledge of his operations. He can argue with more evidence as to why his cost per hour is increasing: the machines are more complicated and proportionately more Tech2s are needed.

   This is obviously a risky strategy, one that could backfire on her. Part of her decision to pursue this strategy is the relative power of Hansen in the organization. If senior managers view Hansen as weak or vulnerable, this option becomes more attractive.

5. Make some organizational change. By decentralizing the firm and giving Marketing decision rights over service pricing, Meyers has incentives to monitor Hansen. However, as a cost center, Hansen has incentives to build slack into the budget. Thus, while the organization's structure appears irrational and calls for change, LaserFlo might be working fine. After all, LaserFlo is the largest firm in its industry (recall: marmots and bears). All the profits from both sales and service are in Marketing's performance measure. Thus, marketing has incentives to jointly set both the sales and service prices to maximize combined profits. By creating the mutual monitoring incentives, corporate management learns when Meyers thinks Field Service costs get out of line with those of the competition. Without a lot more evidence that something is terribly wrong in the organization's structure, there is no compelling reason to redesign it.

6. Decrease the purchase price of the printer and increase the price of maintenance to reach the 60 percent target markup. The total realized increase in maintenance revenue will have to be higher than the decrease in sales revenues due to the lower price.

   It is in LaserFlo's best interest to maintain our level of printer sales, especially given the lucrative servicing portion of the business. Once the printer is sold, service and maintenance is eminent. The option of getting service from someone other than LaserFlo for a LaserFlor printer are almost non-existent, since the technological changes are so rapid that an outside company cannot keep its workforce trained to service the latest models. So LaserFlow can charge a premium for the service.

e. At first it appears odd that most of LaserFlo's profits are coming from servicing the AP2000 versus selling it. But remember the economics of price discrimination. Under price discrimination, a firm with market power would like to charge consumers who value the product a higher price than those who value it lower. In setting a single price, the person who values the product at this price is indifferent between purchasing and not purchasing. Those who value the good higher will purchase and receive some consumer surplus (the difference between the price and their value). Suppose the price of an apple is $0.25. If some one values it at $0.30, they buy it and get a surplus of $0.05. The apple seller would like to charge this person $0.2999. He or she would still buy it, but the seller would capture the consumer surplus. The problem with most price discrimination schemes is how to prevent resale. How do you prevent the person who just values the apple at $0.25 and who buys it for $0.25 from reselling it to the person who values it at $0.30 for $0.2999? Many price discrimination schemes unravel because of reselling.

LaserFlo price discriminates on its printers. Some customers value the AP2000 at near the $74,500 price plus maintenance. Others value it higher. One factor that is probably highly associated with a customer's valuation is print volume; customers value the printers based on the volumes they expect. Higher volume customers are more likely to value the AP2000 higher than customers with lower volumes. And the higher valuation customer is more likely to be willing to pay a higher price. The way that LaserFlo charges the higher price is through a maintenance contract that is a function of print volume. If they charged a higher purchase price, even if they could discriminate between high and low volume users at the time of sale, nothing would prevent the low volume, low price user from reselling the AP2000 to a higher volume user at a price just below AP2000's price. But maintenance cannot be resold, because it is tied to the machine. Therefore, LaserFlo sets a relatively low price on the initial sale to just cover marginal cost and then a high price on its service to price discriminate between the high and low volume users.

This method of price discrimination is well known. In the 1940s and 50s Gillette razors were given away, and the user paid for the blades. Blade prices were set at above marginal cost. IBM required their customers to buy blank punched cards from IBM to be used in their card-based accounting machines prior to computers. The machines were sold at low prices, and the cards were sold at above marginal cost. Copiers, printers, and computers all have tie-in maintenance contracts as price discrimination schemes.

It makes a lot of sense for LaserFlo to make more money on servicing than on sales. Yet this only works as long as there is no reselling. Reselling would occur if third-party service providers enter the market and offer service contracts lower than LaserFlo's prices, but this is unlikely given the rate of technological change in the industry. Knowledge of LaserFlo's printers gives them a comparative advantage over would-be service entrants.

It is somewhat of a mis-statement to say they are making more on servicing printers than on sales. They are joint products. You cannot have a service contract until you have a sale. To allocate the total profits in this way is also a bit misleading and would seem to suggest that, since most of the profits are coming from service, it's acceptable if LaserFlo's service costs are out-of-line.

**Table 1**

**Projected Five Year Profits on AP2000**

| | | |
|---|---|---|
| Expected service hours per AP2000: | | |
| Pages per year | 12,000,000 | |
| Pages per servicing | ÷ 500,000 | |
| Servicings per year | 24 | |
| Tech hours per servicing | × 3 | |
| Normal service hours per year | 72 | |
| Unscheduled service hours (50%) | 36 | |
| Projected service hours per year | 108 | |

| | **\$35.05 Cost** | **\$38.25 Cost** |
|---|---|---|
| Sales price | \$74,500 | \$74,500 |
| less | | |
| Hardware | \$46,295 | \$46,295 |
| Selling & administrative costs (33%) | 24,585 | 24,585 |
| Income on sale | \$3,620 | \$3,620 |
| | | |
| Revenue on service (@\$85/hour) | \$9,180 | \$9,180 |
| Service costs | 3,785 | 4,131 |
| Service income per year | \$5,395 | \$5,049 |
| Five-year annuity factor @ 18% | ×3.127 | ×3.127 |
| Five-year service income | \$16,869 | \$15,788 |
| | | |
| Total five-year income on sale | \$20,489 | \$19,408 |

**Table 2**
**Calculate Fixed and Variable Service Costs for 2010**

| | | |
|---|---|---|
| Tech 1 | | |
| number | 300 | |
| salary, benefits, etc. | $40,100 | |
| Total variable cost of Tech1 | | $12,030,000 |
| Tech 2 | | |
| Number | 275 | |
| Salary, benefits, etc. | $52,900 | |
| Total variable cost of Tech2 | | $14,547,500 |
| Total variable cost | | $26,577,500 |
| Total number of Techs | 575 | |
| Number of tech months per year | × 12 | |
| Number of tech-months | 6900 | |
| Billable hours per tech per month | × 130 | |
| Total billable hours | | ÷ 897,000 |
| Variable cost per hour | | $ 29.63 |
| Total hourly cost | $35.05 | |
| Total hours | x 897,000 | |
| Total cost of service | | $31,439,850 |
| Less: Total variable cost | | 26,577,500 |
| Fixed cost | | $4,862,350 |
| Total hours | | ÷ 897,000 |
| Fixed cost per hour | | $ 5.42 |

**Table 3**
**Comparison of 2010 and 2011**
**Hours, Fixed, and Variable Costs**

| | **2010** | **2011** | **% Change** |
|---|---|---|---|
| Total hours | 897,000 | 780,000 | -13.0% |
| Variable cost | $26,577,500 | $25,300,000 | -4.8% |
| Fixed cost | 4,862,350 | 4,535,000 | -6.7% |
| Total cost | $31,439,850 | $29,835,000 | -5.1% |
| Cost per hour | $35.05 | $38.25 | 9.1% |
| Variable cost per hour | $29.63 | $32.44 | 9.5% |
| Fixed cost per hour | $5.42 | $5.81 | 7.3% |

**Table 4**
**Cost Savings of Servicing an AP2000**
**from Field Service Reorganization**

| | **Number** | **Variable Cost** | **Total** |
|---|---|---|---|
| Tech 1 | 300 | $42,800 | $12,840,000 |
| Tech 2 | 275 | $54,800 | 15,070,000 |
| Total variable cost | | | $27,910,000 |
| Total fixed cost | | | 4,862,350 |
| Total cost | | | $32,772,350 |
| Total hours | | | 897,000 |
| Projected hourly rate for 2011 | | | $ 36.54 |
| Normal servicings/year | | 24 | |
| Tech hours per servicing | | × 3.25 | |
| Tech hours per normal servicing | | 78 | |
| Unscheduled service hours (50%) | | + 39 | |
| Total service hours per year | | | 117 |
| Servicing cost/year (2010 staffing) | | | $4,275 |
| Servicing cost per year (after reorganization) | | | $4,131 |
| Cost savings from reorganization | | | $ 144 |

# CHAPTER 7
## COST ALLOCATION: THEORY

**P 7–1:** **Solution to MRI** (15 minutes)
[Choosing allocation base to maximize hospital reimbursement]

a. Memorial Hospital's cost per image:

$885,000 ÷ 33,600 images = $26.34/image

b. Calculate Memorial Hospital's cost per hour.

$885,000 ÷ 2,800 hours = $316.07/hour

c. The cost of 10 MRI images and one hour of MRI time based on cost per image.

10 images × $26.34 = $263.40

d. The cost of 10 MRI images and one hour of MRI time based on cost per image.

1 hour × $316.07 = $316.07

e. If Memorial Hospital's primary use of accounting costs is third-party reimbursement, then they should use cost per hour. This results in a larger reimbursement from the government ($316.07) than cost per image ($263.40).

**P 7-2:** **Solution to Slawson** (15 minutes)
[Allocating costs using input measures versus noninsulating methods]

a. and b.

| | **Argentina** | **United States** | **Germany** | **Total** |
|---|---|---|---|---|
| Number of employees | 1,500 | 300 | 200 | 2,000 |
| Net Income (loss) in pesos (millions) | (100) | 400 | 500 | 800 |
| | | | | |
| Fraction of total employees | 0.75 | 0.15 | 0.1 | 1.00 |
| Fraction of total income | -0.125 | 0.5 | 0.625 | 1.00 |
| | | | | |
| Allocated corporate headquarter cost | | | | |
| Using employees | 1.8 | 0.36 | 0.24 | 2.4 |
| Using net income | -0.3 | 1.2 | 1.5 | 2.4 |

Notice that in part (b). Argentina is allocated a negative 300,000 pesos to offset their loss. This is like a tax refund.

c. Key issues to mention include:

- Do corporate cost allocations affect income taxes paid by the operating divisions? This is the first question to address and is likely to drive the choice of allocation method if the answer is yes.
- Allocating corporate headquarters cost based on number of employees is effectively a tax on employees and causes each operating company to have fewer employees. Slawson will want to use employees as an allocation base if hiring additional employees causes headquarters to bear additional costs. For example, does hiring additional employees in the United States generate externalities in other divisions or in headquarters for monitoring these employees?
- A disadvantage of using employees as the allocation base is that it does not create as much incentive for the three operating divisions to cooperate as using net income.
- Allocating based on net income is a noninsulating allocation method that provides incentives for the three divisions to cooperate.
- Allocating based on net income also is a risk sharing device among the divisions. As long as the profits of the three operating companies are not perfectly correlated, then allocating corporate overhead results in risk diversification.
- A disadvantage of using net income is that it distorts the performance of an operating company by having that operating company's net income depend on the performance of the other two operating companies.

**P 7–3:** **Solution to the Corporate Jet Problem** (20 minutes)
[Cost allocation as a transfer price is misallocating the resource]

This problem, which at first appears to be a cost allocation question, is really a transfer pricing problem. In fact, most cost allocation issues involve transfer pricing issues.

a. The formula being used consists of monthly expenditures for both fixed and variable costs divided by actual miles flown. In fact, the fixed costs such as depreciation and the pilot's salary are rather significant.

b. As passenger miles increase, the average price charged falls. The proposed cost allocation scheme results in a downward-sloping supply curve for the jet.

c. Uncertainty regarding how much the plane will fly in the month will induce users to shy away from the plane in months of greatest uncertainty. In summer months there will be an excess demand for the jet because it is unlikely the jet will be grounded for weather-related reasons. Hence, the denominator in the formula will be large. In the winter, especially in the beginning of the month when total monthly usage is still uncertain, demand will be light until total passenger miles flown accumulates. Thus, in summer months, the price is low and in winter months it is high.

d. One way to smooth the price of the jet over the year is to base the charge per mile on normal (or average) passenger miles flown per month, not actual. That is, at the beginning of the year the cost per mile is estimated by dividing total annual operating cost by expected total miles to be flown in the year. This charge per mile does not fluctuate month-by-month with actual miles flown.

Even making this proposed change does not overcome a remaining problem. The transfer price on the corporate jet does not take into account the demand curve for the jet. The existing system and the proposed change consider only costs. It is likely that the proposed change will still result in an excess demand for the jet. That is, the cost-based price is likely too low because of the extra convenience and prestige of flying on the jet. Price systems, including transfer pricing, should allocate scarce resources such that there is no excess supply or excess demand for the good or service. The proposed scheme does not ensure that there will be no excess demand for the jet. Because there is likely to be excess demand at least at certain times of the year, some other administrative device is required to ration seats. For example, only executives above a certain level in the firm have the right to make reservations. Or, seats are assigned on a first-come-first-served basis.

Some students may suggest a two-part price: allocate fixed costs to users based on expected usage, and charge per mile at the variable cost rate. This is a good way for the transportation office to capture more of the consumer surplus, although it does not necessarily result in a more efficient allocation of the scarce resources. The issue becomes monitoring what the transportation department claims are the fixed costs and preventing transportation from setting the "fixed costs" to maximize their profits by price discriminating.

**P 7-4:** **Solution to Massey Electronics** (20 minutes)
[Alternative allocation schemes]

a. The following table presents the allocation of the $9.5 million of shared manufacturing overhead using the four proposed schemes.

| | Texas | Mexico | Total | % Texas |
|---|---|---|---|---|
| Direct labor hours | 3,000,000 | 4,000,000 | 7,000,000 | 43.0% |
| Direct labor dollars | $60,000,000 | $40,000,000 | $100,000,000 | 60.0% |
| Direct material dollars | $180,000,000 | $200,000,000 | $380,000,000 | 47.0% |
| Square footage | 200,000 | 300,000 | 500,000 | 40.0% |
| | | | | |
| Allocated overhead based on: | | | | |
| Direct labor hours | $4,085,000 | $5,415,000 | $9,500,000 | |
| Direct labor dollars | 5,700,000 | 3,800,000 | 9,500,000 | |
| Direct material dollars | 4,465,000 | 5,035,000 | 9,500,000 | |
| Square footage of plant | 3,800,000 | 5,700,000 | 9,500,000 | |

b. Questions involving how to allocate costs involve what input base to tax, and hence how the choice of the taxing scheme affects the firm's cash flows. Since Massey has tax loss carry forwards, the allocation of the $9.5 million manufacturing overhead does not affect taxes, which is usually an important cash flow stream to consider.

The four allocation methods create significant differences in the dollars allocated to the two plants. In fact, the Texas and Mexico plants allocations vary by up to $1.9 million, depending on which method is used. Since the lines of business end up paying for these allocated costs through higher full cost-based transfer prices, the choice of allocation method could prove economically important if the lines of business change their prices of heat sinks to final customers based on the transfer prices that result from the four methods. Therefore, before selecting a particular allocation method, the product costs produced under each allocation scheme needs to be examined in light of how the product cost impacts the pricing decision of the three lines of business.

Besides taxes and pricing, allocation methods can affect the choice of inputs used to produce the heat sinks and the amount of cooperation among managers.

Direct labor hours:

- Taxes labor hours. Hence fewer labor hours and more material and machine hours will be used.
- Since Mexico has more hours, it gets more of the shared overhead causing its products' costs to rise relative to Texas products. This shifts production from Mexico to Texas.
- Induces cooperation among lines of business and plants because it is a non-insulating method.

Direct labor dollars:

- Taxes labor dollars. Hence fewer labor dollars and more material and machine hours will be used.
- Having more expensive workers, Texas bears more overhead causing production to move from Texas to Mexico.
- Induces cooperation among lines of business and plants because it is a non-insulating method.

Direct material dollars:

- Taxes material dollars. Hence fewer material and more labor hours and machine hours will be used.
- Induces cooperation among lines of business and plants because it is a non-insulating method.

Plant square footage:

- Taxes square footage. But since square footage is hard to adjust in the short term, it is hard for managers to substitute away from plant
- Induces little cooperation among lines of business and plants because it is an insulating method.
- Having the smaller plant causes Texas to bear less overhead. This shifts production from Mexico to Texas.

**P 7-5:** **Solution to Avid Pharmaceuticals** (20 minutes)
[Insulating vs. non-insulating cost allocations]

a. The following tables report the net incomes of Divisions A and B using the five alternative allocation bases:

| | **Division A** | **Division B** | **Total** |
|---|---|---|---|
| Number of employees | 80 | 20 | 100 |
| Plant square footage (000) | 80 | 120 | 200 |
| Revenues | $2,000 | $1,000 | $3,000 |
| Operating expenses | 600 | 500 | 1,100 |
| Operating profits | $1,400 | $500 | $1,900 |
| | | | |
| % of employees | 80.00% | 20.00% | 100.00% |
| % plant square footage | 40.00% | 60.00% | 100.00% |
| % revenue | 66.67% | 33.33% | 100.00% |
| % op. expenses | 54.55% | 45.45% | 100.00% |
| % operating profits | 73.68% | 26.32% | 100.00% |

| | | | |
|---|---|---|---|
| **Allocated corporate overhead based on:** | | | |
| % of employees | $720.00 | $180.00 | $900 |
| % plant square footage | $360.00 | $540.00 | $900 |
| % revenue | $600.00 | $300.00 | $900 |
| % op. expenses | $490.91 | $409.09 | $900 |
| % operating profits | $663.16 | $236.84 | $900 |
| | | | |
| **Net Profit after allocating corporate overhead:** | | | |
| % of employees | $680.00 | $320.00 | $1,000 |
| % plant square footage | $1,040.00 | ($40.00) | $1,000 |
| % revenue | $800.00 | $200.00 | $1,000 |
| % op. expenses | $909.09 | $90.91 | $1,000 |
| % operating profits | $736.84 | $263.16 | $1,000 |

b. Given the limited facts in the case, management should allocate corporate overhead using divisional operating profits for the following reasons:

- Since Avid is privately held, it cannot give the two division managers stock in the company as a way to provide incentives for the division managers to cooperate.
- All five methods are non-insulating to varying degrees and hence give the two divisions incentives to cooperate. Since synergies exist between the two divisions, managers should have incentives to cooperate. Non-insulating cost allocations provide such incentives.
- Number of employees and square footage probably, being sticky, vary less with division performance than the other three allocation bases. Hence, these two bases create less incentive to cooperate than revenues, or operating profits.
- Using revenue to allocate corporate overhead creates incentives to cooperate on revenue. If Division A's manager helps lower B's operating costs, this does not directly affect B's revenue, nor A's allocated cost. Hence, revenue as an allocation base provides no incentives to cooperate to reduce costs.
- Allocating corporate overhead using operating costs actually creates perverse incentives. If Division B asks A for help to lower B's costs, A is actually harmed. By Division A helping to lower B's costs, B is allocated less overhead and A receives more overhead. So allocating corporate overhead using operating costs as the allocation base creates disincentives for the divisions to cooperate to reduce the other division's costs.
- Operating profits as the allocation base provides incentives for both managers to cooperate to raise the other division's revenues and/or lower the other division's costs. Either higher revenues or lower costs in the other division increases that division's profits, and hence the amount of overhead they

absorb. The more overhead the other division is allocated, the less overhead is allocated to the other division.

- All five methods help to diversify the risk each division manager bears. If one division does well, it absorbs more overhead and the other division less. But basing each division manager's bonus on operating profits less corporate overhead, diversifies the risk in both revenues and operating costs, and better protects the division manager than just diversifying revenue. In a sense, using operating profits as the allocation base provides a "bigger market basket" to help reduce the risk than just using revenues. So again, operating profits is likely the better choice as an allocation base than any of the other four.

**P 7–6:** **Solution to Wasley** (20 minutes)
[Cost allocations create incentives to drop profitable products]

a.

| **Income Statement** | **Product A** | **Product B** | **Product C** | **Product D** | **Total** |
|---|---|---|---|---|---|
| Net Sales | $1,250 | $850 | $1,250 | $1,650 | $5,000 |
| Direct Labor | (450) | (600) | (540) | (640) | (2,230) |
| Direct Materials | (250) | 0 | (125) | (160) | (535) |
| Corporate Overhead* | (360) | (480) | (432) | (512) | (1,784) |
| Operating Income | $ 190 | $(230) | $ 153 | $ 338 | $ 451 |

*OH Rate = $1,784 ÷ $2,230 = 80% of direct labor dollars

b.

| **Income Statement** | **Product A** | **Product B** | **Product C** | **Product D** | **Total** |
|---|---|---|---|---|---|
| Net Sales | $1,250 | $0 | $1,250 | $1,650 | $4,150 |
| Direct Labor | (450) | 0 | (540) | (640) | (1,630) |
| Direct Materials | (250) | 0 | (125) | (160) | (535) |
| Corporate Overhead | (492) | 0 | (592) | (700) | (1,784) |
| Operating Income | $ 58 | $0 | $ (7) | $ 150 | $ 201 |

*OH Rate = $1,784 ÷ $1.630 = 109% of direct labor dollars

c. Yes, Shirley Chen increased her divisional income from –$40 ($190 – $230) to +$58.

d. No, corporate income decreases by dropping a product with positive contribution. *Note that the Contribution margin for A = $550; B = $250, C = $585; D = $850.

e. This is an example of the beginnings of a death spiral. Cost allocations can distort relative profitability and lead to incorrect operating decisions.

Source: Charles Kile

**P 7-7:** **Solution to Hallsite Imaging** (20 minutes)
[Non-insulating allocations create cooperation incentives but distort profitability]

a. Allocated Marketing Division expenses to the Hardware and Software Divisions: (all figures are in millions of dollars).

| | **Last Quarter** | | | **This Quarter** | | |
|---|---|---|---|---|---|---|
| | **Hardware Division** | **Software Division** | **Total** | **Hardware Division** | **Software Division** | **Total** |
| Revenue | $500 | $700 | $1,200 | $510 | $400 | $910 |
| Percent of total sales | 41.67% | 58.33% | 100% | 56.04% | 43.96% | 100% |
| Allocated marketing division costs | $133.33 | $186.67 | $320.00 | $207.36 | $162.64 | $370.00 |

b. Hardware and Software Divisions' profits after allocating Marketing Division's expenses (all figures are in millions of dollars):

| | **Last Quarter** | | | **This Quarter** | | |
|---|---|---|---|---|---|---|
| | **Hardware Division** | **Software Division** | **Total** | **Hardware Division** | **Software Division** | **Total** |
| Revenue | $500.00 | $700.00 | $1,200.00 | $510.00 | $400.00 | $910.00 |
| Division expenses | 315.00 | 308.00 | 623.00 | 321.30 | 176.00 | 497.30 |
| Allocated marketing costs | 133.33 | 186.67 | 320.00 | 207.36 | 162.64 | 370.00 |
| Profits | $51.67 | $205.33 | $257.00 | -$18.66 | $61.36 | $42.70 |

c. Memo to Hardware Division:

Hardware's profits fell from $51.67 million last quarter to a loss of $18.66 million this quarter (or a total change of $70.33 million) because Hardware's share of the Marketing Division's costs went up from $133.33 million to $207.36 million (or a total change of $74.03 million). The profit report you received for this quarter is correct and continues Hallsite's long standing cost allocation methodology of allocating the Marketing Division's expenses back to the Hardware and Software Divisions based on the latter two divisions' relative amount of sales.

Hallsite has adopted this non-insulating cost allocation methodology primarily to foster better cooperation between the Hardware and Software Divisions. By helping the other division to increase its sales, that division absorbs more of the Marketing Division's costs, thereby lowering the costs absorbed by (and raising the profits of) the cooperating division. Because there are substantial synergies and interdependencies between Hardware and Software, cooperation is essential to maximize these synergies, and hence to maximize shareholder value. Moreover, this non-insulating cost allocation more efficiently shares the risks of the two divisions. This quarter Software had the unfortunate and unforeseen adverse outcome of problems with the release of version 7.0. Some of this adverse event was shifted to the Hardware Division via the cost allocation methodology. If Software had an unexpected favorable outcome that resulted in higher Software sales, Hardware would have benefited from this favorable outcome. Had Hardware suffered an adverse shock to its sales, Hardware would not bear the full brunt of the bad event. Rather, Software would in this case bear some of it. Hence, Hallsite's current cost allocation methodology provides two major benefits: it fosters better cooperation among the divisions and it results in better risk sharing. The downside of this methodology is that it distorts the relative profitability of the divisions in the sense that each division's profits depends not only on that division's profits, but also on the sales in the other division. But given the large interdependencies between the Hardware and Software Divisions products, the two divisions are not separate and independent of the other division. Hallsite's non-insulating cost allocation methodology attempts to capture to some extent the true nature of these interdependencies, and to foster cooperation incentives between Hardware and Software Divisions.

**P 7–8:** **Solution to Jolsen International** (25 minutes)
[Evaluating decision alternatives involving overhead]

a. Assuming that Tesoro's 70 percent of the plant cannot be used for any other purpose and cannot be subleased, then Moss' recommendation is inappropriate. If Tesoro's is closed, Daneille's will have to bear the full fixed overhead expense of $140.

| | **Daneille's** |
|---|---|
| Sales Revenue | $1,000 |
| Expenses: | |
| Direct Materials | (465) |
| Direct Labor | (130) |
| Selling Expenses | (200) |
| Overhead Expenses: | |
| Fixed Overhead | (140) |
| Variable Overhead | (45) |
| Net Income Before Taxes | $ 20 |

Furthermore, Mr. Moss' recommendation is inappropriate based on the fact that Tesoro's is covering its variable costs.

| | Tesoro's |
|---|---|
| Sales Revenue | $500 |
| | |
| Expenses: | |
| Direct Materials | (200) |
| Direct Labor | (70) |
| Selling Expenses | (100) |
| | |
| Overhead Expenses: | |
| Variable Overhead | (40) |
| | |
| Net Income Before Taxes, Bonuses & Fixed Overhead | $ 90 |

An evaluation of the profitability of Tesoro depends on the opportunity cost attached to the space Tesoro is using. If this space is worth more than $0.92 per square foot per year ($90,000 ÷ 70% × 140,000 square feet), then Tesoro should be shut down.

b. One of Shoe's major concerns is that the two divisions take advantage of quantity discounts and other benefits of cooperation. Allocating costs based on floor space insulates the two divisions and inhibits the cooperation that Shoe desires. Thus, a non-insulating cost allocation method is more appropriate. One solution is basing cost allocations on the profits for both divisions. This gives both division managers the incentive to reduce costs and participate in mutual monitoring, and also achieves Shoe's goal of increased cooperation. The table below shows each division remains profitable after allocating fixed overhead using profits before allocations. The table assumes bonuses remain the same as before.

| | **Tesoro's Casuals** | **Daneille's Dresses** |
|---|---|---|
| Sales Revenue | $500 | $1000 |
| | | |
| Expenses: | | |
| Direct Materials | (200) | (465) |
| Direct Labor | (70) | (130) |
| Selling Expenses | (100) | (200) |
| Variable Overhead | (40) | (45) |
| Net Income Before Taxes & Fixed Overhead | $ 90 | $160 |
| Fixed Overhead | (50) | (90) |
| Net Income/Loss Before Taxes | $ 40 | $ 70 |

**P 7–9:** **Solution to Winterton Group** (25 minutes)
[Fairness of cost allocations]

a.

**Winterton Group**
Revised Profits by Office
Current Year (Millions)

| | **Rochester** | **Syracuse** | **Buffalo** | **Total** |
|---|---|---|---|---|
| Revenue | $16.00 | $14.00 | $20.00 | $50.00 |
| Operating Expenses | (12.67) | (11.20) | (16.30) | (40.17) |
| Central Services* | (2.10) | (2.10) | (1.80) | (6.00) |
| Profits | $ 1.23 | $ 1.70 | $ 1.90 | $ 3.83 |

*Allocated cost per investment advisor: 1/20 × $6 million = $300,000

b. It is not fairer because the criteria of fairness is not operational. What is fair to one manager (which means less allocated cost) is unfair to another (who bears more allocated cost).

c. Fairness is being used as a code word to avoid arguing self-interest. If adopted, the Buffalo manager's bonus rises by $48,000 [8%($1.9m – $1.3m)]. Thus, it is in the Buffalo manager's interest to get the cost allocation basis changed.

**P 7–10:** **Solution to National Training Institute** (30 minutes)
[Allocation of space costs]

**Allocations:**

| **Department** | **Revenue** | **% Revenue** | **Rent Costs** % of Space | **Rent Costs** % of Revenue |
|---|---|---|---|---|
| Administration | $ 3,600,000 | 12% | $180,000 | $240,000 |
| Support Services | 11,000,000 | 37% | 620,000 | 740,000 |
| Computer Services | 8,800,000 | 29% | 160,000 | 580,000 |
| Technical Training | 1,900,000 | 6% | 80,000 | 120,000 |
| Transportation | 4,700,000 | 16% | 960,000 | 320,000 |
| Total Allocated | $30,000,000 | 100% | $2,000,000 | $2,000,000 |

*Off-Time Usage*

The square footage allocation plan places a cost burden on Technical Training that it can avoid paying. Since Technical Training has the ability to move off-time training to other sites at no additional cost, rent should not be charged to them for off-time space usage. The opportunity costs of the off-time use of the facility are currently zero. Unless other uses are developed, these opportunity costs would remain at zero.

*Rent Allocation*

Mr. Daniels' plan distributes rent based on space allocated. His plan provides incentive for departments to use and request space efficiently. Departments would know rent costs during budget preparation time (assuming space allocations do not change). Since allocated space is the cost driver here, this plan distributes rental costs appropriately.

Ms. Richards' allocation plan places more of the burden of rent on those departments that generate the most revenue. Since these same departments have little or no competition, and are cost centers, the costs would be passed along as part of their service fee. The Transportation department would be the only department that would not have an increase under Mrs. Richards' plan. From the information provided, it is unknown whether or not the customers of the other departments would tolerate the service fee changes necessary to make up for such increases. This rent allocation plan penalizes the departments that generate greater revenue and yet may not require additional space.

Under this plan departments can request and use space inefficiently. Departments can hold onto space they are not using yet not pay the costs. This agency problem does not exist under the space allocation plan.

*Recommendations:*

1. Rent allocation should be based on space expected to be used during the coming year.
2. Do not charge Technical Training additional costs for off-time use.

**P 7-11:** **Solution to Encryption, Inc.** (30 minutes)
[Insulating versus noninsulating methods and risk sharing]

a. The following financial statement calculates the profits of the two divisions using the two alternative cost allocations schemes:

**Encryption, Inc.**
**Pro Forma Divisional Income Statements**
Engineering Design Allocated on Sales (Panel A)
and 50-50 Split (Panel B)

**Panel A: Engineering Design Allocated on Sales**

| | International Sales = $1,500 | | International Sales = $500 | |
|---|---|---|---|---|
| | Federal Systems | International | Federal Systems | International |
| Sales | $1,000 | $1,500 | $1,000 | $500 |
| Variable Cost | 500 | 750 | 500 | 250 |
| Engineering Design | 240 | 360 | 400 | 200 |
| Net Income | $ 260 | $ 390 | $ 100 | $ 50 |

**Panel B: 50-50 Split**

| | International Sales = $1,500 | | International Sales = $500 | |
|---|---|---|---|---|
| | Federal Systems | International | Federal Systems | International |
| Sales | $1,000 | $1,500 | $1,000 | $500 |
| Variable Cost | 500 | 750 | 500 | 250 |
| Engineering Design | 300 | 300 | 300 | 300 |
| Net Income (loss) | $ 200 | $ 450 | $ 200 | ($ 50) |

b. I prefer to allocate Engineer Design costs based on sales (Panel A). First, it is a noninsulating allocation scheme, meaning that each divisions' profits vary inversely with the other's profits. For example, Federal System's profits will either be $260 or $100, even though their sales and costs remain constant over time. With an even split (Panel B), Federal System's profits do not vary, they remain at $200. Noninsulating schemes encourage cooperation among divisions by giving each division an incentive to improve other divisions' sales and thereby their own profits. Second, the non-insulating scheme reduces the risk International bears and is likely to result in more efficient risk sharing. For example, consider the range of profits each division faces under the two schemes:

| | | Federal | Intl | Total |
|---|---|---|---|---|
| Panel A (noninsulating): | Range | $160 | $340 | $500 |
| Panel B (insulating): | Range | 0 | $500 | $500 |

In panel A, Federal System's net income is either $260 or $100, a range of $160. Whereas in Panel B, Federal System's net income is always $200, a range of zero. The insulating method (panel B) imposes all the risk on International. The noninsulating method spreads some of the risk to Federal Systems. Some may argue that it is not "fair" to Federal to bear some of International's risk. Certainly, Federal will have to be paid to bear this risk via a risk premium.

However, by imposing this risk on Federal it creates incentives for Federal to cooperate with International by sharing production, marketing, and selling ideas.

**P 7–12:** **Solution to Ball Brothers Purchasing Department** (30 minutes) [Overhead rates proxying for opportunity costs]

Before answering the questions, it is useful to expand the table presented in the problem.

| No. of items purchased per week | Total cost per week | Average Cost | Incremental Cost | Estimated Marginal Cost |
|---|---|---|---|---|
| 100-199 | $1,000 | $10.00 | — | |
| 200-299 | 1,100 | 5.50 | $100 | $1.00 |
| 300-399 | 1,200 | 4.00 | 100 | 1.00 |
| 400-499 | 1,400 | 3.50 | 200 | 2.00 |
| 500-599 | 1,700 | 3.40 | 300 | 3.00 |
| 600-699 | 2,100 | 3.50 | 400 | 4.00 |
| 700-799 | 2,600 | 3.71 | 500 | 5.00 |
| 800-999 | 3,200 | 4.00 | 600 | 6.00 |

a. Yes, Purchasing Department costs should be allocated back to the users. The reason is that the average cost per item purchased of $3.44 is below marginal cost which is estimated to be approximately $4.00 ($400 ÷ 100). Taxing the divisions at $3.44 per item purchased causes them to reduce the number of items purchased by considering some of the incremental cost they impose on others by using the Purchasing Department. Reaching this conclusion requires an important assumption:

> The purchasing manager’s cost estimates accurately reflect expanding the department efficiently (when the delay costs exceed the cost of the expansion). This allows us to approximate marginal cost using the incremental cost.

b. We don’t know. Recharging the users $5.23 per unit purchased when volume is at 210 items might cause the users to cut back their purchases too much. Estimated marginal cost is only $1.00 per unit.

c. The answers differ because in part (a) AC < MC, so charging the users AC is clearly better than charging them zero. However, in part (b), AC > MC. While charging them zero with no allocation is clearly wrong, it may be the better of the two evils than charging them AC.

**P 7–13:** **Solution to Telstar Electronics** (30 minutes)
[Analyzing alternative allocation schemes for distribution costs]

Telstar should allocate the costs of distribution to the LOBs and they should use the third method: direct assignment of each shipment's costs and then allocating Distribution's overhead based on the direct shipment charges.

Just because LOBs cannot control all the distribution costs, they can certainly affect a large fraction of the costs. In particular, they affect the variable distribution costs. The direct distribution costs depend on the volume of shipments by the LOB. How products are packaged and the design of the packaging affect distribution costs. Therefore, the LOBs do control distribution expenses. Moreover, their actions influence the magnitude of the distribution costs they do not control. For example, if an LOB expands into a new region this causes the distribution center to either expand its scheduling staff or degrade its service to other LOBs. LOBs affect the quantity and quality of distribution services available to the other LOBs by their actions. Allocating the indirect distribution costs is in effect a tax on the LOBs using more of Distribution's fixed capacity and causes them to consider reducing to some extent their demands. [An externality is generated. Allocating the indirect costs of distribution to the LOBs based on the direct costs of the LOB shipments taxes this externality.]

**P 7-14:** **Solution to Diagnostic Imaging Software** (30 minutes)
[Insulating versus non-insulating allocation methods, risk sharing, and mutual monitoring]]

a., b., and c. (Millions of dollars)

| | North America | South America | Total |
|---|---|---|---|
| Revenues | $17.800 | $6.700 | $24.500 |
| Operating expenses | 5.340 | 3.015 | 8.355 |
| Profit before software costs | $12.460 | $3.685 | $16.145 |
| | | | |
| Software costs | | | |
| Allocated based on revenues | $8.718 | $3.282 | $12.000 |
| Allocated based on profits | 9.261 | 2.739 | 12.000 |
| Allocated based on 75%-25% | 9.000 | 3.000 | 12.000 |
| | | | |
| Profit after software development costs | | | |
| Allocated based on revenues | $3.742 | $0.403 | $4.145 |
| Allocated based on profits | 3.199 | 0.946 | 4.145 |
| Allocated based on 75%-25% | 3.460 | 0.685 | 4.145 |

d. Note that all three allocation schemes create incentives for the direct sales organizations to monitor the software cost because they bear these costs. If software cost rises, the direct sales organizations have incentive to complain to senior management. Hence, all three allocation schemes create mutual monitoring incentives.

The advantages of allocating software costs based on revenues include:

- Being a non-insulating method, the two sales organizations have incentives to cooperate and find ways to increase the other's revenues.
- Revenue risk is shared.

The disadvantages of allocating software costs based on revenues include:

- Each sales organization's performance measure (profits after allocated software cost) is distorted because each sales organization's performance (after allocation) depends on the sales in the other sales organization.
- The two sales organizations do not have incentives to cooperate to reduce each other's operating expenses.

The advantages of allocating software costs based on profits before allocating software cost include:

- Being a non-insulating method, the two sales organizations have incentives to cooperate and find ways to increase the other's revenues and decrease the other's operating expenses.
- Revenue and operating expense risk is shared.

The disadvantages of allocating software costs based on profits before allocating software cost include:

- Each sales organization's performance measure (profits after allocated software cost) is distorted because each sales organization's performance (after allocation) depends on the profits in the other sales organization.

The advantages of allocating software costs based on 75 percent - 25 percent shares include:

- Each sales organization's performance measure (profits after allocated software cost) is not distorted.

The disadvantages of allocating software costs based on profits before allocating software cost include:

- The two sales organizations have no incentives to cooperate and find ways to increase the other's revenues and decrease the other's operating expenses.
- Revenue and operating expense risk is not shared.

**P 7-15:** **Solution to Fuentes Systems** (30 minutes)
[Cost allocations as a proxy for hard to observe opportunity cost]

a. $2,184,000/70 = $31,200

b. Including the corporate overhead allocation, the total cost of a sales person is $151,200 ($120,000 + $31,200). Hiring one sales person generates a net expected increase in the western region's profits of $33,800 ($185,000 - $151,200), whereas hiring two sales people will generate net expected profits of $20,600 ($323,000 – 2 × $151,200). To maximize profits in your region, you will hire one sales person.

c. The incremental administrative cost per sales person of going from 70 to 80 sales people is $45,600 ([$2,640,000 - $2,184,000] / 10). This is an estimate of the marginal administrative cost of hiring an additional sales person. The allocated administrative cost currently is only $31,200 and this is expected to rise to $33,000 ($2,640,000 / 80). Thus, while the current cost allocation mechanism does not "tax" the regions enough for adding sales people, it is still better to tax them $33,000 rather than zero. Ideally, Fuentes should charge the regions' the marginal cost (approximately $45,600). But marginal cost is only known after special studies and even the $45,600 does not include the delay costs and other externalities imposed on corporate administrative functions when additional sales people are hired.

d. The incremental administrative cost per sales person of going from 70 to 80 sales people is only $1,600 ([$2,200,000 - $2,184,000] / 10). This is an estimate of the marginal administrative cost of hiring an additional sales person. The allocated administrative cost currently is $31,200 and this is expected to fall to $27,500 ($2,200,000 / 80). Thus, the current cost allocation mechanism "over taxes" the regions for adding sales people. Take the case of the western region. The actual marginal cost of adding a sales person is $121,600 ($120,000 + $1,600). Adding one sales person yields total profits of $63,400 ($185,000 - $121,600), whereas adding two sales people yields total profits of $97,800 ($323,000 – 2 × $112,600). Clearly, Fuentes would like the western region to hire two sales people. But the current cost allocation system causes the western region to add only one sales person. In this case, it would be better if Fuentes did not allocate administrative overhead to the regions.

**P 7-16:** **Solution to Vorma** (30 minutes)
[Cost allocations can distort relative product profitability]

a. Product profits with two products:

| | **LiqVita** | **Dry** | **Total** |
|---|---|---|---|
| Revenue | $2,000,000 | $1,575,000 | $3,575,000 |
| Variable cost | 1,200,000 | 825,000 | 2,025,000 |
| Own Fixed cost | 90,000 | 110,000 | 200,000 |
| Allocated overhead | 888,889 | 611,111 | 1,500,000 |
| Net income (loss) | ($178,889) | $28,889 | ($150,000) |
| | | | |
| *% Variable cost* | *59%* | *41%* | |

b. LiqVita is the least profitable, losing $178,889, while Dry is the most profitable making $28,889.

c. Product profits with three products:

| | LiqVita | Dry | China | Total |
|---|---|---|---|---|
| Revenue | $2,000,000 | $1,575,000 | $8,550,000 | $12,125,000 |
| Variable cost | 1,200,000 | 825,000 | 6,650,000 | 8,675,000 |
| Own Fixed cost | 90,000 | 110,000 | 800,000 | 1,000,000 |
| Allocated overhead | 207,493 | 142,651 | 1,149,856 | 1,500,000 |
| Net income | $502,507 | $497,349 | -$49,856 | $950,000 |
| | | | | |
| *% Variable cost* | *14%* | *10%* | *77%* | |

d. LiqVita is now the most profitable of the three, followed closely by Dry, and China appears to be losing money.

e. This problem illustrates how the relative profitability of products can be altered by cost allocations. By adding China, LiqVita becomes more profitable than Dry even though these two products do not change their prices, units sold, variable cost, or own fixed cost. Moreover, China appears to be losing money even though total Vorma profits rise from a loss of $150,000 to a profit of $950,000. China appears to be losing money because it is allocated the vast majority (77 percent) of the fixed common overhead of $1.5 million. With just two products, LiqVita was allocated 59 percent of the overhead and Dry 41 percent. With China these percentages fall to 14 percent and 10 percent. Prior to China, LiqVita was receiving 18 percentage points more overhead than Dry (59% - 41%). After China, this difference falls to 4 percentage points, which causes LiqVita to appear to be more profitable than Dry.

## P 7–17: **Solution to Bio Labs** (35 minutes)
[Single vs. dual-rate allocations]

a. Because the Corn and Wheat labs already have ample incentive to cooperate and appear to be doing so, the issue of a non-insulating scheme is probably not an important consideration in designing the cost allocation for the laser testing department. The two allocation schemes described are a full-cost, single-rate system and a dual-rate system:

(i) Single-rate, full-cost system:
Overhead (recharge) rate:

$$\frac{\text{total costs}}{\text{expected testing hours}}$$

$$= \frac{\$350,000 + \$25 \times 1,500 \text{ hours}}{1,500 \text{ hours}}$$

= $258.33 per testing hour

(ii) Dual-rate allocation:
Allocate fixed costs of $350,000 using expected usage:

| | | | |
|---|---|---|---|
| Wheat : $\frac{700}{1500} \times \$350,000$ | | = | $163,333 per year |
| Corn: $\frac{800}{1500} \times \$350,000$ | | = | $186,667 per year |
| Total fixed costs | | | $350,000 per year |

Charge each lab a variable cost per testing hour of $25.

Note: The use of expected testing hours versus actual testing hours results in very different incentives. If actual hours are used, the dual-rate scheme is the same as the single-rate scheme because the price per testing hour becomes $258.33 under both schemes. Using expected testing hours creates incentives for each department to underestimate their planned use at the beginning of the year.

b. Assume that actual costs are the same as forecasted. At the end of the year if Wheat Seed uses 650 hours and Corn Seed uses 900 hours, then the charges are:

(i) Single-rate, full-cost system:

| | Wheat Seed | Corn Seed | Total |
|---|---|---|---|
| number of hours | 650 | 900 | |
| cost allocation rate | $ 258.33 | $ 258.33 | |
| total cost | $167,915 | $232,497 | $400,412 |

(ii) Dual-rate system:

| | Wheat Seed | Corn Seed | Total |
|---|---|---|---|
| number of hours | 650 | 900 | |
| variable cost rate | $ 25 | $ 25 | |
| variable cost | $ 16,250 | $ 22,500 | $ 38,750 |
| allocated fixed costs | 163,333 | 186,667 | 350,000 |
| total cost | $179,583 | $209,167 | $388,750 |

Because actual utilization differs from expected utilization, the two methods produce different charges to the two labs. Notice that 50 more hours were used (650 hours + 900 hours = 1,550 hours) than expected (1,500 hours). The 50 extra hours cause the single-rate scheme to charge more costs to the two departments than were actually incurred. This overcharge can be deducted from each department.

c. Single-rate scheme:

Advantage. It's simple and easily understood, and at the end of each year, all the costs of the testing department are transferred to the user group.

Disadvantage. The "price" per testing hour each user sees is greater than the marginal cost of providing that testing hour. Therefore, each user will likely choose to consume fewer testing hours than the number of hours that maximize the value of the firm.

Dual-rate scheme:

Advantage. Each testing hour is priced at variable (marginal) cost. Therefore, in the decision to use one more hour of testing, the marginal (opportunity) cost to the firm of one more testing hour will be compared to the marginal benefits.

Disadvantage. The determination of which costs are "fixed" and allocated as a lump sum versus which costs are "variable" and charged per testing hour is not as clear cut as it seems. Moreover, how these numbers are determined affects the charges to the two labs. Clearly, the Wheat lab would like as many costs as possible to be classified as fixed, since this shifts more of the fixed cost onto the Corn lab. Also, over time, as the capacity of the testing department changes and its fixed costs change, or as the utilization of the capacity by the two labs (or other labs) changes, then the sharing of the fixed costs has to be renegotiated. This again opens the possibility of managers lobbying for changes in the allocation scheme.

Also, the dual system will appear "unfair" by Wheat Seed and Corn Seed if other departments use the laser and pay only $25 per hour. Wheat and Corn Seed managers will argue that they are paying the fixed costs and the other departments are just paying variable costs. But, since the laser has excess capacity, any transfer price to the other three departments greater than $25, which is the laser's opportunity cost, discourages use.

**P 7–18:** **Solution to World Imports** (35 minutes)
[Overhead as a tax that affects pricing and quantity decisions]

a. Using the data provided in the table, the profit-maximizing price is determined to be $5.00. This yields total profits for the district of $45,000.

**World Imports**
**Proposed Australian T-Shirt**
**Derivation of Optimum Price-Quantity Point**
(No Corporate Cost Allocation)

| Quantity (000s) | Sales Price | Total Revenue (000s) | T-Shirt Imported Cost | Total Imported Cost (000s) | 20% Sales Comm. (000s) | Total Cost (000s) | Net Profit (000s) |
|---|---|---|---|---|---|---|---|
| 10 | $6.50 | $65 | $2.00 | $20 | $13 | $33 | $32 |
| 20 | $5.50 | $110 | $2.20 | $44 | $22 | $66 | $44 |
| 30 | $5.00 | $150 | $2.50 | $75 | $30 | $105 | $45 |
| 40 | $4.75 | $190 | $3.00 | $120 | $38 | $158 | $32 |

b. If corporate overhead is allocated to the sales districts, this is a tax on sales commissions. The table below calculates the net profit from various pricing alternatives after including the corporate overhead allocation.

**World Imports**
**Proposed Australian T-Shirt**
**Derivation of Optimum Price-Quantity Point**
(Corporate Cost Allocation)

| Quantity (000s) | Sales Price | T-Shirt Imported Cost | Total Imported Cost (000s) | Sales Comm. (20%) | Allocated Corp. Overhead | Total Cost (000s) | Net Profit (000s) |
|---|---|---|---|---|---|---|---|
| 10 | $6.50 | $2.00 | $20 | $13 | $3.90 | $36.90 | $28.10 |
| 20 | $5.50 | $2.20 | $44 | $22 | $6.60 | $72.60 | $37.40 |
| 30 | $5.00 | $2.50 | $75 | $30 | $9.00 | $114.00 | $36.00 |
| 40 | $4.75 | $3.00 | $120 | $38 | $11.40 | $169.40 | $20.60 |

As can be seen from the table, the district's profit-maximizing price (if corporate overhead is included in district profits) is now $5.50 per T-shirt. The district manager views the allocation as an increase in marginal costs. When marginal cost schedules shift up, the profit-maximizing price tends to increase and the profit-maximizing quantity decreases.

When corporate overhead is allocated to the districts, Krupsak views this as an increase in marginal costs and raises price and lowers quantity sold.

c. The argument for allocating overhead must be that the current system of measuring costs is not capturing the true costs district managers impose on corporate headquarters by their pricing decisions. The arguments given in the case by the corporate controller cannot be complete.

If by deciding to sell the T-shirts, Krupsak imposes costs on corporate headquarters, then Krupsak should take account of these costs in his pricing decision. If the T-shirts generate additional legal or payroll costs or if they consume scarce corporate resources, then an externality is generated that Krupsak should bear. Allocating corporate overhead is one way to do this. But it should be recognized that the overhead rate of 30% of commissions is an average rate, not a marginal rate. Therefore, it might be too high a tax on commissions.

If the headquarters expenses are truly fixed with respect to the number of T-shirts Krupsak sells, then allocating these expenses causes too high a price to be set and too few T-shirts will be ordered.

**P 7-19:** **Solution to Painting Department** (35 minutes)
[Overhead is a tax that alters input decisions]

a. The table below shows that the cost minimizing choice before overhead allocation is 80 gallons of paint and 125 hours of labor.

| **Paint** (gallons) | **Labor** (hours) | **Paint Cost** ($10 × gallons) | **Labor Cost** ($6.40 × hours) | **Total Cost** |
|---|---|---|---|---|
| 50 | 200 | $500 | $1,280 | $1,780 |
| 80* | 125* | 800 | 800 | 1,600* |
| 100 | 100 | 1,000 | 640 | 1,640 |
| 125 | 80 | 1,250 | 512 | 1,762 |
| 200 | 50 | 2,000 | 320 | 2,320 |

* Least cost alternative

b. The table below shows that the cost minimizing choice, including overhead allocations is 100 gallons of paint and 100 hours of labor.

| Paint (gallons) | Labor (hours) | Total Cost before **Overhead** | Labor Cost ($6.40 × hours) | Overhead (56.25% × labor cost) | Total Cost with **Overhead** |
|---|---|---|---|---|---|
| 50 | 200 | $1,780 | $1,280 | $720 | $2,500 |
| 80 | 125 | 1,600 | 800 | 450 | 2,050 |
| 100* | 100* | 1,640 | 640 | 360 | 2,000* |
| 125 | 80 | 1,762 | 512 | 280 | 2,050 |
| 200 | 50 | 2,320 | 320 | 180 | 2,500 |

* Least cost alternative

c. In part (b), overhead is a tax on labor, raising the effective price of labor. Since labor is now more expensive, more paint is substituted for less labor. In fact, the overhead charge on labor causes labor and paint to cost the same (1.5625 × $6.40 = $10.00). Since labor and paint have the same marginal rates of substitution, with equal prices equal amounts of each are used.

d. The accounting department might want to allocate corporate overhead using labor as the allocation base if labor causes (or is associated with) higher overhead costs. If one department's use of labor imposes an opportunity cost on other parts of the firm that use the personnel, payroll, or security departments, then taxing labor forces managers to use less labor. The overhead allocation is a way of making managers internalize the externality they impose on others when they use labor, and hence the overhead departments that must service this labor.

**P 7-20:** **Solution to Scanners Plus** (35 minutes)
[Non-insulating allocations as a risk sharing mechanism]

a. The possible total revenues for the Home model are:

| | **Low** | **High** |
|---|---|---|
| Number of units | 1,000 | 1,400 |
| Selling price | $ 1,600 | $ 1,600 |
| Total revenues | $1,600,000 | $2,240,000 |

b. The possible total revenues for the Pro model are:

| | **Low** | **High** |
|---|---|---|
| Number of units | 600 | 800 |
| Selling price | $ 8,800 | $ 8,800 |
| Total revenues | $5,280,000 | $7,040,000 |

c. The table below (in 000s) calculates the possible levels of profits for the two profit centers:

| | Home | | Pro | |
|---|---|---|---|---|
| | **Low** | **High** | **Low** | **High** |
| Revenues | $1,600 | $2,240 | $5,280 | $7,040 |
| Variable costs | 600 | 840 | 1,680 | 2,240 |
| Contribution margin | 1,000 | 1,400 | 3,600 | 4,800 |
| Fixed costs | 800 | 800 | 2,400 | 2,400 |
| Income before marketing | 200 | 600 | 1,200 | 2,400 |
| Marketing costs (24%, 76%) | 240 | 240 | 760 | 760 |
| Profits | $ (40) | $ 360 | $ 440 | $1,640 |
| Expected profits | $160 | | $1,040 | |
| Standard Deviation | $283 | | $849 | |

d. There can be four different sets of allocations of marketing costs depending on the particular revenues of the Home and Pro models (in 000s):

| | | Pro's Revenues | | | |
|---|---|---|---|---|---|
| | | **Low** | | **High** | |
| **Home's Revenues** | | | | | |
| Low | Home | $1,600 | 23% | $1,600 | 19% |
| | Pro | 5,280 | 77% | 7,040 | 81% |
| | Total | $6,880 | | $8,640 | |
| High | Home | $2,240 | 30% | $2,240 | 24% |
| | Pro | 5,280 | 70% | 7,040 | 76% |
| | Total | $7,520 | | $9,280 | |

e. The table below calculates the various profit numbers that can result from using relative revenues to allocate marketing costs (all amounts in $000).

| | Home | | | | Pro | | | |
|---|---|---|---|---|---|---|---|---|
| | **Low** | **Low** | **High** | **High** | **Low** | **Low** | **High** | **High** |
| Income before marketing | $200 | $200 | $600 | $600 | $1,200 | $1,200 | $2,400 | $2,400 |
| Allocated marketing costs | | | | | | | | |
| Home low & Pro low | 230 | | | | 770 | | | |
| Home low & Pro high | | 190 | | | | | 810 | |
| Home high & Pro low | | | 300 | | | 700 | | |
| Home high & Pro high | | | | 240 | | | | 760 |
| Profits | $ (30) | $10 | $300 | $360 | $430 | $500 | $1,590 | $1,640 |
| Expected profits | | $160 | | | | $1,040 | | |
| Standard Deviation | | $198 | | | | $665 | | |

f. In part (c), using the fixed percentages of 24 percent and 76 percent is an insulating allocation scheme. The allocations do not vary with the performance of the other division. This method does not give one division an incentive to cooperate with the other division. On the other hand, in part (e), a non-insulating method of allocating marketing costs is used. Not only does a non-insulating method create cooperation incentives, it reduces the risk each division bears. In part (c), profits can be either ($40) or $360 in Home and $440 or $1,640 in Pro. This range is smaller in part (e). In fact, the standard deviation of the Home model's profits under the insulating method in part (c) is $283 which is larger than the standard deviation under the non-insulating method in part (e) of $198. Likewise, the Pro model's standard deviation of $665 is lower using the non-insulating method in part (e) than using the insulating method in part (c), $849.

**P 7–21:** **Solution to Giza Farms** (35 minutes)
[Benefits of cost allocations]

a. and b. The table below calculates divisional earnings after allocating 160 million Egyptian pounds of corporate overhead.

**Giza Farms**
**Divisional Earnings after Corporate Overhead Allocations**
(Millions of Egyptian pounds)

| | **Consulting Services** | **Chemicals** | **Agricultural Products** | **Total** |
|---|---|---|---|---|
| Revenue | 250 | 250 | 500 | 1000 |
| Percent revenue | 0.25 | 0.25 | 0.50 | 1.00 |
| Earnings before corporate overhead allocations | 80 | 50 | 70 | 200 |
| Percent earnings | 0.40 | 0.25 | 0.35 | 1.00 |
| | | | | |
| Corporate Overhead Allocation | | | | |
| based on revenue | 40 | 40 | 80 | 160 |
| based on earnings | 64 | 40 | 56 | 160 |
| | | | | |
| Earnings after allocations | | | | |
| based on revenue | 40 | 10 | -10 | 40 |
| based on earnings | 16 | 10 | 14 | 40 |

c. These overhead cost allocations, being non-insulating, will help foster cooperation among the divisions. If another division's revenues or earnings increase, the other divisions' allocated overhead falls. To the extent one division imposes externalities on another division by expanding and therefore consuming more corporate resources such as human resources, then corporate overhead allocations act as a proxy for these externalities.

The choice of which method to use depends on whether revenues or earnings should be taxed. Both allocations are non-insulating in that both create incentives for the divisions to cooperate. Using revenues causes the divisions to cooperate by helping each other increase revenues whereas using divisional earnings cause the divisions to help each other increase revenues and decrease costs. Thus, one factor affecting the choice between the two allocation bases depends on whether the divisions' interactions are primarily on the demand side or are on both the demand and cost side.

Another factor affecting the choice depends on the distortion of relative profitability. Using revenues as the allocation base can distort the relative profitability of the divisions. Using earnings does not distort relative profitability.

d. All three divisional managers are clearly upset because most of their apparent profitability vanishes when they are charged for corporate overhead. While they are profitable at the divisional level, the firm as a whole is not nearly as profitable. The allocation of corporate overhead is likely to affect the divisions' discretionary spending and their compensation. The manager of Agricultural Products is particularly upset because her division goes from generating high profits (70 million) without any allocations to showing a loss (10 million) if corporate overhead is allocated based on divisional revenues.

She is probably correct in saying that the divisions have no direct control over corporate spending. However, the divisions do have indirect control over corporate spending by voicing concerns over the level of costs being allocated to them, especially in relation to the benefits the divisions receive for these expenditures. For example, currently corporate advertising is free to the divisions. The more advertising the better. But if these expenditures are allocated to the divisions, they are likely to complain if the allocated costs exceed the benefits they receive from advertising. Thus, allocating corporate overhead helps to assemble specialized knowledge of the benefits provided by these expenditures. Cost allocations foster mutual monitoring.

**P 7-22:** **Solution to Allied Adhesives** (40 minutes)
[Cost allocations distort performance evaluation and alternative allocation schemes]

a. Parts (i) - (iii) below report net income and ROS after the consolidation using the following allocations of the revised fixed SGA of $3 million.

| | **Aerospace** | **Electronics** | **Total** |
|---|---|---|---|
| Consolidated fixed SGA (% revenue) | $0.856 | $2.144 | $3.000 |
| Consolidated fixed SGA (% mfg cost) | 0.810 | 2.190 | 3.000 |
| Consolidated fixed SGA (% mfg margin) | 0.909 | 2.091 | 3.000 |

(i) Revenue as the allocation base:

| (millions) | Aerospace | Electronics |
|---|---|---|
| Revenue | $16.800 | $42.100 |
| Manufacturing cost | 8.568 | 23.155 |
| Manufacturing margin | $8.232 | $18.945 |
| Allocated fixed SGA (% of revenue) | 0.856 | 2.144 |
| Variable SGA | 5.376 | 12.63 |
| Net income | $2.000 | $4.171 |
| Return on Sales | 11.90% | 9.91% |

(ii) Manufacturing cost as the allocation base:

| (millions) | Aerospace | Electronics |
|---|---|---|
| Revenue | $16.800 | $42.100 |
| Manufacturing cost | 8.568 | 23.155 |
| Manufacturing margin | $8.232 | $18.945 |
| Allocated fixed SGA (% of manufacturing cost) | 0.810 | 2.190 |
| Variable SGA | 5.376 | 12.630 |
| Net income | $2.046 | $4.125 |
| Return on Sales | 12.18% | 9.80% |

(iii) Manufacturing margin as the allocation base:

| (millions) | Aerospace | Electronics |
|---|---|---|
| Revenue | $16.800 | $42.100 |
| Manufacturing cost | 8.568 | 23.155 |
| Manufacturing margin | $8.232 | $18.945 |
| Allocated fixed SGA (% of mfg margin) | 0.909 | 2.091 |
| Variable SGA | 5.376 | 12.630 |
| Net income | $1.947 | $4.224 |
| Return on Sales | 11.59% | 10.03% |

b. Consolidation and allocation changes the relative performance of the two divisions. Aerospace was less profitable; now it is more profitable. This illustrates how cost allocation can change relative performance evaluation.

c. Aerospace will prefer manufacturing cost as the allocation base because this yields the lowest allocated fixed SGA ($810K) and hence highest ROS (12.18 percent). Electronics prefers manufacturing margin as the allocation base as this yields the lowest allocated fixed SGA of $2.091 million and highest ROS of 10.03 percent.

d. AA probably should be allocating the common fixed SGA costs of $3 million using manufacturing margin. Given that both Aerospace and electronics have similar manufacturing process but very dissimilar sales processes and customers, it is more likely that they share common knowledge about manufacturing but not sales. To encourage the sharing of this common manufacturing knowledge, allocate the fixed SGA using manufacturing margin. By helping the other division reduce its manufacturing cost raises its margin, thereby resulting in the other division absorbing more fixed SGA and my division absorbing less. Note that using manufacturing cost creates perverse incentives. If I help the other division lower its manufacturing costs, they absorb less fixed SGA and I absorb more.

e. Return on sales as a performance measure does not create any incentives to use capital efficiently. Under an ROS measure managers have no incentive to eliminate non-productive inventories. ROS encourages over investment in plant and equipment. Accounts receivable will not be managed efficiently. AA should consider adopting either ROI, ROA, residual income or EVA as the performance metric unless there are persuasive reasons (not stated in the problem) to retain ROS. NOTE: after consolidating the two divisions into Atlanta, both managers' ROS increases due to the lower fixed SGA. Without some offsetting change in their compensation packages, these managers' total compensation will rise. They receive windfall gains.

## P 7–23: **Solution to Chicago Omni Hotel** (40 minutes)

[Allocating common costs]

a. There is no single correct answer to this problem. There are numerous ways to measure performance. The issue that arises and which must be addressed in the answer is how alternative ways of defining profit center profits affect the incentives of the profit center managers.

One possible performance report appears below:

| | Lodging | Dining | Catering | Retail Stores | Total |
|---|---|---|---|---|---|
| Revenues (millions) | $39.20 | $9.80 | $5.80 | $1.90 | $56.70 |
| Operating expenses | 31.10 | 6.20 | 3.50 | .30 | 41.10 |
| Contribution margin | 8.10 | 3.60 | 2.30 | 1.60 | 15.60 |
| % of contribution margin | 52% | 23% | 15% | 10% | 100% |
| Less common costs†: | | | | | |
| Occupancy costs | -3.98 | -.34 | -.78 | -.50 | -5.60 |
| Marketing costs | -.73 | -.34 | -.21 | -.11 | -1.39 |
| Administration costs | -.94 | -.13 | -.03 | -0 | -1.10 |
| Net income | 2.45 | 2.79 | 1.28 | $.99 | $7.51 |
| % of net income | 33% | 37% | 17% | 13% | 100% |

†Common cost allocations

| | | | | | |
|---|---|---|---|---|---|
| Square footage (000s) | 625 | 50 | 125 | 80 | 880 |
| % of square footage | 71% | 6% | 14% | 9% | 100% |
| Occupancy costs | $3.98 | $0.34 | $0.78 | $0.50 | $5.60 |
| % of contribution margin | 52% | 23% | 15% | 10% | 100% |
| Marketing costs | $0.73 | $0.32 | $0.21 | $0.14 | $1.40 |
| Number of employees | 1,000 | 140 | 35 | 4 | 1179 |
| % of employees | 85% | 12% | 3% | 0% | 100% |
| Administration costs | $0.94 | $0.13 | $0.03 | $0.00 | $1.10 |

b. The first question to answer is whether performance should be evaluated on contribution margin (before any cost allocations) or on a net income basis (after costs are allocated). The hotel has substantial common costs (occupancy, marketing, and administration). If these costs are not allocated, the profit centers will view them as free and will always be requesting more. For example, if there is not an appropriate charge for floor space by allocating occupancy costs, all the profit centers will want additional space. Therefore, allocating these costs reduces (but does not totally eliminate) over consumption of common costs.

The second question is whether all the common costs are to be allocated in a single lump sum or separately by expense category. Most firms would use separate rates, probably because each common cost represents a different scarce resource. For example, occupancy costs represent the opportunity cost of the space which varies with the amount of floor space (as well as where the space is located in the building), whereas marketing costs do not vary with square footage.

Third, if multiple overhead rates are used, individual allocation bases must be chosen. The logical ones (i.e., the cost drivers most associated with cause and effect) are square footage for occupancy costs, employees for administration, and revenues or contribution margin for marketing costs. Contribution margin is the least insulating basis. It causes profit center allocations to be the most sensitive to the other profit centers' profitability and therefore creates the most cooperation between profit centers. Because of the highly interdependent nature of the four profit centers, a non-insulating scheme will promote mutual monitoring. That is, good restaurants promote shopping and hence higher rental rates. High room occupancy has a beneficial effect on all profit centers. Therefore, the high degree of demand interdependencies among profit centers means we want to promote as much cooperation as possible.

c. This report cannot be used to pick which managers are the winners and which are the losers because of the numerous synergies across departments. Occupancy expenses are a joint cost. You cannot have a major hotel without dining, catering, and shops. Trying to allocate these costs will give a misleading picture of the winners and losers. For example, what is the opportunity cost of renting space in the lobby for a store? It is not the occupancy cost.

At the end of the year, actual results can be compared to budget and those managers who performed better than their budget can be rewarded and those who performed worse than their budget can be penalized.

**P 7–24: Solution to Plastic Chairs** (40 minutes)
[Overhead distorts relative input prices]

The following table calculates the total cost of just the plastic and the plastic and overhead for various combinations of new and recycled plastics.

| Pounds of New Plastic | Pounds of Recycled Plastic | Cost of New Plastic | Cost of Recycled Plastic | Total Cost of New & Recycled Plastic | Overhead Cost on Recycled Plastic | Total Cost including Overhead |
|---|---|---|---|---|---|---|
| 20 | 72 | $320 | $720 | $1,040 | $2,160 | $3,200 |
| 24 | 60 | $384 | $600 | $984 | $1,800 | $2,784 |
| 30 | 48 | $480 | $480 | $960 | $1,440 | $2,400 |
| 32 | 45 | $512 | $450 | $962 | $1,350 | $2,312 |
| 36 | 40 | $576 | $400 | $976 | $1,200 | $2,176 |
| 40 | 36 | $640 | $360 | $1,000 | $1,080 | $2,080 |
| 45 | 32 | $720 | $320 | $1,040 | $960 | $2,000 |
| 48 | 30 | $768 | $300 | $1,068 | $900 | $1,968 |
| 60 | 24 | $960 | $240 | $1,200 | $720 | $1,920 |
| 72 | 20 | $1,152 | $200 | $1,352 | $600 | $1,952 |

a. Plastic costs are minimized if 30 pounds of new and 48 pounds of recycled plastics are used.

b. Total (plastic plus overhead) costs are minimized if 60 pounds of new and 24 pounds of recycled plastics are used.

c. By allocating overhead based on the pounds of recycled plastic, the cost per pound of recycled plastic rises from $10 per pound to $40 per pound ($10 + $30). Because recycled plastic is now viewed as more expensive, the manager substitutes new for recycled plastic. The recycled plastic is more expensive because in the eyes of the manager who is compensated based on accounting costs, a dollar of plastic and a dollar of allocated costs are the same in terms of the manager's evaluation. Allocating overhead using pounds of recycled plastic is a tax on recycled plastic and the manager responds by lowering his/her consumption of the taxed resource.

d. The manager should only be allocated overhead on the basis of recycled plastic usage if such usage is correlated with some other cost the manager can impose elsewhere in the firm by purchasing recycled plastic. For example, suppose the purchase and handling of recycled plastic is very costly by exposing workers to safety risks. Or suppose the use of recycled plastic causes the chairs to have slight discoloration that reduces the demand for the chairs. By using recycled plastic, the chair manufacturing manager imposes costs (externalities) on others in the firm. Allocating overhead based on recycled plastic taxes this externality. In the absence of fairly large externalities in either production or demand caused by using recycled plastic, overhead should not be allocated using recycled plastic as the allocation basis.

**P 7-25:** **Solution to Woodley Furniture** (40 minutes)
[Cost allocations can change the relative profitability of products]

a. Firm-wide profits and product line profits are calculated in the following table:

| | **End Table** | **Coffee Table** |
|---|---|---|
| Price | $250 | $475 |
| Variable cost | 120 | 285 |
| Contribution margin | $130 | $190 |
| Total revenues | $2,000,000 | $2,850,000 |
| Units sold | 8,000 | 6,000 |
| Total contribution margin | $1,040,000 | $1,140,000 |

| | **End Table** | **Coffee Table** | **Total** |
|---|---|---|---|
| Revenue | $2,000,000 | $2,850,000 | $4,850,000 |
| % of total revenue | 41.24% | 58.76% | 100% |
| Fixed cost | | | $2,400,000 |
| Allocated fixed cost based on revenues | $989,691 | $1,410,309 | $2,400,000 |
| Revenue | $2,000,000 | $2,850,000 | $4,850,000 |
| Variable costs | 960,000 | 1,710,000 | $2,670,000 |
| Allocated fixed cost | 989,691 | 1,410,309 | $2,400,000 |
| Net income | $50,309 | -$270,309 | -$220,000 |

b. The end table is more profitable than the coffee table, which is actually losing money. The entire company is losing money (-$220,000).

c. Firm-wide profits and product-line profits are calculated in the following table:

| | End Table | Coffee Table | Dining Table | Total |
|---|---|---|---|---|
| Revenue | $2,000,000 | $2,850,000 | $2,480,000 | $7,330,000 |
| % of total revenue | 27.29% | 38.88% | 33.83% | 100% |
| | | | | |
| Allocated fixed cost based on revenues | $654,843 | $933,151 | $812,005 | $2,400,000 |
| | | | | |
| Revenue | $2,000,000 | $2,850,000 | $2,480,000 | $7,330,000 |
| Variable costs | 960,000 | 1,710,000 | 2,000,000 | 4,670,000 |
| Fixed cost | 654,843 | 933,151 | 812,005 | 2,400,000 |
| Net income | $385,157 | $206,849 | -$332,005 | $260,000 |

d. Woodley was losing money when it was just making the two products with the coffee table showing a large loss and the end table showing a small profit. By adding the dining table, Woodley is now showing a nice profit with both the end table and coffee table showing sizeable profits, but the dining table showing a large loss. This seems inconsistent with our intuition. Adding the dining table causes the entire firm to turn from a loss to a profit, but the dining table itself shows a loss. The reason for this apparent inconsistency is the way the fixed costs are being allocated using sales revenue. The dining table generates a sizeable amount of revenue, and hence is allocated a considerable amount of the fixed overhead, thereby relieving the other two products from absorbing this overhead. This example illustrates the general point that cost allocations can distort relative profitability of products.

e. Firm-wide profits and product-line profits for just the two products, and then the three products using total contribution margin to allocate the fixed costs are calculated in the following tables:

| | End Table | Coffee Table | Dining Table | Total |
|---|---|---|---|---|
| Price | $250 | $475 | | |
| Variable cost | 120 | 285 | | |
| Contribution margin | $130 | $190 | | |
| Units sold | 8,000 | 6,000 | | |
| Total contrib. margin | $1,040,000 | $1,140,000 | | $2,180,000 |
| | | | | |
| Allocated fixed cost | | | | |
| Based on tot cm | $1,144,954 | $1,255,046 | | $2,400,000 |
| | | | | |
| Price | $250 | $475 | $620 | |
| Variable cost | 120 | 285 | 500 | |
| Contribution margin | $130 | $190 | $120 | |
| Units sold | 8,000 | 6,000 | 4,000 | |
| Total contrib. margin | $1,040,000 | $1,140,000 | $480,000 | $2,660,000 |
| | | | | |
| Allocated fixed cost | | | | |
| based on tot cm | $938,346 | $1,028,571 | $433,083 | $2,400,000 |

| | End Table | Coffee Table | Dining Table | Total |
|---|---|---|---|---|
| Revenue | $2,000,000 | $2,850,000 | | $4,850,000 |
| Variable costs | 960,000 | 1,710,000 | | 2,670,000 |
| Fixed cost | 1,144,954 | 1,255,046 | | 2,400,000 |
| Net Income | -$104,954 | -$115,046 | | -$220,000 |
| | | | | |
| Revenue | $2,000,000 | $2,850,000 | $2,480,000 | $7,330,000 |
| Variable costs | 960,000 | 1,710,000 | 2,000,000 | 4,670,000 |
| Fixed cost | 938,346 | 1,028,571 | 433,083 | 2,400,000 |
| Net Income | $101,654 | $111,429 | $46,917 | $260,000 |

f. The primary advantage of using contribution margin to allocate the fixed cost is that the relative profitability of the products is not distorted when a new product is added. In part (e), when the dining table is added it does not absorb a disproportionate amount of overhead, and so all three tables appear profitable in contrast to the situation in part (c). Thus, if there are separate product managers for each of the three products, the dining table manager does not appear to be losing money. There is no misconception that the dining table is losing money and hence should be discontinued as suggested by the computations in part (c). The disadvantage of using contribution margin is that the firm might want to report that it is losing money on the dining room tables. For example, if the dining tables are being sold to a customer who only buys the dining tables and Woodley is trying to make the case that it should receive a higher price, then the allocation method in part (c) might prove beneficial. Or, if the dining tables are sold in a high tax rate jurisdiction while the other two tables are being sold in a low tax rate jurisdiction, allocating fixed costs based on sales revenues could prove useful. Another reason to use contribution margin rather than revenues to allocate the fixed costs involves incentives of the product managers. Both revenues and contribution margin are non-insulating allocation schemes. Using revenues as the allocation base creates incentives for the managers to cooperate to increase each others' revenue. However using contribution margin as the allocation base creates incentives for the product managers to increase the others' revenues AND decrease the others' costs.

**P 7-26:** **Solution to Transmation** (45 minutes)
[Insulating vs. non-insulating allocations]

a. The three divisions' ROAs (before any corporate expense allocations) are calculated in the following table:

| | **DIV A** | **DIV B** | **DIV C** | **TOTAL** |
|---|---|---|---|---|
| Revenues | $370 | $1,050 | $950 | $2,370 |
| Operating expenses | 300 | 900 | 800 | 2000 |
| Net income | $70 | $150 | $150 | $370 |
| Total divisional assets | $500 | $500 | $400 | $1,400 |
| ROA | 14.0% | 30.0% | 37.5% | 26.4% |

b. The three divisions' ROAs (after allocating corporate expense equally to the divisions) are calculated in the following table:

| | **DIV A** | **DIV B** | **DIV C** | **TOTAL** |
|---|---|---|---|---|
| Revenues | $370 | $1,050 | $950 | $2,370 |
| Operating expenses | 300 | 900 | 800 | 2000 |
| Allocated corporate expenses | 90 | 90 | 90 | 270 |
| Division profits | -$20 | $60 | $60 | $100 |
| ROA | -4.0% | 12.0% | 15.0% | 7.1% |

c. The three divisions' ROAs (after allocating corporate expense based on division expenses) are calculated in the following table:

| | DIV A | DIV B | DIV C | TOTAL |
|---|---|---|---|---|
| Operating expenses | $300 | $900 | $800 | $2,000 |
| % operating expenses | 15% | 45% | 40% | 100% |
| Allocated corporate expenses | $40.5 | $121.5 | $108 | $270 |
| | | | | |
| Revenues | $370.0 | $1,050.0 | $950.0 | $2,370 |
| Operating expenses | 300.0 | 900.0 | 800.0 | 2000 |
| Allocated corporate expenses | 40.5 | 121.5 | 108.0 | 270 |
| Division profits | $29.5 | $28.5 | $42.0 | $100 |
| ROA | 5.9% | 5.7% | 10.5% | 7.1% |

d. With no allocations in part (a), all divisions report a healthy ROA with Division C being the most profitable (37.5%) and Division A the least profitable (14%). However, after equal allocations (part b) the divisions do not appear as profitable. In part (c) where the allocations are based on operating expenses, all three divisions report positive ROA with Division C still being the most profitable (10.5%), but now Division B is the least profitable (5.7%).

e. Pros and cons of each method:

No allocations. This method does not distort the relative profitability of the three divisions. It is simple, produces no incentives for the divisions to argue about cost allocations, and will not require any adjustments in the compensation formulas. However, corporate resources are viewed as free by the divisions. The divisions have less incentive to monitor corporate spending.

Allocations of corporate expense (parts (b) and (c)). Allocating corporate expenses gives the divisions incentives to monitor corporate spending. Corporate resources are not viewed as free. However, both allocation schemes require adjustments to the compensation schemes as divisional ROAs are now lower.

Equal allocations (part b). This is the simpler of the two schemes and does not cause one division's ROA to fluctuate with the other divisions' expenses because it is an insulating allocation. Moreover, it likely yields lower influence costs than (c) since it appears "fair." Each division gets one-third. However, this scheme provides no incentives for the divisions to cooperate.

Allocations based on divisional operating expenses (part c). Unlike equal allocations, this scheme is non-insulating and each divisions' ROA fluctuates with the other divisions' operating expenses. This scheme provides incentives for the divisions to cooperate to increase the others' revenues because high revenues will cause higher operating expenses and hence more corporate expense allocated to that division. This lowers the allocation to the division helping the other unit. But allocating based on operating expenses has a perverse incentive. Divisions have a disincentive to assist other divisions in lowering their expenses. By assisting another division to lower its operating expenses, the helping division will see its share of corporate expenses increase.

f. The first question to ask is, "Is the current system broke?" What is motivating the CFO and CEO to change the status quo? What behaviors do the CEO and CFO seek to change? Will the new allocations change any cash flows of Transmation, such as taxes, cost plus contracts, etc. If the CEO and CFO believe that better incentive alignment between the divisions is necessary and they want the divisions to bear the cost of the corporate office, then I would recommend none of the three allocations proposed in the problem. Rather, I suggest they allocate corporate expenses based on division profits defined as revenues minus division operating expenses. Unlike the CEO's scheme that allocates corporate expenses based on division expenses, this scheme gives the divisions incentives to assist each other to raise the other divisions' revenues AND lower the other divisions' operating expenses. As in the other two allocation schemes, mine also requires Transmation to change the compensation plans so as not to reduce the pay to the division presidents resulting from the lower reported ROAs. The following table illustrates my alternative method:

| | **DIV A** | **DIV B** | **DIV C** | **TOTAL** |
|---|---|---|---|---|
| Revenues-operating expense | $70 | $150 | $150 | $370 |
| % revenues-operating expense | 18.9% | 40.5% | 40.5% | 100.0% |
| | | | | |
| Revenues | $370.0 | $1,050.0 | $950.0 | $2,370.0 |
| Operating expenses | 300.0 | 900.0 | 800.0 | 2000.0 |
| Allocated corporate expenses | <u>51.1</u> | <u>109.5</u> | <u>109.5</u> | <u>270.0</u> |
| Division profits | $18.9 | $40.5 | $40.5 | $100.0 |
| ROA | 3.8% | 8.1% | 10.1% | 7.1% |

**P 7–27:** **Solution to BFR Ship Building** (45 minutes)
[Incentives of make-buy decisions in cost-plus contracts and overhead allocations]

a. The following table calculates the amount of overhead allocated to the Coast Guard contract depending on whether the engines are manufactured by BFR or purchased from an external vendor.

| BFR<br>Overhead Allocation based on Direct Labor Dollars<br>(millions) | | | |
|---|---|---|---|
| | Commercial Division | Coast Guard Contract - Engines manufactured internally | Coast Guard Contract - Engines purchased externally |
| Direct labor | \$14.600 | \$22.800 | \$18.200 |
| Total firm-wide direct labor | | \$37.400 | 32.800 |
| % direct labor: | | | |
| Internal manufacturing | 39% | 61% | |
| External purchase | 45% | | 55% |
| Allocated overhead | | \$50.935<br>(61% × \$83.5) | \$45.925<br>(55% × \$83.5) |

Over \$5 million more overhead is allocated to the Coast Guard contract if the engines are manufactured internally rather than purchased externally.

b. The following table calculates the contract price paid by the Coast Guard under the two alternatives of internal and external engine manufacturing.

| BFR<br>Contract Price of Internal vs. External Engine Manufacturing<br>(millions) | | |
|---|---|---|
| | Coast Guard Contract - Engines manufactured internally | Coast Guard Contract - Engines purchased externally |
| Direct labor | $22.800 | $18.200 |
| Direct material | 32.900 | 25.900 |
| Purchased engines | 0.000 | 17.000 |
| Allocated overhead | 50.935 | 45.925 |
| Total cost | $106.635 | $107.025 |
| Contract price (105% × cost) | $111.967 | $112.376 |

The Coast Guard will pay about $0.4 million less if the engines are manufactured internally and therefore will prefer, all else equal, that the engines be manufactured internally.

c. The following table compares the cash flows to BFR of internal versus external sourcing of the engines. Since overhead is invariant to the sourcing decision, it is not included in the analysis.

| Net Cash Flow to BFR of<br>Internal vs. External Engine Manufacturing<br>(millions) | | |
|---|---|---|
| | Coast Guard Contract - Engines manufactured internally | Coast Guard Contract - Engines purchased externally |
| Contract price (105% × cost) | $111.967 | $112.376 |
| Direct labor | (22.800) | (18.200) |
| Direct material | (32.900) | (25.900) |
| Purchased engines | (0.000) | (17.000) |
| Net cash flow | $56.267 | $51.276 |

BFR generates an additional $4.9 million of net cash flow by manufacturing the engines internally. The reason is that internal sourcing raises the overhead allocation percentage from 55 percent to 61 percent. Since this overhead does not vary with the sourcing decision, BFR is able to recover more of its fixed costs from the government by increasing the amount of direct labor chargeable to the Coast Guard.

d. Given that defense contractors have fixed overhead that is allocable to cost-plus contracts and the allocation is often based on direct labor, any decision that causes the contractor to consume more direct labor on the government contract increases the amount of overhead chargeable to the government. The make-buy decision is one that involves the contractor using internal labor versus external labor. Therefore, cost-plus contracts will encourage contractors to make rather than buy.

The make-buy decision is not the only internal decision affected by cost-plus contracts. The decision to substitute capital for labor is also affected by the contracts. Defense contractors will shun capital in favor of labor to boost the amount of overhead allocated to government contracts using direct labor as the allocation base. Researchers have found that defense contractors employ less automation (capital) and have more internal sourcing than is optimal.[1]

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1 See W. Rogerson, "Overhead Allocation and Incentives for Cost Minimization in Defense Procurement," *Accounting Review* 67 (October 1992), pp. 671-690.

**Case 7–1:** **Solution to Phonetex** (40 minutes)
[Product profitability and allocated common costs]

Plant labor and overhead are at capacity at Southern. Southern's management argues that the opportunity cost to the firm of making the 3,000 phones at Southern is $85,000, the next best alternative contract. Unfortunately, all these numbers contain allocated costs. The question to ask is: What are the incremental cash flows to the firm of shifting production to Westbury and adding the new contract? Based on the analysis below, the firm is better off shifting production to Westbury.

The central point in this analysis is that because Westbury is committed to maintaining its current labor force, the $95 of direct labor per phone and the $45 of variable overhead per phone are sunk costs. The only incremental labor costs are the $120,000 to hire back the 20 production workers and the additional variable overhead that will be incurred because of these additional workers. Fixed factory overhead and burden are sunk costs with respect to moving this missile contract to Westbury.

However, Southern's reported profits will fall. A one-time credit to Southern can offset this decline. This can be done by reducing Southern's general burden charges of corporate headquarter expense to solve this incentive problem.

**Incremental Cash Flows from Accepting the New Contract for Southern and Shifting the Missile Base Contract to Westbury**

| | Southern | | Westbury | |
|---|---|---|---|---|
| Revenues from new contract | $1,100,000 | | | |
| Direct materials | (435,000) | | (45,000) | 1 |
| Direct labor | (50,000) | 2 | (120,000) | |
| Variable overhead | (25,000) | 3 | (56,800) | 4 |
| Incremental Cash flows | | | $368,200 | |

[1] Additional direct materials in Westbury = ($55 – 40) × 3,000

[2] Additional direct labor in Southern = $260,000 – 3,000 × $70

[3] Additional variable overhead in Southern = ($130,000 – $35 × 3,000)

[4] Additional variable overhead in Westbury = (45/95 × $120,000)

Note: General Burden may or may not be included depending on whether this additional project is expected to impose costs on the corporate headquarter.

**Case 7-2:** **Solution to Durango Plastics** (50 minutes)
[Distortions in divisional performance evaluation from noninsulating allocations]

This problem illustrates the problems of allocating common costs and then evaluating divisional performance. The reason why Durango is able to start the Auto Division is because there is excess capacity at Durango.

a. Evaluating the three alternatives in terms of net cash flows:

(i) Close Durango:

| | |
|---|---|
| Annual operating loss | $7 |
| plus: depreciation | 5 |
| Net annual cash outflow saved | $2 |

(ii) Produce only film plastic at Durango:

| | |
|---|---|
| Net annual cash outflow | ($2) |

(iii) Produce both film and auto plastic at Durango:

**Net Cash Flow Analysis**
(millions)

| | | | |
|---|---|---|---|
| Revenue (auto plastic) | | | $28 |
| less: | Variable costs (auto plastic) | $11 | |
| | Leased equipment (auto plastic) | 3 | |
| | Additional fixed costs (auto plastic) | 4 | 18 |
| Incremental cash flow before tax income (auto plastic) | | | $10 |
| Annual cash outflow from film plastic only | | | ( 2) |
| Net cash flow of plastic and film | | | $ 8 |

Given the three alternatives, closing Durango results in an improvement of $2 million over just producing the film plastic. But producing both film and auto plastic results in a positive cash flow of $8 million. Therefore, producing both film and auto plastics is the best alternative.

b. Performance report for Film and Auto Divisions:

| **Durango Plant<br>2009 Performance Report of<br>Film and Auto Divisions**<br>(millions) | | |
|---|---|---|
| | **Film** | **Auto** |
| Revenue | $36.000 | $28.000 |
| Variable costs | 21.000 | 11.000 |
| Fixed costs attributable to Auto Division | | 7.000 |
| Allocated common costs: | | |
| $22 × ($36/$64) | 12.375 | |
| $22 × ($28/$64) | | 9.625 |
| Net income | $2.625 | $0.375 |

c. Something seems odd. Film was loosing $7 million before adding Auto. Now Film appears seven times more profitable than Auto ($2.625 ÷ $0.375). The performance report in part (b) appears to be distorting our understanding of the facts of the situation.

d. Performance report for the year 2010:

| **Durango Plant<br>2010 Performance Report of<br>Film and Auto Divisions**<br>(millions) | | |
|---|---|---|
| | **Film** | **Auto** |
| Revenue | $39.000 | $28.000 |
| Variable costs | 23.100 | 11.000 |
| Fixed costs attributable to Auto Division | | 7.000 |
| Allocated common costs: | | |
| $21 × ($39/$67) | 12.224 | |
| $21 × ($28/$67) | | 8.776 |
| Net income | $3.676 | $1.224 |

e. Auto profits increased $0.849 ($1.224 - $0.375). This is due entirely to factors outside of Auto's control. Common costs fell by the amount of the property tax reduction and because they are using a non-insulating allocation scheme, Film's higher revenues causes Film to absorb more common costs and Auto to absorb less common costs.

Durango's profits increase $1.9 million ($4.9 -$3.0). This is due to the $1.0 million lower taxes plus $0.9 of higher profits.

# CHAPTER 8
## COST ALLOCATION: PRACTICES

**P 8-1:** **Solution to Step-Down** (15 minutes)
[Step down vs. direct allocations]

This statement is not correct for a number of reasons:

1. One allocation method can only be assessed as "better" than another one after specifying how the resulting accounting numbers are being used (taxes, decision making, control, etc). Since the quote does not specify how the cost allocations are being used, there is no logical way to assess which method is better.

2. Presumably, one criteria implied by the quote is in terms of accuracy. That is, does the step-down method more accurately reflect the opportunity costs of resources consumed by the service department? Under this criterion, it is still not obvious that the step-down allocation method is more accurate than the direct allocation method. Both allocation methods are approximations and each contains errors.

   Look at the formula for the overhead rate in the step down method:

   > Service department's allocation rate = (own cost + allocated costs from higher service departments) **/** (quantity of services provided to users below the service department)

   The numerator becomes more accurate in terms of resources used by the service department the further down in the sequence of service departments. But the denominator becomes less accurate because fewer actual users are included in the denominator. Look at the first department in the sequence. Its numerator includes no service department costs allocated to it, and hence understates the resources consumed by the first department in the sequence. But its denominator includes all of the users of its services.

   The direct allocation method also contains errors. The numerator excludes costs of resources consumed from other service departments and the denominator excludes other service department users.

3. Both methods include fixed service department costs, and hence the allocated costs per unit of service provided do not reflect marginal (variable) costs of the service provided.

**P 8-2:** **Solution to Outback Opals** (20 minutes)
[Joint cost allocations and NRV does not necessarily minimize taxes]

a. Allocated joint cost per stone using the number of stones:

| | **Grade I** | **Grade II** | **Grade III** | **Total** |
|---|---|---|---|---|
| Number of stones per batch | 70 | 105 | 175 | 350 |
| Percent of stones | 20.00% | 30.00% | 50.00% | 100.00% |
| Allocated cost to each grade | A$7,000 | A$10,500 | A$17,500 | A$35,000 |
| Allocated joint cost per stone | A$100 | A$100 | A$100 | |

Alternatively, A$35,000 / 350 stones = A$100.00 per stone.

b. Allocated joint cost per stone (before taxes) using net realizable value:

| | **Grade I** | **Grade II** | **Grade III** | **Total** |
|---|---|---|---|---|
| Selling price per stone | A$800 | A$300 | A$110 | |
| Additional cost to package and sell each stone | (250) | (120) | (5) | |
| Net realizable value per stone | A$550 | A$180 | A$105 | |
| X Number of stones per batch | 70 | 105 | 175 | |
| Net realizable value per batch | A$38,500 | A$18,900 | A$18,375 | A$75,775 |
| Percent of net realizable value per batch | 50.81% | 24.94% | 24.25% | 100% |
| Allocated cost to each grade | A$17,784 | A$8,729 | A$8,488 | A$35,000 |
| Allocated joint cost per stone | A$254.05 | A$83.13 | A$48.50 | |

c. Which of the two methods to choose depends on how the numbers will ultimately be used. If they are used for decision making, one might be tempted to argue that NRV is better because it does not distort the relative profitability of the joint products. However, this answer is short sighted because it does not consider the possible tax affects of the alternative joint cost allocations. Presumably, whichever method Outback uses for internal purposes is likely to be seen by the tax authorities if Outback's tax returns are audited. That is, although Outback can use different joint cost allocation methods for taxes and internal purposes, separate systems undermine Outback's tax case if they are ever audited. The following tables calculate the income tax liability arising from each method.

| **Income taxes based on number of stones:** | **Grade I** | **Grade II** | **Grade III** | **Total** |
|---|---|---|---|---|
| Revenue | A$56,000 | A$31,500 | A$19,250 | A$106,750 |
| Allocated joint cost (based on number of stones) | (7,000) | (10,500) | (17,500) | (35,000) |
| Additional packaging and selling cost | (17,500) | (12,600) | (875) | (30,975) |
| Net income before taxes | 31,500 | 8,400 | 875 | 40,775 |
| Income taxes | A$ 9,450 | A$ 1,260 | A$394 | A$ 11,104 |

**Income taxes based on NRV:**

| | | | | |
|---|---|---|---|---|
| Revenue | A$56,000 | A$31,500 | A$19,250 | A$106,750 |
| Allocated joint cost (based on nrv) | (17,784) | (8,729) | (8,488) | (35,000) |
| Additional packaging and selling cost | (17,500) | (12,600) | (875) | (30,975) |
| Net income before taxes | 20,717 | 10,171 | 9,888 | 40,775 |
| Income taxes | A$ 6,215 | A$ 1,526 | A$ 4,449 | A$ 12,190 |

Notice, that the pre-tax cash flows are identical under the two joint cost allocation methods. Net income before taxes (and cash flows) is A$40,775. How the joint costs are allocated affects the amount of profit and hence taxes paid in each of the three countries, because the three tax jurisdictions have very different tax rates. The NRV method actually results in higher taxes than using the number of stones. Therefore, to minimize taxes, the number of stones should be used, assuming that it is an allowed method by all three tax jurisdictions.

**P 8-3:** **Solution to Rose Hospital** (25 minutes)
[Step-down allocations]

a. & b. The first of the following two tables computes the allocation rates, and the second table applies these rates to allocate the service department costs.

### ALLOCATION RATES

| | Building Services | Food Service | Intensive Care | Surgery | General Medicine | Total |
|---|---|---|---|---|---|---|
| **Direct Allocations:** | | | | | | |
| Building | | | 10,000 | 20,000 | 40,000 | 70,000 |
| Services | | | 14% | 29% | 57% | 100% |
| Food | | | 3,000 | 4,000 | 98,000 | 105,000 |
| Service | | | 3% | 4% | 93% | 100% |
| **Step-down — Building Services First:** | | | | | | |
| Building | | 15,500 | 10,000 | 20,000 | 40,000 | 85,500 |
| Services | | 18% | 12% | 23% | 47% | 100% |
| Food | | | 3,000 | 4,000 | 98,000 | 105,000 |
| Service | | | 3% | 4% | 93% | 100% |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Step-down — Food Service First:** | | | | | | |
| Building | | | 10,000 | 20,000 | 40,000 | 70,000 |
| Services | | | 14% | 29% | 57% | 100% |
| Food | 12,000 | | 3,000 | 4,000 | 98,000 | 117,000 |
| Service | 10% | | 3% | 3% | 84% | 100% |

## ALLOCATED COSTS

| | Building Services | Food Service | Intensive Care | Surgery | General Medicine | Total |
|---|---|---|---|---|---|---|
| **Direct Allocations:** | | | | | | |
| Building | | | 14% | 29% | 57% | |
| Services | | | $.84 | $1.74 | $3.42 | $6.00 |
| Food | | | 3% | 4% | 93% | |
| Service | | | $0.09 | $0.12 | $2.79 | $3.00 |
| | | | $0.93 | $1.86 | $6.21 | $9.00 |
| **Step-down — Building Services First:** | | | | | | |
| Building | | 18% | 12% | 23% | 47% | |
| Services | | $1.08 | $0.72 | $1.38 | $2.82 | $6.00 |
| Food | | | 3% | 4% | 93% | |
| Service | | | $0.12 | $0.16 | $3.79 | $4.08 |
| | | | $0.84 | $1.54 | $6.61 | $10.08* |
| **Step-down — Food Service First:** | | | | | | |
| Food | 10% | | 3% | 3% | 84% | |
| Service | $0.30 | | $0.09 | $0.09 | $2.25 | $3.00 |
| Building | | | 14% | 29% | 57% | |
| Services | | | $0.88 | $1.83 | $3.59 | $6.30 |
| | | | $0.97 | $1.92 | $6.11 | $9.30* |

* Note: The totals allocated ($10.08 and $9.30) contain amounts allocated first to the service departments and then re-allocated to the end users. The total allocated costs to the end users in all cases sum to $9.0 million.

c. The step-down method with Food Service first allocates about $0.50 million less to General Medicine and about $0.4 million more to Surgery than using Building Services first. These differences are caused by General Medicine's almost entire consumption of meals (ranging between 84 percent to 93 percent). By starting with Building Services, another $1.08 million of building costs are assigned to Food Service, most of which are passed through to General Medicine. Starting with Food Service reduces the total amount of Food Service costs allocated, thus lowering General Medicine's total bill.

**P 8-4:** **Solution to Mystic Herbals** (30 minutes)
[Joint cost allocations are not useful for decision making]

a. Allocated joint cost is $60 per ounce ($30,000 ÷ 500 ounces):

| | **QV3** | **VX7** | **HM4** | **LZ9** | **Total** |
|---|---|---|---|---|---|
| % of batch by ounce | 20% | 16% | 25% | 39% | 100% |
| Allocated joint cost | $6,000 | $4,800 | $7,500 | $11,700 | $30,000 |

b. Decisions to process further:

| | **QV3** | **VX7** | **HM4** | **LZ9** |
|---|---|---|---|---|
| Incremental revenue per ounce from further processing | $23 | $8 | $25 | $14 |
| Number of ounces per batch | 100 | 80 | 125 | 195 |
| Incremental revenue from further processing | $2,300 | $640 | $3,125 | $2,730 |
| Cost of further processing | $2,400 | $400 | $2,500 | $2,800 |
| Decision to process further | NO | YES | YES | NO |

c. Batches of Xubonic root should be produced because each batch yields profits of $3,200.

| | **QV3** | **VX7** | **HM4** | **LZ9** | **Total** |
|---|---|---|---|---|---|
| Revenue from further processing or immediate sale | $6,200 | $4,560 | $15,875 | $9,165 | |
| Cost of further processing | 0 | 400 | $2,500 | 0 | |
| Net realizable value | $6,200 | $4,160 | $13,375 | $9,165 | $32,900 |
| Joint cost of processing a batch | | | | | $30,000 |
| Profit per batch | | | | | $ 2,900 |

d. Profit after allocating joint cost using net realizable value:

| | QV3 | VX7 | HM4 | LZ9 | Total |
|---|---|---|---|---|---|
| NRV | $6,200 | $4,160 | $13,375 | $9,165 | $32,900 |
| % of NRV | 18.84% | 12.64% | 40.65% | 27.86% | 100% |
| Allocated joint cost | $5,653 | $3,793 | $12,196 | $8,357 | $30,000 |
| Net income per batch | $547 | $367 | $1,179 | $808 | $2,900 |

e. Joint cost allocations do not enhance the decision to further process joint products. Net realizable value does not harm the decision process, but it does not add anything. The decisions in part (b) to process each joint product further or sell after the split off point were made without any joint cost allocations.

**P 8–5:** **Solution to Fidelity Bank** (30 minutes)
[Step-down allocations]

a. The first step is to allocate Telecom's costs to Information Management (IM):

| | |
|---|---|
| Telecom direct operating expenses | $ 3,500,000 |
| IM's share of Telecom's services | 0.15 |
| Costs allocated to IM | $ 525,000 |
| IM's Direct operating expenses | 9,800,000 |
| Total IM costs to be allocated | $10,325,000 |

Next, calculate Credit Card's share of IM services, ignoring Telecom's use of IM (20 percent). Telecom's utilization must be ignored in order that all the service department's costs can be stepped down.

Credit Card's share of IM: 15% ÷ (100% - 20%) = 18.75%

IM cost allocated to credit cards: $10,325,000 × 18.75% = $1,935,938

b. The calculated cost per gigabyte increases if IM is moved to the end of the sequence for two reasons. First, IM receives allocated costs from all four of the other service departments rather than just Telecom. Thus, the numerator in the overhead rate formula is higher. Second, the denominator is smaller because the only users of IM services are now the three lines of business.

c. Using the direct allocation method, IM is not allocated any other service department costs and does not allocate any of its costs to the other service departments. Thus, all of its $9.8 million are allocated directly to the three lines of business. Using only the lines of business utilization rates, the percentage of Credit Card division's use of IM is 0.15 ÷ (0.20 + 0.20 + 0.15) = 27.27%. This leads to an allocated IM cost to Credit Cards of $2,672,460 (27.27% × $9.8 million).

**P 8–6:** **Solution to Joint Products, Inc.** (30 minutes)
[Joint cost allocation and further processing]

Use net realizable value to allocate joint costs. While all allocation methods are arbitrary, NRV does not distort the relative product profitabilities.

a. Inventory values calculated using net realizable value:

| | Products X | Products V | Total |
|---|---|---|---|
| Sales value per batch | $ 8,000 | $ 4,000 | $12,000 |
| less: Additional processing costs | 1,800 | 3,400 | 5,200 |
| Net realizable value | $ 6,200 | $ 600 | $ 6,800 |
| % of net realizable value | 91.2% | 8.8% | 100% |
| Allocated joint cost | $ 7,296 | $ 704 | $ 8,000 |
| Processing + allocated joint cost | $ 9,096 | $ 4,104 | |
| Number of pounds/batch | 200 | 400 | |
| Cost per pound | $45.48 | $ 10.26 | |
| Units in ending inventory | 2,000 | 1,000 | |
| Ending Inventory value | $90,960 | $10,260 | $101,220 |

These ending inventory valuations are above market value, indicating that the overall operation is unprofitable. Because of the financial accounting rule that says that inventory must be valued at the lower of cost or market, the inventory values are $40 and $10 respectively, and the ending inventory values are:

| | | | |
|---|---|---|---|
| Ending Inventory | $80,000 | $10,000 | $90,000 |

Inventory values calculated using pounds:

| | Products X | Products V | Total |
|---|---|---|---|
| Pounds per batch | 200 | 400 | 600 |
| % of batch | 33.33% | 66.66% | 100% |
| Allocated joint cost | $ 2,667 | $ 5,333 | $8,000 |
| Processing cost | 1,800 | 3,400 | |
| Total cost | $ 4,467 | $ 8,733 | |
| Number of pounds/batch | 200 | 400 | |
| Cost per pound | $ 22.33 | $ 21.83 | |
| Units in ending inventory | 2,000 | 1,000 | |
| Ending Inventory value | $44,670 | $21,830 | $66,500 |

b. Currently, the firm is losing money processing the joint products. Each batch has joint costs of $8,000 plus additional processing costs of $5,200 or total costs of $13,200. Each batch generates revenues of $12,000, thus producing a loss of $1,200.

The table below indicates X should be sold before additional processing whereas V should be processed further.

| | Products | |
|---|---|---|
| **Further Processing** | **X** | **V** |
| Revenues | $8,000 | $4,000 |
| Additional costs | 1,800 | 3,400 |
| Net realizable value | $6,200 | $ 600 |
| Sale of intermediate product | $7,000 | $ 400 |
| Optimal decision | Sell | Process Further |

If X is sold and V is processed, the net receipts are $7,000(X) + $600(V) – $8,000 = $-400. The best the firm can do is lose $400 on each batch processed.

The question is whether the firm can make money by purchasing the intermediate products, X and V, in the market and processing them further.

| | X | V |
|---|---|---|
| Net realizable value from additional processing/lb. | $31 | $1.50 |
| Price of intermediate products | $35 | $1.00 |

If these prices are expected to persist, the firm should stop buying the common input and separating it into X and V. Rather, it should buy the intermediate product V for $1 and process it into a final product. V can be purchased for $1, processed into a final product for $8.50, and sold for a $.50 profit. If they decide to continue to process the joint products, then to minimize their losses, X should be sold at $35 without further processing, but V should be processed further.

**P 8–7:** **Solution to Talor Chemical Company** (CMA adapted) (30 minutes) [Evaluating an analysis involving joint costs]

a. The net relative sales value method does not provide the correct analysis for the marketing decision. Joint cost allocation is necessarily arbitrary and, although useful for financial accounting purposes, is not relevant to the decision to market DMZ-3 and Pestrol. The joint or common costs are irrelevant to this decision because they are incurred in both cases, i.e., the method of cost allocation has no impact on the differential profit. Talor Company should calculate the incremental profit of its alternate choices by comparing the incremental revenues and incremental costs.

b. Talor Company's analysis is incorrect because it incorporates allocated portions of the common costs of VDB. The weekly cost of VDB ($246,000) will be incurred whether or not RNA-2 is converted through further processing. Thus, any allocation of the common cost of VDB is strictly arbitrary and not relevant to the decision to market DMZ-3 and Pestrol.

Talor Company's decision not to process RNA-2 further is incorrect. The decision resulted in a loss of $20,000 in gross profit per week as indicated by the following analysis.

| | |
|---|---|
| Revenue from further processing of RNA-2: | |
| DMZ-3 (400,000 × $57.50/100) | $230,000 |
| Pestrol (400,000 × $57.50/100) | 230,000 |
| Total revenue from further processing | $460,000 |
| Less revenue from sale of RNA-2 (400,000 × $80/100) | 320,000 |
| Incremental revenue | $140,000 |
| Less incremental cost* | 120,000 |
| Incremental profit | $ 20,000 |

* The cost of VDB is not relevant and, thus, is omitted from the solution.

**P 8–8:** **Solution to Donovan Steel** (30 minutes)
[Step-down allocations]

a. Using the step-down allocation method starting with the Water service department results in a cost per kilowatt hour of $0.019, calculated as follows:

| | Service Departments | | Profit Centers | | |
|---|---|---|---|---|---|
| Service Departments | Electricity | Water | Ingots | Stainless Steel | Total |
| Water consumed | 1,000 gal | --- | 1,000 gal | 2,000 gal | 4,000 gal |
| % of cost | 25% | --- | 25% | 50% | 100% |
| Allocated cost of Water Department | $15 million | --- | $15 million | $30 million | $60 million |
| Electricity operating cost | $80 million | --- | --- | --- | --- |
| Total cost to be allocated | $95 million | --- | --- | --- | $95 million |
| Electricity consumed (millions) | --- | --- | 3,000 kwh | 2,000 kwh | 5,000 kwh |
| **Cost per kwh** | **---** | **---** | **---** | **---** | **$.019/kwh** |
| Electricity costs allocated to profit centers | --- | --- | $57 million | $38 million | $95 million |
| Electricity + Water costs allocated to profit centers | --- | --- | $72 million | $68 million | $140 million |

b. There are several problems with using the step-down method:

(i) Arbitrariness. If, instead of starting with the Water department, Electricity was the first department allocated, the cost per kilowatt is lower for two reasons. First, no water costs are included in the electricity charge and second, more kilowatt hours are used in the allocation base because Water's use of kilowatts is included. Specifically, the cost per kilowatt hour is roughly half of that when Electricity includes Water charges ($.0107 versus $.019) and is computed as:

| | Service Departments | | Profit Centers | | |
|---|---|---|---|---|---|
| Service Departments | Electricity | Water | Ingots | Stainless Steel | Total |
| Electricity consumed (millions) | --- | 2,500 kwh | 3,000 kwh | 2,000 kwh | 7,500 kwh |
| % of cost | --- | 33% | 40.0% | 27% | 100% |
| Electricity operating cost | $80 million | --- | --- | --- | $80 million |
| **Cost per kwh** | --- | --- | --- | --- | **$.0107/kwh** |
| Allocated cost of Electricity Department | --- | $26.4 million | $32.0 million | $21.6 million | $80 million |
| Water operating cost | --- | $60 million | --- | --- | $60 million |
| Total cost to be allocated | --- | $86.66 million | --- | --- | --- |
| Water consumed | --- | --- | 1,000 gal | 2,000 gal | 3,000 gal |
| % of cost | --- | --- | 33% | 67% | 100% |
| Water costs allocated to profit centers | --- | --- | $28.5 million | $57.9 million | $86.4 million |
| Electricity + Water costs allocated to profit centers | --- | --- | $60.5 million | $79.5 million | $140 million |

Notice that under both cases, the entire $140 million of service department costs are allocated to the two profit centers. Because the cost per kilowatt hour varies so much depending on which method is used, it leads to the belief that the accounting system is arbitrary.

(ii) Conflicts of interest. Starting with the Water department's costs, Ingots receives $72 million of cost. Starting with the Electricity department's costs, Ingots can lower their allocation to $60.5 million of service costs. Thus, Ingots has the incentive to argue for starting with Water costs and Stainless Steel has the incentive to argue for starting with Electricity costs. This creates a conflict between the two profit centers that will only be resolved by (costly) senior management intervention.

(iii) Incentive effects. Clearly, the managers' consumption of electricity will differ if the transfer price is $.019 per kwh versus $.0107 per kwh. If the opportunity cost to the firm of supplying another kwh differs from the allocated cost, then the managers of the profit centers will use either too much or too little electricity. Neither of these cost allocations is a market-based transfer price. If the market price is below these cost-based transfer prices, the profit center managers have incentives to go outside the firm to purchase electricity. Likewise, if the market price is above the cost-based transfer price, the profit center managers have incentive to stay with the inside Electricity department when outside purchase is warranted.

**P 8-9:** **Solution to Murray Hill's Untimely Demise** (30 minutes)
[Step-down allocations]

(a) The first step is to recompute the allocation percentages for the remaining service and operating departments. For example, when allocating B's costs to C, D1, D2, and D3, you can not use the percentage of A's use of B (8 percent) because this would allocate 8 percent of B back to A and then not all of B's costs are allocated DOWN to the remaining departments. So C's use of B is 15 percent/92 percent, or about 16.30 percent. Panel B recomputes the revised utilizations and Panel C completes poor Murray's spreadsheet using these recomputed utilization percentages.

**Panel A: Utilization Data**

| Service | | Service Departments | | | Operating Departments | | | |
|---|---|---|---|---|---|---|---|---|
| Dept. Cost | | A | B | C | D1 | D2 | D3 | Total |
| $600,000 | A | 5% | 10% | 20% | 30% | 15% | 20% | 100% |
| 300,000 | B | 8% | 0% | 15% | 22% | 20% | 35% | 100% |
| 200,000 | C | 15% | 5% | 7% | 20% | 30% | 23% | 100% |
| 1,100,000 | | | | | | | | |

**Panel B: Revised Utilizations**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A | 0 | 0.105263 | 0.210526 | 0.315789 | 0.157895 | 0.210526 | 1.0000 |
| B | 0 | 0 | 0.163043 | 0.23913 | 0.217391 | 0.380435 | 1.0000 |
| C | 0 | 0 | 0 | 0.273973 | 0.410959 | 0.315068 | 1.0000 |

**Panel C: Completed Step-Down Allocations**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $600,000 | A | $0 | $63,158 | $126,316 | $189,474 | $94,737 | $126,316 | $600,001 |
| $363,158 | B | $0 | $0 | $59,211 | $86,842 | $78,947 | $138,158 | $363,158 |
| $385,527 | C | $0 | $0 | $0 | $105,624 | $158,436 | $121,467 | $385,527 |
| | | | | | $381,940 | $332,120 | $385,941 | $1,100,001 |

b. The following table lists the dollar utilization of each service department (percentage utilized times the department costs)

| Service Dept. Cost | | Service Departments A | B | C |
|---|---|---|---|---|
| 600000 | A | $30,000 | $60,000 | $120,000 |
| 300000 | B | $24,000 | $0 | $45,000 |
| 200000 | C | $30,000 | $10,000 | $14,000 |

Here we see that the three largest dollar utilizations are $120,000, $60,000, and $45,000. So the preferred step-down order should capture these large dollar flows. A should be allocated first in order that the $60,000 of B's use of A and C's $120,000 use of A are captured. B should be second in order to allocate the $45,000 of C's use of B. Finally, C is allocated last. Thus, the preferred step-down order that captures the largest dollar utilizations is A, then B, and finally C.

**P 8–10:** **Solution to Enzymes** (30 minutes)
[Pricing joint products and allocating joint costs]

a. The analysis of the pricing decisions is completely wrong because it takes the joint cost of the batch (which is a fixed cost), allocates it to the products, and then treats it as though the allocated costs are marginal costs.

There are separate demand curves for the final, fully processed enzymes:

$$P_Q = 1{,}300 - 2Q$$

$$P_Y = 950 - 4Y$$

The $200,000 joint cost is a fixed cost of each batch. The marginal cost of Q = $100, and the marginal cost of Y = $150. These should be the only costs that enter the pricing decision.

In the problem, it appears as if Q is generating profits of $80,000 and Y is generating profits of $10,000, or in total $90,000. But this $90,000 profit ignores the fixed costs that are included in the 250 ounces that are not sold. Only half the output is sold. The other 250 ounces have been allocated $100,000 of joint costs (250 ounces × [$200,000 ÷ 500]) that have been incurred, but not included in the profits of $90,000. So, in reality, the firm is losing $10,000 ($90,000 - $100,000) per batch. Another way to see this is: each ounce of Q has a contribution margin of $800, and each ounce of Y has a contribution margin of $600. Selling 200 ounces of Q and 50 ounces of Y yields total contribution margin of $190,000 ($800 × 200 + $600 × 50). Deducting the $200,000 of joint costs again yields a loss of $10,000 per batch.

b. The joint cost of producing a batch is a fixed cost, once a batch is produced. As long as the maximum profits from the optimum pricing decisions for Q and Y exceed the joint cost of $225,000, they should continue to produce batches. The table below shows that the maximum profit is $220,000. When the cost per batch was $200,000, maximum profit after batch costs was $20,000. However, once batch costs rise to $225,000, the firm should stop producing.

| QTY | Price of Q | Price of Y | Revenue of Q | Incremental cost of Q | Total profit of Q | Revenue of Y | Incremental cost of Y | Total profit of Y |
|---|---|---|---|---|---|---|---|---|
| 50 | $1200 | $750 | $60000 | $5000 | $55000 | $37500 | $7500 | $30000 |
| 100 | 1100 | $\boxed{550}$ | 110000 | 10000 | 100000 | 55000 | 15000 | $\boxed{40000}$ |
| 150 | 1000 | 350 | 150000 | 15000 | 135000 | 52500 | 22500 | 30000 |
| 200 | 900 | 150 | 180000 | 20000 | 160000 | 30000 | 30000 | 0 |
| 250 | 800 | na | 200000 | 25000 | 175000 | | | |
| 300 | $\boxed{700}$ | na | 210000 | 30000 | $\boxed{180000}$ | | | |

**P 8–11:** **Solution to Sunder Toys** (30 minutes)
[Ignoring fixed costs when excess capacity exists leads to overinvestment]

a. The following table shows that Sunder should produce 1,000 chewies daily:

| Price | Quantity | Variable Cost/unit | Contribution Margin/unit | Contribution Margin | Lease Cost | Profit |
|---|---|---|---|---|---|---|
| $16.11 | 900 | $3 | $13.11 | $11,800 | $10,000 | $1,800 |
| 15.00 | 1,000 | 3 | 12.00 | 12,000 | 10,000 | 2,000 |
| 14.18 | 1,100 | 3 | 11.18 | 12,300 | 10,800 | 1,500 |
| 12.83 | 1,200 | 3 | 9.83 | 11,800 | 10,800 | 1,000 |
| 12.23 | 1,300 | 3 | 9.23 | 12,000 | 11,200 | 800 |
| 11.50 | 1,400 | 3 | 8.50 | 11,900 | 11,200 | 700 |

b. The table below shows that with private information the manager produces 1,100 chewies daily and will buy a machine with 1,200 units of capacity so as not to be charged any fixed cost. There is no reason to lease the machine with 1,400 units of capacity since the 1,200 unit machine gives excess capacity (and hence no fixed costs are charged). In fact, leasing the 1,400 unit machine may cause senior managers to review this lease if they begin to see 300 units of unused capacity, whereas they are more likely to ignore 100 units of excess capacity on the 1,200 unit machine.

| Price | Leased Capacity | Quantity | Variable Cost/unit | Contribution Margin | Profit |
|---|---|---|---|---|---|
| 16.11 | 1,000 | 900 | 3 | 13.11 | 11,799 |
| 15.00 | 1,200 | 1,000 | 3 | 12.00 | 12,000 |
| 14.18 | 1,200 | 1,100 | 3 | 11.18 | 12,298 |
| 12.83 | 1,400 | 1,200 | 3 | 9.83 | 11,796 |
| 12.23 | 1,400 | 1,300 | 3 | 9.23 | 11,999 |
| 11.50 | 1,400 | 1,400 | 3 | 8.50 | 700 |

c. The policy of not charging managers fixed cost when excess capacity exists causes the firm to overinvest in capacity.

**P 8-12: Solution to WWWeb Marketing** (35 minutes)
[Tradeoff between over investment and underutilization]

a. WWWeb Marketing's current policy of not charging the profit centers the IT costs as long as IT has excess capacity creates the incentive for the three divisions to always lobby for more capacity to ensure that the divisions are not charged IT costs. This leads to an over investment problem in IT capacity. This over investment in IT capacity is contributing to WWWeb's current low profitability. The advantage of the current policy is that it causes the divisions to efficiently utilize the existing excess capacity – WWWeb is avoiding the under utilization problem. That is, whenever IT has unused capacity (and the opportunity cost of this capacity is zero because the users are not interfering with each other), by charging the divisions zero for their use of this excess capacity encourages the divisions to more fully utilize these resources. However, since the divisions view IT resources as free, they are probably not considering IT costs when pricing the services the divisions charge WWWeb clients. Each division is maximizing their division profits, which excludes IT costs.

By not charging IT costs to the three profit centers, the profit center managers have no incentive to monitor IT's spending. That is, there is no mutual monitoring of IT by the profit centers.

With respect to the decision as to whether WWWeb should double its IT capacity at an additional cost of 20 percent, this decision should be deferred until after they evaluate the current treatment of IT charges to the divisions.

b. To reduce WWWeb's over investment problem, the divisions should be charged for IT services. The cost recovery system or cost allocation should be based on the long-run cost IT incurs for hardware, software, and access line fees. For example, if the IT system tracks megabytes uploaded or downloaded, then IT can develop a cost per megabyte transferred by dividing the budgeted cost of the IT department ($548,000) by the budgeted number of megabytes transferred. In this way, each division is charged the average cost of the IT resources consumed by the division. Such a non-insulating allocation or recharge system encourages cooperation among the profit centers. If one expands, the overhead rate falls and the other divisions' IT costs call.

After they implement this cost allocation scheme, WWWeb can then determine whether to double its existing capacity. The “cost” of this change in the policy of charging the divisions for IT resources consumed is that there will be a tendency for the divisions to under utilize any excess capacity of the IT group.

**P 8–13:** **Solution to ITI Technology** (35 minutes)
[Joint costs of computer chips]

a. The major problem with ITI's accounting method is that they are allocating both joint and separable costs based on the number of chips manufactured and not using net realizable value (NRV). This leads to erroneous conclusions about the relative profitability of the two products.

HD and LD chips, up until they are tested and sorted, are joint products. The joint costs are $8,000 and the costs beyond the split-off point are $21,100. The profitability of LD and HD chips are being overstated by the treatment of the scrap costs. By separating scrap costs out as a separate “product,” the costs of the HD and LD costs are lowered.

By allocating the joint costs using NRV, product profitability is not distorted. The following table illustrates the calculation:

ITI Technology
Relative Profitability of HD and LD Chips
(Net Realizable Value Method)

| | Total | HD Chips | LD Chips |
|---|---|---|---|
| Revenue | $36,400 | $30,000 | $6,400 |
| Cost beyond split-off | $21,100 | $14,500 | $6,600 |
| NRV | $15,300 | $15,500 | ($200) |
| Percent NRV | 100% | 101.31% | -1.31% |
| Joint Cost Allocation | $8,000 | $8,105 | ($105) |
| Profit per batch | $7,300 | $7,395 | ($95) |

Revenues from the LD chips are not covering the costs incurred beyond the split-off point to produce the chips.

b. LD chips are not profitable beyond the split-off point and further processing should be discontinued unless the final selling price can be increased or the costs of processing and marketing beyond split-off can be decreased.

However, there might be demand-side interdependencies that might prevent ITI from discontinuing LD chips. Suppose that customers of HD chips also want to buy LD chips, presumably from the same supplier of HD chips so they only have to deal with one vendor. If this is the case, then ceasing to produce LD chips adversely affects the demand for HD chips.

**P 8–14:** **Solution to Metro Blood Bank** (35 minutes)
[Advantages and disadvantages of net realizable value]

a. i Profits after allocation by pints:

| | |
|---|---|
| Joint cost to be allocated | $300 |
| ÷ Number of pints of plasma and platelets | 3 |
| Cost of whole blood per pint | $100 |

**Profits Per Pint**

| | **Platelets** | **Plasma** |
|---|---|---|
| Selling Price | $165 | $115 |
| Cost of whole blood | (100) | (100) |
| Variable cost of additional processing | (15) | (45) |
| Profit (loss) | $ 50 | ($30) |

a. ii Profits after allocating the cost of whole blood by Net Realizable Value:

| | **2 Pints of Platelets** | **1 Pint of Plasma** | **Total** |
|---|---|---|---|
| Selling Price | $330 | $115 | $445 |
| Further Processing Costs | (30) | (45) | (75) |
| Net realizable value | $300 | $70 | $370 |
| % of Total | 81.08% | 18.92% | 100% |
| Allocated cost of whole blood | $243 | $57 | $300 |
| Allocated cost per pint | $122 | $57 | |

**Profits Per Pint**

| | **Platelets** | **Plasma** |
|---|---|---|
| Selling price | $165 | $115 |
| Cost of whole blood | (122) | (57) |
| Variable cost of processing | (15) | (45) |
| Profits | $ 28 | $ 13 |

b. Advantages of NRV (disadvantages of allocating by pints):

- Product line profits are not distorted. Both products are yielding positive contribution margins.
- The contribution to overall profits of each product is more clearly delineated. There are fewer tendencies to shut down either product line because it appears to be losing money.

Advantages of allocating by pints (disadvantages of NRV):

- It is simple. You do not have to collect data on the selling prices (or revenues) of the products, nor further processing costs.
- Allocating by pints is an insulating allocation scheme. The profit of each product line does not vary with the selling prices or further processing costs in the other product line.[1]
- Performance evaluation of each product manager is not distorted by the performance of the other manager.

In summary, NRV tends to be better for decision management. Allocation by pints might be better for decision control if cooperation and risk sharing among profit centers are not important.

**P 8-15: Solution to Vigdor Wood Products (35 minutes)**
[Decision making regarding joint products do not depend on joint cost allocations]

a. The following table demonstrates that all joint products should be processed further, except B691 and B722.

| Outputs | Tons per batch | Intermed. Sales Price | Finished Sales Price | Costs beyond split off | Net cash flow of further process'g | Further Process? | Max. net cash flow/ unit | Total net cash flow |
|---|---|---|---|---|---|---|---|---|
| A342 | 1 | $75 | $88 | $12 | $76 | yes | $76 | $76 |
| A453 | 2 | 68 | 82 | 12 | 70 | yes | 70 | 140 |
| B691 | 4 | 62 | 73 | 12 | 61 | no | 62 | 248 |
| B722 | 3 | 60 | 71 | 12 | 59 | no | 60 | 180 |
| C132 | 6 | 40 | 57 | 12 | 45 | yes | 45 | 270 |
| Total | | | | | | | | $914 |

b. Each batch yields net cash flows after the split-off point of $914. Therefore, Vigdor should process trees if the joint processing cost is $800. Each batch yields net cash flows of $114.

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[1] So product A's profits don't improve when B's price increases.

c. Vigdor should continue to process trees as long as the joint processing cost is below $914 and the selling prices of the intermediate and finished wood products and the costs beyond the split-off point do not change.

d. The following table calculates the profit per ton of each wood product after allocating the joint cost

i. based on tons produced:

| Outputs | Tons per batch | Percent of total tons | Allocated Cost per ton | Profit/ton before allocation | Profit/ton after allocation |
|---|---|---|---|---|---|
| A342 | 1 | 0.0625 | $50.00 | $76 | $26.00 |
| A453 | 2 | 0.1250 | 50.00 | 70 | 20.00 |
| B691 | 4 | 0.2500 | 50.00 | 62 | 12.00 |
| B722 | 3 | 0.1875 | 50.00 | 60 | 10.00 |
| C132 | 6 | 0.3750 | 50.00 | 45 | -5.00 |
| Total per batch | 16 | 1.0000 | | | |

ii. The following table calculates the profits per ton of each wood product after allocating the joint cost based on net realizable value from each wood product:

| Outputs | NRV Per Batch | % of total tons | Allocated Cost per ton | Profit/ton After allocation |
|---|---|---|---|---|
| A342 | $76 | 0.0832 | $66.52 | $9.48 |
| A453 | 140 | 0.1532 | 61.27 | 8.73 |
| B691 | 248 | 0.2713 | 54.27 | 7.73 |
| B722 | 180 | 0.1969 | 52.52 | 7.48 |
| C132 | 270 | 0.2954 | 39.39 | 5.61 |
| Total per batch | 914 | 1.0000 | | |

e. No.

f. The allocation of the $800 did not affect the decisions in parts (a) – (c). All these decisions do not require the allocation of joint costs.

**P 8-16:** **Solution to Advanced Micro Processors** (35 minutes)
[Allocating joint costs can distort relative profitability]

a. To prepare the income statements, notice that the fixed selling and distribution costs per unit are based on budgeted volumes. Since the fixed S&D expenses are period costs, the entire amount of these costs ($360,000 and $120,000) are written off as expenses in the current year. Also, AMP is allocating the chip fabrication joint cost of $270,000 based on the number of good chips in the batch ($15 per chip). Using this allocated cost per chip, the following income statements for the current year show that DUALxl microprocessors had income of $3,090,000 and MAXV microprocessors had a loss of $58,000.

| | **DUALxl** | **MAXV** |
|---|---|---|
| Revenue | $8,280,000 | $775,000 |
| Chip fabrication expense | 1,035,000 | 465,000 |
| Variable selling and distribution costs | 3,795,000 | 248,000 |
| Fixed selling and distribution costs | 360,000 | 120,000 |
| Net income (loss) | $3,090,000 | ($58,000) |

b. The $15 chip fabrication cost is the only product cost that is included in inventory. The variable and fixed selling and distribution costs are period expenses. The following table reports the inventory values of the two microprocessors in inventory.

| | **DUALxl** | **MAXV** |
|---|---|---|
| Units in inventory | 3,000 | 5,000 |
| Cost of units in inventory at $15 per chip | $45,000 | $75,000 |

c. The income statements in part (a) report that the DUALxl chips are making over $3 million of profit while the MAXV chips are showing a loss of $58,000. But this is misleading because of the way AMP is allocating the joint chip fabrication costs of $270,000 per batch. Each type of microprocessor is being allocated the same $15 of joint cost.

Instead of allocating the joint fabrication costs based on the number of good chips produced (either DUALxl or MAXV), had AMP allocated the $270,000 per batch using net realizable value (NRV), MAXV would show a profit of $260,319 instead of the $58,000 loss (see below). This illustrates that any allocation of joint costs other than NRV can distort relative profitability.

| | DUALxl | MAXV | TOTAL |
|---|---|---|---|
| Net realizable value: | | | |
| Selling Price | $ 120 | $ 25 | |
| Variable selling and distribution costs | 55 | 8 | |
| NRV per unit | $ 65 | $ 17 | |
| Number of units sold | 69,000 | 31,000 | |
| NRV | $4,485,000 | $527,000 | $5,012,000 |
| % of total NRV | 89.49% | 10.51% | 100% |
| Allocation of $270,000 batch cost | $241,610 | $28,390 | $270,000 |
| Chip fabrication cost per unit | $20.1342 | $4.7316 | |
| | | | |
| Revenue | $8,280,000 | $775,000 | |
| Allocated chip fabrication expense | 1,389,260 | 146,680 | |
| Variable selling and distribution costs | 3,795,000 | 248,000 | |
| Fixed selling and distribution costs | 360,000 | 120,000 | |
| Net income | $2,735,740 | $260,320 | |

Therefore, to avoid the erroneous conclusion that AMP is losing money on the MAXV chips, management should consider allocating the joint chip fabrication cost of $270,000 using net realizable value.

**P 8-17:** **Solution to Jason Rocks** (40 minutes)
[Joint costs can distort decision making]

a and b. The total cost per unwashed and washed ton of each type of stone:

| Type of Stone | % of daily production | Tons per day | Allocated Joint Cost | Allocated Joint Cost/unwashed ton | Total cost/ washed ton |
|---|---|---|---|---|---|
| #1 | 10% | 50 | $7,500 | $150 | $158 |
| #2 | 20% | 100 | 15,000 | 150 | 158 |
| #3 | 20% | 100 | 15,000 | 150 | 158 |
| #4 | 35% | 175 | 26,250 | 150 | 158 |
| #5 | 15% | 75 | 11,250 | 150 | 158 |
| Total | 100% | 500 | $75,000 | | |

c. The reported profit per ton of each type of unwashed stone:

| Type of Stone | Price/ton Unwashed | Cost/ton Unwashed & Delivered | Reported Profit |
|---|---|---|---|
| #1 | $210 | $157 | $53 |
| #2 | 185 | 157 | 28 |
| #3 | 150 | 157 | -7 |
| #4 | 145 | 157 | -12 |
| #5 | 160 | 157 | 3 |

d. The reported profit per ton of each type of washed stone:

| Type of Stone | Price/ton Unwashed | Cost/ton Washed & delivered | Reported Profit |
|---|---|---|---|
| #1 | $219 | $165 | $54 |
| #2 | 192 | 165 | 27 |
| #3 | 170 | 165 | 5 |
| #4 | 155 | 165 | -10 |
| #5 | 165 | 165 | 0 |

e. All of the stones should be sold because each stone's selling price (either washed or unwashed) is far in excess of the out-of-pocket cost needed to wash and deliver the stone. The following table provides the incremental cash flow per ton from delivering either washed or unwashed stones:

| Type of Stone | Price/ton Unwashed | Delivery Cost/ton | Net cash flow/ton Unwashed | Price/ton Washed | Delivery & washing cost/ton | Net cash flow/ton Washed |
|---|---|---|---|---|---|---|
| #1 | $210 | $7 | $203 | $219 | $15 | $204 |
| #2 | 185 | 7 | 178 | 192 | 15 | 177 |
| #3 | 150 | 7 | 143 | 170 | 15 | 155 |
| #4 | 145 | 7 | 138 | 155 | 15 | 140 |
| #5 | 160 | 7 | 153 | 165 | 15 | 150 |

After comparing the net cash flow per ton of washing or not washing each stone, the following table provides the firm-value maximizing decision for each stone:

| Type of Stone | Sell stone as: |
|---|---|
| #1 | Washed |
| #2 | Unwashed |
| #3 | Washed |
| #4 | Washed |
| #5 | Unwashed |

f. Given the facts as described in the problem, Jason Rocks should stop operating the quarry in the long run. Increasing the daily joint cost from $75,000 to $85,000 does not change any of the marginal decisions regarding which stones to wash and which ones not to wash. The decision to further process each stone is determined entirely by the selling prices and the incremental costs to process further. These are not changing. However, the increase in the joint cost to $85,000 now makes the entire operation unprofitable as detailed in the following table.

| | Tons | Price | Revenue | Washing Cost | Delivery cost | Net realizable Value |
|---|---|---|---|---|---|---|
| #1 | 50 | $219 | $10,950 | $400 | $350 | $10,200 |
| #2 | 100 | 185 | 18,500 | 0 | 700 | 17,800 |
| #3 | 100 | 170 | 17,000 | 800 | 700 | 15,500 |
| #4 | 175 | 155 | 27,125 | 1,400 | 1,225 | 24,500 |
| #5 | 75 | 160 | 12,000 | 0 | 525 | 11,475 |
| Total | | | | | | $79,475 |
| Joint cost | | | | | | 85,000 |
| Net Loss | | | | | | -$5,525 |

However, some of the joint cost includes historical cost depreciation and allocated costs. Jason Rocks might still be cash flow positive in the short-run and will still want to operate. But in the long-run, when the equipment has to be replaced, they will have to shut down, unless selling prices have changed.

## P 8–18: **Solution to Bank Service Centers** (40 minutes)
[Reciprocal cost allocations]

To begin, write down the three equations for service department costs.

(1) $E = \$8.9 + 0.15\,E + 0.10\,C + 0.08\,A$

(2) $C = \$1.8 + 0.06\,E + 0.04\,A$

(3) $A = \$6.4 + 0.32\,E + 0.25\,C + 0.12\,A$

where E = EDP's total reciprocal cost
C = Copy Center's total reciprocal cost
A = Accounting's total reciprocal cost.

These three equations in three unknowns can be solved by linear algebra or matrix algebra. Both solutions are illustrated. The linear algebra solution is provided first.

Substitute equation (2) into equations (1) and (3) to get two equations in two unknowns:

(1) $E = 8.9 + 0.15\,E + 0.10\,[1.8 + 0.06\,E + 0.04\,A] + 0.08\,A$

$0.844\,E = 9.08 + 0.084\,A$

(3') $A = 6.4 + 0.32\,E + 0.25\,[1.8 + 0.06\,E + 0.04\,A] + 0.12\,A$

$0.87\,A = 6.85 + 0.335\,E$

With two equations and two unknowns, solve equation (3') for A and substitute into (1'):

(3") $A = 7.874 + 0.385\,E$

(1') $0.844\,E = 9.08 + 0.084\,[7.874 + 0.385\,E]$

$E = \$12.002$

Substitute the value of E back into equation (3") and solve for A:

(3") $A = 7.874 + 0.385\,(12.002)$

$A = \$12.495$

Finally, substitute the values of A and E back into equation (2) and solve for C:

(2) $C = \$1.8 + 0.06\,(12.002) + 0.04\,(12.495)$

$C = \$3.020$

The values of A, C, and E can also be calculated using matrix algebra. Rewrite equations (1-3) after collecting like terms:

(1) $+0.85\,E - 0.10\,C - 0.08\,A = \$8.9$

(2) $-0.06\,E + 1.00\,C - 0.04\,A = \$1.8$

(3) $-0.32\,E - 0.25\,C + 0.88\,A = \$6.4$

This system of three equations in three unknowns can be expressed in matrix form as:

$$\begin{bmatrix} +0.85 & -0.10 & -0.08 \\ -0.06 & +1.00 & -0.04 \\ -0.32 & -0.25 & +0.88 \end{bmatrix} \begin{bmatrix} E \\ C \\ A \end{bmatrix} = \begin{bmatrix} \$8.9 \\ \$1.8 \\ \$6.4 \end{bmatrix}$$

Solving for the vector of unknowns gives:

$$\begin{bmatrix} E \\ C \\ A \end{bmatrix} = \begin{bmatrix} +0.85 & -0.10 & -0.08 \\ -0.06 & +1.00 & -0.04 \\ -0.32 & -0.25 & +0.88 \end{bmatrix}^{-1} \begin{bmatrix} \$8.9 \\ \$1.8 \\ \$6.4 \end{bmatrix}$$

The inverse matrix is:

$$\begin{bmatrix} +0.85 & -0.10 & -0.08 \\ -0.06 & +1.00 & -0.04 \\ -0.32 & -0.25 & +0.88 \end{bmatrix}^{-1} = \begin{bmatrix} 1.232 & 0.153 & 0.119 \\ 0.093 & 1.023 & 0.055 \\ 0.474 & 0.346 & 1.195 \end{bmatrix}$$

Substituting the solution of the inverse into the preceding equation and solving yields:

$$\begin{bmatrix} E \\ C \\ A \end{bmatrix} = \begin{bmatrix} \$12.002 \\ \$3.020 \\ \$12.495 \end{bmatrix}$$

The same values for E, C, and A are generated by matrix algebra as from linear algebra. The amounts for E, C, and A are then allocated to the service departments and operating divisions using the percentages given in the problem resulting in the following:

| | EDP | Copy | Accounting | Div. A | Div. B | Div. C | Total Cost | Cost to Div A,B,C |
|---|---|---|---|---|---|---|---|---|
| EDP | $1.80 | $0.72 | $3.84 | $2.28 | $1.56 | $1.80 | $12.00 | $ 5.64 |
| Copy Center | $0.30 | $0.00 | $0.76 | $0.76 | $0.66 | $0.54 | $ 3.02 | $ 1.96 |
| Accounting | $1.00 | $0.50 | $1.50 | $3.75 | $3.00 | $2.75 | $12.49* | $ 9.50 |
| | | | | | | | $27.51 | $17.10 |

* $.01 rounding difference.

Notice that the amounts allocated to the three operating divisions exactly equals the total costs in the three service departments, $17.10 million.

**P 8–19:** **Solution to Ferguson Metals** (40 minutes)
[Joint cost allocation distorting product line profitability]

From finance we know that the financing and investment decisions should not be commingled. The decision as to how to finance the new joint venture should be separated from the decision to divest the Lead Division. The decision to sell the Lead Division should be based on a comparison of its net present value to the outside offer price. Ferguson should raise the capital for the new venture in the capital markets at their cost of capital, around 12%, and continue to operate both the copper and lead divisions.

Lead shows low profits only because joint costs are being allocated based on tonnage. In fact, the lead is being transferred at 42¢ per pound [$42,000/(50 tons/batch × 2,000 pounds/ton)]. This suggests that the internal transfer price is distorting Lead Division's profits. If metal costs are allocated based on net realizable value, the Lead Division's ROI increases, as shown below.

| | Net Realizable Value (in 000's) | | |
|---|---|---|---|
| | Lead | Copper | Total |
| Net income (Table 2) | $300 | $2,700 | |
| + transferred cost* | 4,200 | 2,100 | |
| Net Realizable Value | $4,500 | $4,800 | $9,300 |
| % | 48.4% | 51.6% | |
| Allocated cost of mining** | $3,048 | $3,252 | $6,300 |
| Income based on NRV | $1,452 | $1,548 | |
| ROI | 14% | 11% | |

* Transferred cost represent the revenues received by the Mining Division from the Lead and Copper Divisions. For example, from Table 1, revenue from Mining for lead is $42,000 / batch × 100 batches = $4.2 million.

**Note: $6.3 million includes Mining's profits. The $6.3 million being allocated as a joint cost is the total revenue to the Mining Division [i.e., from Table 1, ($42,000/batch + $21,000/batch) × 100 batches]. If only Mining's costs are allocated, substitute $5.7 million for the $6.3 million. $5.7 million = 100 batches × ($22,000 + $16,000 + $11,000 + $8,000).

The preceding analysis illustrates that under a different cost allocation scheme, the Lead Division becomes more profitable than Copper. But, selling the Lead Division could still be a positive net present value project. The table below calculates the annual cash flows forgone from selling the Lead Division:

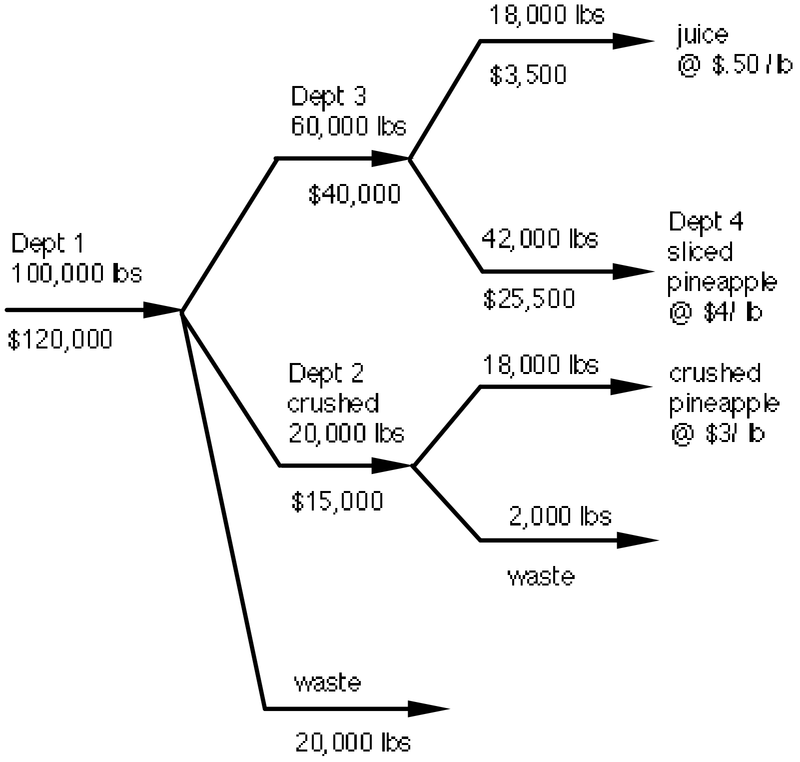
| | |
|---|---|
| Lead sales | $6,600 |
| - Other costs | 500 |
| - Fixed costs | 800 |
| - Outside metal purchases ($5,000 - 4,200) | 800 |
| Contribution forgone | 4,500 |
| less: Sale of impure lead† | 1,700 |
| Net cash flow forgone from selling Lead Division | $2,800 |

† $1.7 million = $0.17 × 50 tons/batch × 100 batches/year × 2,000 pounds/ton

Assuming 12 percent is the appropriate, risk-adjusted cost of capital to value the Lead Division's cash flows and assuming an infinite life for the Lead Division, then the value of the Lead Division to Ferguson is $23.3 million ($2.8 million ÷ 12%). If the Lead Division is only expected to last ten years, then the net present value of the cash flows drops to $2.8 million/year × 5.650 = $15.82 million. Clearly, the $5 million offer for the Lead Division is far below its net present value to Ferguson and should be rejected.

**P 8–20:** **Solution to the Doe Company** (40 minutes)
[Joint costs with several downstream joint products]

A diagram of the process is:




Allocation of joint costs between sliced and crushed pineapples:

| | | Sliced | | Crushed |
|---|---|---|---|---|
| Sales value 42,000 @ $4 (Sliced) | | $168,000 | (18,000 @ $3) | $54,000 |
| 18,000 @ $.5 (Juice) | | 9,000 | | |
| | | $177,000 | | $54,000 |
| Less: Selling cost of juice | $3,500 | | | |
| Additional costs (Dept. 3) | 40,000 | | | |
| (Dept. 4) | 25,500 | 69,000 | | |
| (Dept. 2) | | | | 15,000 |
| Net realizable value at split-off | | $108,000 | | $39,000 |

| | Estimated Net Realizable Value | Percent | Allocation of Joint Costs |
|---|---|---|---|
| | | | $120,000 |
| Sliced Pineapple | $108,000 | 73.47 | 88,164 |
| Crushed Pineapple | 39,000 | 26.53 | 31,836 |
| | $147,000 | 100.00 | $120,000 |

**P 8-21: Solution to RBB Brands** (40 minutes)
[Analyzing step-down allocations]

Charging the investment centers for their utilization of the service departments is a change in one leg of the three-legged organizational stool. The first question to raise is: "If it ain't broke, why fix it?" Taking this perspective requires a broader analysis of the question than just focusing more narrowly on which form of the step-down method be used.

Starting to charge the two investment centers for centrally supplied services has a number of consequences:

• This is a change in the divisions' performance evaluation scheme. The divisions' reported profits will be lower. Since the divisional senior managers are paid 1 percent of divisional profits, allocating the service department costs to the divisions reduces bonuses. Unless there is an offsetting change in the compensation scheme, the divisional managers are worse off. The divisions may lose their better senior managers if their total compensation falls below what they can earn elsewhere. (This is another case where a change in one leg of the three-legged stool requires other changes.)

• Prior to allocating the service departments, the two divisions treated them as free. Now they will pay for the services on a per hour basis. This will cause each division to more closely evaluate the costs and benefits of using the centrally supplied service departments. Allocating the maintenance and engineering faces the divisions with a positive "price" which causes them to reduce their consumption from what it would be under a zero "price" (no cost allocations). "Pricing" the internal service helps allocate a scarce resource. At a zero "price," demand will almost always exceed supply. In the absence of allocations, senior management will be confronted with complaints to increase the amount of service via larger budgets and must devise non-price priority schemes to manage the queue waiting for service.

• Both allocation schemes are likely to lead to a "death spiral" if the divisions can buy similar services outside the firm. Consider the hourly rates of the two service departments based on the two allocation schemes:

| | Step down Method Used | | |
|---|---|---|---|
| | Start with Maintenance | Start with Engineering | Average Cost to Firm |
| Cost per engineering hour | $36.15 | $30.68 | $25.00 |
| Cost per maintenance hour | $10.53 | $13.08 | $9.00 |

No matter which allocation scheme is used, one of the two service hourly charge rates is significantly above the average cost to the firm. It might be possible that an external supplier will undercut the firm's service department. This will cause the remaining RBB users to bear more of the service department's fixed costs, thereby further raising the hourly rate. More business will go outside causing further rate increases. In the end, RBB loses any synergies of providing the service in house.

• The controller proposes two alternative ways of allocating service department costs: starting with maintenance and starting with engineering. Household Products will bear lower allocated costs of $48.54 million versus $49.38 million if they start with engineering. Our division will bear $840,000 less allocated costs if the controller adopts the method in Table 3. Therefore, you should argue for starting with engineering. One rational for them starting with engineering is that this results in less distorted cost per engineering hour and engineering is more important to RBB than maintenance, if one is to be outsourced.

- If the internal transfer prices of the service departments are substantially above the external market price for substantially equivalent services, this probably indicates that the inside service departments are inefficient at supplying these services.

**P 8-22:** **Solution to Karsten Mills** (40 minutes)
[Adopting new technologies even though product costs are higher]

This question introduces a problem all firms face: how to handle a new plant or machine that offers better technology, but at a higher cost.

a. Overhead rates:

| | Old Plant | New Plant |
|---|---|---|
| Overhead costs excluding depreciation | $15,000,000 | $21,000,000 |
| Depreciation | $ 6,000,000 | $21,000,000 |
| Total overhead costs | $21,000,000 | $42,000,000 |
| ÷ Number of yards per year | 6,000,000 | 7,000,000 |
| Total overhead costs per yard | $3.50 | $6.00 |

b. Cost of job A6106

| | Old Plant | | New Plant |
|---|---|---|---|
| Direct materials | $ 800 | (× 85%) | $ 680 |
| Direct labor | 600 | (× 85%) | 510 |
| Overhead (100 yards) | 350 | | 600 |
| Total cost | $1,750 | | $1,790 |

c. Some of the suggested solutions:

(i) For transfer pricing purposes, merge the historical costs of the plants into one cost pool and calculate a single overhead rate for the two plants:

| | Old Plant | New Plant | Merged Cost Pool |
|---|---|---|---|
| Number of yards per year | 6,000,000 | 7,000,000 | 13,000,000 |
| Total overhead costs | $21,000,000 | $42,000,000 | $63,000,000 |
| Overhead cost/yard | | | $4.84 |

If this were all that was done, then the two sales managers would want the new plant producing their products because both direct labor and direct material costs are lower in the new plant (while the overhead rates have been equated). Therefore, some additional scheme must be devised to equalize direct costs. The simplest way to do this is to "tax" each job in the new plant at 1/.85 of the job's direct cost. The problem with this procedure is that this "tax" would have to be backed out of the cost accounts because it does not represent any actual accounting cost incurred by the firm.

The advantage of this solution is that it neutralizes the incentives of the two sales departments to have one of the plants produce only their product. The disadvantage is it destroys information. By averaging across plants, any opportunity cost difference across plants is destroyed.

(ii) Change the overhead rate in the old plant to reflect the higher opportunity cost of providing the new capacity. Accounting depreciation presumably is an estimate of the opportunity cost of providing the fixed capacity. Since the old plant has 6/7 the capacity of the new plant, then use 6/7 of the new plant's depreciation as an estimate of the old plant's depreciation. By similar logic, use the new plant's entire cost structure including direct costs and overhead (excluding depreciation) to cost *all* jobs, whether at the new or old plant. In this way, all jobs are costed (and transferred) using the most recent costs of adding capacity.

The problem generated by this method is that the sum of the profits in the two sales departments is less than total firm profits. This occurs because products produced at the old plant but costed as if produced at the new plant contain more depreciation than the firm actually incurs.

The advantage of this method is that it sends cost signals to the sales managers that are more in line with the opportunity cost of replacing capacity.

(iii) Have the plants specialize by product but don't change the accounting system for computing transfer prices. The manager who happens to get his/her products manufactured in the old plant is given a bottom-line charge on his/her profit statement each year that eliminates the cost advantage of the old plant.

(iv) Evaluate departments as cost centers, not profit centers. This removes incentives to worry about costs. But now, sales can no longer have decision rights over pricing. If they do, they will set price where marginal revenues equal zero, not where marginal revenue equals marginal cost, because sales sees a zero transfer price.

(v) Transfer some of the construction cost of the new plant to the old plant. By doing this, you raise the overhead rate at the old plant and lower it on the new plant. The amount transferred does not have to equalize the overhead rates at both plants because then the variable cost differences would favor the new plant. Only that amount of initial cost that causes total unit costs to come into line need be transferred.

The interesting aspect of this problem is that there is no obvious right answer.

**P 8–23:** **Solution to Four Service Centers** (40 minutes)
[Reciprocal cost allocations]

To begin, write down the four equations for service department costs.

(1) S1 = \$4.8 + 0.05 S1 + 0.08 S2 + 0.09 S3 + 0.12 S4

(2) S2 = \$7.3 + 0.11 S1 + 0.03 S2 + 0.16 S3 + 0.13 S4

(3) S3 = \$6.5 + 0.19 S1 + 0.14 S2 + 0.04 S3 + 0.02 S4

(4) S4 = \$5.9 + 0.22 S1 + 0.31 S2 + 0.16 S3 + 0.09 S4

where S1 = S1's total reciprocal cost
S2 = S2's total reciprocal cost
S3 = S3's total reciprocal cost
S4 = S4's total reciprocal cost

The simplest solution of these four equations in four unknowns uses matrix algebra. Rewrite equations (1)-(4) after collecting like terms:

(1) 0.95 S1 - 0.08 S2 - 0.09 S3 - 0.12 S4 = \$4.8

(2) - 0.11 S1 + 0.97 S2 - 0.16 S3 - 0.13 S4 = \$7.3

(3) - 0.19 S1 - 0.14 S2 + 0.96 S3 - 0.02 S4 = \$6.5

(4) - 0.22 S1 - 0.31 S2 - 0.16 S3 + 0.91 S4 = \$5.9

This system of three equations in three unknowns can be expressed in matrix form as:

$$\begin{bmatrix} 0.95 & -0.08 & -0.09 & -0.12 \\ -0.11 & 0.97 & -0.16 & -0.13 \\ -0.19 & -0.14 & 0.96 & -0.02 \\ -0.22 & -0.31 & -0.16 & 0.91 \end{bmatrix} \begin{bmatrix} S1 \\ S2 \\ S3 \\ S4 \end{bmatrix} = \begin{bmatrix} \$4.8 \\ \$7.3 \\ \$6.5 \\ \$5.9 \end{bmatrix}$$

Solving for the vector of unknowns gives:

$$\begin{bmatrix} S1 \\ S2 \\ S3 \\ S4 \end{bmatrix} = \begin{bmatrix} 0.95 & -0.08 & -0.09 & -0.12 \\ -0.11 & 0.97 & -0.16 & -0.13 \\ -0.19 & -0.14 & 0.96 & -0.02 \\ -0.22 & -0.31 & -0.16 & 0.91 \end{bmatrix}^{-1} \begin{bmatrix} \$4.8 \\ \$7.3 \\ \$6.5 \\ \$5.9 \end{bmatrix}$$

The inverse matrix is:

$$\begin{bmatrix} 0.95 & -0.08 & -0.09 & -0.12 \\ -0.11 & 0.97 & -0.16 & -0.13 \\ -0.19 & -0.14 & 0.96 & -0.02 \\ -0.22 & -0.31 & -0.16 & 0.91 \end{bmatrix}^{-1} = \begin{bmatrix} 1.148 & 0.176 & 0.167 & 0.180 \\ 0.229 & 1.149 & 0.246 & 0.200 \\ 0.269 & 0.212 & 1.117 & 0.090 \\ 0.403 & 0.471 & 0.321 & 1.226 \end{bmatrix}$$

Substituting the solution of the inverse into the preceding equation and solving yields:

$$\begin{bmatrix} S1 \\ S2 \\ S3 \\ S4 \end{bmatrix} = \begin{bmatrix} \$8.949 \\ \$12.265 \\ \$10.637 \\ \$14.695 \end{bmatrix}$$

The amounts for S1, S2, S3, and S4 are now allocated to the service departments and operating divisions using the percentages given in the problem resulting in the following:

**Allocated Costs**

| | S1 | S2 | S3 | S4 | Div. A | Div. B | Div. C | Total Cost | Cost to Div A,B,C |
|---|---|---|---|---|---|---|---|---|---|
| S1 | $0.447 | $0.984 | $1.700 | $1.969 | $1.253 | $1.432 | $1.163 | $8.949 | $3.848 |
| S2 | 0.981 | 0.368 | 1.717 | 3.802 | 1.717 | 2.453 | 1.226 | 12.265 | 5.396 |
| S3 | 0.957 | 1.702 | 0.425 | 1.702 | 2.553 | 0.851 | 2.446 | 10.637 | 5.850 |
| S4 | 1.763 | 1.910 | 0.294 | 1.323 | 3.233 | 3.380 | 2.792 | 14.695 | 9.405 |
| | | | | | | | | $46.546 | $24.500 |

Notice that the amounts allocated to the three operating divisions exactly equals the total costs in the three service departments, $24.5 million.

**P 8-24:** **Solution to Beckett Manufacturing** (40 minutes)
[Changing the order of departments in step-down allocations]

a. Step-down method where Maintenance is the first service department allocated and Administration is the second service department to be allocated

| | Maintenance | Administration | Small Components | Large Components | |
|---|---|---|---|---|---|
| Allocation Percentages: | | | | | |
| Maintenance | 0.00% | 31.58% | 42.11% | 26.32% | |
| Administration | 0.00% | 0.00% | 23.53% | 76.47% | |
| | | | | | |
| Allocated Costs: | | | | | |
| Maintenance | $0 | $300,000 | $400,000 | $250,000 | |
| Administration | $0 | $0 | $204,000 | $663,000 | |
| Total | | | $604,000 | $913,000 | $1,517,000 |

b. Step-down method where Administration is the first service department allocated and Maintenance is the second service department to be allocated

| | Maintenance | Administration | Small Components | Large Components | |
|---|---|---|---|---|---|
| Allocation Percentages: | | | | | |
| Administration | 5.56% | 0.00% | 22.22% | 72.22% | |
| Maintenance | 0.00% | 0.00% | 61.54% | 38.46% | |
| | | | | | |
| Allocated Costs: | | | | | |
| Administration | $31,500 | $0 | $126,000 | $409,500 | |
| Maintenance | $0 | $0 | $604,000 | $377,500 | |
| Total | | | $730,000 | $787,000 | $1,517,000 |

c. The allocated cost per square foot and the allocated cost per employee resulting from using the step-down method where Maintenance is the first service department allocated and Administration is the second service department to be allocated (part a).

| | |
|---|---|
| Cost of Maintenance to be allocated | $950,000 |
| Square feet in allocation base | 950,000 |
| Cost per square foot of Maintenance | $ 1.00 |
| | |
| Cost of Administration to be allocated | $867,000 |
| Number of employees in allocation base | 289 |
| Cost per employee of Administration | $ 3,000 |

d. The allocated cost per square foot and the allocated cost per employee resulting from using the step-down method where Administration is the first service department allocated and Maintenance is the second service department to be allocated (part b).

| | |
|---|---|
| Cost of Maintenance to be allocated | $981,500 |
| Square feet in allocation base | 650,000 |
| Cost per square foot of Maintenance | $ 1.51 |
| | |
| Cost of Administration to be allocated | $567,000 |
| Number of employees in allocation base | 306 |
| Cost per employee of Administration | $ 1,853 |

e. The cost per square foot of Maintenance in part (d) increases for two reasons: the numerator increases because besides Maintenance's own cost of $950,000, Maintenance is allocated $31,500 of Administration cost; and the denominator falls because there are fewer square feet in the allocation base since Administration is no longer in the allocation base. Likewise, the cost per employee of Administration decreases in part (d) for two reasons: the numerator decreases because now only Administration's own cost of $567,000 is allocated (there are no Maintenance costs allocated to Administration) and the denominator increases because Maintenance's square footage of 50,000 square feet is included in the allocation base.

**P 8-25:** **Solution to Littleton Medical Center** (40 minutes)
[Direct vs. step down allocations]

a. Direct allocation method

| **Service Departments** | **Department Cost** | **Clinics** | **Hospital** | **Total** |
|---|---|---|---|---|
| Human resources | $1,200 | 2,000 | 3,000 | 5,000 |
| Accounting | $1,600 | 6,000 | 4,000 | 10,000 |
| Janitorial/Maint. | $2,400 | 150,000 | 400,000 | 550,000 |
| Total | $5,200 | | | |
| | | | | |
| Service Departments | | | | |
| Human resources | $1,200 | 40.00% | 60.00% | 100.00% |
| Accounting | $1,600 | 60.00% | 40.00% | 100.00% |
| Janitorial/Maint. | $2,400 | 27.27% | 72.73% | 100.00% |
| | | | | |
| Human resources | | $480.00 | $720.00 | $1,200.00 |
| Accounting | | $960.00 | $640.00 | $1,600.00 |
| Janitorial/Maint. | | $654.55 | $1,745.45 | $2,400.00 |
| Total allocated cost | | $2,094.55 | $3,105.45 | $5,200.00 |

b. Step down method

| **Service Departments** | **Dept cost** | **HR** | **Acctg** | Jan/Main. | **Clinics** | **Hospital** | **Total** |
|---|---|---|---|---|---|---|---|
| HR | $1,200 | | 50 | 150 | 2,000 | 3,000 | 5,200 |
| Accounting | $1,600 | 50 | | 100 | 6,000 | 4,000 | 10,100 |
| Janitorial/Maint. | $2,400 | 8,000 | 9,000 | | 150,000 | 400,000 | 550,000 |
| Total | $5,200 | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| STEP DOWN ALLOCATION: | | | | | | |
| Human resources | $1,200 | 0.96% | 2.88% | 38.46% | 57.69% | 100.00% |
| | | $11.54 | $34.62 | $461.54 | $692.31 | $1,200.00 |
| Accounting | $1,611.54* | | 0.99% | 59.41% | 39.60% | 100.00% |
| | | | $15.96 | $957.35 | $638.23 | $1,611.54 |
| Janitorial/Maint. | $2,450.57** | | | 27.27% | 72.73% | 100.00% |
| | | | | $668.34 | $1,782.23 | $2,450.57 |
| Total allocated cost | | | | $2,087.23 | $3,112.77 | $5,200.00 |

* $1,611.54 = $1,600 + $11.54
**$2,450.57 = $2,400 + $34.62 + $15.96

c. The step down method better captures some of the utilization of one service department by the others. For example, Accounting and Janitorial/Maintenance are charged for their use of HR, and Janitorial/Maintenance is charged for its use of Accounting. So, under the step down method, most of the service departments do not treat the other service departments as free. Another advantage of the step down method is that it provides management additional discretion as to where to allocate the costs. Besides choosing the allocation bases to use, they also have discretion in how to order the service departments.

**P 8–26: Solution to Aurora Medical Center** (45 minutes)
[Choosing the best way to allocate service costs for cost reimbursement]

a. The following table presents three alternative service department cost allocations: panel A is the direct allocation, Panel B is the step-down method starting with accounting first, and Panel C is the step-down method starting with IM first. Since Medicare reimburses for clinic costs but not hospital costs, then AMC should choose the allocation scheme that allocates the most costs to the clinic. Panel B (step-down starting with accounting) results in the highest amount of service costs being allocated to the clinic.

| | Administrative Department | | |
|---|---|---|---|
| | **Accounting** | **IM** | **Total** |
| **Panel A. DIRECT ALLOCATIONS** | | | |
| Service provided to: | | | |
| Hospital | 64.71% | 43.75% | |
| Clinic | 35.29% | 56.25% | |
| | | | |
| Cost allocated to: | | | |
| Hospital | $2,458,824 | $2,100,000 | $4,558,824 |
| Clinic | $1,341,176 | $2,700,000 | $4,041,176 |
| TOTAL | | | $8,600,000 |
| **Panel B: STEP DOWN (Accounting first)** | | | |
| Service provided to: | | | |
| IM | 2.30% | | |
| Hospital | 63.22% | 43.75% | |
| Clinic | 34.48% | 56.25% | |
| | | | |
| Cost allocated to: | | | |
| IM | $87,356 | | |
| Hospital | $2,402,299 | $2,138,218 | $4,540,517 |
| Clinic | $1,310,345 | $2,749,138 | $4,059,483 |
| TOTAL | | | $8,600,000 |
| **Panel C: STEP DOWN (IM first)** | | | |
| Service provided to: | | | |
| Accounting | | 33.33% | |
| Hospital | 64.71% | 29.17% | |
| Clinic | 35.29% | 37.50% | |
| | | | |
| Cost allocated to: | | | |
| Accounting | | $1,600,000 | |
| Hospital | $3,494,118 | $1,400,000 | $4,894,118 |
| Clinic | $1,905,882 | $1,800,000 | $3,705,882 |
| TOTAL | | | $8,600,000 |

b. Using the step-down method and starting with accounting results in approximately $18,000 more cost assigned to clinics than under the next best allocation scheme: direct allocations. This results in roughly $18,000 more cash inflow for AMC assuming Medicare reimburses AMC for 100 percent of its reported costs. The disadvantage of step-down is it's more complicated than the direct method. However, spreadsheet programs once set up are very inexpensive to operate.

**P 8–27: Solution to Grove City Broadcasting** (45 minutes)
[Allocating the cost of a shared resource and incentives]

a. Both the radio and TV managers will reject the Sports Wire because neither of them generates sufficient additional revenues to pay the entire $30,000 price for a single user. The table below shows that each station's incremental revenue is less than the Sports Wire fee.

| | | |
|---|---|---|
| Increased revenues of | | |
| Radio: | | |
| Added listeners | 1,500 | |
| Revenue per listener | ×$0.005 | |
| Added revenue per ad | $ 7.50 | |
| Number of ads per month | 3,550 | |
| Additional radio revenue | | $26,625 |
| TV: | | |
| Added viewers | 500 | |
| Revenue per viewer | ×$0.008 | |
| Added revenue per ad | $ 4.00 | |
| Number of ads per month | 3,200 | |
| Additional TV revenue | | $12,800 |
| Total increased revenues | | $39,425 |

b. If both buy the Sports Wire for $35,000, the combined increase in advertising revenue is $39,425 and Grove City Broadcasting has increased net cash flow of $4,425 per month. The owner would purchase Sports Wire.

c. The allocated cost of the Sports Wire using the number of stories is:

| | Radio | TV | Total |
|---|---|---|---|
| Stories used | 826 | 574 | 1,400 |
| % of stories | 59% | 41% | 100% |
| Sports Wire cost allocated | $20,650 | $14,350 | $35,000 |
| Additional revenues | $26,625 | $12,800 | $39,425 |
| Incremental profits (loss) | $ 5,975 | ($1,550) | $ 4,425 |

d. The cost of a Sports Wire story in the first month is:

| | |
|---|---|
| Total cost of Sports Wire | $35,000 |
| Number of stories used | ÷ 1,400 |
| Cost per Story | $ 25.00 |

e. Since the TV manager is losing money on the Sports Wire, she will start cutting back on her usage. This will reduce the amount of the allocated cost she bears. At the same time her audience size also shrinks back as do her advertising rates.

This causes the radio manager to bear a larger percentage of the Sports Wire. Probably after a few months, TV is hardly using any of the Sports Wire and radio is receiving most of the cost, at which point radio is losing money and will ask that the Sports Wire be dropped. Thus, a "death spiral" is induced by this allocation scheme.

f. A number of allocations don't work:

A fifty-fifty split ($17,500 to each) will cause the TV station to lose money.

Allocating the incremental cost of $5,000 just to the TV station causes the radio station to lose money.

One way to allocate the wire service cost is to use net realizable value:

| | Radio | TV | Total |
|---|---|---|---|
| Added revenues from Sports Wire | $26,625 | $12,800 | $39,425 |
| % of added revenue | 67.5% | 32.5% | 100% |
| Allocated cost | $23,625 | $11,375 | $35,000 |
| Net profit after allocated cost | $ 3,000 | $ 1,425 | $ 4,425 |

This scheme has the advantage that both stations make money from the Sports Wire and both will continue to use the Wire. However, the above solution assumes that the owner of Grove City has the same specialized knowledge as the two station managers and that the data exist to allocate the Sports Wire costs each month. For example, as audience size changes for reasons unrelated to the Sports Wire in the future, how does one continue to use net realizable value?

**P 8–28:** **Solution to Barry's Fashions** (45 minutes)
[Direct versus step-down allocations]

a. Information Management expense allocated to the Mall Store using the direct allocation.

| | Downtown Store | Mall Store | Total |
|---|---|---|---|
| Number of lines printed | 120 | 90 | 210 |
| Fraction of lines printed | 0.571 | 0.429 | |
| Amount allocated | $0.857 | $0.643 | $1.500 |

b. Allocated cost per line printed for Information Management using the direct allocation method.

| | Downtown Store | Mall Store | Total |
|---|---|---|---|
| Number of lines printed | 120 | 90 | 210 |
| Info. Mgmt. expenses | | | $1.500 |
| Allocated cost per line printed | | | $0.007 |

c. Information Management expense allocated to the Mall Store using the step-down allocation method.

| | | Fraction of Allocation Base Used by Downstream Departments or Stores | | | | |
|---|---|---|---|---|---|---|
| | Operating Expense | Human Resources | Maintenance | IM | Downtown Store | Mall Store |
| Human resources | $0.400 | 0 | 0.050 | 0.014 | 0.388 | 0.548 |
| Maintenance | $0.900 | 0 | 0 | 0.087 | 0.348 | 0.565 |
| Info. Management | $1.500 | 0 | 0 | 0 | 0.571 | 0.429 |
| | | | **Allocated Service Department Costs** | | | |
| Allocate HR first | $0.400 | | $0.020 | $0.006 | $0.155 | $0.219 |
| Allocate Maintenance second | $0.920 | | | $0.080 | $0.320 | $0.520 |
| Allocate IM third | $1.586 | | | | $0.905 | $0.680 |
| Total allocated to stores | | | | | $1.381 | $1.419 |

d. Allocated cost per line printed for Information Management using the step-down allocation method.

| | Downtown Store | Mall Store | Total |
|---|---|---|---|
| Number of lines printed | 120 | 90 | 210 |
| Info. Mgmt. expenses | | | $1.586 |
| Allocated cost per line printed | | | $0.008 |

e. The step-down method (part d) results in a high cost per line because being the last service department in the step-down order, IM is allocated some of the other service department costs. Thus, the numerator is higher and the denominator is the same, causing the allocated cost per line to be higher. Answering the second question depends on several factors. These include:

- Simplicity. The direct allocation is simple to compute and easy to explain. Given that most of each service department is consumed by the two stores (i.e., there are few large internal transfers among the three service departments) ignoring these internal transfers does not radically distort the opportunity costs of a store using a particular service department.

- Taxes. Are any taxes likely to be affected by the different allocations? Given the two stores are in the same tax jurisdiction and there are no inventory valuations involved, taxes are unlikely to be a consideration.

- Resource utilization. Allocating IM based on lines printed is in effect a transfer pricing method for lines printed. Equivalently, lines printed are being taxed. Fewer lines will be printed with the higher transfer price in part d ($0.008) than in part b ($0.007). Which of these two numbers best captures the opportunity cost imposed on Barry Fashions when one more line is printed? Moreover, the transfer price of the other two service departments is affected by placing IM last. The other two transfer prices will be lower by placing IM last. Thus, the likelihood of inducing a death spiral in each service department is affected.

- Control and Compensation. The reported profits of the two stores will differ depending on which service department allocation method is chosen. If compensation depends on reported profits after service department allocations, the store managers' pay will be impacted positively or negatively. However, given the magnitude of the difference ($0.001 x 120 million lines) is relatively small, the control/compensation effects are likely trivial.

Given the above factors, it appears that in this situation the direct allocation method is best.

**P 8–29:** **Solution to Janitorial Services** (45 minutes)
[Reordering stepdown cost allocations]

a. The cost per square foot Janitorial Services currently charges its customers:

| **Departments being allocated S3 costs** | **Percent** |
|---|---|
| S4 | 0.02 |
| S5 | 0.08 |
| D1 | 0.19 |
| D2 | 0.24 |
| D3 | 0.23 |
| D4 | 0.17 |
| Total % | 0.93 |
| Total square feet | 650,000 |
| Square feet in allocation base | 604,500 |
| S3 total cost ($100,000) | $19.62 |
| Cost/square foot | $3.25 |

b. Revised cost of Janitorial Services (S3) when placed at the end of the step-down process.

| | Costs Allocated to: | | | |
|---|---|---|---|---|
| | **S2** | **S4** | **S5** | **S3** |
| Costs from S1 | $1.25 | $2.00 | $1.00 | $1.25 |
| Costs from S2 | | 0.69 | 2.74 | 1.37 |
| Costs from S4 | | | 4.10[2] | 0.37[3] |
| Costs from S5 | | | | 5.57[4] |
| Cost of Service Dept (only) | 32.00 | 29.00 | 18.00 | 17.00 |
| Total Cost of Service Dept | $33.25 | $31.69 | $25.84 | $\boxed{\$25.56}$ |

c. Cost per square foot:

| Departments being allocated S3 costs | Percent |
|---|---|
| D1 | 0.19 |
| D2 | 0.24 |
| D3 | 0.23 |
| D4 | 0.17 |
| Total % | 0.83 |
| Total square feet | 650,000 |
| Square feet in allocation base | 539,500 |
| S3 total cost ($100,000) | $25.562 |
| Cost/square foot | $4.74 |

d. Senior managers might change the order of the service departments being allocated in the step-down method either to better reflect the actual opportunity costs being incurred by the firm, or for strategic reasons. By making Janitorial Services last in the chain, it raises the implicit transfer price, and hence increases the likelihood users will seek cheaper alternative sources of these services either by outsourcing them or performing the janitorial services themselves. This could lead to a death spiral that would ultimately eliminate Janitorial Services as an internally provided service. Thus, senior management might want to eliminate this service department without formally having to announce its closing, especially if it were unionized and managers want to avoid a direct conflict with the union.

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[2] $4.10 = (.11 / (1.00 -.08 -.07)) × ($29.00 + $2.00 + $0.69)

[3] $0.37 = (.01 / (1.00 - .08 - .07)) ×($29.00 + $2.00 + $0.69)

[4] $5.57 = (.14 / (1.00 - .07 - .12 - .16)) × ($18.00 + $1.00 + $2.74 + $4.10)

**P 8-30:** **Solution to Jones Consortium** (50 minutes)
[Allocating a common cost and incentives to cooperate]

a. For the consortium to be viable, it must meet the quantity and geography requirements of the vendor while reducing the pesticide costs to every member. The expected group demand of 360,000 gallons is within the stated requirements for purchases and all members are within a 10-mile area, so the vendor's requirements are met.

Everyone can end up saving money if and only if the total costs expected for purchasing through the consortium are less than the total costs expected by purchasing outside of the consortium, suggesting the existence of potential savings to be shared by each member of the consortium.

The total expected outside costs are:

| | *Gallons* | *Price per Gallon* | *Total Cost* |
|---|---|---|---|
| Jones | 25,000 | $11.30 | $ 282,500 |
| Gilbert | 35,000 | 11.20 | 392,000 |
| Santos | 50,000 | 11.12 | 556,000 |
| Singh | 100,000 | 10.90 | 1,090,000 |
| Chen | 150,000 | 10.70 | 1,605,000 |
| Total | 360,000 | | $3,925,500 |

Within the consortium, the guaranteed maximum cost is the management fee plus the pesticide cost, $275,000+360,000 × $10.00 = $3,875,000. Therefore, costs are expected to be less within the consortium than outside it, providing an expected savings of $3,925,500 -$3,875,000 = $50,500. Some may interpret the requirement that all members pay the same price for materials as implying that the maximum guaranteed price to be paid for materials within the consortium must be less than the cheapest outside price paid by any member. Since the $10 per gallon cost guaranteed to the consortium is less than Chen's $10.70 expected outside cost, this requirement would also be met.

b. Neither method would work. Under equal allocation, Jones Orchard would pay $275,000 ÷ 5 + 25,000 × $10 = $305,000 within the consortium, versus $282,500 outside of it.

Since all members of the consortium have agreed to pay the same for materials purchased through the consortium, allocating by percentage would serve to provide all members with identical average costs per gallon. Under this allocation scheme, the average cost per gallon for the consortium would be (360,000 × $10.00 + $275,000) ÷ 360,000 = $10.764. Since this is greater than Chen's outside cost of $10.70 per gallon, this cost allocation scheme would also fail. The complete set of allocations follows:

*Equal Allocation*
Under equal allocation, each member would be allocated $275,000 ÷ 5 = $55,000 of the management fee. At a maximum cost of $10 per gallon for materials, Jones and Gilbert would pay more within the consortium than outside it:

| | *Materials* | + | *Fee* | = | *Consortium Cost* | *vs* | *Outside Cost* |
|---|---|---|---|---|---|---|---|
| Jones | $250,000 | | $55,000 | | $305,000 | | $282,500 |
| Gilbert | $350,000 | | $55,000 | | $405,000 | | $392,000 |
| Santos | $500,000 | | $55,000 | | $555,000 | | $556,000 |
| Singh | $1,000,000 | | $55,000 | | $1,055,000 | | $1,090,000 |
| Chen | $1,500,000 | | $55,000 | | $1,555,000 | | $1,605,000 |

*Percentage Allocation*
Under percentage allocation, each member of the consortium would be allocated the management fee based upon his or her portion of the total group purchases. All members are better off except Chen, whose consortium cost of $1,614,583 is greater than his outside cost of $1,605,000:

| | *Materials* | + | (Total Fee | × | Proportion) | = | *Consortium Cost* |
|---|---|---|---|---|---|---|---|
| Jones | $250,000 | | $275,000 | | 25/360 | | $ 269,097 |
| Gilbert | $350,000 | | $275,000 | | 35/360 | | $ 376,736 |
| Santos | $500,000 | | $275,000 | | 50/360 | | $ 538,194 |
| Singh | $1,000,000 | | $275,000 | | 100/360 | | $1,076,389 |
| Chen | $1,500,000 | | $275,000 | | 150/360 | | $1,614,583 |

c. Potential Savings. In this problem, the question of allocating the management fee to the individual consortium members is conceptually similar to allocating the joint chicken costs as presented in the text. Just as the wings of the chicken are "free" with each chicken, membership in the consortium is free with the existence of the consortium. The management fee can be treated as a joint cost. Once in the consortium, each member is entitled to purchase materials at a cost that will not exceed $10 per gallon. The anticipated materials cost for each member, therefore, can be treated as the costs beyond the split-off point. The total consortium purchases are “disassembled” into five components: Jones's 25,000 gallons, Gilbert's 35,000 gallons, and so on. Once the joint costs and the costs beyond split-off have been identified, the opportunity costs of not buying from the consortium must be defined. The opportunity costs are the potential savings lost by continuing to purchase from outside the consortium once the consortium is in existence. The total incurred by each farmer in purchasing outside the consortium, therefore, serves the same function in this example as revenue served in the chicken example. In this case, allocating by this potential savings will guarantee that all members are expected to save money by forming the consortium. The numbers work out as follows:

| | Total | Jones | Gilbert | Santos | Singh | Chen |
|---|---|---|---|---|---|---|
| Outside cost | $3,925,500 | $282,500 | $392,000 | $556,000 | $1,090,000 | $1,605,000 |
| Consortium cost | 3,600,000 | 250,000 | 350,000 | 500,000 | 1,000,000 | 1,500,000 |
| Opportunity cost | $ 325,500 | $ 32,500 | $ 42,000 | $ 56,000 | $ 90,000 | $ 105,000 |
| Percentage of opportunity cost | 100% | 9.985% | 12.903% | 17.204% | 27.650% | 32.258% |
| Fee | $ 275,000 | $ 27,458 | $ 35,483 | $ 47,312 | $ 76,037 | $ 88,710 |
| Materials | 3,600,000 | 250,000 | 350,000 | 500,000 | 1,000,000 | 1,500,000 |
| Consortium cost | $3,875,000 | $277,458 | $385,483 | $547,312 | $1,076,037 | $1,588,710 |
| Outside cost | 3,925,500 | 282,500 | 392,000 | 556,000 | 1,090,000 | 1,605,000 |
| Savings | $ 50,500 | $ 5,042 | $ 6,517 | $ 8,688 | $ 13,963 | $ 16,290 |

d. At first glance, it would seem that the allocation schemes presented in (b) should be adequate. These methods fail, however, when examined within the context of the members' cost and demand expectations, thereby causing Jones to consider the more complex ability-to-pay scheme of (c). Despite the fact that the ability-to-pay scheme is promising, they do not appear likely to succeed due to their reliance on what is essentially private information. Since the amount of pesticides demanded by each farmer varies greatly, equal allocation is intuitively the least satisfying of the three general cost allocation methods presented. Equal allocation, however, relies only on public information: the amount of the management fee and the number of members in the consortium. This information can be easily shared by all members and can be determined at the formation of the consortium.

Allocation by percentage of total demand would appear to be the most direct way to solve any problems created by differences in quantities demanded. But allocating by percentage places greater reliance on private information than equal allocation in that the anticipated number of gallons required by each farm, and hence the relative proportions of quantities required, is self-reported and not verifiable a priori. This would not be a problem if the consortium could allocate the management fee after all purchases for the period were made. In that case, allocations could be based on actual purchase data that all members should have direct access to.

Evaluating the feasibility of the ability-to-pay method requires data on what each farmer would have paid absent the consortium. Since there is really no definitive ex post method to measure the accuracy of these self-reported expectations, there is opportunity to use private information to "game the system." Without a way to objectively determine and/or verify each farmer's cost information, there are strong incentives, once it is known that common costs are allocated based upon ability to pay, for members to attempt to increase savings through the understatement of expected outside costs. Since the savings offered by the consortium are relatively small ($50,500 ÷ $3,875,000 = 1.3%), it would not take very much misreporting to render it untenable.

**P 8-31:** **Solution to IVAX** (55 minutes)
[Allocating service department costs]

a. Direct allocation method:

| | O1 | O2 | Total |
|---|---|---|---|
| HR % | 57.89% | 42.11% | 100.00% |
| Janitorial/Maintenance % | 33.90% | 66.10% | 100.00% |

| | O1 | O2 | Total |
|---|---|---|---|
| HR allocations | $347.37 | $252.63 | $600.00 |
| Janitorial/Maintenance allocations | $271.19 | $528.81 | $800.00 |
| | $618.55 | $781.45 | $1,400.00 |

b. Step-down allocation (Human Resource first)

| | Janitorial/ Maintenance | O1 | O2 | Total |
|---|---|---|---|---|
| HR % | 5.00% | 55.00% | 40.00% | 100.00% |
| Janitorial/Maintenance % | | 33.90% | 66.10% | 100.00% |
| | | | | |
| HR allocations | $30.00 | $330.00 | $240.00 | $600.00 |
| Janitorial/Maintenance allocations | | $281.36 | $548.64 | $830.00 |
| | | $611.36 | $788.64 | $1,430.00 |

c. Step-down allocation (Janitorial/Maintenance first)

| | Human Resources | O1 | O2 | Total |
|---|---|---|---|---|
| Janitorial/Maintenance % | 1.67% | 33.33% | 65.00% | 100.00% |
| HR % | | 57.89% | 42.11% | 100.00% |
| | | | | |
| Janitorial/Maintenance allocations | $13.33 | $266.67 | $520.00 | $800.00 |
| HR allocations | | $355.09 | $258.25 | $613.33 |
| | | $621.75 | $778.25 | $1,413.33 |

d. Cost per employee:

i) Direct Allocation:
$600,000 / 950 employees = $631.58

ii) Step-down – Human Resources first:
$600,000 / 1,000 employees = $600

iii) Step-down – Janitorial/Maintenance first:

($600,000 + 13,333) / 950 = $645

e. Cost per square foot:

i) Direct Allocation:

$800,000 / 590 sq. ft. = $1,355.93

ii) Step-down – Human Resources first:

$830,000 / 590 = $1,406.78

iii) Step-down – Janitorial/Maintenance first:

$800,000 / 600 = $1,333.33

f. In considering how to (or even whether to) allocate the two service department costs, management should consider:

- *Taxes.* Will the allocations affect IVAX's tax liability?
- *Decision Making*. How are key decisions in the firm, such as pricing and outsourcing affected by the allocated service department costs? If the purpose of the cost allocation is to provide accurate estimates of opportunity cost, then either one of the two step down methods more accurately captures the resource consumption pattern than the direct allocation method.
- *Decision Control*. If the purpose of the allocation is to change managers' incentives (control) as to how they consume the service departments, then the allocation method with the highest tax rate will result in less of this department being utilized by the other divisions.

**Case 8–1:** **Solution to Carlos Sanguine Winery** (60 minutes)
[Product line profitability in the presence of joint costs]

The basic error that management is making in this case is allocating a joint cost, the grape costs, and then using these allocated numbers to assess product line profitability. Any decisions based on allocated joint costs are at risk of being wrong because the net realizable value (NRV) method for allocating grape costs is not being used.

Tables 1 and 2 both contain grape costs allocated by gallons, not NRV. Therefore, these analyses do not measure the incremental contribution to cash flows if a product is dropped. If table wines are dropped, grape costs of $250,000 ($3.57/case) are not saved. The firm still is paying $1,900,000 for grapes. All that will happen is that the $250,000 that is being allocated to the table wines will now be absorbed by the remaining premium wines. Or, if this juice is sold to the bulk purchasers, then $100,000 ($250,000 – $150,000) will be absorbed by the premium wines.

To assess the table wines' product line profitability, Exhibit A displays the incremental cash flows contributed by the table wines.

**Exhibit A**
Cash Flows Contributed by Table Wines

| | | |
|---|---|---|
| Revenues | | $ 490,000 |
| Less: Incremental costs of processing the juice beyond pressing | | |
| Packaging costs | $140,000 | |
| Labor costs[1] | 35,000 | |
| Selling & distribution[1] | 35,000 | |
| Manufacturing overhead[2] ($50,300 × 25%) | 12,575 | 222,575 |
| Incremental cash flows of producing | | $267,425 |

[1] This is the worst-case assumption in that all of the costs are assumed to be incurred to produce table wines.

[2] General winery costs are not incremental with respect to table wines. Producing table wines generates incremental costs equal to the variable cost of the production facilities.

From Exhibit A we see that the table wines are contributing positive cash flows. In fact, the cash flows of $267,425 exceed the amount by which the firm can sell the unprocessed juice ($150,000). The only question is whether these incremental cash flows (the $117,425 = 267,425 – 150,000) justify *not* selling the facilities. Exhibit B compares these two alternatives.

**Exhibit B**
Evaluating the Keep vs. Sell Alternatives

| Two Alternatives | | Single Cash Flow | Annual Cash Flows |
|---|---|---|---|
| 1. | Keep producing: Annual cash flows | | $267,425 |
| 2. | Shut down: | | |
| | Sale of equipment | $350,000 | |
| | Annual cash flows | | 150,000 |
| | Incremental cash flows | $350,000 | $117,425 |

If we continue to produce, we forgo the $350,000, but we gain an additional $117,425 per year of cash flows. It would take a (real) before-tax cost of capital in excess of 30 percent to make the shutdown the better of the two decisions.[5]

[5] If the annual cash flows are treated as a perpetuity, then the discount rate, r, that equates the present value of the two alternatives is:

Therefore, the best alternative is to keep producing. The president erroneously believes that he can save the grape costs if they shut down. Also, he believes that some of the fixed manufacturing overhead (in particular the winery costs) will be saved. But both of these are allocated costs.

One way to avoid the misleading impression that the table wines are unprofitable is to allocate grape and common winery costs based on net realizable value (relative profitability) of the two products. This method does not distort the products' relative profitability. Exhibit C computes product profitability using net realizable value to allocate grape and manufacturing overhead costs.

**Exhibit C**

Product Profitability Using Net Realizable
Values to Allocate Grape Costs

| Product Contribution | Premium Wines | Table Wines | Total |
|---|---|---|---|
| Revenues | $4,400,000 | $490,000 | $4,890,000 |
| Less variable costs: | | | |
| Packaging | (1,000,000) | (140,000) | (1,140,000) |
| Labor | (200,000) | (35,000) | (235,000) |
| Selling and distribution | (266,666) | (23,333) | (289,999) |
| Manufacturing overhead | (46,800) | (12,575) | (59,375) |
| Contribution | $2,886,534 | $279,092 | $3,165,626 |
| % of total contribution | 91.1837% | 8.8163% | 100% |
| Allocated grape costs | $1,732,490 | $167,510 | $1,900,000 |
| Allocated fixed manufacturing overhead | $390,380[1] | $37,745[2] | $428,125 |
| Product line profitability: | | | |
| Contribution | $2,886,534 | $279,092 | $3,165,626 |
| Less allocated or fixed costs: | | | |
| Grapes | ($1,732,490) | ($167,510) | ($1,900,000) |
| Manufacturing overhead | (390,380) | (37,745) | (428,125) |
| Selling & distribution | (133,334) | (11,667) | (145,001) |
| Product Line profits | $ 630,330 | $ 62,170 | $ 692,500 |

---

$$\frac{\$267{,}425}{r} = \$350{,}000 + \frac{150{,}000}{r}$$

r = $33%.

[1] $390,380 = 91.1837% × $428,125

[2] $37,745 = 8.8163% × $428,125, where $428,125 = $487,500-$59,375 and $59,373 = 25% × $237,500 since 25% of Production Facility costs are variable (see Table 2).

Using net realizable value to allocate grape and manufacturing overhead costs produces a positive profit for the table wine product line. Notice that the total profits of premium and table wines of $692,500 is the same as that reported in Table 1 ($750,000 less loss of $57,500).

**Case 8-2:** **Solution to Wyatt Oil** (90 minutes)
[Joint cost allocations can distort investment and operating decisions]

a. Joint distillation costs when distilling Kuwait Export are $180 million + 60 million X ($30 + $2) = $2.1 billion, or $35 per barrel when using physical volume costing. The net realizable value of the three products is:

Light distillates: $48 x 20 million = $960 million.
Processed heavy distillates = ($48 - $3) x 30 million - $90 million = $1.26 billion.
Sold heavy distillates: $30 x 10 million = $300 million.

So the net realizable value of the three products is $2.52 billion, or $5 of joint costs for every $6 of net realizable value. The following table shows the allocation of income by product line under these two methods.

| | **Physical volume** | **Net realizable value** |
|---|---|---|
| Sold light distillates | $260 million | $160 million |
| Processed heavy distillates | $210 million | $210 million |
| Sold heavy distillates | ($50 million) | $50 million |
| Total | $420 million | $420 million |

Accounting profit/NRV under the two methods is shown in the following table.

| | **Physical volume** | **Net realizable value** |
|---|---|---|
| Sold light distillates | 27.0833% | 16.6667% |
| Processed heavy distillates | 16.6667% | 16.6667% |
| Sold heavy distillates | -16.6667% | 16.6667% |

b. No. The net realizable value from 60 million barrels of West Texas Intermediate is:

Light distillates: $48 x 30 million = $1.44 billion
Processed heavy distillates = ($48 - $3) x 30 million - $90 million = $1.26 billion

for a total NRV of \$2.7 billion. Switching should occur when the difference in crude oil costs equals the difference in net realizable value, which occurs when the price differential is: 60 million x $\Delta P$ = \$180 million. Or, when $\Delta P$ = \$3 per barrel.

c. With expanded cat cracker capacity, switching should occur when the price differential is \$0.50 per barrel, because the only cost associated with Kuwait Export is an addition \$30 million of variable costs at the cat cracker (\$3 per barrel x 10 million additional heavy distillates.)

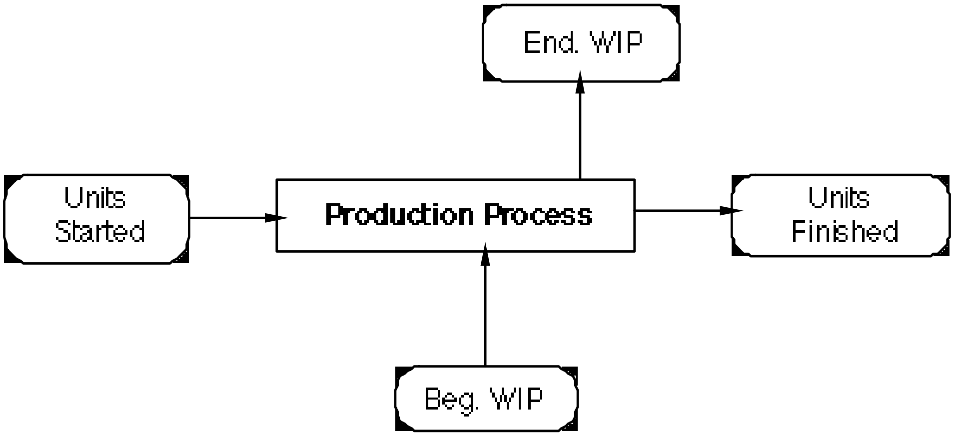
d. Yes. John Hanks' analysis is wrong on several counts. The relevant cost of heavy distillates is not the accounting cost (\$35 under physical costing) but the opportunity cost—the \$30 per barrel selling price of heavy distillates. Second, the problem should be framed as a capital budgeting exercise. Additional cash flows of \$48 - \$30 - \$3 = \$15 per barrel is available from expanding cat cracking capacity, which translates into incremental annual cash flows of \$150 million. Given the 15% discount rate and the \$900 million cost, this project has a net present value of about \$39 million.

e. No. Simulation analysis shows that the project has a negative net present value of about \$9,000,000. If the price differential between West Texas Intermediate and Kuwait Export drops, the capital investment will turn out to have a substantial negative NPV.

# CHAPTER 9
## ABSORPTION COST SYSTEMS

**P 9-1:** **Solution to Equivalent Units** (15 minutes)
[Basic calculation of equivalent units]

The solution to this problem requires an understanding of the relation among the beginning and ending WIP accounts and the flow of units through the production process. In particular, the following diagram illustrates these relations:




Beg. WIP + Units started = Units finished + End. WIP

Units started & completed = Units finished - Beg. WIP
= Units started - End. WIP

| | Units | Materials | Conversion Costs |
|---|---|---|---|
| Beginning Work-In-Process | | | |
| (70% complete) | 30,000 | 0 | 30% × 30,000 = 9,000 |
| Units started this quarter | 580,000 | | |
| Units to account for | 610,000 | | |
| | | | |
| Units completed this quarter | | | |
| and transferred out | 550,000 | | |
| Ending Work-In-Process | | | |
| (60% complete) | 60,000 | 60,000 | 60% × 60,000 = 36,000 |
| Units accounted for | 610,000 | | |
| | | | |
| Units completed this quarter | 550,000 | | |
| less: Beginning Work-In-Process | (30,000) | | |
| Units started and completed | | | |
| this quarter | 520,000 | 520,000 | 100% × 520,000 = 520,000 |
| Total equivalent units | | 580,000 | 565,000 |

**P 9-2: Solution to IPX Packaging** (15 minutes)
[Calculating and disposing of underapplied overhead]

a. Plantwide overhead rate

$$= \frac{\text{Estimated overhead}}{\text{Estimated machine hours}}$$

$$= \frac{\$6 \text{ million} + \$120 \times 20{,}000}{20{,}000 \text{ machine hours}}$$

$$= \$420 \text{ per machine hour}$$

b.

| | |
|---|---|
| Actual overhead incurred | $9,140,000 |
| Overhead applied: | |
| 21,000 hours × $420/machine hour | $8,820,000 |
| | |
| Underapplied Overhead | $ 320,000 |

c. Writing off $320,000 of underabsorbed overhead to cost of goods sold increases cost of goods sold and thereby decreases net income. Because actual products produced absorbed too little overhead, these unabsorbed dollars lower reported profits when taken to cost of goods sold.

**P 9-3:** **Solution to Densain Water** (15 minutes)
[Calculating overhead rates, absorbing overhead to products, and writing off over/under absorbed overhead)

a. Overhead rate = ($1.8 million + $0.005 × 200 million oz.) / 200 million oz.
= $1.8 million / 200 million oz. + $0.005
= $0.009 + $0.005
= $0.014

b. Overhead absorbed:

| | |
|---|---|
| Actual Volume (millions) | 210 |
| OH rate/ ounce | $0.014 |
| Overhead absorbed (millions) | $2.940 |

c. Over/under absorbed(millions):

| | |
|---|---|
| Overhead absorbed | $2.940 |
| Less: Actual overhead incurred | 2.850 |
| Over absorbed overhead | $0.090 |

d. $90,000 more overhead was charged to products (WIP, Finished goods, and Cost of Goods Sold) than was actually incurred. So, when this over-absorbed overhead is written off to CGS, it lowers CGS and raises net income before taxes.

**P 9-4:** **Solution to MacGiver Brass** (15 minutes)
[Over/underabsorbed overhead]

a. This footnote adversely affects the likelihood of renewing the loan. MacGiver had $462,000 of overhead that was not assigned to product costs. Hence, before prorating this overhead, income was overstated. After prorating, income was reduced by $154,000 to its current level of $625,000. However, there is an additional $308,000 of underabsorbed overhead in the inventory accounts. If all the underabsorbed overhead had been written off, reported income would have been $317,000 or $308,000 less. Cash flows before taxes are not distorted since these overhead costs presumably have already been incurred.

b. I am interested in MacGiver's answers to the following two questions:

i What caused this underabsorbed overhead: higher than anticipated expenses or lower than anticipated volumes? Neither prospect is good news.

ii. Why didn't MacGiver write-off all the underabsorbed overhead to reduce their tax liability? What are they trying to hide?

**P 9-5:** **Solution to Pool Scrubbers** (15 minutes)
[Calculating overhead rate, absorbing overhead, and over-/under-absorbed overhead]

a. The following table calculates the plant-wide overhead rate:

| **Models** | **710** | **720** | **830** | **Total** |
|---|---|---|---|---|
| Budgeted production (units) | 5,000 | 4,000 | 2,000 | |
| Budgeted direct labor hours per scrubber | 3.00 | 4.00 | 6.00 | |
| Total budgeted direct labor hours | 15,000 | 16,000 | 12,000 | 43,000 |
| Budgeted variable overhead per DL hour | $3.00 | $3.00 | $3.00 | $3.00 |
| Total budgeted variable overhead | $45,000 | $48,000 | $36,000 | $129,000 |
| Budgeted fixed manufacturing overhead | | | | $1,400,000 |
| Total budgeted overhead | | | | $1,529,000 |
| Overhead rate per DL hour | | | | $35.5581 |

b. Overhead absorbed by a batch of 100 model 720s produced using 405 direct labor hours:

405 DL hours × $35.5581 = $14,401.40

c. The over-/under-absorbed overhead is calculated as follows:

| **Models** | **710** | **720** | **830** | **Total** |
|---|---|---|---|---|
| Overhead rate per DL hour | | | | $35.5581 |
| Actual number of units produced | 5,100 | 3,900 | 2,200 | |
| Actual DL hours per unit | 3.10 | 4.20 | 5.90 | |
| Actual DL hours | 15,810 | 16,380 | 12,980 | 45,170 |
| Actual overhead absorbed | $562,174 | $582,442 | $461,544 | $1,606,159 |
| Total overhead incurred | | | | 1,520,500 |
| Over absorbed overhead | | | | $85,659 |

d. Overhead was over-absorbed by $85,659. This means that too many dollars were taken out of the overhead account than was actually put into the account. More overhead dollars were absorbed to products than were actually incurred. When the over-absorbed balance in the overhead account is written off to cost of goods sold, this lowers cost of goods sold and increases net income.

**P 9-6:** **Solution to Thermalloy** (20 minutes)
[Calculate missing values in overhead absorption]

The following table calculates budgeted direct labor hours:

| | |
|---|---|
| Over absorbed overhead | $121,402 |
| Actual overhead incurred | $5,200,098 |
| Overhead absorbed | $5,321,500 |
| | |
| Divide by Actual Direct labor hours | 183,500 |
| Overhead rate | $29.00 |
| less: Variable overhead/DL hour | $9 |
| Fixed overhead/Budgeted volume | $20.00 |
| | |
| Budgeted fixed overhead | $3,500,000 |
| divided by Fixed OH/Budgeted volume | $20.00 |
| Budgeted volume (direct labor hours) | 175,000 |

**P 9-7:** **Solution to Lys Wheels** (20 minutes)
[Calculating overhead rates backwards]

| | |
|---|---|
| Actual overhead incurred | $197,000 |
| Underabsorbed overhead | (7,000) |
| Overhead absorbed to products | $190,000 |
| ÷ Actual direct labor hours | 19,000 |
| Overhead rate per direct labor hour | $10.00 |
| Budgeted overhead | $210,000 |
| Budgeted volume | 21,000 |

$$\text{OH rate} = \$10 = \frac{\$210,000}{BV}$$

$$\text{Or, } BV = \frac{\$210,000}{\$10} = \text{ 21,000 direct labor hours .}$$

**P 9-8:** **Solution to Ware Paper Box** (20 minutes)
[Tracking cost flows through the accounts]

| Month Ending | Work-in-Process Inventory Job # | Work-in-Process Inventory Cost | Finished Goods Inventory Job # | Finished Goods Inventory Cost | Cost of Goods Sold Job # | Cost of Goods Sold Cost |
|---|---|---|---|---|---|---|
| February | 616 | $10,100 | 615 | $18,500 | 613 | $12,500 |
| | 734 | 4,300 | | | 614 | 17,200 |
| | 735 | 9,100 | | | | $29,700 |
| | | $23,500 | | | | |
| March | 618 | $14,400 | 734 | $12,500 | 615 | $18,500 |
| | 735 | 11,500 | 736 | 16,300 | 616 | 23,500 |
| | | $25,900 | | $28,800 | 617 | 19,200 |
| | | | | | | $61,200 |

**P 9-9:** **Solution to DeJure Scents** (20 minutes)
[Simple Process Costing]

**DeJure Scents**
**Process Costing Report**

a. Equivalent units of conversion and materials:

| | | EQUIVALENT UNITS | |
|---|---|---|---|
| Physical flow: | Gallons | Conversion | Materials |
| Work-In-Process, beginning | 0 | 0 | 0 |
| Units started | 15,000 | | |
| Units to account for | 15,000 | | |
| | | | |
| Work-In-Process, ending (50%) | 2,000 | 1,000 | 2,000 |
| Completed | 13,000 | 13,000 | 13,000 |
| Units accounted for | 15,000 | 14,000 | 15,000 |
| | | | |
| b. Cost per equivalent unit: | | | |
| Equivalent units | | 14,000 | 15,000 |
| | | | |
| Costs per unit: | | | |
| Total costs | $73,000 | $28,000 | $45,000 |
| Costs per equivalent unit | | $ 2.00 | $ 3.00 |

c. Cost of inventory and transfer to finished goods:

| | | | |
|---|---|---|---|
| Work-In-Process, ending | $ 8,000 | $2,000<br>($2×1000) | $6,000<br>($3×2000) |
| Finished goods inventory | $65,000 | $26,000<br>($2×13,000) | $39,000<br>($3×13,000) |
| Total costs | $73,000 | $28,000 | $45,000 |

**P 9-10: Solution to Chemtrex** (20 minutes)
[Calculating equivalent units]

Units Started and Completed:

| | |
|---|---|
| Units finished | 3,700,000 |
| – Beginning W-I-P | (700,000) |
| Units started & completed | 3,000,000 |

| | Equivalent Units |
|---|---|
| Beginning W-I-P [700,000 × (1-.70)] | 210,000 |
| Started and completed | 3,000,000 |
| Ending W-I-P [1,000,000 × .6] | 600,000 |
| Equivalent units of conversion work | 3,810,000 |

$$\text{Overhead rate} = \frac{FOH + VOH \times EV}{EV}$$

$$150\% = \frac{FOH + 0.70 \times \$257{,}400}{\$257{,}400}$$

where:

FOH = fixed overhead
FOH = 1.50 × $257,400 - 0.70 × $257,400
= $205,920

**P 9–11: Solution to Media Designs** (20 minutes)
[Multiple overhead rates and over/under-absorbed overhead]

a. Overhead rate:
for the Design Department

$$\frac{\text{DesignOverhead}}{\text{DirectLaborHours}} = \frac{\$800{,}000}{50{,}000} = \$16.00 \text{ per direct labor hour}$$

for the Printing Department

$$\frac{\text{Printing Overhead}}{\text{Direct Material Cost}} \quad \frac{\$500,000}{\$250,000} \quad = \quad \$2.00 \text{ per direct material dollar}$$

b. Overhead costs for Matsui job

| | | |
|---|---|---|
| Design Department | $16 × 700 direct labor hours | $11,200 |
| Printing Department | $2 × $12,000 direct material cost | $24,000 |
| Total overhead cost | | $35,200 |

c.

| | Design Dept. | Printing Dept. |
|---|---|---|
| Actual overhead | $802,000 | $490,000 |
| Overhead applied | | |
| 51,500 × $16/direct labor hour | 824,000 | |
| $230,000 × $2/direct material cost | | 460,000 |
| | $22,000 O | $30,000 U |

U - Underapplied O - Overapplied

**P 9–12: Solution to Simple Plant** (20 minutes)
[Cash flows through the accounts]

a. Simple' overhead rate for next year

Overhead rate = ($110,000 + 20% × $50,000) / (80% × $50,000)
= $120,000 / $40,000
= $3 per direct labor dollar

b. Account balances:

**Overhead**

| | | | |
|---|---|---|---|
| Indirect labor | $75 | Allocated to WIP | $375 |
| (3 hrs × $25/hr) | | (5 hrs × $25/hr × $3) | |
| | | Balance | $300 |

**Work-in-process**

| | | |
|---|---|---|
| Allocated OH | $375 | |
| Direct labor | | |
| (5 hrs × $25/hr) | $125 | |

c. The balance in the overhead account before any adjusting entry:

**Overhead**

| | | | |
|---|---|---|---|
| Indirect labor | $6,000 | Allocated to wip | |
| Property taxes | $103,000 | ($44,000/hr x $3) | $132,000 |
| | $109,000 | | |
| | | Balance | $23,000 |

Before any adjusting entry, there is a $23,000 over absorbed balance in the overhead account.

## P 9-13: **Solution to Rick's Bags** (25 minutes)
[Basic absorption costing]

a. The manufacturing overhead rate is calculated as:

| | Golf Bag | Tennis Tote | Total |
|---|---|---|---|
| Budgeted production | 12,000 | 18,000 | |
| × Direct labor hours per unit | 2.5 | 1.8 | |
| Expected direct labor hours | 30,000 | 32,400 | 62,400 |
| | | | |
| Flexible Overhead Budget: | | | |
| Variable overhead per DLH | | | $1.10 |
| × Expected direct labor hours | | | 62,400 |
| Budgeted variable overhead | | | $ 68,640 |
| + Fixed overhead | | | 187,200 |
| Budgeted overhead | | | $255,840 |
| /Expected direct labor hours | | | 62,400 |
| Manufacturing overhead rate per DLH | | | $ 4.10 |

b. A batch of tennis totes is produced in May. It used 1,900 direct labor hours. This batch of tennis totes is charged 1,900 DLH × $4.10 = $7,790 of manufacturing overhead.

c. Over/under-absorbed overhead at the end of the year is calculated as:

| | Golf Bag | Tennis Tote | Total |
|---|---|---|---|
| Actual direct labor hours used | 34,060 | 16,250 | 50,310 |
| Manufacturing overhead rate per DLH | | | × $4.10 |
| Manufacturing overhead absorbed | | | $206,271 |
| Manufacturing overhead incurred | | | 207,500 |
| Under-absorbed manufacturing overhead | | | $ 1,229 |

d. Of the $207,500 of manufacturing overhead actually incurred last year, all but $1,229 was allocated to bags produced. Cost of goods sold will be increased and net income before taxes decreased by $1,229 when this under-absorbed overhead is written off to cost of goods sold.

**P 9-14:** **Solution to Unknown Company** (30 minutes)
[Understanding manufacturing, inventory, and income statement accounts]

The easiest way to compute the answers is to prepare a statement filling in the known items and solving for the unknown (shown as **bold** figures in the statement below).

Unknown Company Income Statement
(Figures in $000's)

| | | |
|---|---|---|
| Sales (given) | | $100 |
| Cost of goods sold: | | |
| Finished goods 1/1 (given) | 0 | |
| Cost of goods manufactured* | **74** | |
| Cost of goods available for sale | 74 | |
| less: Finished goods 12/31 (given) | 0 | |
| Cost of goods sold | | 74 |
| Gross profit | | **$26** |
| Less | | |
| Selling and administration exp. | | |
| Variable (given) | $16 | |
| Fixed (given) | 9 | 25 |
| Net Income (given) | | $1 |

| | | |
|---|---|---|
| *Cost of goods manufactured: | | |
| Direct Material | | |
| Inventory 1/1 (given) | $3 | |
| Purchases | **36** | |
| Material available for use | 39 | |
| Less inventory 12/31 (given) | (10) | |
| Material used (given) | | $29 |
| Direct labor (given) | | 10 |
| Manufacturing overhead | | |
| Variable | **5** | |
| Fixed (given) | 30 | |
| Total manufacturing overhead | | 35 |
| Total manufacturing costs incurred | | 74 |
| Add Work-In-Process 1/1 (given) | 0 | |
| | 74 | |
| Less Work-In-Process 12/31 (given) | 0 | |
| Cost of goods manufactured | | $74 |

**P 9-15:** **Solution to Wellington** (30 minutes)
[Prorating over/under-absorbed overhead]

a. Overhead rate = $\frac{\text{Budgeted overheads}}{\text{Budgeted direct labor costs}} = \frac{\$187{,}500}{\$250{,}000}$ = \$0.75/direct labor \$

| Work-In-Process: | Job A | Job B | Total |
|---|---|---|---|
| Direct Labor | \$10,000 | \$28,000 | \$ 38,000 |
| Direct Materials | \$32,000 | \$22,000 | \$ 54,000 |
| Overhead (\$0.75 × Labor \$) | \$ 7,500 | \$21,000 | \$ 28,500 |
| Total | \$49,500 | \$71,000 | \$120,500 |

b. Amount over/underapplied:

| | |
|---|---|
| Actual overhead incurred | \$192,500 |
| Overhead applied (\$350,000 × \$0.75) | \$262,500 |
| Overapplied | \$ 70,000 |

The following proration of the overapplied overhead is based on total costs in work-in-process, finished goods, and cost of goods sold. A more technically correct method is to base the allocation on the amount of overhead in each of these accounts.

| | Unadjusted amt. | Overapplied overhead | Adjusted amt. |
|---|---|---|---|
| Work-In-Process | \$120,500 (16%) | (\$11,200) | \$109,300 |
| Cost of goods sold | 550,000 (74%) | ( 51,800) | \$498,200 |
| Finished Goods | 75,000 (10%) | ( 7,000) | \$ 68,000 |
| | \$745,500 (100%) | (\$70,000) | \$675,500 |

c. Operating Income will increase by \$11,200 + 7,000 = \$18,200. This amount represents the overapplied overhead prorated to work-in-process and finished goods. If all the overapplied overhead is charged to cost of goods sold then operating income will go up by the amount prorated to work-in-process and finished goods.

**P 9-16:** **Solution to Building Services Department** (30 minutes)
[Preventing the death spiral in a service organization]

The interesting question raised by this problem is whether cleaning should be outsourced. What comparative advantage does Rochco have in supplying cleaning services internally? One synergy is BSD is an employment/screening agency for manufacturing. This synergy is one reason the current service cost of BSD is higher than the outside market. However, since BSD's customers are paying the higher internal price, and assuming they recognize the value of the screening benefits, then they presumably are able to trade off costs and benefits.

a. Jim Corrado is accountable for overall site profitability. He is compensated based on overall performance of the site's units. He does not, however, have the specific knowledge necessary to make all the lower-level decisions. He must therefore structure incentives for Mr. Flynn and Mr. Laurri to use their specific knowledge in support of his goals. Corporate has encouraged decentralized decision making to support this type of behavior. Obviously Jim would prefer those services which are provided at the least cost.

Dennis Flynn is held accountable for the cost of providing cleaning services to Rochco's other departments. Specifically, he has three years to become the most economical provider of these services or risk closing BSD and losing some of his own reputational capital. He has just about reached the break-even cost when direct costs are considered. He is constrained by the need to allocate all costs out to consumers of BSD's services.

J. William Laurri is also attempting to minimize costs in his department. He has considerable bargaining power over BSD because of the effect he has on utilization of BSD's capacity. From his point of view, a less expensive outside cleaning contractor may be desirable if it reduces the overhead allocated to his products, which he too must pass on to his customers. Because his budget is charged the full and not marginal cost of BSD's services, it is the full cost he looks at when making his decision.

b. To price discriminate with Mr. Laurri's department would spell disaster for BSD. Although the complex is very large and diverse, department managers communicate frequently. Since the service performed across the department’s entire customer base is very similar, it would be very difficult for Mr. Flynn to explain to his other customers why Laurri received special pricing.

Dennis Flynn can use the following arguments to convince Mr. Laurri of the value in using in-house cleaning services:

- BSD is projected to be cost competitive on a fully-absorbed basis in three years. Bill Laurri should consider the long view (difficult if he is expecting a transfer or promotion before then).
- BSD performs a valuable service in addition to cleaning. The training and supply of motivated employees reduces Laurri’s direct costs and intangible costs (e.g. poor attendance, lost productivity and quality) for those activities.
- Being its majority customer, Laurri has market power over BSD. Mr. Flynn will be very attentive to Mr. Laurri's needs.

c. Jim Corrado should review BSD's business plan with his direct reports. He should point out the long-term benefits to the firm and individual departments of allowing BSD to reach its goal. To date BSD is meeting its forecasted progress. To force manufacturing departments to use BSD services would contradict corporate policy of encouraging lower-level decision making. As one alternative, Jim could add a component to his subordinates' performance evaluation based on their consideration of firm objectives, which do not directly benefit their department.

Final Note**:** This problem is based on a real case. The manager of BSD was able to persuade his customers of the value in staying with internal services, and now his unit is competitive on a full-cost basis with outside cleaning services. Moreover, BSD currently places over 60 workers per year in production jobs after they have worked for BSD for at least 18 months. BSD hires workers at slightly above minimum wage. If they can make the grade, BSD workers can transfer to production departments at double the minimum wage. This proves to be a very strong incentive motivating the BSD work force and allows BSD to be very selective in its hiring practices.

**P 9-17: Solution to Welding Robots** (30 minutes)
[Units of production depreciation — fixed or variable cost?]

Converting a fixed accounting cost into a variable accounting cost does not mean that a fixed opportunity cost has been converted into a variable opportunity cost. Remember from Chapter 2 that accounting costs are not the same as opportunity costs!

The division manager is right when she says that units-of-production depreciation will convert a fixed accounting cost into a variable accounting cost. But as long as they continue to use accelerated depreciation for taxes, the firm's "real" operating leverage remains unchanged. Taxes are not affected, and operating cash flows will not change if the manager's proposal is adopted. Fixed cash flows are not being converted to variable cash flows. The firm has already purchased the robots and their cost is sunk.

The opportunity cost of using the robots to make welds is the interest on the proceeds from selling the robots, which does not depend on the number of units produced. This opportunity cost of the robots is a fixed cost and will not change if the depreciation method changes. Even if robots deteriorate as they make welds, changing the depreciation accounting treatment does not affect the physical wear and tear relation. Therefore, the manager is incorrect to think that the firm's real, underlying operating leverage and risk will change if they adopt her proposal.

If units-of-production depreciation is used, the accounting cost per weld is lower; this appears to be the manager's major motivation. There is no information in the case about the incentives facing the welding department manager, Amy Miller. But for some reason she likes the idea of lowering the accounting cost per weld.

The reasons given by Miller for wanting to switch to units-of-production depreciation are not correct. However, there is a reason for adopting the proposal. The current use of straight-line depreciation when combined with the existing budgeting scheme of calculating the cost per weld causes the cost per weld to vary inversely with volume. That is, the current depreciation method produces a large fixed accounting cost. This is converted to a unitized fixed cost by dividing the fixed costs by expected volume where the expected volume is based on forecasted frame volume. When frame production is down, expected number of welds is down. This causes the cost per weld to rise when frame production is down and the cost per weld to fall when frame production is up. The current computation of cost per weld is not based on "normal costing." If units-of-production depreciation is used, the depreciation component of the cost per weld will be invariant to the volume of frame production. The depreciation portion of the cost per weld is $0.08 and does not vary in years of high or low frame production. Thus, units-of-production depreciation is equivalent to normal costing. The advantage of normal costing and thus of units-of-production depreciation is to prevent product costs from varying inversely with business activity. Normal costing does not send the erroneous signal of higher unit costs through the firm when volumes fall nor lower unit costs when volumes rise.

**P 9-18:** **Solution to DigiEar** (30 minutes)
[Overhead rate for multiple products and over/under absorbed overhead]

a. The following table first calculates the budgeted volume measured as total direct labor hours for the budgeted production levels, and then calculates the overhead rate for the year.

| | **A21** | **B45** | **C24** | **D88** | **Total** |
|---|---|---|---|---|---|
| Budgeted Volume | 12,000 | 8,000 | 5,000 | 3,000 | |
| Direct labor hours per unit | 2.0 | 2.8 | 3.0 | 3.5 | |
| Total direct labor hours | 24,000 | 22,400 | 15,000 | 10,500 | 71,900 |

| | |
|---|---|
| Total direct labor hours | 71,900 |
| Variable OH per direct labor hour | × $12.00 |
| Total variable OH | $862,800 |
| Fixed mfg OH | 2,157,000 |
| Budgeted manufacturing OH | $3,019,800 |
| Total direct labor hours | ÷ 71,900 |
| OH rate per direct labor hour | $42.00 |

b. The budgeted unit manufacturing cost of the four devices:

| | **Unit manufacturing cost (Absorption costing)** | | | |
|---|---|---|---|---|
| | **A21** | **B45** | **C24** | **D88** |
| Direct material | $110.00 | $120.00 | $130.00 | $150.00 |
| Direct labor | 50.00 | 70.00 | 75.00 | 87.50 |
| Manufacturing OH | 84.00 | 117.60 | 126.00 | 147.00 |
| Mfg cost per unit | $244.00 | $307.60 | $331.00 | $384.50 |

c. Overhead was over-absorbed by $277,300, as calculated in the following table:

| | A21 | B45 | C24 | D88 | Total |
|---|---|---|---|---|---|
| Actual direct labor hours | 26,000 | 23,800 | 18,600 | 12,250 | 80,650 |
| Overhead rate per DL hour | | | | | × $42.00 |
| OH absorbed to products | | | | | $3,387,300 |
| Actual OH incurred | | | | | 3,110,000 |
| Over absorbed OH | | | | | $277,300 |

d. If the entire $277,300 is written off to cost of goods sold (CGS), net income increases from what it was before the write off. An over-absorbed overhead amount indicates that too much overhead was absorbed into the products (more overhead was absorbed than was incurred). So, the write off to cost of goods sold backs out of expenses (CGS) the amount of the over-absorbed overhead, thereby lowering CGS and raising net income.

**P 9-19:** **Solution to Specialized Surgical Instruments** (30 minutes)
[Solving for the unknown budgeted variable overhead rate]

| | VX4 | VX8 | CMA | ALX | Total |
|---|---|---|---|---|---|
| Direct labor hours per unit | 3 | 2 | 4 | 5 | |
| Budgeted units | 5,000 | 4,500 | 3,500 | 2,400 | |
| Actual volume (DL hours) | 13,950 | 8,500 | 14,250 | 10,800 | 47,500 |
| Budgeted volume | 15,000 | 9,000 | 14,000 | 12,000 | 50,000 |

Overhead absorbed = OH incurred – under absorbed OH = $1,258,300 – $184,800
= $1,073,500
= OH rate × Actual volume (DL hours)
$1,073,500 = OH rate × 47,500 DL hours
OH rate = $1,073,500 / 47,500
= $22.60

OH rate = Fixed OH / Budgeted volume + variable OH rate
$22.60 = $580,000 / 50,000 + variable OH rate
$22.60 = $11.60 + variable OH rate
Variable OH rate = $11.00 per direct labor hour

**P 9-20:** **Solution to Pebble Beach Sandals** (30 minutes)
[Normal versus expected volumes and underproduction]

a. The U.S. sales division profit maximizing price is $250.

| Price | Quantity | Revenue | Transfer Cost | Own Variable Cost | Own Fixed Cost | Profit |
|---|---|---|---|---|---|---|
| $260 | $7,200 | $1,872,000 | $936,000 | $144,000 | $700,000 | $92,000 |
| 255 | 7,600 | 1,938,000 | 988,000 | 152,000 | 700,000 | 98,000 |
| 250 | 8,000 | 2,000,000 | 1,040,000 | 160,000 | 700,000 | 100,000 |
| 245 | 8,400 | 2,058,000 | 1,092,000 | 168,000 | 700,000 | 98,000 |
| 240 | 8,800 | 2,112,000 | 1,144,000 | 176,000 | 700,000 | 92,000 |
| 235 | 9,200 | 2,162,000 | 1,196,000 | 184,000 | 700,000 | 82,000 |

b. Next year's allocated fixed manufacturing overhead per sandal is:

$48 = $678,600 / 14,200

and the transfer cost of the sandals will be $139 = $38 + 44 + 9 + 48.

c. Using a transfer cost of $139 per pair, the U.S. sales division will reduce their purchases of sandals from 8,000 pairs to 7,600 pairs.

| Price | Quantity | Revenue | Transfer Cost | Own Variable Cost | Own fixed Cost | Profit |
|---|---|---|---|---|---|---|
| $260 | $7,200 | $1,872,000 | $1,000,800 | $144,000 | $700,000 | $27,200 |
| 255 | 7,600 | 1,938,000 | 1,056,400 | 152,000 | 700,000 | 29,600 |
| 250 | 8,000 | 2,000,000 | 1,112,000 | 160,000 | 700,000 | 28,000 |
| 245 | 8,400 | 2,058,000 | 1,167,600 | 168,000 | 700,000 | 22,400 |
| 240 | 8,800 | 2,112,000 | 1,223,200 | 176,000 | 700,000 | 12,800 |
| 235 | 9,200 | 2,162,000 | 1,278,800 | 184,000 | 700,000 | -800 |

d. The U.S. sales division's decision to purchase only 7,600 sandals does not maximize shareholder value. The problem involves including fixed manufacturing cost in the transfer price. Sandals should not be transferred at full cost of $139, but rather at variable cost of $91. Charging full cost causes both divisions to order fewer than the firm-profit maximizing number of sandals.

e. One suggestion is to adopt variable cost transfer pricing. But this can lead to influence costs and gaming over what costs are fixed versus variable. Another solution is to adopt normal costing. Instead of basing the overhead rate on expected production next year of 14,200 sandals, base the fixed manufacturing overhead allocation on long-run or normal volume. In this case, normal volume is

18,000 pairs thereby causing the fixed overhead per pair to be lower and the divisions will order and sell more sandals.

**P 9-21:** **Solution to Jacklin Stampings** (30 minutes)
[Overhead rate, flexible budget, and overabsorbed overhead]

| | |
|---|---|
| Overabsorbed overhead | = Actual overhead – Overhead absorbed |
| ($220,000) | = $8,750,000 – Overhead absorbed |
| Overhead absorbed | = $8,970,000 |
| Overhead absorbed | = Overhead rate × Actual machine hours |
| $8,970,000 | = Overhead rate × 46,000 |
| Overhead rate | = $8,970,000 ÷ 46,000 |
| | = $195/ machine hour |
| Overhead rate | = Budgeted fixed overhead ÷ Budgeted volume + Variable overhead per machine hour |
| $195 | = $3,800,000 ÷ Budgeted volume + $100 |
| Budgeted volume | = $3,800,000 ÷ [$195 - $100] |
| | = 40,000 machine hours |

**P 9–22:** **Solution to Bartolotta Company** (30 minutes)
[Calculating fixed overhead given overabsorbed overhead]

| | |
|---|---|
| 1/3 overabsorbed overhead written off to CGS | $ 100,000 |
| Total overabsorbed overhead (× 3) | 300,000 |
| Overhead incurred | 9,700,000 |
| Overhead absorbed | $10,000,000 |
| ÷ Direct labor cost | $ 1,250,000 |
| Overhead rate | $ 8/DL$ |

| | | |
|---|---|---|
| Overhead rate | = | (FOH + VOH x BV)/BV |
| \$8 | = | (FOH + \$7 ×\$1M)/\$1M |
| | | |
| \$8/DL\$ | = | FOH + \$7 × \$1M)/\$1M |
| \$8M | = | FOH + \$7M |
| Fixed overhead | = | \$1 million |

**P 9–23:** **Solution to Kitchen Rite** (35 minutes)
[Incremental costs of outsourcing]

This problem illustrates that not all direct labor costs are incremental and not all fixed overhead costs are sunk.

The current cash flows of manufacturing the chassis per unit are:

| | |
|---|---|
| Direct material | \$ 4.75 |
| Direct labor | |
| Stamping | 1.60 |
| Welding | 2.50 |
| Overhead | |
| Stamping | 0 |
| Welding (\$4,300 ÷ 2,000) | 2.15 |
| Total | \$11.00 |

The cash flows if the chassis is outsourced are:

| | |
|---|---|
| Purchased chassis | \$ 9.90 |
| Stamping labor (75% × 1.60) | 1.20 |
| Welding lease early termination (\$1,800 ÷ 2,000) | .90 |
| Total | \$12.00 |

*Recommendation*: Do not outsource because the net cash flows of outsourcing are higher than continuing to manufacture the chassis internally.

Note: The stamping machine has a book value of \$604,800 [\$1,728,000 × (7÷20)] which becomes a taxable loss upon disposal. However, since Kitchen Rite does not have any taxable income, it has no way of utilizing this tax loss.

**P 9-24:** **Solution to Frames, Inc.** (35 minutes)
[Plantwide, account, and departmental overhead rates]

This problem illustrates that the method of allocating overhead costs can make a substantial difference in reported product costs. Three different overhead allocation schemes are described: a single factory-wide overhead rate, separate rates for each overhead expense category, and departmental rates.

a. Plantwide overhead allocation:

| | Large | Small | Total |
|---|---|---|---|
| Direct labor | $480,000 | $1,140,000 | $1,620,000 |
| Percent of direct labor | 29.63% | 70.37% | |
| | | | |
| Total overhead (as % of DL) | $382,820 | $909,180 | $1,292,000 |
| Direct costs (DL + DM) | 1,430,000 | 1,940,000 | 3,370,000 |
| Total frame costs | $1,812,820 | $2,849,180 | $4,662,000 |
| ÷ number of units | 10,000 | 30,000 | |
| Unit costs | $ 181.28 | $ 94.97 | |

b. Separate overhead rates for each overhead expense category:

| | Large | Small | Total |
|---|---|---|---|
| Kilowatt hours | 1,570 | 2,110 | 3,680 |
| Percent of kilowatt hours | 42.66% | 57.34% | |
| | | | |
| Direct costs | $1,430,000 | $1,940,000 | 3,370,000 |
| Percent of direct costs | 42.43% | 57.57% | |
| | | | |
| Direct costs | $1,430,000 | $1,940,000 | $3,370,000 |
| Utility & indirect labor (as % of KWH) | 487,177 | 654,823 | 1,142,000 |
| General factory overhead costs (as % of direct cost) | 63,645 | 86,355 | 150,000 |
| Total frame costs | $1,980,822 | $2,681,178 | $4,662,000 |
| ÷ number of units | 10,000 | 30,000 | |
| Unit costs | $ 198.08 | $ 89.37 | |

c. Departmental Overhead rates:

| | Cutting | Welding |
|---|---|---|
| Utilities | $58,000 | $174,000 |
| Indirect labor | 430,000 | 480,000 |
| 1/2 of General factory costs | 75,000 | 75,000 |
| Totals | $563,000 | $729,000 |

| | Large | Small | Total |
|---|---|---|---|
| Direct materials | $950,000 | $800,000 | $1,750,000 |
| Percent of direct materials | 54.29% | 45.71% | |
| | | | |
| Welding kilowatt hrs. | 1,040 | 1,200 | 2,240 |
| Percent of kilowatt hrs. | 46.43% | 53.57% | |
| | | | |
| Direct costs | $1,430,000 | $1,940,000 | $3,370,000 |
| Cutting Department costs (as % of direct materials) | 305,653 | 257,347 | 563,000 |
| Welding Department costs (as % of KHW) | 338,475 | 390,525 | 729,000 |
| Total frame costs | $2,074,128 | $2,587,872 | $4,662,000 |
| ÷ number of units | 10,000 | 30,000 | |
| Unit costs | $ 207.41 | $ 86.26 | |

d. Large-frame full costs vary by 14 percent depending on which allocation method is used whereas small-frame costs vary by 10 percent. In the plantwide method, large frames are assigned only about 30 percent of the overhead, whereas under separate rates and departmental rates, large frames are assigned about 42 percent and between 46 percent and 54 percent of overhead, respectively. Thus, how overhead is allocated can make a difference in reported product costs.

Which of the three methods is best depends on the costs and benefits of each system. The benefits depend on how the reported product costs are used and the opportunity costs of dysfunctional decisions. The accuracy of each overhead cost allocation method depends on how closely the allocated costs approximate overhead opportunity costs. One cannot conclude that because departmental overhead rates are the most complicated, they are automatically the most accurate in capturing product costs. For example, Cutting Department overhead is being allocated based on direct material cost, but we do not know whether direct material cost is highly correlated with the actual cost drivers in the Cutting Department.

**P 9-25:** **Solution to Hurst Mats** (40 minutes)
[Choosing overhead allocation bases: decision management vs. control]

a. Overhead rates:

| | Plush | Deluxe | Total |
|---|---|---|---|
| Number of batches | 14,000 | 9,000 | |
| Direct labor cost/batch | × $4 | × $6 | |
| Total direct labor cost | $56,000 | $54,000 | $ 110,000 |
| | | | |
| Number of batches | 14,000 | 9,000 | |
| Machine minutes per batch | × 12 | × 9 | |
| Total machine minutes | 168,000 | 81,000 | 249,000 |
| Variable overhead per mach. min. | | | × $1.50 |
| Variable overhead | | | $ 373,500 |
| Fixed overhead | | | 680,000 |
| Total budgeted overhead | | | $1,053,500 |
| Total direct labor cost | | | ÷$110,000 |
| Overhead/direct labor $ | | | 9.58 |
| | | | |
| Total budgeted overhead | | | $1,053,500 |
| Total machine minutes | | | ÷ 249,000 |
| Overhead/machine minute | | | $ 4.23 |

b. Cost per batch:

Direct labor cost as the allocation base:

| | Plush | Deluxe |
|---|---|---|
| Overhead rate/direct labor $ | 9.58 | 9.58 |
| Direct labor per batch | × $4 | × $6 |
| Allocated overhead | $38.32 | $57.48 |
| Direct costs | 11.00 | 11.00 |
| Total cost per batch | $49.32 | $68.48 |

Machine minutes as the allocation base:

| | Plush | Deluxe |
|---|---|---|
| Overhead rate/machine minute | $ 4.23 | $4.23 |
| Machine minutes per batch | × 12 | × 9 |
| Allocated overhead | $50.76 | $38.07 |
| Direct costs | 11.00 | 11.00 |
| Total cost per batch | $61.76 | $49.07 |

c. Choosing between machine minutes and direct labor cost as the basis for allocating overhead involves trading off decision management and decision control. Machine minutes are likely more highly correlated with overhead cost than is direct labor. The more machine minutes, the more variable overhead and hence the more total overhead. Actions that increase machine minutes (such as more mats produced or substituting a batch of plush for a batch of deluxe) cause machine minutes to increase. Therefore, to get an accurate estimate of the opportunity cost of the mats, one would want to use machine minutes as the allocation base. This leads to accounting product costs that more accurately reflect the marginal cost of the mats. Thus, if Hurst is solely concerned with decision making, use machine minutes. However, notice that two-thirds of the total overhead is fixed overhead, which does not vary (by definition) with machine minutes. Hence, even using machine minutes as the allocation base still yields a false impression of marginal costs. An additional batch of plush floor mats does not cost $61.76.

Using direct labor cost as the allocation base provides decision control advantages. Hurst's labor union is restricting its competitiveness. Reducing the union's influence will in the long run allow Hurst to better compete. Using direct labor as the overhead allocation base "taxes" direct labor and in the long run will cause Hurst to use less labor. To create incentives for managers to use less labor (decision control), overhead should be allocated based on direct labor cost.

**P 9-26:** **Solution to Mutual Fund Company** (40 minutes)
[Allocating the cost of a centralized service department]

a. The overhead allocation rate equals the annual estimated overhead divided by the normal volume of the allocation base. MFC's allocation base is the estimated pounds for the year (315,000). Therefore, the overhead rate is:

**Overhead Rate** = $75,000 / 315,000 pounds = **$.24 per pound**

b.

**Estimated Overnight Mail Cost: Present System**

| | *Annual Volume* | *Cost per Package ** | *Annual Estimated Cost* |
|---|---|---|---|
| Trades Proc. | 25,000 | 12.25 | $306,250 |
| Trades Verif. | 25,000 | 9.75 | 243,750 |
| Security Proc. | 25,000 | 9.50 | 237,500 |
| Accounts Control | 12,500 | 16.50 | 206,250 |
| Customer Svc. | 2,500 | 16.00 | 40,000 |
| **Total** | | | **$1,033,750** |

* Based on present rates (first table in problem) and the average weight per package (second table in problem).

**Estimated Overnight Mail Cost: Centralized System**

| | *(Annual* | × *Corporate)* | + | *Allocated Overhead* | | |
|---|---|---|---|---|---|---|
| | *Volume* | *Rate* | | *(# of Pds.* | *× O.H. Alloc. Rate)* | *Total* |
| Trades Proc. | 25,000 | 11.60 | + | 125,000 | .24 | = $320,000 |
| Trades Verif. | 25,000 | 9.65 | + | 75,000 | .24 | = $259,250 |
| Security Proc. | 25,000 | 8.70 | + | 50,000 | .24 | = $229,500 |
| Accounts Control | 12,500 | 11.60 | + | 62,500 | .24 | = $160,000 |
| Cust. Svc. | 2,500 | 7.75 | + | 2,500 | .24 | = $ 19,975 |
| **Total** | | | | | | **$988,725** |

c. (i) The managers of Trades Processing and Trades Verifications are opposed to the plan because their overnight mail costs will increase under the centralized system.

| | Estimated Annual Cost (Present System) | Estimated Annual Cost (Centralized System) | Additional Cost |
|---|---|---|---|
| Trades Proc. | $306,250 | $320,000 | $13,750 |
| Trades Verif. | $243,750 | $259,250 | $15,500 |

(ii) The two managers' criticisms are not valid. First, while these two departments pay more ($29,250), MFC as a whole, pays less. MFC will save $45,025 annually by going to a centralized system. Second, the managers of Trades Processing and Trades Verifications are not considering the implicit costs involved with handling the overnight mail function individually. In addition to the annual cost they presently pay to overnight services, they must consider the additional labor and overhead costs which are incurred by handling this function under the present system.

d. Yes, there is a better, less contentious way to allocate overhead. Use the number of packages instead of the number of pounds as the allocation base. Since an equal amount of time, energy, and resources go into handling every package, regardless of its weight, the number of packages is probably a more accurate cost driver than number of pounds.

e. Yes, the proposed centralized system could be improved. MFC should implement a performance evaluation system that gives both the department managers and the centralized mailing unit manager the incentive to reduce costs. By having a link between reduced costs and annual bonus, the managers will have the incentive to engage in mutual monitoring and work together to lower costs in both their own departments and the company as a whole.

MFC could reduce costs by reducing multiple mailings to the same destinations. This could be done at either the department level or at the centralized mailing unit.

*At Department Level:*
Certain departments send packages to the same areas within a mutual fund company, which receives multiple packages from MFC. For example, Trades Processing and Trades Verification may send the majority of their packages to the same trades area within the same companies. Consequently, by coordinating their overnight mailing, they could save $6.75 by sending one ten-pound package ($16.45) to a company rather than sending this company two five-pound packages at $11.60 each ($23.20).

*At Centralized Level:*
If the proper incentives are put in place, the manager would be motivated to work with the five departments and the companies which receive packages from MFC to coordinate an improved and more efficient overnight process. This manager would have the incentive to understand what packages the MFC departments are sending out and how packages from different departments could be sent in a consolidated package to common receivers.

**P 9-27:** **Solution to Amalfi Texts** (40 minutes)
[Overhead rates and expected versus normal volume]

a. The following table calculates the overhead rates (based on expected volume) in the Printing and Binding Departments.

| | **Printing** | **Binding** |
|---|---|---|
| Variable overhead per unit of volume | $0.0200 | $1.2500 |
| Expected number of pages | 240,000,000 | |
| Expected # of books | | 400,000 |
| Variable overhead | $4,800,000 | $500,000 |
| Fixed overhead | 3,600,000 | 1,460,000 |
| Budgeted overhead | $8,400,000 | $1,960,000 |
| Budgeted volume (based on expected) | 240,000,000 | 400,000 |
| Overhead rate | $0.0350 | $4.9000 |

b. The cost of producing the Zhang book is calculated as:

| | |
|---|---|
| Number of books | 10,000 |
| Number of pages per book | 550 |
| Number of pages | 5,500,000 |

| Cost of publishing Zhang book: | **Printing** | **Binding** | **Total Cost** |
|---|---|---|---|
| Direct materials | $61,000 | $21,500 | $82,500 |
| Direct labor | 13,500 | 19,000 | 32,500 |
| Overhead | | | |
| ($0.035 x 5.5 million pages) | 192,500 | | |
| ($4.90 x 10,000 books) | | 49,000 | 241,500 |
| Total cost | $267,000 | $89,500 | $356,500 |

c. The over or under absorbed overhead is calculated as:

| | **Printing** | **Binding** | **Total** |
|---|---|---|---|
| Actual number of books published | | 410,000 | |
| Actual number of pages published | 250,000,000 | | |
| Overhead rate | $0.0350 | $4.90 | |
| Absorbed overhead | | | |
| ($0.0325 x 250 million pages) | $8,750,000 | | |
| ($4.2197 x 410,000 books) | | $2,009,000 | $10,759,000 |
| Actual overhead incurred | 8,820,000 | 2,185,000 | 11,005,000 |
| Under absorbed overhead | $70,000 | $176,000 | $246,000 |

d. Over or under absorbed overhead based on normal volume is calculated as:

| | **Printing** | **Binding** | **Total** |
|---|---|---|---|
| Fixed overhead (millions) | $3,600,000 | $1,460,000 | |
| Normal volume | 288,000,000 | 480,000 | |
| Fixed overhead rate | $0.0125 | $3.0417 | |
| Variable overhead per unit of volume | 0.0200 | 1.2500 | |
| Overhead rate (normal volume) | $0.0325 | $4.2917 | |
| | | | |
| Actual number of books published | | 410,000 | |
| Actual number of pages published | 250,000,000 | | |
| | | | |
| Absorbed overhead | $8,125,000 | $1,759,583 | $9,884,583 |
| Actual overhead incurred | 8,820,000 | 2,185,000 | 11,005,000 |
| Under absorbed overhead | $695,000 | $425,417 | $1,120,417 |

e. Normal volume produces an overhead rate that does not vary inversely with volume. Hence, it does not send inappropriate information that marginal costs are rising when volume falls and marginal costs are falling when volume rises. Hence, it is better for pricing and out sourcing decisions. Unfortunately, normal volume is easier to game because what is "normal volume" is often not objective and verifiable.

**P 9-28:** **Solution to Pyramid Products** (40 minutes)
[Analyzing acquisitions and manufacturing overhead absorption]

In this actual case, the plant manager was evaluating possible acquisition targets based on the amount of overhead they would absorb in the firm's existing plant that had excess capacity. The problem illustrates the fallacy of making decisions based on absorbing fixed manufacturing overhead.

a. Plant's fixed manufacturing overhead rate before any acquisition:

| | |
|---|---|
| Fixed manufacturing overhead | $3,000,000 |
| Divided by: Volume (direct labor hours) | 50,000 |
| Overhead rate (per direct labor hour) | $ 60 |

b. and c. Plant's fixed manufacturing overhead rate if Zapp or Kleann is acquired:

| | **Zapp** | **Kleann** |
|---|---|---|
| Annual volume (cases) | 80,000 | 60,000 |
| × Direct labor hours per case | 0.20 | 0.60 |
| Additional direct labor hours | 16,000 | 36,000 |
| Current direct labor hours | 50,000 | 50,000 |
| Total direct labor hours after acquisition | 66,000 | 86,000 |
| | | |
| Current fixed manufacturing overhead | $3,000,000 | $3,000,000 |
| Additional (incremental) fixed overhead | 600,000 | 400,000 |
| Total manufacturing overhead after acquisition | $3,600,000 | $3,400,000 |
| Divided by: Direct labor hours after acquisition | 66,000 | 86,000 |
| Revised fixed manufacturing overhead rate | $54.55 | $39.53 |

The plant's overhead rate drops from $60 per direct labor hour to $54.55 if Zapp is acquired or to $39.53 if Kleann is acquired.

d. Choosing which company to acquire based on which absorbs more overhead is an incorrect decision-making objective. Take the extreme case of two products. One generates zero incremental cash flow but absorbs a lot of overhead and the other absorbs no overhead (because it's not manufactured by the plant) but has large incremental net cash flows. Which one is better? Clearly, the second one is better. You can take net cash flow to the bank, pay shareholders dividends, and/or pay bonuses to employees. You can't do any of these things by "absorbing more overhead." In fact, looking at the net cash flows generated by the two targets, we see that Zapp (the one that absorbs less overhead) is the better of the two targets (holding constant the initial purchase price and possible synergies with our existing products). The following table shows that Zapp generates $160,000 more net cash flow per year than Kleann.

| | Zapp | Kleann |
|---|---|---|
| Price (per case) | $45.00 | $37.50 |
| Variable cost | 33.00 | 27.50 |
| Contribution per case | $12.00 | $10.00 |
| ×number of cases | 80,000 | 60,000 |
| Total contribution | $960,000 | $600,000 |
| Less: Additional fixed factory overhead | 600,000 | 400,000 |
| Incremental cash flow | $360,000 | $200,000 |

**P 9-29:** **Solution to Magic Floor** (40 minutes)
[Setting overhead rates based on expected and normal volumes]

a. Expected volume of the bottling fill line for 2012:

| | Pints | Quarts | ½ gallons | Gallons | Total Expected Seconds |
|---|---|---|---|---|---|
| Wax stripper | 40,000 | 50,000 | 60,000 | 47,000 | |
| Soap | 48,000 | 62,000 | 79,000 | 70,000 | |
| Wax | 44,000 | 55,000 | 68,000 | 49,000 | |
| Total | 132,000 | 167,000 | 207,000 | 166,000 | |
| Fill time (seconds) | 3 | 5 | 9 | 17 | |
| Total time | 396,000 | 835,000 | 1,863,000 | 2,822,000 | 5,916,000 |

b. Normal volume of the bottling fill line for 2012:

| | |
|---|---|
| Number of seconds/minute | 60 |
| Number of minutes/hour | 60 |
| Number of hours/day | 7 |
| Number of days/week | 5 |
| Number of weeks/year | 50 |
| Normal volume (seconds/year) | 6,300,000 |

c. Overhead absorption rate for the bottling fill line for 2012 based on expected volume:

| | |
|---|---|
| Budgeted costs: | |
| Maintenance | $77,000 |
| Indirect labor | 182,000 |
| Depreciation | 127,000 |
| Allocated utilities | 29,000 |
| Indirect supplies | 27,000 |
| Total Fill Department budget | $442,000 |

| | |
|---|---|
| Divided by expected volume | 5,916,000 |
| OH rate based on expected volume | $0.0747 |

d. Overhead absorption rate for the bottling fill line for 2012 based on normal volume:

| | |
|---|---|
| Total Fill Department budget | $442,000 |
| Divided by normal volume | 6,300,000 |
| OH rate based on normal volume | $ 0.0702 |

e. Over/under absorbed overhead amount for the bottling fill line for 2012 based on expected volume.

| | |
|---|---|
| **Actual fill line costs:** | |
| Maintenance | $76,000 |
| Indirect labor | 179,000 |
| Depreciation | 127,000 |
| Allocated utilities | 28,000 |
| Inirect supplies | 25,000 |
| Total OH incurred | $435,000 |

| | | | | | |
|---|---|---|---|---|---|
| **Actual Volume (in seconds):** | | | | | |
| Wax stripper | 118,000 | 246,000 | 542,000 | 800,000 | |
| Soap | 145,000 | 305,000 | 703,000 | 1,180,000 | |
| Wax | 130,000 | 270,000 | 608,000 | 840,000 | |
| Total | 393,000 | 821,000 | 1,853,000 | 2,820,000 | 5,887,000 |

| | |
|---|---|
| Actual volume (in seconds) | 5,887,000 |
| × OH rate (expected volume) | $0.0747 |
| Overhead absorbed (expected volume) | $439,758.90 |
| Total OH incurred | 435,000.00 |
| Over absorbed OH | $4,758.90 |

f. Over/under absorbed overhead amount for the bottling fill line for 2012 based on normal volume.

| | |
|---|---|
| Actual volume (in seconds) | 5,887,000 |
| × OH rate (normal volume) | $ 0.0702 |
| Overhead absorbed (normal volume) | $413,267.40 |
| Total OH incurred | 435,000.00 |
| Under absorbed OH | $ 21,732.60 |

g. Expected volume results in a higher OH rate ($0.0747) than normal volume $0.0702). Expected volume more closely represents actual volume produced in 2012. Thus, there is a small balance (over absorbed) in the overhead account. Normal volume is based on long-run average volume (6.3 million seconds), which is higher than was expected and produced (expected was 5.916 million seconds and actual was 5.887 million seconds). Because the overhead rate using normal volume is based on a higher volume than was produced, not enough overhead was absorbed to products produced. Thus, there was a balance left in the overhead account ($21,732.60 under absorbed). This problem illustrates that using normal volume to estimate overhead rates usually results in an over/under absorbed overhead balance whenever normal and expected volumes (which approximates actual) differ.

**P 9-30:** **Solution to Neweway Plastics** (60 minutes)
[Process costing - weighted average and FIFO methods]

Exhibit I details the calculations using the weighted average method and Exhibit II the FIFO method.

**Exhibit I**
Neweway Plastics
May
(Weighted Average Cost Flow)

| | | EQUIVALENT UNITS | | |
|---|---|---|---|---|
| **Step 1:** | | | | |
| Physical Flow: | Units | Conversion | Materials | Total |
| Work-in-process, begin. (50%) | 6,000 | | | |
| Units started | 38,000 | | | |
| Units to account for | 44,000 | | | |
| Work-in-process, ending (70%) | 4,000 | 2,800 | 4,000 | |
| Transferred out | 40,000 | 40,000 | 40,000 | |
| Units accounted for | 44,000 | | | |
| **Step 2:** | | | | |
| Equivalent units of work done to date | | 42,800 | 44,000 | |
| Costs per unit: | | | | |
| Work-in-process, beginning | | $892 | $2,680 | |
| Current costs added | | 17,512 | 19,760 | |
| Total cost | | $18,404 | $22,440 | |
| Cost per equivalent unit | | $ 0.43 | $ 0.51 | $0.94 |
| **Step 3:** Total costs to account for: | | | | |
| Work-in-process, beginning | $3,572 | | | |
| Conversion costs | 17,512 | | | |
| Materials | 19,760 | | | |
| Total costs | $40,844 | | | |
| **Step 4:** | | | | |
| Work-in-process, ending | $3,244 | $1,204 | $2,040 | |
| | | $0.43 × 2,800 | $0.51 × 4,000 | |
| Transferred out: 40,000 x $0.94 | 37,600 | | | |
| Total costs | $40,844 | | | |

**Exhibit II**
Neweway Plastics
May
(FIFO Cost Flow)

| | | EQUIVALENT UNITS | | |
|---|---|---|---|---|
| **Step 1**: | | | | |
| Physical Flow: | Units | Conversion | Materials | Total |
| Work-in-process, begin. (50%) | 6,000 | | | |
| Units started | 38,000 | | | |
| Units to account for | 44,000 | | | |
| Work-in-process, ending (70%) | 4,000 | 2,800 | 4,000 | |
| Transferred out | 40,000 | 40,000 | 40,000 | |
| Units accounted for | 44,000 | | | |
| **Step 2**: | | | | |
| Less: Equivalent units in beginning WIP | | (3,000) | (6,000) | |
| Equivalent units of work done in March | | 39,800 | 38,000 | |
| Costs per unit: | | | | |
| Total costs incurred in May | | $17,512 | $19,760 | |
| Cost per equivalent unit | | $ 0.44 | $ 0.52 | $0.96 |
| **Step 3**: Total costs to account for: | | | | |
| Work-in-process, beginning | $3,572 | | | |
| Conversion costs | 17,512 | | | |
| Materials | 19,760 | | | |
| Total costs | $40,844 | | | |
| **Step 4**: | | | | |
| Work-in-process, ending | $3,312 | $1,232<br>$0.44 × 2,800 | $2,080<br>$0.52 × 4,000 | |
| Transferred out: | | | | |
| WIP, beginning | $3,572 | | | |
| Cost to complete begin. WIP | 1,320 | 50%× 6,000 × $.44 | | |
| Started & completed: 40,000-6,000 = 34,000 × $0.96 | 32,640 | | | |
| Total costs | $40,844 | | | |

**Case 9-1: Solution to Heath Metal Products** (45 minutes)
[Workers' incentives to mis-state product costs]

This case illustrates a number of issues involving job order costing. All job order costing systems rely on the assumption that costs get posted to jobs accurately. But as this case illustrates, workers can have incentives to misreport their time thereby distorting job costs. We usually think of the accounting system affecting incentives. This is an actual case study of dysfunctional incentives causing systematic errors in the accounting numbers.  This case also raises a number of more general management issues involving small, privately owned companies.

a. Problems at Heath

At the heart of all cost systems is the accurate recording of direct costs (including direct labor hours) to jobs.  Heath has a problem of inaccurate product costs.  After a job is completed and the cost is computed, numerous errors in labor costs are usually discovered.  Workers, afraid of layoffs because of lack of contracts, post idle time to other jobs.  Or, if a particular process should only take six hours of labor to complete, the worker will spend eight hours at a slower pace to complete it.  This inflates the cost of the particular job.  Inaccurate job costs appear to be affecting their pricing decisions.  Supervisors appear to be uninterested in getting labor costs accurately assigned to jobs. Management does not want to take the time to go back to the original time reporting sheets to correct the errors.  Clearly, this is a firm where owners and senior managers don't care about accurate job costs.  They view their accounting system primarily as satisfying tax requirements.

Besides misstating particular jobs' costs, the fear of layoffs and working at a slower pace is causing another problem.  Workers could be using their idle time performing preventive maintenance, worker training, or machine and tool servicing.  But workers worry that idle time increases their chance of layoffs.  Therefore, they reduce their work pace and/or misreport their time.  Obviously, there must be some way to change their incentives to report idle time and use it for maintenance.  Now, there are negative incentives for reporting idle time.  Senior managers must create positive incentives to report idle time.  One way to do this is to pay workers a premium for maintenance and cross training.

Another problem at Heath is the lack of clear incentives.  Employees do not know what is being rewarded in their annual bonuses.  This causes them to misdirect their efforts into actions that do not necessarily increase firm value.

The owners do not appear to understand that their accounting system is useful beyond tax reporting.  Moreover, they do not want to install more objective performance evaluations systems.  The owners are either too lazy to implement organizational changes that can increase firm value, or they are ignorant that such changes can increase firm value.

b. Possible reforms

Supervisors should more closely monitor workers' time reporting to jobs.  This will provide more accurate job costs.  But this is unlikely to happen as long as the owners do not view the accounting system as a management tool.

Heath might want to consider paying a small premium for workers doing maintenance and cross training.  Since workers view reporting idle time as having negative consequences (possible layoffs), Heath must provide positive incentives to get employees to use time not worked on jobs to do maintenance and training.

More explicit performance evaluations should be provided their key people.  Each year the owners should put in writing each manager's strengths and weaknesses and goals for the coming year. This will force the owners to set objectives and communicate these objectives to the worker.

Besides illustrating how fear of layoffs can sabotage the accounting system, this case also allows some interesting discussion of problems often plaguing small companies. Spence and Carter are in their mid-sixties. They have very little exposure to alternative management schemes. Having only previously worked for one company as skilled tradesmen before running their own firm, they seem uninformed that accounting systems can help them better run the firm. They do not appear to be strongly motivated to maximize firm value because this would require more effort on their part.

Owner-managers maximize their utility, not firm value. The owner's utility consists of both leisure and profits. They trade-off work for leisure. This is sometimes called "satisficing." As long as the firm is returning an adequate profit, they don't want to exert additional effort for a higher profit. Further reducing each owner's incentive to maximize profit is the free rider problem. If one exerts additional effort to increase profits by $1, he only receives $0.25 of the additional income. About $0.50 goes for taxes and $0.25 goes to the other partner.

Lack of understanding of modern management techniques and reduced motivation of elderly owners are not unusual problems in small businesses. Even if the owners' children are working in the small business, one common complaint heard is the constant bickering between the two generations regarding adopting more modern systems. Complicating the situation is the lack of a fixed retirement policy for the firm. The founders tend to be very reluctant to retire and assign all the decision rights to their successors.

**Case 9-2: Solution to Portable Phones, Inc.** (40 minutes)
[Analyzing the incentive effects of an absorption costing system]

a. If the accounting system begins charging idle time at the beginning of each day or each month, then the phone assembly managers will tend to request their boards be scheduled at the beginning of each day or month. If all idle time is charged to the next job then the assembly managers will request board assembly dates towards the end of each month. This will minimize the unexpected idle time charges. If you ask for a time early in the month, say on the fifth, and the only other job was done on the third, you would be charged for all the idle time between the two jobs. By requesting a time late in the month, say the last day, your risk of very large idle time charges is lowered.

Phone assembly managers will also schedule their boards in months with the most working days. This will reduce the average allocated cost. They also will tend to load all their jobs into the board department at the same time.

b. There are a number of dysfunctional behaviors in the plant:

1. The peak load problem identified in the question.

2. The board department is in a death spiral. Since it is operating at 70 percent of planned capacity and given that 80 percent of its costs are fixed, the phone assembly departments are likely moving more and more of their board assembly work outside, or are redesigning their circuit boards to purchase more of the board's sub-assemblies outside to reduce inside assembly times in the board department.
3. Managers have incentives to schedule production in months with more working days (e.g., March versus February) and thus lower hourly rates.
4. If operating expenses vary by months (e.g., winter months are more expensive because of higher heating charges), managers will avoid assembling in these months.
5. One might expect to see side-payments, bribes (free sports tickets), quid pro quos, offered to the board department manager responsible for scheduling.

c. There are a number of accounting system changes that should be implemented:

1. Set an annual rate per hour in the board department to eliminate the incentive of assembly department managers of shifting their board assembly into months with more working days or lower total charges.
2. Charge assembly departments for only assembly time, not idle time. This will eliminate the incentives to request assembly dates late in the month.
3. Take a one-time write-off of the fixed costs in the board department that represent permanent excess capacity. This one-time charge is to corporate earnings and is not charged against individual products. This will lower the hourly charge to the boards being assembled and will stem the flow of work to outside board assemblers. As long as the variable cost of assembling the boards inside is less than the price of outside assemblers, the work should be done inside.
4. Instead of taking a one-time charge to earnings for the excess capacity, cut the board department's transfer price (i.e., the hourly charge) 30 percent. Charge this 30 percent to each of the five product lines based on operating income to avoid distorting relative profitability of the product lines and the marginal cost of assembling boards inside. Given this is a change in the performance evaluation system, be sure to make corresponding changes in the performance reward systems. This proposal reduces the hourly charge and again stems the death spiral.

**Case 9-3:** **Solution to PortCo Products** (CMA adapted) (90 minutes)
[Opportunity cost-based transfer prices]

This is a good review problem to assign in the chapter on absorption costing because it illustrates how the cost records can be used to construct transfer prices based on opportunity costs. Thus, not only is absorption costing reviewed, but also the material in Chapters 2 and 4.

a. The transfer price based on variable manufacturing costs to produce the cushioned seat and the Office Division's opportunity cost is $1,869 for a 100-unit lot or $18.69 per seat as summarized below.

| | |
|---|---|
| Variable cost | $1,329 |
| Forgone profits | 540 |
| Transfer price | $1,869 |

The detail on how this transfer price was derived is presented below.

Variable cost

| | | |
|---|---|---|
| • Cushioned material | | |
| Padding | $2.40 | |
| Vinyl | 4.00 | |
| Total cushion material | 6.40 | |
| Cost increase 10% | × 1.10 | |
| Cost of cushioned seat | | $7.04 |
| • Cushion fabrication labor | | |
| ($7.50 × .5) | | 3.75 |
| • Variable overhead (see below) | | |
| ($5.00 × .5) | | 2.50 |
| Total variable cost per cushioned seat | | $13.29 |
| Total variable cost per 100-unit lot | | $1,329 |

Overhead Analysis

| Item | Variable Amount Total | Variable Amount Per DLH | Fixed Amount Total | Fixed Amount Per DLH |
|---|---|---|---|---|
| Supplies | $ 420,000 | $1.40 | | |
| Indirect labor | 375,000 | 1.25 | | |
| Supervision | | | $ 250,000 | $ .83 |
| Power | 180,000 | .60 | | |
| Heat and light | | | 140,000 | .47 |
| Property taxes and insurance | | | 200,000 | .67 |
| Depreciation | | | 1,700,000 | 5.67 |
| Employee benefits: | | | | |
| 20% direct labor | 450,000* | 1.50 | | |
| 20% supervision | | 50,000 | .16 | |
| 20% indirect labor | 75,000** | .25 | | |
| Total | $1,500,000 | $5.00 | $2,340,000 | $7.80 |

* 20% × 300,000 DLH × $7.50

** 20% × $375,000

$$\text{Variable overhead rate} = \frac{\$1,500,000}{300,000} = \$5.00/\text{direct labor hour}$$

$$\text{Fixed overhead rate} = \frac{\$2,340,000}{300,000} = \$7.80/\text{direct labor hour}$$

- Labor hour constraint

| | |
|---|---|
| Labor hours to make a 100-unit lot of deluxe office stools 1.50 × 100 | 150 hours |
| Less labor hours to make a 100-unit lot of cushioned seats .50 × 100 | 50 hours |
| Labor hours available for economy office stool | 100 hours |
| Labor hours required to make one economy office stool | .8 hours/stool |
| Use of extra labor devoted to economy office stool production (100 ÷ 8) | 125 stools |

- Forgone profit calculation

| | Deluxe office stool | | Economy office stool |
|---|---|---|---|
| Selling price | $58.50 | | $41.60 |
| Costs | | | |
| Material | $14.55 | | $15.76 |
| Labor ($7.50 × 1.5) | 11.25 | ($7.50 × .8) | 6.00 |
| Variable overhead ($5.00 × 1.5) | 7.50 | ($5.00 × .8) | 4.00 |
| Fixed overhead (not relevant) | --- | | --- |
| Total costs | $33.30 | | $25.76 |
| Contribution margin per unit | $25.20 | | $15.84 |
| Units produced | 100 | | 125 |
| Total contribution margin | $2,520 | | $1,980 |
| Opportunity cost of shifting production to the economy office stool ($2,520 – 1,980) | | $540 | |

b. Variable manufacturing cost plus forgone profits would be the best transfer price system to use because it would allow the supplying division to be indifferent between selling the product internally to another division or selling the product in the external market. This transfer price method assures that the supplying division's contribution to profit would be the same under either alternative. The sum of the variable manufacturing cost and the opportunity cost represent the effort put forth by the supplying division to the overall well-being of the company.

However, estimating opportunity cost requires subjective estimates from the Office Division. These estimates are costly to generate and subject to managerial opportunism.

An appropriate transfer price must attempt to fulfill the company objectives of autonomy and firm profit maximization. While no one transfer price can necessarily satisfy each of these objectives fully in all situations, the opportunity cost transfer price should be the most appropriate method for meeting these objectives in most situations. However, opportunity cost provides no incentive to the Office Division and Fliegel to cooperate. Fliegel is just indifferent.

# CHAPTER 10
## CRITICISMS OF ABSORPTION COST SYSTEMS: INCENTIVE TO OVERPRODUCE

**P 10-1:** **Solution to Federal Mixing** (10 minutes)
[Explaining absorption versus variable costing]

Variable costing writes off to income all fixed manufacturing costs incurred during the year. Absorption costing prorates the fixed overheads between units in inventory and units sold based on machine hours.

Absorption costing net income is higher than under variable costing by \$1.2 million. This means that inventories under absorption costing are higher by \$1.2 million.

The ending work-in-process inventory contains 20,000 more machine hours than the beginning inventory (90,000 – 70,000 machine hours). From the data given, the fixed overhead rate applied to products is \$60 per machine hour. Or,

$$\$1.2 \text{ million} = (90{,}000 - 70{,}000) \times \text{fixed overhead rate}$$

$$\text{Fixed overhead rate} = \frac{\$1{,}200{,}000}{20{,}000}$$

$$= \$60$$

**P 10–2:** **Solution to Xerox** (15 minutes)
[Incentives to over produce]

By building inventories and using absorption costing, Xerox shifts some of its fixed manufacturing costs from cost of goods sold to inventories. This decreases cost of goods sold and increases net income as long as average unit costs are decreasing. This is a short-term strategy to boost accounting earnings and earnings will reverse as soon as inventories are depleted. This strategy is unlikely to mislead the stock market. Since the higher inventories must be disclosed as part of the financial statements, the market is not likely to be fooled by such over production.

Note: In May, 2000 Richard Thoman was replaced as CEO. The previous CEO, Paul Allaire returned as CEO and Anne Mulcahy was promoted to president and chief operating officer. Paul Allaire described the change as, "We are grateful for Rick's contributions in leading the company through a period of major repositioning. However, both Rick and the board felt it best for the company to move forward with an experienced Xerox team that will lead Xerox people and efficiently execute the strategy."

**P 10–3:** **Solution to Varilux** (20 minutes)
[Volume changes' affect on variable and absorption costing]

Varilux
Income Statements (Absorption and Variable Costing)
Current Year (in 000's)

| | Absorption Costing | Variable Costing |
|---|---|---|
| Revenues (1,000 + 10,000) x $10 | $110 | $110 |
| Less: Cost of goods sold: | | |
| Beginning inventory (1,000 units) | (5) | (2) |
| This period (10,000) | 70* | 30 |
| Gross margin | 35 | 78 |
| Less: Fixed factory overhead | | (40) |
| Selling and administrative costs | (30) | (30) |
| Net income | $ 5 | $ 8 |

* 10,000 × $3 + $40,000

In this problem absorption costing produces a lower net income figure than variable costing. The reason for this is that sales exceed current year production. Under variable costing only this year's fixed costs are on the income statement. Under absorption costing not only are this year's fixed costs on the income statement but also some of the prior year's fixed costs because beginning inventories under absorption costing contain some prior-year fixed costs. The difference in net income is $3,000 and results from the fixed costs in the beginning inventory written off this period under absorption costing. It is the 1,000 units in beginning inventory times the $3 of fixed cost per unit.

**P 10–4**: **Solution to Truini Paints** (20 minutes)
[Variable versus absorption costing]

Comparison of absorption costing to variable costing. This problem is a slightly modified version of the example in Table10-6:

Truini Paints
Net Income Under Absorption Costing and
Variable Costing When $10,000
less Overhead is Incurred than Budgeted

## A. Absorption Costing

| | Year 1 | | Year 2 | |
|---|---|---|---|---|
| Sales | | $100,000 | | $100,000 |
| Direct Labor & Materials | (20,000) | | (20,000) | |
| Overhead: | | | | |
| $\frac{\$60,000}{10,000} \times 10,000$ | (60,000) | (80,000) | | |
| $\frac{\$63,000}{11,000} \times 10,000$ | | | (57,273) | (77,273) |
| | | $20,000 | | $22,727 |

## B. Variable Costing ($10,000 treated as a reduction in fixed cost)

| | Year 1 | | Year 2 | |
|---|---|---|---|---|
| Sales | | $100,000 | | $100,000 |
| Direct Labor and Materials | (20,000) | | (20,000) | |
| Variable Overhead | (30,000) | | (30,000) | |
| Fixed Overhead ($40,000 - $10,000) | (30,000) | (80,000) | (30,000) | (80,000) |
| Net Income | | $20,000 | | $20,000 |

C. Variable Costing ($10,000 treated as a reduction in variable cost)

| | | Year 1 | | Year 2 |
|---|---|---|---|---|
| Sales | | $100,000 | | $100,000 |
| Direct Labor and Materials | (20,000) | | (20,000) | |
| Variable Overhead: | | | | |
| ($3 var. OH- $\frac{\$10,000}{10,000}$) × 10,000 | (20,000) | | | |
| ($3 var. OH- $\frac{\$10,000}{11,000}$) × 10,000 | | | (20,909) | |
| Fixed Overhead | (40,000) | | (40,000) | |
| | | (80,000) | | (80,909) |
| Net Income | | $20,000 | | $19,091 |

As seen above, treating the $10,000 as a reduction to variable costs as opposed to a reduction in fixed costs acts to lower reported income. Unlike Table 10-6, treating the $10,000 cost reduction as a fixed cost transfers all the savings through to the income statement under variable costing. Now the manager has the incentive to treat the $10,000 cost reduction as fixed in order to increase current-period earnings.

**P 10–5:** **Solution to Zipp Cards** (20 minutes)
[Income effects of absorption costing when inventory levels increase]

a. The table below calculates absorption costing net income for 2010 and 2011.

**Zipp Cards**
Net Income
2010-2011
(one unit = 48 cards)

| | 2010 | 2011 | Change |
|---|---|---|---|
| Revenue | $250,000 | $235,200 | ($14,800) |
| Variable cost | 50,000 | 48,000 | (2,000) |
| Fixed overhead | 160,000 | 102,400* | (57,600) |
| Net income | $40,000 | $84,800 | $44,800 |

* $\$160{,}000 \times \dfrac{48{,}000}{75{,}000}$

b. Income rose by $44,800 between 2010 and 2011 as outlined below:

**Zipp Cards**
Reconciliation of Net Income
2010-2011
(one unit = 48 cards)

| | 2010 | 2011 | Change |
|---|---|---|---|
| Contribution margin | $200,000 | $187,200 | ($12,800) |
| Fixed cost in inventory | $0 | $57,600 | $57,600 |
| | | | $44,800 |

Net income rose by $44,800 even though the contribution margin fell by $12,800. Zipp added 27,000 units to inventory (75,000 - 48,000). Each unit in inventory carries fixed costs per unit of $2.13333 ($160,000÷75,000). This means that instead of writing off all the fixed costs, $57,600 (27,000 × $2.13333) is still on the balance sheet.

**P 10-6:** **Solution to TransPacific Bank** (20 minutes)
[Financial analysis involving variable costing]

Note: This client is using variable costing. The paragraph explaining this to the loan committee is:

> The client's reported income (after taxes) is $720,000 lower than if the client had used traditional costing methods, which allocate all overhead to products produced. This client writes off all fixed overhead when incurred. Because the amount of overhead written off this year increased by $1.2 million ($4.2 - $3.0), then given a tax rate of 40 percent, the after-tax impact of this accounting policy is to lower reported income after taxes by $720,000 ($1.2 million × [1 - 40%] = $1.2 × .60 = $720,000). Compared to other firms in its industry using absorption costing, this client's reported income is lower by the amount of $720,000, which should cause TransPacific Bank to look more favorably on this client, everything else being equal.
>
> One question raised by this footnote is: Why did fixed overhead rise by $1.2 million or over 40 percent? Was the firm engaged in a major capital expansion program? Does this increase in fixed overhead represent a significant increase in capacity and can the firm generate the sales to justify this capacity expansion?

**P 10-7:** **Solution to Zeflax Bottles** (25 minutes)
[Variable costing and over production]

a. The following statements show that under absorption costing, net income did in fact fall last year from $165,220 to $124,783 this year:

| | **Last Year** | **This Year** |
|---|---|---|
| Units produced | 230,000 | 200,000 |
| Units sold | 200,000 | 230,000 |
| Change in inventory | 30,000 | (30,000) |
| | | |
| Fixed mfg cost | $500,000 | $500,000 |
| Variable mfg cost | $1.0000 | $1.0000 |
| Unit mfg cost | $3.174 | $3.5000 |

| | Last Year | This Year | Total |
|---|---|---|---|
| Revenue | $800,000 | $920,000 | $1,720,000 |
| Cost of goods sold | | | |
| produced this year | (634,780) | ($700,000) | (1,334,780) |
| produced last year | (0) | (95,220)* | (95,220) |
| Net income | $165,220 | $124,780 | $ 290,000 |
| *Inventory | $95,220 (30,000 bottles × $3.174) | | |

b. Under variable costing, net income rose from $100,000 last year to $190,000 this year:

| | Last Year | This Year | Total |
|---|---|---|---|
| Revenue | $800,000 | $920,000 | $1,720,000 |
| Cost of goods sold | | | |
| variable cost | (200,000) | (230,000) | (430,000 |
| Fixed mfg cost | (500,000) | (500,000) | (1,000,000) |
| Net income | $100,000 | $190,000 | $290,000 |

Notice, that the sum of last year and this year net income, $290,000, is the same under both methods.

c. Last year's net income was higher than this year's because Zeflax over-produced bottles last year. This lowered the average cost of the bottles sold, thus inflating last year's profits. This year, fewer bottles were produced, raising average costs and lowering profits. In other words, last year, by over-producing, some of the $500,000 of fixed manufacturing costs went on the balance sheet and not the income statement, thereby inflating profits. This year, when we not only sold all the bottles we produced this year but all the inventory we built last year, all of this year's fixed costs flowed into profits, and all of the fixed costs we had in inventory from last year also went into profits.

**P 10-8:** **Solution to Alliance Tooling** (25 minutes)
[Variable costing with no fixed manufacturing costs]

a. Absorption costing:

**Alliance Tooling**
Absorption Costing Income Statement

| | |
|---|---|
| Revenues (100,000 @ $26.75) | $2,675,000 |
| Cost of goods sold (100,000 @ $13.50) | (1,350,000) |
| Gross margin | $1,325,000 |
| Sales commissions and shipping (100,000 @ $2.70) | (270,000) |
| Selling and administration | (720,000) |
| Operating income before taxes | 335,000 |
| Taxes (40%) | (134,000) |
| Net income | $201,000 |

b. Variable costing:

**Alliance Tooling**
Variable Costing Income Statement

| | | |
|---|---|---|
| Revenues | | $2,675,000 |
| Less: | Variable manufacturing costs | (1,350,000) |
| | Variable selling and distribution costs | (270,000) |
| | Contribution margin | $1,055,000 |
| Less: | Fixed selling and administrative costs | (720,000) |
| Operating income before taxes | | 335,000 |
| Taxes (40%) | | (134,000) |
| Net income | | $201,000 |

c. There is no difference in net income in parts (a) and (b) because Alliance Tooling has no fixed manufacturing overhead. Its unit manufacturing cost is its variable manufacturing cost of $2.70, which does not vary with units produced.

**P 10–9:** **Solution to Aspen View** (25 minutes)
[Variable costing excludes non-manufacturing variable costs]

a. Ending inventory value using variable costing:

| | |
|---|---|
| Variable costing product cost: | |
| Direct labor | $3.50 |
| Direct material | 7.50 |
| Variable manufacturing overhead | 4.50 |
| Total variable cost of product | $15.50 |
| | |
| Units produced | 5,300 |
| Units sold | 4,900 |
| Ending inventory | 400 |
| | |
| × Unit manufacturing cost | $15.50 |
| | |
| Ending inventory value | $6,200 |

b. Income would have been higher had Aspen View used absorption costing. Under absorption costing, some of the fixed manufacturing costs would have been allocated to the ending inventory rather than all of them being written off to cost of goods sold.

c. Assuming constant variable cost per unit, income would have been lower. With fewer units produced, less fixed costs would have been allocated to the ending inventory under absorption costing. The preceding statement assumes variable cost per unit is constant.

d. Assuming that they can sell the 400 pairs of sunglasses in inventory, the cost of overproducing is the additional warehousing costs plus 400 × $15.50 x 20% x fraction of the year the glasses are held until being sold. This calculation assumes that all of the variable advertising, distribution, and selling expenses are incurred when the sunglasses are sold, not manufactured.

**P 10–10:** **Solution to CLIC Lighters** (30 minutes)
[Absorption versus variable costing as production and sales vary]

a. Calculation of overhead rate per machine minute:

| | *Products* | | |
|---|---|---|---|
| | *Basic* | *Super* | *Total* |
| Fixed overhead | | | $103,000 |
| Number of units produced | 200,000 | 160,000 | |
| Machine minutes per lighter | 1.1 | 1.2 | |
| Total minutes hours | 220,000 | 192,000 | ÷ 412,000 |
| Fixed overhead rate/minute | | | $0.25 |

b. Absorption costing income statement:

**CLIC Lighters**
**Income Statement--Manufacturing**
**For the Year Ended December 31**

| | *Products* | | |
|---|---|---|---|
| | *Basic* | *Super* | *Total* |
| Sales revenue | $90,000 | $77,000 | $167,000 |
| Cost of goods sold | | | |
| Variable cost | 18,000 | 22,000 | $40,000 |
| Fixed cost[1] | 49,500 | 33,000 | 82,500 |
| Income from manufacturing | $22,500 | $22,000 | $44,500 |

[1] For Basic lighters: 180,000 units × 1.1 minutes/unit × $0.25 fixed overhead/unit
For Super lighters: 110,000 units × 1.2 minutes/unit × $0.25 fixed overhead/unit

c. Reconciliation:

| Difference in income from manufacturing: | |
|---|---|
| Absorption costing | $44,500 |
| Variable costing | 24,000 |
| Difference | $20,500 |

| | *Products* | | |
|---|---|---|---|
| | *Basic* | *Super* | *Total* |
| Ending inventory | 20,000 | 50,000 | |
| Machine hours per lighter | 1.1 | 1.2 | |
| Total machine hours | 22,000 | 60,000 | 82,000 |
| Fixed overhead per minute | | | $0.25 |
| Fixed overhead in inventory | | | $20,500 |

d. Absorption costing produces a higher income figure by $20,500 because some of the fixed overhead is in inventory and not on the income statement as under variable costing. Because CLIC produced more lighters than they sold, some of the fixed overhead is allocated to units in inventory, whereas under variable costing all fixed overhead is written off to the income statement.

**P 10–11:** **Solution to Medford Mug Company** (30 minutes)
[Incentives to overproduce under absorption costing]

a. The operating profit for 2011 is given below:

**Medford Mug Company**
Income Statement
Year Ending 2011
(millions)

| | | |
|---|---|---|
| Sales (18 million @ $2) | | $36.00 |
| Less: Cost of Goods Sold | | |
| Variable cost (18 million @ $0.50) | (9.00) | |
| Fixed cost ($\frac{18}{45}$ × $20 million) | (8.00) | (17.00) |
| Gross Margin | | 19.00 |
| Less: Selling and administration | | (8.00) |
| Operating Profit | | $11.00 |
| President's bonus (15%) | | $ 1.65 |

b. The evaluation of the president's performance in 2011 depends on whether you think the firm can sell all the inventory of mugs produced. Notice that the ending inventory of mugs in 2011 is 27 (45-18) million mugs valued at:

| | |
|---|---|
| Variable costs (27 million @ $0.50) | $13.5 |
| Fixed costs ( $\frac{27}{45}$ × $20 million) | 12.0 |
| Ending inventory value | $25.5 |

The change in profits between 2010 and 2011 resulted from three factors: sales increased by three million mugs, production tripled, and marketing expenses doubled. Increased sales caused profits to increase by $4.5 million ($1.50 contribution margin x three million). By tripling production, $12 million of fixed manufacturing costs were inventoried. This is the most significant change in operations that accounted for the spectacular "turnaround" in profits. To see this more clearly, recast the 2011 income statement on a variable cost basis:

**Medford Mug Company**
Variable Costing Income Statement
Year Ending 2011
(millions)

| | | |
|---|---|---|
| Sales (18 million @ $2) | | $36.0 |
| Less: Cost of Goods Sold | | |
| Variable cost(18 million @ $0.50) | (9.0) | |
| Fixed costs | (20.0) | (29.0) |
| Cost of Goods Sold | | 7.0 |
| Less: Selling and administration | | (8.0) |
| Operating Profit | | $(1.0) |
| President's bonus (15%) | | $ 0.0 |

If all the fixed costs are written off instead of inventoried on the balance sheet as is done by absorption costing, a loss of $1.0 million is incurred.

**P 10–12: Solution to Kothari Inc.** (30 minutes)
[Variable costing incentives to outsource fixed costs]

a. The net income of the Telecom Division (before taxes using variable costing)

| | |
|---|---|
| Revenues: | |
| Internal sales (50,000 ×1.1×$43) | $2,365,000 |
| External sales (50,000 × $150) | 7,500,000 |
| Total revenue | $9,865,000 |
| Less: | |
| Variable manufacturing cost | $4,300,000 |
| Fixed manufacturing overhead | 1,700,000 |
| Variable period cost | 1,800,000 |
| Fixed period cost | 1,900,000 |
| Net income | $ 165,000 |

b. Telecom's net income from outsourcing:

| | |
|---|---|
| Revenues: | |
| Internal sales (50,000 × 1.1 × $51*) | $ 2,805,000 |
| External sales (50,000 × $150) | 7,500,000 |
| Total revenue | $10,305,000 |
| Less: | |
| Outsourcing (100,000 × $9) | $ 900,000 |
| Variable manufacturing cost (100,00 × ($43 - $1)) | 4,200,000 |
| Fixed manufacturing overhead | 1,000,000 |
| Variable period cost | 1,800,000 |
| Fixed period cost | 1,900,000 |
| Net income | $ 505,000 |

*$51 = $43 + $9 -$1

Telecom will outsource because their net income increases from $165,000 to $505,000.

c. Kothari's net cash flows fall if the modulators are outsourced.

| | |
|---|---|
| Outsourcing costs ($9 × 100,000) | $900,000 |
| Savings: | |
| Variable cost ($1 × 100,000) | -100,000 |
| Fixed manufacturing overhead | -700,000 |
| Net loss from outsourcing | $100,000 |

**P 10-13: Solution to Mystic Mugs** (30 minutes)
[Absorption versus variable costing]

a. Absorption costing net income:

| | **16 oz mug** | **24 oz mug** | **Total** |
|---|---|---|---|
| Revenue | $219,375 | $183,680 | $403,055 |
| Direct materials | (24,750) | (23,780) | (48,530) |
| Direct labor | (13,500) | (13,120) | (26,620) |
| Variable overhead | (6,750) | (6,560) | (13,310) |
| Fixed manufacturing overhead* | (41,697) | (40,523) | (82,220) |
| Operating income | $132,678 | $99,697 | $232,375 |
| Selling and distribution expense: | | | |
| Variable | (37,125) | (28,700) | (65,825) |
| Fixed** | | | (148,000) |
| Net Income | $95,553 | $70,997 | $18,550 |

| | | | |
|---|---|---|---|
| *Fixed manufacturing overhead: | | | |
| Fixed manufacturing overhead | | | $85,000 |
| Units produced | 24,000 | 16,400 | |

| | | | |
|---|---|---|---|
| × Direct labor per unit | $0.60 | $0.80 | |
| Total direct labor | $14,400 | $13,120 | $27,520 |
| Fixed mfg overhead/direct labor $ | | | $3.0887 |
| Direct labor | $13,500 | $13,120 | $26,620 |
| Allocated fixed mfg overhead | $41,697 | $40,523 | $82,220 |

** There is no reason to allocate the fixed selling and distribution expense to the two products for income determination because all of it is written off as a period cost.

b. Variable costing net income:

| | 16 oz mug | 24 oz mug | Total |
|---|---|---|---|
| Revenue | $219,375 | $183,680 | $403,055 |
| Direct materials | (24,750) | (23,780) | (48,530) |
| Direct labor | (13,500) | (13,120) | (26,620) |
| Variable overhead | (6,750) | (6,560) | (13,310) |
| Variable selling & distribution | (37,125) | (28,700) | (65,825) |
| Contribution | $137,250 | $111,520 | $248,770 |
| Fixed manufacturing overhead | | | (85,000) |
| Fixed selling & distribution | | | (148,000) |
| Net income | | | $15,770 |

c. Reconciliation of the difference between absorption and variable costing net income:

| | |
|---|---|
| Absorption net income | $18,550 |
| Variable net income | 15,770 |
| Difference to be explained | $2,780 |

| | 16 oz mug | 24 oz mug | Total |
|---|---|---|---|
| Units added to inventory: | | | |
| Units produced | 24,000 | 16,400 | |
| Units sold | (22,500) | (16,400) | |
| Units added to inventory | 1,500 | 0 | |
| Direct labor per unit | $0.60 | $0.80 | |
| Mfg overhead per direct labor $ | $3.0887 | $3.0887 | |
| Mfg overhead in inventory | $2,780 | $0 | $2,780 |

d. Memo explaining the difference in net incomes:

Absorption costing allocates fixed manufacturing overhead to all units produced, whereas variable costing writes off all fixed manufacturing overhead to the income statement. 1,500 units of 16 oz mugs were added to inventory. Because each 16 oz mug under absorption costing contains about $1.85 ($0.60 × $3.0887) of fixed manufacturing overhead, then $2,780 of fixed manufacturing overhead is included on the balance sheet as opposed to being written off to the income statement, which is how variable costing treats all fixed manufacturing overhead.

**P 10-14:** **Solution to Avant Designs** (30 minutes)
[Variable vs. absorption costing with two products]

a. The budgeted variable costing income statement:

**Avant Designs**
Budgeted Income Statement - Variable Costing
Current Year

| | Aztec | Mayan | Total |
|---|---|---|---|
| Sales price | $12 | $15 | |
| Variable cost | 4 | 5 | |
| Contribution margin | $8 | $10 | |
| Units sold | 30,000 | 20,000 | |
| Net Margin | $240,000 | $200,000 | $440,000 |
| Budgeted fixed manufacturing overhead | | | 258,000 |
| Net income | | | $182,000 |

b. Prior to preparing the budgeted absorption costing income statement, the budgeted fixed manufacturing overhead rate is calculated, which requires computing the budgeted number of machine minutes.

**Avant Designs**
Calculation of Budgeted Machine Minutes
Current Year

| | Change in Inventory | Units Sold | Units Produced | Machine Minutes/unit | Total Machine minutes |
|---|---|---|---|---|---|
| Aztec | 3,000 | 30,000 | 33,000 | 2 | 66,000 |
| Mayan | 1,000 | 20,000 | 21,000 | 3 | 63,000 |
| Budgeted machine minutes | | | | | 129,000 |

Fixed manufacturing overhead rate = $258,000 / 129,000 = $2/machine minute

The next step is calculating the fully absorbed cost of manufacturing each bracelet.

**Avant Designs**
Calculation of Fully Absorbed Cost per Bracelet
Current Year

| | Variable Cost | Machine Minutes/unit | Fixed Manufacturing Overhead Rate/machine Minute | Overhead per Bracelet | Fully Absorbed Cost per Bracelet |
|---|---|---|---|---|---|
| Aztec | $4 | 2 | $2 | $4 | $8 |
| Mayan | $5 | 3 | $2 | $6 | $11 |

Using the preceding fully absorbed manufacturing costs per bracelet, the absorption cost income statement follows:

**Avant Designs**
Budgeted Income Statement - Absorption Costing
Current Year

| | Aztec | Mayan | Total |
|---|---|---|---|
| Sales price | $12 | $15 | |
| Absorption cost | 8 | 11 | |
| Net margin per bracelet | $4 | $4 | |
| Units sold | 30,000 | 20,000 | |
| Net Margin | $120,000 | $80,000 | |
| Net income | | | $200,000 |

c. Absorption costing net income ($200,000) is $18,000 higher than net income calculated under variable costing ($182,000) because $18,000 of fixed manufacturing inventory is in the ending inventory of the two bracelets.

**Avant Designs**
Reconciliation of Net Incomes Computed Using Absorption and Variable Costing
Current Year

| | Change in inventory | Machine Minutes per Bracelet | Machine Minutes in Inventory |
|---|---|---|---|
| Aztec | 3,000 | 2 | 6,000 |
| Mayan | 1,000 | 3 | 3,000 |
| Total machine minutes in inventory | | | 9,000 |
| Fixed manufacturing overhead rate per machine minute | | | $2 |
| Total fixed manufacturing overhead in inventory | | | $18,000 |

Alternatively, if the ending inventories are computed using variable and absorption costing the difference again should be the $18,000:

**Avant Designs**

Reconciliation of Net Incomes Computed Using Absorption and Variable Costing

Current Year

| | Ending Inventory | Variable Cost per Bracelet | Ending Inventory Value |
|---|---|---|---|
| Aztec | 3,000 | $4 | $12,000 |
| Mayan | 1,000 | $5 | 5,000 |
| Ending Inventory (variable costing) | | | $17,000 |

| | Ending Inventory | Full Absorption Cost per Bracelet | Ending InventoryValue |
|---|---|---|---|
| Aztec | 3,000 | $8 | $24,000 |
| Mayan | 1,000 | $11 | 11,000 |
| Ending Inventory (absorption costing) | | | $35,000 |
| | | Difference in inventory values | $18,000 |

**P 10-15: Solution to Taylor Chains** (35 minutes)
[Variable versus absorption costing]

a. The overhead rate for the year:

| | **Challenger** | **Tour** | **Total** |
|---|---|---|---|
| Number of units produced | 43,000 | 55,000 | |
| Direct labor hours per unit | 2 | 3 | |
| Expected direct labor hours | 86,000 | 165,000 | 251,000 |
| Variable OH per DL hour | | | €1.75 |
| Variable overhead | | | €439,250 |
| Fixed overhead | | | 1,650,000 |
| Total overhead | | | €2,089,250 |
| Overhead rate / DL hour | | | €8.3237 |

b. Product line and firm net income for the year:

| | Challenger | Tour | Total |
|---|---|---|---|
| Number of units sold | 40,000 | 52,000 | |
| Direct labor hours per unit | 2 | 3 | |
| Direct labor hours | 80,000 | 156,000 | 236,000 |
| Actual overhead incurred | | | €2,100,000 |
| Direct labor cost per hour | €22 | €22 | |
| Direct materials per unit | €45 | €61 | |
| Sales price | €110 | €155 | |
| | | | |
| Revenue | €4,400,000 | €8,060,000 | €12,460,000 |
| Direct materials | 1,800,000 | 3,172,000 | 4,972,000 |
| Direct labor | 1,760,000 | 3,432,000 | 5,192,000 |
| Manufacturing overhead | 665,896 | 1,298,498 | 1,964,394 |
| Under absorbed overhead | | | 10,750 |
| Net income | €174,104 | €157,502 | €320,856 |
| | | | |
| Ending inventory | 3,000 | 3,000 | |
| Direct labor hours in inventory | 6000 | 9000 | |
| Overhead in inventory | €49,942 | €74,913 | €124,856 |
| | | | |
| Total OH in products sold | | | €1,964,394 |
| Over absorbed OH written off | | | 10,750 |
| Overhead in inventory | | | 124,856 |
| Total overhead incurred | | | €2,100,000 |

Taylor reports net income (using absorption costing) of €487,856. But because they over produced, €124,856 of fixed manufacturing inventory was in inventory, and not in net income. At the bottom of the table we see that the sum of the overhead included in product costs, plus the overhead in inventory, plus the under absorbed overhead written off to cost of goods sold equals the total overhead incurred.

c. Variable costing net income:

| | Challenger | Tour | Total |
|---|---|---|---|
| Revenue | €4,400,000 | €8,060,000 | €12,460,000 |
| Direct materials | 1,800,000 | 3,172,000 | 4,972,000 |
| Direct labor | 1,760,000 | 3,432,000 | 5,192,000 |
| Var. mfgg overhead | 140,000 | 273,000 | 413,000 |
| Product line profits | €700,000 | €1,183,000 | €1,883,000 |
| Fixed overhead | | | 1,650,000 |
| Under absorbed overhead* | | | 10,750 |
| Net income | | | €222,250 |

* 2,100,000 - 413,000 - 1,650,000 - 15,000 × €1.75

d. Absorption net income of €320,856 in part (b) is higher than variable cost net income of €222,250 in part (c) because Taylor produced more chains than it sold. The full absorption cost of the 6,000 chains added to inventory contained some allocated fixed overhead. Under variable costing, all fixed manufacturing overhead is written off against net income, none is allocated to inventory, and hence variable costing net income is lower when firms produce more than they sell.

The following table reconciles the difference in net incomes between parts (b) and (c) as the amount of fixed manufacturing overhead added to inventory. The difference in net incomes is due to the fixed overhead per direct labor hour (€8.3237 - €1.7500) times the number of direct labor hours in inventory (15,000).

| | | | |
|---|---|---|---|
| Absorption cost net income | | | €320,856 |
| Variable cost net income | | | €222,250 |
| Difference | | | €98,606 |
| | **Challenger** | **Tour** | |
| Ending inventory | 3,000 | 3,000 | |
| Direct labor hours in inventory | 6000 | 9000 | |
| Fixed overhead rate per DL hour* | €6.5737 | €6.5737 | |
| Fixed overhead in inventory | €39,442 | €59,163 | €98,606 |

* €8.3237 - €1.7500

e. Under absorption costing, Taylor Chains income statement will contain €2,424,856 of manufacturing overhead. €2.3 million was incurred during that year and €124,856 (15,000 DL hours in inventory x €8.3237 OH per DL hour) was in inventory from the previous year.

Under variable costing, the income statement will contain €2,326,250 consisting of the €2.3 million of overhead incurred this year plus the €26,250 of variable overhead in inventory from last year (15,000 DL hours x €1.75 variable overhead per DL hour).

**P 10-16:** **Solution to Navisky** (40 minutes)
[Variable costing and incentives to over produce]

a. Mr. Hoffman, because he expects to retire next year and hence will not have to deal with any excess inventory, has an incentive to over produce. The table below indicates that given sales of 1200 units Mr. Hoffman would like to produce about 1,360 units. At 1,360 units, expected earnings are about €1,401,647, or just above the bonus cap of €1,400,000. So to maximize his bonus, Mr. Hoffman will want to produce 1,360 units, or 160 more than he expects to sell.

| | | | | |
|---|---|---|---|---|
| Production | 1200 | 1300 | 1350 | 1360 |
| Revenue (assuming sales of 1200 units) | €6,600,000 | €6,600,000 | €6,600,000 | €6,600,000 |
| Cost of goods sold: | | | | |
| Variable mfg cost | (456,000) | (456,000) | (456,000) | (456,000) |
| Fixed mfg overhead | (2,700,000) | (2,492,308) | (2,400,000) | (2,382,353) |
| Period costs: | | | | |
| Development costs | (900,000) | (900,000) | (900,000) | (900,000) |
| Fixed Selling and administration costs | (1,100,000) | (1,100,000) | (1,100,000) | (1,100,000) |
| Variable selling and admin costs | (360,000) | (360,000) | (360,000) | (360,000) |
| Actual earnings before taxes | €1,084,000 | €1,291,692 | €1,384,000 | €1,401,647 |
| | | | | |
| Bonus | €11,700 | €22,084 | €26,700 | €27,500 |

b. With an inventory holding cost of 20 percent deducted from earnings, Mr. Hoffman will prefer to produce 1,420 units because at this production level (and given sales of 1,200 units) Mr. Hoffman will reach the bonus cap of €27,500.

| | | | | |
|---|---|---|---|---|
| Production | 1200 | 1350 | 1400 | 1420 |
| Revenue (assuming sales of 1200 units) | €6,600,000 | €6,600,000 | €6,600,000 | €6,600,000 |
| Cost of goods sold: | | | | |
| Variable mfg cost | (456,000) | (456,000) | (456,000) | (456,000) |
| Fixed mfg overhead | (2,700,000) | (2,400,000) | (2,314,286) | (2,281,690) |
| Period costs: | | | | |
| Development costs | (900,000) | (900,000) | (900,000) | (900,000) |
| Fixed Selling and administration costs | (1,100,000) | (1,100,000) | (1,100,000) | (1,100,000) |
| Variable selling and admin costs | (360,000) | (360,000) | (360,000) | (360,000) |
| Actual earnings before inventory costs | €1,084,000 | €1,384,000 | €1,469,714 | €1,502,310 |
| | | | | |
| Ending inventory | 0 | 150 | 200 | 220 |
| Cost per unit of inventory | €2630 | €2380 | €2309 | €2281 |
| Ending inventory cost | 0 | 357,000 | 461,800 | 501,820 |
| | | | | |
| Weighted average cost of capital | 0.2 | 0.2 | 0.2 | 0.2 |
| Holding cost of inventory | 0 | (71,400) | (92,360) | (100,364) |
| | | | | |
| Earnings after inventory cost | €1,084,000 | €1,312,600 | €1,377,354 | €1,401,946 |
| Bonus | €11,700 | €23,130 | €26,368 | €27,500 |

c. Interestingly, charging Mr. Hoffman an inventory holding cost of 20 percent actually causes him to over produce even more. Without the 20 percent inventory charge Mr. Hoffman only has to produce about 1,360 units (or 160 more than he expects to sell) to reach the €1.4 million earnings cap. But with the 20 percent inventory charge, Mr. Hoffman needs to produce about 1,420 (or 220 more than he expects to sell) to reach the cap. Hence, including the inventory holding charge has the perverse incentive of actually causing Mr. Hoffman to over produce even more. The reason for this is the existence of the bonus cap, and the fact that the 20 percent charge on inventory is less than the reduction in average fixed costs charged to cost of goods sold.

d. Under variable costing and a 20 percent inventory holding cost, Mr. Hoffman will not over produce. He will produce exactly what he intends to sell, 1,200 devices. If he over produces under variable costing, earnings falls, and hence his bonus is lower.

| | | | | |
|---|---|---|---|---|
| Production | 1200 | 1350 | 1390 | 1400 |
| Revenue (assuming sales of 1200 units) | €6,600,000 | €6,600,000 | €6,600,000 | €6,600,000 |
| Cost of goods sold: | | | | |
| Variable mfg cost | (456,000) | (456,000) | (456,000) | (456,000) |
| Fixed mfg overhead | (2,700,000) | (2,700,000) | (2,700,000) | (2,700,000) |
| Period costs: | | | | |
| Development costs | (900,000) | (900,000) | (900,000) | (900,000) |
| Fixed Selling and administration costs | (1,100,000) | (1,100,000) | (1,100,000) | (1,100,000) |
| Variable selling and admin costs | (360,000) | (360,000) | (360,000) | (360,000) |
| Actual earnings before inventory cost | €1,084,000 | €1,084,000 | €1,084,000 | €1,084,000 |
| | | | | |
| Ending inventory | 0 | 150 | 190 | 200 |
| Cost per unit of inventory | 380 | 380 | 380 | 380 |
| ending inventory cost | 0 | 57,000 | 72,200 | 76,000 |
| | | | | |
| Weighted average cost of capital | 0.2 | 0.2 | 0.2 | 0.2 |
| Holding cost of inventory | 0 | (11,400) | (14,440) | (15,200) |
| | | | | |
| Earnings after inventory cost | €1,084,000 | €1,072,600 | €1,069,560 | €1,068,800 |
| Bonus | €11,700 | €11,130 | €10,978 | €10,940 |

**P 10-17: Solution to DIM** (45 minutes)
[The incentive to over produce only holds when average cost is falling]

a. While management expects to sell six units, they will want to produce 10 units because this increases absorption costing profits. At 10 units, DMI's average cost is at its minimum. Once DMI produces more than 10 units, average product costs start to rise and profits fall as shown in the following table.

| | | | | | | |
|---|---|---|---|---|---|---|
| production | 6 | 7 | 8 | 9 | 10 | 11 |
| unit sales | 6 | 6 | 6 | 6 | 6 | 6 |
| price | $500,000 | $500,000 | $500,000 | $500,000 | $500,000 | $500,000 |
| Revenue | $3,000,000 | $3,000,000 | $3,000,000 | $3,000,000 | $3,000,000 | $3,000,000 |
| Mfg cost | 2,314,000 | 2,130,857* | 2,017,500 | 1,953,333 | 1,926,000 | 1,927,636 |
| Profit | $686,000 | $869,143 | $982,500 | $1,046,667 | $1,074,000 | $1,072,364 |

* $2,486,000 × 6/7

b. While management expects to sell 11 units, they will want to produce 11 units because higher levels of production reduce absorption costing profits. Since average cost is increasing past 10 units, management will try to produce as close to 11 units as possible as shown in the table below.

| | | | | | |
|---|---|---|---|---|---|
| production | 11 | 12 | 13 | 14 | 15 |
| unit sales | 11 | 11 | 11 | 11 | 11 |
| price | $400,000 | $400,000 | $400,000 | $400,000 | $400,000 |
| Revenue | $4,400,000 | $4,400,000 | $4,400,000 | $4,400,000 | $4,400,000 |
| Mfg cost | 3,534,000 | 3,580,500* | 3,663,846 | 3,779,286 | 3,923,333 |
| Profit | $866,000 | $819,500 | $736,154 | $620,714 | $476,667 |

* $3,906,000 × 11/12

c. In part (a) management will over produce as much as they can up to 10 units. In part (b), they have a disincentive to over produce, and will try to under produce because average cost is rising in the region of the cost curve beyond 10 units. This illustrates that the incentive to over produce only operates in the region of the cost curve where average costs are falling.

d. Average costs can increase if beyond a certain quantity of production (i) variable costs per unit increase due to having to add a night shift that requires higher hourly wages or congestion costs increase, or (ii)additional fixed costs must be incurred because the firm must add capacity (a step cost).

**P 10–18:** **Solution to Easton Plant** (45 minutes)
[Variable costing with overabsorbed overhead]

a. Expected machine minutes for the year is 73,620 (40,300 + 33,320)
Overhead rate = [$820,000 + $3.00 × 73,620] / 73,620
= $14.14

b. Actual machine hours are used to absorb overhead to the products. Thus, the amount of overhead absorbed is:

Overhead absorbed = (44,640 + 38,220) × $14.14
= 82,860 × $14.14
= $1,171,640

Overhead incurred = $1,084,080

Overaborsbed overhead = $87,560

c. To calculate the effect of switching to variable costing requires calculating how much fixed cost is in the ending inventory. The ending inventory contains 23,700 minutes of machine time. Each minute of machine time absorbs $11.14

($820,000 ÷ 73,620 or $14.14 - $3.00) of fixed overhead.  Therefore, there is $264,018 ($11.14 × 23,700) of fixed overhead in inventory under absorption costing.  Under variable costing these fixed costs would be written off to income, thereby lowering net income by $264,018.

d. The following table presents the analysis:

| | |
|---|---|
| Total overhead incurred | $1,084,080 |
| Fixed overhead | (820,000) |
| Variable overhead | 264,080 |
| actual machine hours | ÷82,860 |
| Variable overhead per machine minute | $ 3.19 |
| x Machine minutes in inventory | ×23,700 |
| Variable overhead in inventory | $75,603 |
| Variable overhead from part (c) (23,700×$3) | (71,100) |
| Difference in inventory | $ 4,503 |

In part (c), variable costing inventory value is $71,100.  Under the assumptions in part (d), the variable cost inventory is $75,603, or $4,503 higher.  This means that if the assumptions in part (d) are used in calculating variable cost income, then net income under this version of variable costing is $259,515 lower than absorption income ($264,018 - $4,503).

Parts (c) and (d) illustrate that variable costing still involves discretion. Whenever actual overhead incurred differs from that predicted by the flexible overhead budget, discretion is required as to whether the difference is fixed or variable.

**P 10–19:** **Solution to Weststar Appliances** (45 minutes)
[Overproduction incentives and ROA and residual income]

a. Annual earnings for various production levels is given in the following table:

| | | | |
|---|---|---|---|
| 4th quarter production | 10,000 | 15,000 | 20,000 |
| 1st 3 quarters production | 58,000 | 58,000 | 58,000 |
| Annual production | 68,000 | 73,000 | 78,000 |
| | | | |
| Expected sales (units) | 73,000 | 73,000 | 73,000 |
| | | | |
| Revenues | $14,600,000 | $14,600,000 | $14,600,000 |
| Cost of sales from beg inventory[1] | (450,000) | 0 | 0 |
| Variable manufacturing costs | (5,100,000) | (5,475,000) | (5,475,000) |
| Fixed manufacturing cost | (1,300,000) | (1,300,000) | (1,216,667)[2] |
| Variable selling cost[3] | (1,095,000) | (1,095,000) | (1,095,000) |
| Fixed selling & administrative cost | (2,920,000) | (2,920,000) | (2,920,000) |
| Net income | $3,735,000 | $3,810,000 | $3,893,333 |

[1] 5,000 units × $90/unit
[2] $1,300,000 × (73,000/78,000)
[3] 73,000 × $15

b. Tweedie is likely to produce 20,000 washers in the fourth quarter or 78,000 for the year as this level maximizes reported profit.

c. The ending inventory values for various production levels are:

| | | | |
|---|---|---|---|
| Annual production | 68,000 | 73,000 | 78,000 |
| | | | |
| Beginning inventory | 12,000 | 12,000 | 12,000 |
| Production | 68,000 | 73,000 | 78,000 |
| Less: Sales | (73,000) | (73,000) | (73,000) |
| Ending inventory | 7,000 | 12,000 | 17,000 |
| | | | |
| Ending Inventory @ LIFO cost: | | | |
| Units from the beginning inventory | 7,000 | 12,000 | 12,000 |
| Valued at $90/washer | $630,000 | $1,080,000 | $1,080,000 |
| Units from current year production | 0 | 0 | 5,000 |
| Valued at current year cost: | | | |
| ($75 + $1,300,000/78,000 = $91.6666) | | | $458,333 |
| Total inventory value at cost (LIFO) | $630,000 | $1,080,000 | $1,538,333 |

d. Residual income for various production levels:

| Annual production | 68,000 | 73,000 | 78,000 |
|---|---|---|---|
| Total inventory value at cost (LIFO) | $630,000 | $1,080,000 | $1,538,333 |
| Invested capital excluding inventories | 18,000,000 | 18,000,000 | 18,000,000 |
| Total invested capital | $18,630,000 | $19,080,000 | $19,538,333 |
| Times weighted average cost of capital | 0.17 | 0.17 | 0.17 |
| Residual income[1] | $567,900 | $566,400 | $571,817 |

[1] Net income – 15% × total invested capital

Based on the above data, Tweedie is likely to produce 78,000 washers since this level maximizes her residual income.

e. ROA for various production levels:

| Annual production | 68,000 | 73,000 | 78,000 |
|---|---|---|---|
| Net income | $3,735,000 | $3,810,000 | $3,893,333 |
| Divided by Total invested capital | $18,630,000 | $19,080,000 | $19,538,333 |
| ROA | 20.05% | 19.97% | 19.93% |

If Tweedie is rewarded based on ROA she is likely to produce 68,000 washers for the year.

**P 10–20:** **Solution to Blauvelt Products** (45 minutes)
[Variable costing can still create incentives to overproduce]

a. Net income in year 1 using absorption costing and variable costing is the same because production and sales are the same. There is no inventory at the end of the year. Net income under both absorption and variable costing is:

**Absorption Costing Net Income**
**Year 1**

| | |
|---|---|
| Revenue (80,000 × $30) | $2,400,000 |
| Direct material & labor (80,000 × $5) | 400,000 |
| Overhead (80,000 × $14.50*) | 1,160,000 |
| Net income | $ 840,000 |

*$14.50 = ($1,000,000 + $2 × 80,000) / 80,000

**Variable Costing Net Income**
**Year 1**

| | |
|---|---|
| Revenue (80,000 × $30) | $2,400,000 |
| Direct material & labor (80,000 × $5) | 400,000 |
| Variable overhead (80,000 × $2.00) | 160,000 |
| Fixed overhead | 1,000,000 |
| Net income | $ 840,000 |

b. Net income in year 2 using absorption costing where the overhead rate used to assign overhead to products is based on actual overhead incurred

**Absorption Costing**
**Year 2**

| | |
|---|---|
| Revenue (60,000 × $30) | $1,800,000 |
| Direct material & labor (60,000 × $5) | 300,000 |
| Overhead (60,000 × $16.875*) | 1,012,500 |
| Net income | $ 487,500 |

*$16.875 = $1,350,000 / 80,000

c. Net income in year 2 using variable costing where the difference between budgeted overhead and actual overhead is treated as a fixed cost.

**Variable Costing**
**(Excess overhead is treated as fixed)**
**Year 2**

| | |
|---|---|
| Revenue (60,000 × $30) | $1,800,000 |
| Direct material & labor (60,000 × $5) | 300,000 |
| Variable overhead (60,000 × $2) | 120,000 |
| Fixed overhead ($1,000,000 + (1,350,000 – 1,160,000*) | 1,190,000 |
| Net income | $ 190,000 |

*$1,160,000 = $1,000,000 + $2 × 80,000

d. Net income in year 2 using variable costing where any difference between budgeted overhead and actual overhead is treated as a variable cost.

**Variable Costing**
**(Excess overhead is treated as variable)**
**Year 2**

| | |
|---|---|
| Revenue (60,000 × $30) | $1,800,000 |
| Direct material & labor (60,000 × $5) | 300,000 |
| Variable overhead (60,000 × $4.375*) | 262,500 |
| Fixed overhead | 1,000,000 |
| Net income | $ 237,500 |

*$4.375 = $2.00 + ($1,350,000 – 1,160,000)/80,000

e. Absorption costing reports higher net income ($487,500) than variable costing ($190,000 or $237,500) when production exceeds sales because some of the fixed overhead costs are placed in the ending inventory. However, by treating the excess overhead costs as variable (part d) some of these excess overhead costs are placed in inventory by over producing. Thus, variable costing does not totally eliminate the incentives to over produce.

**P 10-21: Solution to UniCom** (45 minutes)
[Variable vs. absorption costing]

a. Variable cost income statements for 2009 and 2010 (thousands)

| | | **2009** | | | **2010** | |
|---|---|---|---|---|---|---|
| | **2.4 GHz** | **6.0Ghz** | **Total** | **2.4 GHz** | **6.0Ghz** | **Total** |
| Revenue | $4,500 | $4,680 | $9,180 | $4,500 | $4,680 | $9,180 |
| Variable Mfg Cost | 2,750 | 2,100 | 4,850 | 2,750 | 2,100 | 4,850 |
| Operating margin | $1,750 | $2,580 | $4,330 | $1,750 | $2,580 | $4,330 |
| Fixed mfg costs | | | 4,000 | | | 4,000 |
| Variable cost net income | | | $330 | | | $330 |

b. Absorption cost income statements for 2009 and 2010 using FIFO:

The first step is to allocate the fixed manufacturing overhead to the phones produced based on direct material dollars:

| | | **2009** | | | **2010** | |
|---|---|---|---|---|---|---|
| | **2.4 GHz** | **6.0Ghz** | **Total** | **2.4 GHz** | **6.0Ghz** | **Total** |
| **Allocate fixed mfg cost based on Direct Materials** | | | | | | |
| Direct materials per phone | $18.00 | $24.00 | | $18.00 | $24.00 | |
| Phones produced | 120,000 | 70,000 | | 90,000 | 50,000 | |
| Total Direct materials | $2,160 | $1,680 | $3,840 | $1,620 | $1,200 | $2,820 |
| % of total Direct material | 56.25% | 43.75% | | 57.45% | 42.55% | |
| Allocated fixed mfg overhead (000) | $2,250 | $1,750 | $4,000 | $2,298 | $1,702 | $4,000 |
| Fixed mfg overhead per phone produced | $18.75 | $25.00 | | $25.53 | $34.04 | |
| Phones in inventory at beginning of year | 0 | 0 | | 20,000 | 10,000 | |
| Phones sold from current year production | 100,000 | 60,000 | | 80,000 | 50,000 | |
| Fixed OH of phones sold (FIFO): | | | | | | |
| Beginning inventory (units) | 0 | 0 | | 20,000 | 10,000 | |
| Produced this year (units) | 100,000 | 60,000 | 0 | 80,000 | 50,000 | |
| Beginning inventory ($) | 0 | 0 | | 20,000 x $18.75 | 10,000 x $25.00 | |
| Produced this year ($) | 100,000 x $18.75 | 60,000 x $25.00 | | 80,000 x $25.53 | 50,000 x $34.04 | |
| Beginning inventory ($) (000) | $0 | $0 | $0 | $375 | $250 | $625 |
| Produced this year ($) (000) | 1,875 | 1,500 | 3,375 | 2,043 | 1,702 | 3,745 |
| Fixed OH of phones sold | $1,875 | $1,500 | $3,375 | $2,418 | $1,952 | 4,370 |

**FIFO ABSORPTION COST NET INCOME (000)**

| | 2009 | | | 2010 | | |
|---|---|---|---|---|---|---|
| | **2.4 GHz** | **6.0Ghz** | **Total** | **2.4 GHz** | **6.0Ghz** | **Total** |
| Revenue | $4,500 | $4,680 | $9,180 | $4,500 | $4,680 | $9,180 |
| Variable Mfg Cost | 2,750 | 2,100 | 4,850 | 2,750 | 2,100 | 4,850 |
| Operating margin | $1,750 | $2,580 | $4,330 | $1,750 | $2,580 | $4,330 |
| Fixed OH of phones sold | 1,875 | 1,500 | 3,375 | 2,418 | 1,952 | 4,370 |
| Absorption cost net income | -$125 | $1,080 | $955 | -$668 | $628 | -$40 |

c. Reconciliation of variable and absorption cost net incomes for 2009 and 2010 (FIFO):

| | **Variable Costing** | **Absorption Costing** | **Difference** |
|---|---|---|---|
| 2009 net income | $330 | $955 | -$625 |
| 2010 net income | 330 | -40 | $370 |
| Total | | | -$255 |
| | 2009 | 2010 | |
| Units in inventory | | | |
| 2.4 Ghz | 20,000 | 10,000 | |
| 6.0 Ghz | 10,000 | 0 | |
| | | | |
| Fixed OH in inventory | | | |
| 2.4 Ghz | $375,000 | $255,319 | |
| 6.0 Ghz | 250,000 | 0 | |
| Total | $625,000 | $255,319 | |

The difference between absorption and variable cost net incomes in 2009 is $625,000, which is the amount of fixed overhead in the inventory at the end of 2009. At the end of 2010, the cumulative difference between absorption and variable cost net incomes (i.e., the sum of the net incomes from 2009 and 2010) is $255,000, which is the amount of fixed overhead remaining in the inventory at the end of 2010.

If instead of using FIFO, had Unicom used LIFO, the following would be the absorption cost net incomes for 2090 and 2010.

b. Absorption cost net income for 2009 and 2010 (LIFO).

| | 2009 | | | 2010 | | |
|---|---|---|---|---|---|---|
| | **2.4 GHz** | **6 Ghz** | **Total** | **2.4 GHz** | **6 Ghz** | **Total** |
| Direct materials per phone | $18.00 | $24.00 | | $18.00 | $24.00 | |
| Phones produced | 120,000 | 70,000 | | 90,000 | 50,000 | |
| Total direct materials (000) | $2,160 | $1,680 | $3,840 | $1,620 | $1,200 | $2,820 |
| % of total direct material | 56.25% | 43.75% | | 57.45% | 42.55% | |
| Allocated fixed mfg overhead (000) | $2,250 | $1,750 | $4,000 | $2,297.9 | $1,702.1 | $4,000 |
| Fixed mfg OH per phone produced in current year | $18.75 | $25.00 | | $25.53 | $34.04 | |
| Fixed mfg OH of phones produced and sold (000) in current year | $1,875 | $1,500 | $3,375 | $2,298 | $1,702 | $4,000 |

Using these allocated fixed manufacturing costs per phone, the absorption cost income statements (000):

| | 2009 | | | 2010 | | |
|---|---|---|---|---|---|---|
| | **2.4 GHz** | **6.0Ghz** | **Total** | **2.4 GHz** | **6.0Ghz** | **Total** |
| Revenue | $4,500 | $4,680 | $9,180 | $4,500 | $4,680 | $9,180 |
| Variable Mfg Cost | 2,750 | 2,100 | 4,850 | 2,750 | 2,100 | 4,850 |
| Operating margin | $1,750 | $2,580 | $4,330 | $1,750 | $2,580 | $4,330 |
| Fixed mfg cost of phones produced in current year | 1,875 | 1,500 | 3,375 | 2,298 | 1,702 | 4,000 |
| Fixed mfg cost of phones produced in prior years | | | 0 | 188 | 250 | 437 |
| Absorption cost net income | -$125 | $1,080 | $955 | -$735 | $628 | -$107 |

c. Reconciliation of variable and absorption cost net incomes for 2009 and 2010 (LIFO):

| | **Variable Costing** | **Absorption Costing** | **Difference** |
|---|---|---|---|
| 2009 net income | $330,000 | $955,000 | $625,000 |
| 2010 net income | 330,000 | -107,500 | -$437,500 |
| total net income | $660,000 | $847,500 | $187,500 |

Fixed mfg OH added (deducted from) to inventory

| | **2009** | **2010** | |
|---|---|---|---|
| 2.4 Ghz | $375,000 | -$187,500 | |
| 6.0 Ghz | $250,000 | -$250,000 | |
| Total | $625,000 | -$437,500 | $187,500 |

**P 10–22:** **Solution to Sants Brakes Co.** (50 minutes)
[Converting from variable to absorption costing with a three product plant]

a. The first step in converting from variable to absorption costing is to compute the full cost of each product. This requires the overhead rate to be calculated:

Fixed Overhead Rate: $\dfrac{\$3{,}600{,}000 \text{ fixed overhead}}{1{,}800{,}000 \text{ machine hours}}$ = \$2/machine hour

Unit variable cost:

| | Cost of Goods Sold | Units Sold | Unit Variable Cost |
|---|---|---|---|
| G–226 . . . . . . . . . . . . | \$5,200 | 650 | \$8 |
| G–348 . . . . . . . . . . . . | 840 | 280 | 3 |
| G–714 . . . . . . . . . . . . | 480 | 120 | 4 |

| | Hours Per Unit | Machine Hour Rate | Unit Fixed Cost |
|---|---|---|---|
| G–226 . . . . . . . . . . . . | 0.5 | \$2 | \$1 |
| G–348 . . . . . . . . . . . . | 2 | 2 | 4 |
| G–714 . . . . . . . . . . . . | 4 | 2 | 8 |

| | Unit Variable Cost | Unit Fixed Cost | Unit Full Cost |
|---|---|---|---|
| G–226 . . . . . . . . | \$8 | \$1 | \$ 9 |
| G–348 . . . . . . . . | 3 | 4 | 7 |
| G–714 . . . . . . . . | 4 | 8 | 12 |

The next step is to calculate any over/underabsorbed overhead arising from using budgeted volume of 1.8 million machine hours instead of actual machine hours.

Total machine hours (in thousands):

| | Units Sold | Increase in Inventory. | Units Produced | Machine hours per unit | Total Machine hours |
|---|---|---|---|---|---|
| G–226 | 650 | 70 | 720 | 0.5 | 360 |
| G–348 | 280 | 40 | 320 | 2 | 640 |
| G–714 | 120 | 30 | 150 | 4 | 600 |
| | | Actual machine hours | | | 1,600 |
| | | Idle capacity | | | 200 |
| | | Budgeted hours | | | 1,800 |
| Underabsorbed overhead (200 × \$2) | | | | | \$ 400 |

Given the preceding analyses, we can now prepare the income statement on an absorption costing basis.

**Sants Brakes Company**
2001 Full Cost Income Statement

| | 226 | 348 | 714 | Total |
|---|---|---|---|---|
| No. of units sold | 650 | 280 | 120 | |
| Sales | $7,800 | $2,240 | $1,920 | $11,960 |
| Cost of goods sold/unit | $9 | $7 | $12 | |
| Cost of goods sold | $5,850 | $1,960 | $1,440 | ($9,250) |
| Underabsorbed overhead (Idle capacity × Unit cost) | | | | (400) |
| Income | | | | $2,310 |

b. Income from manufacturing (in thousands):

| | |
|---|---|
| Absorption | $2,310 |
| Variable costing | 1,840 |
| Difference | $ 470 |

The income from manufacturing is higher on the absorption cost statement because of the carryover of fixed overhead to the next year as a part of the cost of the ending inventory.

| | (In thousands of units) Ending Inventory | Beginning Inventory | Increase in Inventory Units | Unit Machine Hours | Machine Hour Difference |
|---|---|---|---|---|---|
| G–226 | 90 | 20 | 70 | 0.5 | 35 |
| G–348 | 90 | 50 | 40 | 2 | 80 |
| G–714 | 50 | 20 | 30 | 4 | 120 |
| Machine hour difference | | | | | 235 |

235,000 machine hours retained in inventories × $2 rate per hour = $470,000 difference in income.

**Case 10-1: Solution to Joon** (60 minutes)
[Adding volume to absorb overhead]

a. The following table reallocates the manufacturing overhead per product line after recalculating the overhead rates assuming that the additional $450,000 of manufacturing overhead is allocated among all the product lines.

| | Stick Goods | Floor care | Brushes | Aerosols | Car Care | Total |
|---|---|---|---|---|---|---|
| Quantity (000 cases) | 20 | 35 | 15 | 30 | 60 | |
| Direct labor hours/case | 1.5 | 1 | 2 | 1.6 | 1.9 | |
| Total direct labor hours (000) | 30 | 35 | 30 | 48 | 114 | 257 |
| | | | | | | |
| Manufacturing Cost per Case: | | | | | | |
| Direct material | $51.00 | $21.00 | $31.00 | $11.00 | $18.00 | |
| Variable overhead | 5.25 | 3.50 | 7.00 | 5.60 | 6.65 | |
| Direct labor cost | 31.50 | 21.00 | 42.00 | 33.60 | 39.90 | |
| Fixed manufacturing overhead* | 28.50 | 19.00 | 38.00 | 30.40 | 36.10 | |
| Total cost per case | $116.25 | $64.50 | $118.00 | $80.60 | $100.65 | |
| | | | | | | |
| Selling price per case | $165 | $122 | $189 | $145 | $138 | |
| Total revenue (000) | 3300 | 4270 | 2835 | 4350 | 8280 | $23,035.00 |
| Operating margin per case | 48.75 | 57.50 | 71.00 | 64.40 | 37.35 | |
| Total operating margin (000) | 975 | 2012.5 | 1065 | 1932 | 2241 | $8,225.50 |
| | | | | | | |
| SGA (000): | | | | | | |
| Fixed | | | | | | (1,750.00) |
| Variable (20% of revenues) | | | | | | (4,607.00) |
| Net income (000) | | | | | | $1,868.50 |

*Fixed manufacturing overhead rate = ($4.433 million + $.450 million)/.257 million direct labor hours = $19/DL hour

An alternative, more straightforward solution is to examine the incremental costs and revenues from adding Snuffy to Joon.

| | |
|---|---|
| Net income (loss) | ($32.50) |
| Car care revenue | 8,280.00 |
| Car care variable cost | (3,873.00) |
| Additional manufacturing overhead | (450.00) |
| Additional fixed SGA | (400.00) |
| Additional variable SG&A | (1,656.00) |
| Total profit with Snuffy | $1,868.50 |

b. No. While adding Snuffy's car care line does increase net income by approximately $1.9 million (from -$32,000 to $1,868,000), the Snuffy acquisition is a negative NPV project. The $1.9 million improvement is before taxes. Assume a 30 percent tax rate. The additional before tax net cash flow from Snuffy is about $1.9. Then the after-tax cash flow is about $1.3 million, which generates about a 3 percent internal rate of return on a $38 million investment. This is clearly too low a return to justify the purchase of Snuffy, given there are no synergies from this acquisition.

c. Joon's arguments for acquiring Snuffy (to reduce the overhead being allocated to existing Joon products) is flawed. It is certainly the case that Joon's products are absorbing a lot of overhead and that by bringing Snuffy into the plant, the average reported cost of Joon's products will fall. But the marginal cost of producing these products does not change.

Joon has gotten itself into a death spiral. The product managers are trying to recover the higher fixed cost allocations by raising the prices of their products, further reducing the demand for these products.

Joon has excess capacity and a flawed organizational architecture. Product managers are being charged full cost transfer prices for Joon products and these managers are building these full costs into the prices they are setting for Joon products. Bringing in Snuffy's auto products, just to add capacity to the plant is a very costly (negative net present value investment) way to lower the allocated overhead charges on Joon's products.

d. Joon should change their manufacturing overhead accounting. They should stop allocating fixed overheads to the products. Alternatively, they can take a one-time charge to earnings of the book value of the plant and equipment. This would then eliminate (or at least reduce) the annual depreciation that is included in the overhead rates.

Alternatively, they could remove the pricing decisions from the product line managers and set the prices centrally, where the prices are not based on the reported costs that include the allocated fixed manufacturing overhead.

# CHAPTER 11
## CRITICISMS OF ABSORPTION COST SYSTEMS: INACCURATE PRODUCT COSTS

**P 11–1:** **Solution to Maui Seminar** (15 minutes)
[Pros and cons of activity-based costing systems]

The current absorption-based accounting system has survived (evolved?) up until now and is similar to the system used by many other firms in our type of industry. The fact that we hold a competitive position in the marketplace with the current system implies that it is at least adequate and has many unseen advantages (bear and marmot).

Activity-based cost systems are advantageous in plants where the output is not homogeneous in inputs or volumes. An analysis needs to be performed to determine if product costs derived from an activity-based cost system are significantly different from product costs as currently calculated. Moreover, even if some product costs change dramatically, what organizational effects will be generated with respect to performance evaluation? Who will be the winners and losers inside the firm and whose "ox will be gored?"

Activity-based cost systems are more costly to establish and maintain than absorption-based systems. ABC usually improves the accuracy of product costs for decision making. However, in improving costing for decision management, there can be a deterioration of the accounting system for decision control. Managers' incentive plans will have to be adjusted to accommodate the new accounting figures. Organizational conflicts are certain to occur. There will be winners and losers. In the extreme, unless performance reward systems are adjusted the firm will lose key people over the conflicts.

**P 11–2:** **Solution to GAMMA (**15 minutes)
[Calculate absorption product cost from ABC data]

| | | |
|---|---|---|
| Plant-wide overhead rate | = | \$68.5 million ÷ \$90 million |
| | = | \$0.76111 per direct labor dollar |

Cost of Explorer Model

| | |
|---|---|
| Direct labor | \$121,700 |
| Direct material | 90,500 |
| Plant overhead (\$0.76111 × \$121,700) | 92,627 |
| Total cost | \$304,827 |
| Number of units | 12,500 |
| Product cost per unit | \$ 24.39 |

**P 11–3:** **Solution to ABC and Volume Changes** (20 minutes)
[ABC and normal costing]

a. *Unit level costs* vary with the number of units manufactured. Examples include direct labor, direct materials, machine costs, and energy.

*Batch level costs* vary not with the number of units but with the number of batches. Examples include set-ups, material movements, purchase orders, and inspections.

*Product line costs* vary with the number of different product lines in the factory. Examples include process engineering, product specifications, engineering change notices, and product enhancement activities.

*Production sustaining costs* are all remaining costs in the factory incurred to provide the capacity to produce. These costs do not vary with the number of units produced, batches processed, or product lines manufactured in the factory. Examples include plant management, building and grounds, and heating and lighting.

b. False. As long as production-sustaining costs (which are fixed with respect to all volume measures) are allocated to products based on expected or actual volume, then unit costs will vary inversely with volume. "Normal costing" must be used for each allocation base to prevent unit costs from varying with volumes. For example, batch-level costs must be allocated based on the normal number of batches over the business cycle as long as there are any fixed costs (fixed with respect to the number of batches) in batch-level costs.

**P 11–4:** **Solution to Milan Pasta** (20 minutes)
[Absorption versus activity-based costing]

a. Traditional absorption costing based on machine hours:

| | Spaghetti | Fettuccine | Total |
|---|---|---|---|
| Pounds produced | 6,000 | 2,000 | |
| Machine minutes per pound | 0.2 | 0.4 | |
| Machine minutes per day | 1,200 | 800 | 2,000 |
| Percent of time | 60% | 40% | 100% |
| | | | |
| Inspection cost | $300 | $200 | $500 |
| Inspection cost/lb. | $0.05 | $0.10 | |

Fettuccine's inspection cost per pound of $0.10 is twice as high as spaghetti's of $0.05 because fettuccine takes twice as much machine time per pound as spaghetti (0.4 minutes per pound vs. 0.2 minutes).

b. Activity-based costing using inspection time.

| | Spaghetti | Fettuccine | Total |
|---|---|---|---|
| Inspection hours | 8 | 24 | 32 |
| Percent inspection time | 25% | 75% | 100% |
| | | | |
| Inspection cost | $125 | $375 | $500 |
| Pounds produced | 6,000 | 2,000 | |
| Inspection cost/lb. | $0.0208 | $0.1875 | |

Fettuccine's per pound inspection cost is higher under ABC than absorption costing ($0.1875 vs. $0.10), whereas spaghetti's inspection cost falls from $0.05 to $0.0208.

c. When inspection costs are allocated based on actual inspection hours, fettuccine's cost of inspection per pound, instead of being twice as large, is now nine times larger than spaghetti's per-pound cost. Even though inspectors spend three times more hours inspecting fettuccine (24 hours vs. 8 hours), only one-third the amount of fettuccine is produced (2,000 pounds vs. 6,000) pounds.

In this problem, inspection costs are being converted from an indirect cost to direct cost because the times of the inspectors are being metered.

**P 11-5:** **Solution to Implementing ABC** (20 minutes)
[Decision management vs. decision control of ABC]

The author of this quote, Robin Cooper, an early advocate of ABC, makes the following implicit points:

i. ABC will not replace traditional costing methods for financial accounting.
ii. ABC will be a supplemental source of information in most firms.
iii. Dual cost systems will be used.

The author fails to discuss which system (ABC or financial accounting) will be used for performance measurement. Just giving the users control over the ABC system does not change their incentives if they are still evaluated and rewarded based on the traditional financial accounting system that remains under the control of accounting and finance.

This quotation correctly points out that in most firms, successful implementation of ABC requires the users to have the decision rights over system design, not the accounting department. The likely (unstated) reason for this being that the users have better specialized knowledge of the underlying cost drivers than the accounting department. However, the author fails to discuss two critical issues:

i. Why will anyone pay attention to the ABC numbers if they are still evaluated and compensated based on the traditional financial accounting numbers?

ii. How large are the costs of having two accounting systems reporting costs for the same products? For example, how large are the reconciliation costs and influence costs if two systems are used?

The quote is typical of ABC proponents. They assume that cost systems serve primarily a decision management function and they ignore the decision control role served by traditional systems under the control of accounting departments.

**P 11–6:** **Solution to Astin Car Stereos** (30 minutes)
[Allocating selling and distribution costs using revenue vs. ABC costing]

a. S&D expenses allocated based on sales revenue:

| | A90 | B200 | B300 | Z7 | Total |
|---|---|---|---|---|---|
| Revenue | $1,500,000 | $1,560,000 | $1,680,000 | $1,620,000 | $6,360,000 |
| Manufacturing costs | 1,200,000 | 1,170,000 | 1,200,000 | 1,080,000 | 4,650,000 |
| Gross margin | 300,000 | 390,000 | 480,000 | 540,000 | 1,710,000 |
| S&D expenses | 299,528 | 311,509 | 335,472 | 323,491 | 1,270,000 |
| Net income | $ 472 | $ 78,491 | $ 144,528 | $ 216,509 | $ 440,000 |

b. All S&D expenses allocated using advertising and marketing budget shares:

| | A90 | B200 | B300 | Z7 | Total |
|---|---|---|---|---|---|
| Advertising & marketing shares | 10% | 20% | 30% | 40% | 100% |
| S&D expenses | $127,000 | $254,000 | $381,000 | $508,000 | $1,270,000 |
| Net income | $173,000 | $136,000 | $ 99,000 | $ 32,000 | $ 440,000 |

c. Advertising & marketing costs allocated using advertising & marketing budget shares, distribution & administration costs divided equally, and selling costs assigned based on gross margin.

| | A90 | B200 | B300 | Z7 | Total |
|---|---|---|---|---|---|
| S&D expenses: | | | | | |
| 1/2 on advertising & marketing shares | $63,500 | $127,000 | $190,500 | $254,000 | $635,000 |
| 25% assigned equally | 79,375 | 79,375 | 79,375 | 79,375 | 317,500 |
| 25% on gross margin | 55,702 | 72,412 | 89,123 | 100,263 | 317,500 |
| S&D expenses | $198,577 | $278,787 | $358,998 | $433,638 | $1,270,000 |
| net income | $101,423 | $111,213 | $121,002 | $106,362 | $ 440,000 |

d. This problem illustrates that the common practice among many companies of allocating selling and distribution costs based on sales revenue can distort product-line profitability analysis. Under method (a), Z7 is the most profitable and A90 the least profitable. Under method (b), A90 is the most profitable and Z7 the least profitable. Finally, under method (c), all products are of roughly equal profitability.

The critical question involves how S&D resources are consumed by the various product lines. If the ABC-type analysis in the problem is reasonably accurate, then method (c) is probably the most accurate portrayal of product-line profitability. However, this analysis does not capture the synergies (interdependencies) among the product lines. For example, A90 may be "piggy-backing" off the reputation of Z7. Likewise, the manufacturing cost of Z7 may be lower because of the learning-curve effects of producing large numbers of A90.

Remember the Coase analysis of why firms exist. Why are all four of these stereos produced by the same firm as opposed to four separate firms? Presumably there are efficiencies that allow the four to be produced and sold more cheaply in one firm than in four separate firms. There are joint costs and joint <u>benefits</u>. These joint costs and benefits belong to all four products, and trying to divide them up can distort product-line profitability analyses. Thus, even method (c) may not be an accurate estimate of the relative profitability of a stereo line.

**P 11–7:** **Solution to DVDS** (35 minutes)
[ABC and taxes]

a. Unit manufacturing costs of Basic and Custom DVDs using traditional absorption costing. Manufacturing overhead is allocated based on direct labor dollars.

| | **Basic** | **Custom** | **Total** |
|---|---|---|---|
| Quantity | 60,000 | 70,000 | |
| Direct labor/unit | $15.00 | $ 30.00 | |
| Total direct labor | $900,000 | $2,100,000 | $3,000,000 |
| | | | |
| Percent of direct labor | 30.00% | 70.00% | |
| Allocated overhead | $600,000 | $1,400,000 | $2,000,000 |
| Quantity | 60,000 | 70,000 | |
| Overhead per unit | $10.00 | $20.00 | |
| | | | |
| Direct labor/unit | $15.00 | $30.00 | |
| Direct materials/unit | 40.00 | 80.00 | |
| Overhead/unit | 10.00 | 20.00 | |
| Unit manufacturing cost | $65.00 | $130.00 | |

b. Unit manufacturing costs of Basic and Custom DVDs using ABC. Manufacturing overhead is allocated based on number of parts.

| | **Basic** | **Custom** | **Total** |
|---|---|---|---|
| Number of parts | 140 | 160 | 300 |
| Percent of parts | 46.67% | 53.33% | 100% |
| Allocated overhead | $933,333 | $1,066,667 | $2,000,000 |
| Quantity | 60,000 | 70,000 | |
| Overhead per unit | $15.56 | $15.24 | |
| | | | |
| Direct labor/unit | $15.00 | $30.00 | |
| Direct materials/unit | 40.00 | 80.00 | |
| Overhead/unit | 15.56 | 15.24 | |
| Unit manufacturing cost | $70.56 | $125.24 | |

c. DVDS should not change its costing method because this will likely cause its total tax liability to increase. Custom DVDs are sold in the high tax rate country (35%) whereas Basic DVDs are sold in the low tax rate country (15%). Therefore, assuming that both countries' tax authorities accept absorption costing as an acceptable tax method (and apparently they are using this method now), activity-based costing causes the unit manufacturing cost of Custom DVDs to fall from $130.00 to $125.24. Higher profits in the high tax rate country generate a larger tax liability. The table below calculates that ABC would cause taxes to rise by $66,667 ($401,667 - $335,000). If DVDS uses ABC for internal reporting and absorption costing for taxes, it exposes itself to charges by tax authorities that its choice of cost allocation methods for taxes (absorption costing) is being used solely to minimize taxes and has no legitimate business purpose as evidenced by the use of ABC.

**Overhead allocated based on direct labor dollars**

| | **Basic** | **Custom** | |
|---|---|---|---|
| Revenues | $4,500,000 | $9,800,000 | $14,300,000 |
| Direct labor | 900,000 | 2,100,000 | 3,000,000 |
| Direct material | 2,400,000 | 5,600,000 | 8,000,000 |
| Overhead | 600,000 | 1,400,000 | 2,000,000 |
| Income before taxes | $600,000 | $700,000 | $1,300,000 |
| Income taxes | 90,000 | 245,000 | 335,000 |
| Net income | $510,000 | $455,000 | $965,000 |

**Overhead allocated based on part numbers**

| | Basic | Custom | |
|---|---|---|---|
| Revenues | $4,500,000 | $9,800,000 | $14,300,000 |
| Direct labor | 900,000 | 2,100,000 | 3,000,000 |
| Direct material | 2,400,000 | 5,600,000 | 8,000,000 |
| Overhead | 933,333 | 1,066,667 | 2,000,000 |
| Income before taxes | $266,667 | $1,033,333 | $1,300,000 |
| Income taxes | 40,000 | 361,667 | 401,667 |
| Net income | $226,667 | $671,667 | $898,333 |

**P 11–8: Solution to True Cost Manufacturing, Inc.** (40 minutes)
[Inaccurate ABC systems can exist]

This case study illustrates that poorly designed ABC systems trying to recover the cost of excess capacity can fail.

a. The problem is they are trying to recover a sunk cost — fixed asset depreciation of $400,000. Because volumes have fallen, the original decision to acquire this much capacity turns out to have been wrong. They should take a one-time charge to profits by writing off some or most of the $400,000 machine. This will then lower unit costs. Other issues include:

- The volume-related death spiral. When volume decreases you raise prices, volume decreases more, you raise prices more, etc.
- Is the accounting system broken? They are installing ABC to fix a broken accounting system but that is not the major problem. Allocating the historical cost of excess capacity is the problem.
- Unitized transfer price. Unitization of fixed costs provides the wrong decision information to management for short-run decision making such as pricing special orders. Beware of unitized costs.
- Both the old absorption and new ABC accounting systems are sending the wrong signal for short-run decisions. Both systems are signaling higher costs and thus the apparent necessity to raise prices. Given the high fixed costs and decreasing volume, this is an incorrect inference.
- Allocation of decision rights (decision management versus decision control). How should management change the allocation and what will the systems' changes do to the focus of management? Are the benefits of the imperfect decentralized system outweighing the costs?

b. In reviewing the data provided in Table 2, the apparent cost drivers have been identified and "properly" allocated to the parts using ABC costing. What is not apparent is that the unitized costs are misleading in the first place. Unitizing the fixed costs will cause the apparent profitability of parts to vary with volume. This unitization is misleading and should be avoided. Since the firm has so much excess capacity, the opportunity cost of this capacity is close to zero. Thus, none of the depreciation on the plant should be charged to products.

The details of the cost drivers are not provided, although one can see shifts in parts costs of up to 100 percent. The question to be asked is what effect the changes in cost will have on the workload and whether the costs of these drivers should be reduced. If no action or effort is placed on using the data obtained from the ABC system to reduce the cost of the elements, then why incur the expense of implementing ABC? The cost and benefits of the system need to be evaluated.

c. If management is gaining a better understanding of the cost drivers of the business and implementing cost reduction activities, and the reductions outweigh the cost of ABC, then they have not made a mistake.

They may have made a mistake in the implementation process. The ABC costing system is aimed at decision management. However, the finishing department did not understand the implications of the signals that ABC costs send to the rest of the firm (decision control) for short-run decisions. If the department management operated the ABC system in parallel to the old system then they could have the information required to reduce costs and not send the misleading signals within the firm.

**P 11–9:** **Solution to Friendly Grocer** (40 minutes)
[ABC in a retail store]

a. The following statement presents the ABC-based operating incomes for the three divisions.

| | Beverages | Dairy & Meats | Canned & Packaged Foods | Total |
|---|---|---|---|---|
| Sales | $250.00 | $470.00 | $620.00 | $1,340.00 |
| Direct costs: | | | | |
| Cost of Goods Sold | 200.00 | 329.00 | 527.00 | 1,056.00 |
| Indirect costs: | | | | |
| Shelf space costs | 22.50 | 31.50 | 36.00 | 90.00 |
| Handling costs | 0.00 | 15.00 | 5.00 | 20.00 |
| Coupon costs | 3.00 | 0.00 | 12.00 | 15.00 |
| Shrinkage | 1.00 | 21.00 | 6.00 | 28.00 |
| Other indirect costs | 11.02 | 18.13 | 29.04 | 58.20 |
| Total costs | 237.52 | 414.63 | 615.04 | 1,267.20 |
| Operating income | $ 12.48 | $ 55.37 | $ 4.96 | $ 72.80 |

The preceding indirect costs were calculated using the following allocation rates:

| | Beverages | Dairy & Meats | Canned & Packaged Foods |
|---|---|---|---|
| Shelf space costs | 25% | 35% | 40% |
| Handling costs | 0% | 75% | 25% |
| Coupon costs | 20% | 0% | 80% |
| Shrinkage (given) | $1 | $21 | $6 |
| Other indirect costs | 19%* | 31% | 50% |

* 19% = $200 ÷ $1056

b. Before this question can be answered, one must first determine how management will use the statement. Is the primary function of the statement decision management or decision control or both?

Without a more detailed description of the function of the statement, some, more general comments can be offered.

i. The revised, ABC statement has some attractive features. In particular, some of the previous indirect costs are metered more accurately to the three departments. These consist of handling, coupons, and shrinkage. These former indirect costs are now directly traced to the departments.

ii. Based on the apparently more accurate allocation of costs under the ABC system, it is tempting to argue that canned and packaged foods are really making a small profit (instead of a loss) and that dairy and meats is not making as much money as originally thought. However, the ABC report may be no better a gauge of relative profitability than the original statement for two reasons. First, a substantial portion of the indirect costs are occupancy costs which include accounting depreciation. Accounting depreciation is not the opportunity cost of shelf space. The opportunity cost of shelf space is the profits forgone by the product(s) not stocked. Second, the grocery store offers one stop shopping for the consumer — a joint product for the consumer. Thus, dropping a product line (e.g., canned and packaged goods) would likely severely affect the demand for the remaining products. Allocating joint and common costs can produce misleading information for dropping/adding product lines.

iii. If the financial statement is used for performance evaluation, then adopting the ABC report requires adjustments to the performance reward system. Without such adjustments there will be windfall gains and windfall losses among the department managers if their compensation is tied to their department's operating income.

iv. The issue of the other indirect costs and how to allocate them remains. Is cost of goods sold the right cost driver to tax? Does this create the desired incentives?

v. One must compare the costs of tracking the cost drivers versus the benefits from ABC.

**P 11-10:** **Solution to Houston Milling** (40 minutes)
[ABC is not necessarily more accurate]

a. The table below calculates product costs using the more disaggregate data:

**Houston Milling**
**Revised Cost Allocations Based on Disaggregated Cost Pool Data**

| | | **Setup** | | **Machining** | | |
|---|---|---|---|---|---|---|
| | | **Dept. 1** | **Dept. 2** | **Dept. 1** | **Dept. 2** | **Total** |
| Total Cost | | $3,000 | $2,000 | $8,000 | $2,000 | $15,000 |
| Allocation base | | Number of setups | Number of setups | Direct labor hours | Direct labor hours | |
| Usage: | A11 | 7 | 3 | 32 | 34 | |
| | D43 | 13 | 2 | 18 | 16 | |
| | Total | 20 | 5 | 50 | 50 | |
| Allocation rate | | $150/setup | $400/setup | $160/dl hr. | $40/dl hr. | |
| Allocations: | A11 | $1,050 | $1,200 | $5,120 | $1,360 | $8,730 |
| | D43 | 1,950 | 800 | 2,880 | 640 | 6,270 |
| | Total | $3,000 | $2,000 | $8,000 | $2,000 | $15,000 |

b. With the very limited knowledge provided in this case, one cannot discuss the pros and cons of the two different allocation bases. We know nothing of how these costs are being used by Houston. Are they being used for decision making and/or control, or for tax purposes? Given that more cost drivers and cost pools are used, one is tempted to argue that the data in part (a) is a more accurate reflection of the "true" costs of A11 and D43 than the data in Table 1. But what do we mean by "true" costs? Is this the "true" historical cost of production? For what purpose are these numbers being used? Are there joint and/or common costs in the production process? If so, then allocating these costs is not a meaningful exercise. Besides, both A11 and D43 are sold to Pratt & Whitney who presumably wants to source both housings from a single supplier (Houston). Why is more "accurate" cost data important to Houston? If the cost of one product falls, the other product's cost rises. Houston is only interested in the total profit on the P&W contract. Finally, as we will see in part (c), more complex allocations do not necessarily produce more accurate costs.

c. The table below computes the costs of A11 and D43 using setup hours and machine hours as the allocation bases.

**Houston Milling**
**Revised Cost Allocations Using**
**Setup Hours and Machine Hours in Dept. 1 and 2**

| | | *Dept. 1* | | *Dept. 2* | | *Total* |
|---|---|---|---|---|---|---|
| | | *Setup* | *Machining* | *Setup* | *Machining* | |
| Total Cost | | $3,000 | $8,000 | $2,000 | $2,000 | |
| Allocation base | | Setup hours | Machine hours | Setup hours | Machine hours | |
| Usage: | A11 | 15 | 115 | 6 | 120 | |
| | D43 | 15 | 85 | 4 | 80 | |
| | Total | 30 | 200 | 10 | 200 | |
| Allocation rate | | $100 per setup hr. | $40 per machine hr. | $200 per setup hr. | $10 per machine hr. | |
| Allocations: | A11 | $1,500 | $4,600 | $1,200 | $1,200 | $8,500 |
| | D43 | 1,500 | 3,400 | 800 | 800 | 6,500 |
| | Total | $3,000 | $8,000 | $2,000 | $2,000 | $15,000 |

d. One thing we learn from this exercise is that the simple, more aggregate allocation scheme in Table 1 provides reasonably accurate estimates of product costs. Total allocated costs to each product vary little across the three methods. For example, in Table 1 A11 has a product cost of $8,600 compared to the most accurate estimate in part (c) of $8,500, or an error of $100. Using more disaggregated data in part (a) yields a product cost estimate of $8,730 or a difference of $230. Therefore, more cost drivers do not necessarily guarantee more accurate product cost estimates. What drives "accuracy" is whether or not the cost driver used captures the "true" cause-and-effect relation.

**P 11-11:** **Solution to Sanchez Gadgets** (40 minutes)
[Using ABC to identify unprofitable products]

This problem illustrates how considering just costs to identify unprofitable products can lead to unwise decisions because ABC incorporates only costs and not benefits of having multiple products. Moreover, ABC typically ignores the common costs associated with a direct sales force.

a. Based on management's analysis of the marketing group, it seems reasonable to assign the marketing costs to the SKUs using number of SKUs, in this case ¼. Also, the inventory handling costs vary with SKUs. Dropping a SKU saves the inventory holding cost. If the direct sales force costs are assigned based on sales revenue, then the following table computes the profitability of each SKU.

| | SKU 1 | SKU 2 | SKU 3 | SKU 4 | Total |
|---|---|---|---|---|---|
| Wholesale price (to retailer) | $51.00 | $13.00 | $85.00 | $7.00 | |
| Cost (including all freight) | $29.00 | $8.00 | $49.00 | $5.00 | |
| Sales volume | 12,000 | 25,000 | 8,000 | 30,000 | |
| | | | | | |
| ABC analysis: | | | | | |
| Revenue | $612,000 | $325,000 | $680,000 | $210,000 | $1,827,000 |
| Cost of goods sold (including freight) | (348,000) | (200,000) | (392,000) | (150,000) | (1,090,000) |
| Inventory holding cost* | (69,600) | (40,000) | (78,400) | (30,000) | (218,000) |
| Marketing costs (1/4th per SKU) | (33,750) | (33,750) | (33,750) | (33,750) | (135,000) |
| Direct selling cost (% of revenue) | (117,241) | (62,261) | (130,268) | (40,230) | (350,000) |
| Net income | $43,409 | $(11,011) | $45,582 | $(43,980) | $34,000 |

* 20% of Cost of goods sold

The problem with the above analysis is that it assumes that if SKU2 is dropped, $62,261 of direct selling costs would be eliminated, and if SKU4 is dropped, $40,230 of direct selling costs would be eliminated. However, the dollars spent on the direct sales force is unlikely to change by these amounts if these SKUs were deleted. The existing sales people will be selling fewer products. Given that they have fewer SKUs to sell, they may exert more effort selling the remaining SKUs and the sales of the remaining SKUs might increase, but by how much is difficult to estimate.

An alternative SKU profitability analysis is to focus on the direct costs and allocated marketing department costs, and to ignore the direct selling costs:

| | SKU 1 | SKU 2 | SKU 3 | SKU 4 | Total |
|---|---|---|---|---|---|
| Revenue | $612,000 | $325,000 | $680,000 | $210,000 | $1,827,000 |
| Cost of goods sold (including freight) | (348,000) | (200,000) | (392,000) | (150,000) | (1,090,000) |
| Inventory holding cost | (69,600) | (40,000) | (78,400) | (30,000) | (218,000) |
| Marketing costs (1/4th per SKU) | (33,750) | (33,750) | (33,750) | (33,750) | (135,000) |
| Contribution before direct selling costs | $160,650 | $51,250 | $175,850 | ($3,750) | $384,000 |
| Direct selling costs | | | | | (350,000) |
| Net income | | | | | $34,000 |

The first table assumes that direct selling costs vary with revenues. The second table assumes they are entirely fixed and will not vary with revenues. In the second table, we see that only SKU4 is unprofitable. If SKU4 is dropped, all of its revenues are lost, but Sanchez saves SKU4's cost of goods sold, inventory holding costs, and ¼ of the marketing costs. The second table treats the direct selling costs as a JOINT COST. Like other joint costs, all of the direct selling costs of $350,000 must be incurred to generate sales of SKUs.

b. Based on the analysis in the second table in part (a), Sanchez should consider dropping SKU4. However, before this decision is made, management should consider the issues discussed in part (c), below.

c. The critical assumptions in the profitability methodology in the second table in part (a) is that there are no demand interdependencies among the four SKUs. That is, the analysis assumes that dropping a particular SKU does not affect the number of units sold of other SKUs. For example, the product line might contain a very popular, low-margin product. Retailers always buy this product and once they have incurred the fixed costs of making the purchase from Sanchez, they are more likely to buy other Sanchez products that can be included in the same shipment. Another critical assumption, discussed above, is that the sales force is a common or joint cost. Dropping a product does not cause the sales force size to drop or that they exert more effort on the remaining products and sell more. If the later is the case, then the analysis becomes more complicated. Suppose a SKU is dropped that has a contribution margin of 3 percent of its sales. This product comprises 10 percent of the total sales volume. Assume the remaining products have an average contribution margin of 5 percent and the sales force shifts its effort to the remaining products. If the firm has total sales of $2 million, then dropping the SKU with a 3 percent margin increases net cash flow by $6,000 ($2 million × 10% × (5%-3%)). In other words, the opportunity cost of selling the 3% percent margin SKU is the forgone sales of the 5 percent margin products. Dropping the 3 percent margin SKU results in still selling $2 million of products, but now (on average) 5 percent margin products are being sold. Notice, in this case, the cost assigned to each SKU is not the allocated cost of the sales force, but the opportunity cost of what net cash flow the sales force could generate without the product.

Neither table presented above captures the opportunity cost of the sales force shifting their selling effort to higher margin items when lower margin items are dropped.

## P 11-12: **Solution to Wedig Diagnostics** (45 minutes)
[ABC and taxes]

a. Unit manufacturing cost of the U.S. and EU models using total direct labor to allocate the $39 million of manufacturing overhead.

| | **U.S. Model** | **EU Model** | **Total** |
|---|---|---|---|
| Direct labor per unit | $560 | $500 | |
| Number of units sold | 15,000 | 16,800 | |
| Total direct labor | $8,400,000 | $8,400,000 | $16,800,000 |
| % of direct labor | 50% | 50% | 100% |
| Allocated overhead | $19,500,000 | $19,500,000 | $39,000,000 |
| Overhead per unit | $1,300.00 | $1,160.71 | |
| Direct labor per unit | 560.00 | 500.00 | |

| | | |
|---|---|---|
| Direct material per unit | 235.00 | 260.00 |
| Manufacturing cost per unit | $2,095.00 | $1,920.71 |

b. Unit manufacturing cost of the U.S. and EU models using the ABC analysis to allocate the $39 million of manufacturing overhead.

| | U.S. Model | EU Model | Total |
|---|---|---|---|
| # of batches | 45 | 55 | 100 |
| Percent of batches | 45% | 55% | |
| Allocated batch-related cost | $5,400,000 | $6,600,000 | $12,000,000 |
| Batch cost per unit | $ 360.00 | $ 392.86 | |
| | | | |
| # of parts per model | 40 | 80 | 120 |
| % of parts | 33.33% | 66.67% | |
| Allocate parts-related costs | $3,000,000 | $6,000,000 | $9,000,000 |
| Parts-related costs per unit | $ 200.00 | $ 357.14 | |
| | | | |
| % of direct labor | 50% | 50% | |
| Allocated labor-related costs | $9,000,000 | $9,000,000 | $18,000,000 |
| Labor-related costs per unit | $ 600.00 | $ 535.71 | |
| | | | |
| Direct labor per unit | $560.00 | $500.00 | |
| Direct material per unit | 235.00 | 260.00 | |
| Batch cost per unit | 360.00 | 392.86 | |
| Parts-related costs per unit | 200.00 | 357.14 | |
| Labor-related costs per unit | 600.00 | 535.71 | |
| Manufacturing cost per unit | $1,955.00 | $2,045.71 | |

c. Income statements (including income tax expense) for Wedig and its European. subsidiary using the unit manufacturing cost calculated in part (a) (overhead is allocated using direct labor).

| | U.S. Model | EU Model | Total |
|---|---|---|---|
| Quantity | 15,000 | 16,800 | |
| Price | $2,500.00 | $2,200.00 | |
| Manufacturing cost per unit | $2,095.00 | $1,920.71 | |
| | | | |
| Revenues | $37,500,000 | $36,960,000 | $74,460,000 |
| Cost of goods sold | (31,425,000) | (32,268,000) | (63,693,000) |
| Net income before taxes | $6,075,000 | $4,692,000 | $10,767,000 |
| Income taxes | (1,822,500) | (703,800) | (2,526,300) |
| Net income after taxes | $4,252,500 | $3,988,200 | $8,240,700 |

d. Income statements (including income tax expense) for Wedig and its European subsidiary using the unit manufacturing cost calculated in part (b) (overhead is allocated using the ABC analysis).

| | U.S. Model | EU Model | Total |
|---|---|---|---|
| Quantity | 15,000 | 16,800 | |
| Price | $2,500.00 | $2,200.00 | |
| Manufacturing cost per unit | $1,955.00 | $2,045.71 | |
| | | | |
| Revenues | $37,500,000 | $36,960,000 | $74,460,000 |
| Cost of goods sold | (29,325,000) | (34,368,000) | (63,693,000) |
| Net income before taxes | $8,175,000 | $2,592,000 | $10,767,000 |
| Income taxes | (2,452,500) | (388,800) | (2,841,300) |
| Net income after taxes | $5,722,500 | $2,203,200 | $7,925,700 |

e. The major advantage of using direct labor instead of ABC to allocate the $39 million of overhead is the lower total tax liability of the entire firm. Direct labor allocation results in a total tax liability of $2,526,300 compared to a tax liability of $2,841,300, or $315,000 difference. The usual assumed advantages of ABC, namely that it is better for decision making, are unlikely to offset the tax disadvantage of ABC in the case of Wedig. Trying to maintain two sets of books (ABC for internal use and direct labor for taxes) places Wedig at some risk if the U.S. tax authorities challenge Wedig to show that their costing methodology for taxes (direct labor) has a legitimate business purpose.

**P 11–13:** **Solution to Toby Manufacturing** (45 minutes)
[Activity-based costing of warehousing costs]

a. The first step is calculating the overhead rate:

| | Product AAA | Product BBB | Product CCC | Total |
|---|---|---|---|---|
| Projected number of units | 6,000 | 3,000 | 1,000 | |
| Direct labor per unit | × $11 | × $12 | x$16 | |
| Total direct labor cost | $66,000 | $36,000 | $16,000 | $118,000 |
| times: variable overhead rate per direct labor dollar | | | | × 120% |
| Variable overhead | | | | $141,600 |
| plus: fixed overhead | | | | $450,000 |
| Total budgeted overhead | | | | $591,600 |
| divided by: total direct labor dollars | | | | ÷$118,000 |
| Overhead rate per direct labor dollar | | | | 501.4% |

Given the overhead rate, the pro forma income statement by product line is:

**Toby Manufacturing**
**Pro Forma Income Statement**
Overhead Assigned on Direct Labor Cost

| | Product AAA | Product BBB | Product CCC | Total |
|---|---|---|---|---|
| Price per unit | $98.00 | $115.00 | $140.00 | |
| less: | | | | |
| Direct labor | $11.00 | $12.00 | $16.00 | |
| Direct material | 22.00 | 25.00 | $30.00 | |
| Overhead (501.4% of dir. lab) | 55.15 | 60.17 | 80.22 | |
| Total cost | $88.15 | $97.17 | $126.22 | |
| Gross Margin per unit | $ 9.85 | $17.83 | $ 13.78 | |
| Times: Projected number of units | 6,000 | 3,000 | 1,000 | |
| Gross margin | $59,100 | $53,490 | $13,780 | $126,370 |

Under absorption costing, all three products are profitable, but CCC is the least profitable.

b. Since half of the fixed overhead is in the warehousing function, these costs are assigned to the products using "unit days in warehousing."

**Toby Manufacturing**
**Pro Forma Income Statement**
Overhead Assigned Based on Direct Labor Cost & Warehousing Days

| | Product AAA | Product BBB | Product CCC | Total |
|---|---|---|---|---|
| Price per unit | $98.00 | $115.00 | $140.00 | |
| less: | | | | |
| Direct labor per unit | 11.00 | 12.00 | 16.00 | |
| Direct material per unit | 22.00 | 25.00 | 30.00 | |
| Variable overhead (120% of direct labor) | 13.20 | 14.40 | 19.20 | |
| Warehousing costs* | 11.84 | 35.53 | 47.37 | |
| Non-warehousing fixed costs** (190.7% direct labor) | 20.98 | 22.88 | 30.51 | |
| Total cost per unit | 79.02 | 109.81 | 143.08 | |
| Gross margin per unit | $18.98 | $ 5.19 | ($3.08) | |
| Times: Projected number of units | 6,000 | 3,000 | 1,000 | |
| Gross margin | $113,880 | $15,570 | ($3,080) | $126,370 |

| | Product AAA | Product BBB | Product CCC | Total |
|---|---|---|---|---|
| *Warehousing costs: | | | | |
| Warehouse time (cycle time - 10) | 10 | 30 | 40 | |
| Times: Number of units | 6,000 | 3,000 | 1,000 | |
| Unit days in warehousing | 60,000 | 90,000 | 40,000 | 190,000 |
| Warehousing costs assigned | $71,053 | $106,579 | $47,368 | $225,000 |
| Warehousing costs per unit | $11.84 | $35.53 | $47.37 | |
| | | | | |
| **Non-warehousing costs: | | | | |
| Non-warehousing fixed overhead | | | | $225,000 |
| ÷ Direct labor cost | | | | 118,000 |
| Fixed overhead rate | | | | 190.7% |

c. It now appears that product CCC is losing money after the warehousing costs are allocated on unit-days. However, without further analysis of how warehousing costs vary (i.e., the opportunity costs of warehousing one more unit), the allocations produced in (b) above *may* be no more representative of opportunity costs than traditional full absorption costs in (a). For example, does a unit of AAA require the same amount of space in the warehouse as a unit of CCC? Do some units require special handling or special racks? The issue is: should warehousing unit-days be *taxed*?

**P 11–14:** **Solution to Kay Enterprises** (45 minutes)
[ABC can increase taxes]

This problem demonstrates that while ABC can be useful in producing more accurate product cost data, it can increase the firm's tax liability at the same time.

The first step is to compute overhead cost per switch using direct labor and number of set-ups.

| | European Switches | U.S. Switches | Total |
|---|---|---|---|
| Batch size (000s) | 20 | 30 | |
| Number of batches | 50 | 30 | 80 |
| Final selling price | $30 | $32 | |
| Direct labor per unit | $2 | $3 | |
| Direct material per unit | $8 | $9 | |
| Fixed cost (000s) | | | $24,000 |
| Total direct labor (millions) | $2.0 | $2.7 | $4.7 |
| Allocated fixed manufacturing OH | | | |
| based on direct labor (millions) | $10.213 | $13.787 | $24.000 |
| based on setups (millions) | $ 15.00 | $9.00 | $24.000 |
| Allocated fixed OH/unit | | | |
| based on direct labor | $ 10.21 | $15.32 | |
| based on setups | $ 15.00 | $10.00 | |
| Full cost per unit | | | |
| based on direct labor | $ 20.21 | $27.32 | |
| based on setups | $ 25.00 | $22.00 | |

N/A not applicable

a. Income statements using direct labor to allocate manufacturing overhead (000s):

| | U.S. Income | Ireland Income | Total Income |
|---|---|---|---|
| Revenues | | | |
| European switches | $20,212.77 | $30,000 | |
| U.S. switches | 28,800.00 | 0 | |
| Total revenue | $49,012.77 | $30,000.00 | |
| Cost of goods sold | | | |
| European switches | 20,212.77 | 20,212.77 | |
| U.S. switches | 24,587.23 | 0 | |
| Total cost of goods sold | $44,800.00 | $20,212.77 | |
| Income before tax | $4,212.77 | $9,787.23 | |
| Income taxes | 1,474.47 | 978.72 | |
| Income after tax | $2,738.30 | $8,808.51 | $11,546.81 |

b. Income statements using setups to allocate manufacturing overhead (000s):

| | U.S. Income | Ireland Income | Total Income |
|---|---|---|---|
| Revenues | | | |
| European switches | $25,000.00 | $30,000 | |
| U.S. switches | 28,800.00 | 0 | |
| Total revenue | $53,800.00 | $30,000.00 | |
| Cost of goods sold | | | |
| European. switches | 25,000.00 | 25,000.00 | |
| U.S. switches | 19,800.00 | 0 | |
| Total cost of goods sold | $44,800.00 | $25,000.00 | |
| Income before tax | $9,000.00 | $5,000.00 | |
| Income taxes | 3,150.00 | 500.00 | |
| Income after tax | $5,850.00 | $4,500.00 | $10,350.00 |

c. The income statements in part a based on allocating overhead using direct labor are likely to be better than those in part b which allocate overhead using ABC. The reason is that taxes are lower by about $1.2 million using direct labor. Given the U.S. tax rate (35 percent) is higher than the tax rate in Ireland (10 percent), a transfer price that causes more overhead expense to be reported in the U.S. entity results in a lower overall tax liability. The direct labor allocation base causes the cost of the U.S. switches to be higher by about $5.00 per switch than if the number of batches is used as the allocation scheme. Because this is a closely held firm with the two brothers managing the two entities, control of agency problems is likely to be unimportant. Likewise, given the high margins they are earning on the switches, the pricing decision is unlikely to be sensitive to accurate product cost data. Therefore, both decision control and decision management reasons for allocating overhead costs are unlikely to be important in this firm. Thus, minimizing taxes is likely to dominate these other criteria, especially given the magnitude of the difference in taxes resulting from a change to ABC. In other words, it's hard to imagine that the decision management and decision control benefits of ABC are worth $1.2 million to justify the larger tax liability that might result if ABC is adopted.

**P 11-15:** **Solution to Goodstone Tire (**50 minutes)
[ABC allocates costs, not benefits]

a. Traditional performance report where corporate overhead is allocated based on division revenues.

| | **Racing** | **Passenger** | **Industrial** | **Total** |
|---|---|---|---|---|
| Revenue | $135.00 | $2,900.00 | $2,400.00 | $5,435.00 |
| Division variable expenses | 81.00 | 1160.00 | 1200.00 | 2441.00 |
| Division fixed expenses | 13.50 | 580.00 | 480.00 | 1073.50 |
| Corp overhead | 34.77 | 747.01 | 618.22 | 1400.00 |
| Division profits | $5.73 | $412.99 | $101.78 | $520.50 |

b. Pros: The allocation is simple, easy to understand, and creates incentives for the three divisions to cooperate.

Cons: It does not necessarily capture accurately the consumption of corporate resources by the divisions.

c. ABC performance report:

Using the percentages supplied in the problem, the following allocations of each corporate overhead item is calculated, and then used to determine divisional profits.

| | **Racing** | **Passenger** | **Industrial** | **Total** |
|---|---|---|---|---|
| R&D | $210.00 | $126.00 | $84.00 | $420.00 |
| Corporate image advertising | 198.00 | 99.00 | 33.00 | 330.00 |
| Interest | 111.00 | 185.00 | 74.00 | 370.00 |
| Corporate office | 112.00 | 126.00 | 42.00 | 280.00 |
| Total | $631.00 | $536.00 | $233.00 | $1,400.00 |

| | **Racing** | **Passenger** | **Industrial** | **Total** |
|---|---|---|---|---|
| Revenue | $135.00 | $2,900.00 | $2,400.00 | $5,435.00 |
| Division variable expense | 81.00 | 1,160.00 | 1,200.00 | 2,441.00 |
| Division fixed expense | 13.50 | 580.00 | 480.00 | 1,073.50 |
| Corp overhead | 631.00 | 536.00 | 233.00 | 1,400.00 |
| Division profits | -$590.50 | $624.00 | $487.00 | $520.50 |

d. Pros: the report appears to more accurately reflect the actual consumption of corporate resources.

Cons: Racing is now showing a large loss and will be under pressure to become "profitable." Likewise, Passenger and Industrial appear more profitable and may be tempted to consume more perks, including empire building via negative NPV projects. Higher influence costs are likely as division managers jockey over the "correct" ways to allocate various corporate overhead line items. Also, the ABC report does not capture the synergies among the three divisions.

e. Based on the consultant's conclusion that each dollar of revenue generated by Racing increases sales in the other division, we can compute how much net cash flow (contribution margin) Racing generates in Passenger and Industrial:

| | **Passenger** | **Industrial** | **Total** |
|---|---|---|---|
| Revenues | $2,900.00 | $2,400.00 | |
| Additional revenue % | 10% | 5% | |
| Revenue due to Racing | 290.00 | 120.00 | |
| Additional variable expense | $116.00 | $60.00 | |
| Additional contribution margin | $174.00 | $60.00 | $234.00 |

The consultant's analysis of corporate R&D and image advertising suggests that these expenditures are in reality joint costs. They are conducted to enhance all the divisions simultaneously, and one division's "consumption" of the resource does not really reduce the resource for other divisions. Research projects are chosen that have "maximum corporate-wide benefits." To allocate R&D and image advertising, the following report uses Net Realizable Value (division contribution margin before division fixed expense) as the allocation base.

Finally, corporate interest and corporate office expenses are allocated per the ABC percentages in (c).

| | **Racing** | **Passenger** | **Industrial** | **Total** |
|---|---|---|---|---|
| Revenue | $135.00 | $2,900.00 | $2,400.00 | $5,435.00 |
| Division variable expense | 81.00 | 1160.00 | 1200.00 | 2441.00 |
| Division contribution margin | $54.00 | $1,740.00 | $1,200.00 | $2,994.00 |
| Additional contribution margin generated for other divisions | 234.00 | | | 234.00 |
| Division fixed expense | 13.50 | 580.00 | 480.00 | 1,073.50 |
| R&D and corporate advertising (NRV) | 13.53 | 435.87 | 300.60 | 750.00 |
| Interest | 111.00 | 185.00 | 74.00 | 370.00 |
| Corporate office | 112.00 | 126.00 | 42.00 | 280.00 |
| Division profits | $37.97 | $413.13 | $303.40 | $754.50 |

One can argue that NRV should be calculated using division contribution margin after deducting division fixed expenses. The following table provides this alternative:

| | Racing | Passenger | Industrial | Total |
|---|---|---|---|---|
| Revenue | $135.00 | $2,900.00 | $2,400.00 | $5,435.00 |
| Division variable expense | 81.00 | 1160.00 | 1200.00 | 2441.00 |
| Division fixed expense | 13.50 | 580.00 | 480.00 | 1073.50 |
| Division contribution margin | $40.50 | $1,160.00 | $720.00 | $1,920.50 |
| Additional contribution margin generated for other divisions | 234.00 | | | 234.00 |
| R&D and corporate advertising (NRV) | 15.82 | 453.01 | 281.18 | 750.00 |
| Interest | 111.00 | 185.00 | 74.00 | 370.00 |
| Corporate office | 112.00 | 126.00 | 42.00 | 280.00 |
| Division profits | $35.68 | $395.99 | $322.82 | $754.50 |

Divisional profits change slightly, but the overall tenor of the results remains unaffected.

f. Pros: The report in (e) credits Racing for the net cash flow it generates for the other two divisions. In this sense, the report e attempts to capture the benefits (synergies) among the divisions. Using NRV to allocate R&D and corporate advertising, does not distort the relative profitability of the three divisions. NRV as an allocation base creates incentives for the three divisions to cooperate.

Cons: The allocations are complicated. Moreover, the sum of the three divisional profits no longer total firm-wide profits because the Passenger and Industrial margin that is credited to Racing is double counted. This leads to some confusion within Goodstone. Also, the consultant's estimate of the 10 percent and 5 percent of additional revenue generated by Racing for Passenger and Industrial is arbitrary and subject to substantial measurement error. Presumably, these percentages vary over time, and it is costly to hire the consultant each year to re-estimate these percentages. Moreover, these percentages are subject to lobbying (influence costs) by Racing seeking to improve its bottom line.

Notice, that the simple allocations in part (a) are fairly close to the presumably more accurate, but much more complicated ones in part (e). This illustrates that apparently inaccurate allocations can often capture both the common costs and synergies among divisions.

**P 11–16: Solution to Hospital Admissions Office** (50 minutes)
[ABC in a hospital]

a. The first table takes the operating data presented in the problem and converts it to total number of patients, total days, total billings, and total minutes by inpatients and outpatients. Using these totals an allocation rate is computed for each potential allocation base (number of patients, total days, total billings, and total minutes).

| | Number of patients | Total days by patient class | Total billings by patient class | Total minutes by patient class |
|---|---|---|---|---|
| Inpatient | 25,000 | 162,500 | $205,000,000 | 300,000 |
| Outpatient | 120,000 | 120,000 | 84,000,000 | 960,000 |
| Total | 145,000 | 282,500 | $289,000,000 | 1,260,000 |
| Allocation Rate | $4.8276 | $2.4779 | $0.0024 | $0.5556 |

The next table converts the overhead rates above into a cost per patient encounter by multiplying the allocation rate above by the average allocation base per patient.

| | Number of patients | Total days by patient class | Total billings by patient class | Total minutes by patient class |
|---|---|---|---|---|
| Inpatient | $4.83 | $16.11 | $19.86 | $6.67 |
| Outpatient | $4.83 | $2.48 | $ 1.70 | $4.44 |

The last table shows the total dollars allocated to inpatient and outpatient services. Each cell in the table is computed by taking the allocation rate (above) times the totals reported in the first table above.

| | Number of patients | Total days by patient class | Total billings by patient class | Total minutes by patient class |
|---|---|---|---|---|
| Inpatient | $120,690 | $402,655 | $496,540 | $166,667 |
| Outpatient | $579,310 | $297,345 | $203,460 | $533,333 |
| TOTAL | $700,000 | $700,000 | $700,000 | $700,000 |

b. This actual case study illustrates the rather dramatic differences that can result when costs are allocated based on estimated usage of the admissions office (minutes to register) instead of bed days or number of admissions.

Using number of patients, inpatient services receive about 17 percent of the admission office's costs. If these costs are allocated based on total billings, inpatient services receive 71 percent of the costs.

The managerial implications of the various allocation bases depend on two things: (i) what drives costs in the admission office, and (ii) how are these numbers going to be used? If all or most of the costs in the admission office are variable with the number of minutes spent admitting patients, then the number of minutes is a reasonably accurate, maybe the most accurate, cost driver (predictor) of admission office costs. However, if most of the admission office costs are fixed (supervisors, computer systems, etc.), then each additional minute spent admitting patients does not cost the hospital $0.5556 per minute. The allocation rate is an average, not a marginal cost.

This leads to the second issue: how are these numbers going to be used? If they are used for decision making (such as expanding/contracting a medical unit), then number of minutes as the allocation base is likely best as long as most of the admission office costs are not fixed. However, if these numbers are going to be used for cost reimbursement, minutes may not be the best. Cost reimbursement will dictate finding how reimbursement varies with allocated costs.

What is interesting here is that number of patients and number of minutes yield roughly similar allocations whereas total days and total billings are similar. Total patients and minutes are similar because they weight each patient as roughly equal in consuming admission office resources, whereas patient days and patient billings use how much hospital resources patients use (bed-days or billings) to allocate admission office costs.

**P 11-17:** **Solution to ABC and Taxes** (55 minutes)
[Does ABC and income taxes]

a. ABC product costs

| | Hi-V | Lo-V |
|---|---|---|
| Direct materials | $52.00 | $20.00 |
| Direct labor | 9.00 | 3.00 |
| Overhead: | | |
| Variable | 0.75 | 0.25 |
| Fixed | | |
| .75 @ $4[1] | 3.00 | |
| .25 @ $4[1] | | 1.00 |
| Setups | 5.83[2] | 70.00[3] |
| | $70.58 | $94.25 |

[1] ($390,000 – 350,000) ÷ 10,000 hours
[2] $350,000 × (10 ÷ 50) ÷ 12,000 = $5.83
[3] $350,000 × (40 ÷ 50) ÷ 4,000 = $70

b. Product-line profits

| | Absorption Costing | | ABC | |
|---|---|---|---|---|
| | Hi-V | Lo-V | Hi-V | Lo-V |
| Selling price | $ 95 | $ 100 | $ 95.00 | $100.00 |
| Unit cost | 91 | 33 | 70.58 | 94.25 |
| Margin | $ 4 | $ 67 | $ 24.42 | $ 5.75 |
| Units sold | 11,300 | 4,000 | 11,300 | 4,000 |
| Product line profits | $45,200 | $268,000 | $275,946 | $23,000 |

c. Total liability under two allocation methods:

| | Absorption Costing | | ABC |
|---|---|---|---|
| Hi-V profits | $ 45,200 | | $275,946 |
| Lo-V profits | 268,000 | | 23,000 |
| Net income before taxes | $313,200 | | $298,946 |
| Taxes (50%) | 156,600 | | 149,473 |
| Net income after taxes | $156,600 | | $149,473 |
| Difference in Taxes | | $7,127 | |
| Reconciliation: | | | |
| Ending inventory of Hi-V | | | 700 |
| × change in cost of Hi-V ($91 – $70.58) | | | $20.42 |
| × Tax rate | | | 50% |
| | | | $7,147 |

d. Switching to ABC will not, in general, lower taxes. However, under certain conditions, ABC can lower taxes. The general conditions are: [1]

(i) ABC must yield substantially different product costs than the old system.

(ii) Average closing inventories of overcosted products are greater than the average closing inventories of undercosted products (in switch years).

(iii) The average change in closing inventories of overcosted products minus undercosted products is positive (after switch year).

(iv) Both annual costs and production are either constant or growing.

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[1] This problem is based on S. Dilley, F. Jacobs, and R. Marshall, "The Tax Benefits of ABC," *Journal of Accountancy* (March 1997), pp. 34–37.

**P 11-18:** **Solution to Familia Insurance Company** (55 minutes)
[ABC in a divisionalized firm to report profit center profits]

a. The first step is to implement an ABC costing by recalculating the allocated revenues and expenses using the revised allocation bases.

| | **Life Insurance** | **Home Insurance** | **Auto Insurance** | **Total** |
|---|---|---|---|---|
| Premium revenue | $500.00 | $900.00 | $600.00 | $2,000.00 |
| Insurance losses and loss adjustments | (300.00) | (540.00) | (560.00) | (1,400.00) |
| Difference | $200.00 | $360.00 | $40.00 | $600.00 |
| Allocation % | 33.33% | 60.00% | 6.67% | 100.00% |
| Investment income allocated | $116.67 | $210.00 | $23.33 | $350.00 |
| | | | | |
| Policy acquisition % | 40.00% | 30.00% | 30.00% | 100.00% |
| Policy acquisition expenses | ($180.00) | ($135.00) | ($135.00) | ($450.00) |
| | | | | |
| Underwriting and Claims | | | | |
| Number of policies | 150,000 | 375,000 | 225,000 | 750,000 |
| Allocation % | 20.00% | 50.00% | 30.00% | 100.00% |
| Underwriting expenses | ($18.00) | ($45.00) | ($27.00) | ($90.00) |
| | | | | |
| Accounting and IT | | | | |
| Number of policies | 150,000 | 375,000 | 225,000 | 750,000.00 |
| Allocation % | 20.00% | 50.00% | 30.00% | 100.00% |
| Accounting and IT expenses | ($14.00) | ($35.00) | ($21.00) | ($70.00) |
| | | | | |
| Human resources: | | | | |
| Policy acquisition expenses | ($180.00) | ($135.00) | ($135.00) | ($450.00) |
| Profit center expenses | ($6.00) | ($15.00) | ($9.00) | ($30.00) |
| Total labor costs | ($186.00) | ($150.00) | ($144.00) | ($480.00) |
| Allocation % | 38.75% | 31.25% | 30.00% | 100.00% |
| Human resource expenses | ($15.50) | ($12.50) | ($12.00) | ($40.00) |
| | | | | |
| Premium revenues | $500.00 | $900.00 | $600.00 | $2,000.00 |
| Allocation % | 25.00% | 45.00% | 30.00% | 100.00% |
| Advertising | ($30.00) | ($54.00) | ($36.00) | ($120.00) |
| Corporate office expenses | ($12.50) | ($22.50) | ($15.00) | ($50.00) |

Given the preceding revised allocations of the investment income and expenses, the following table presents the revised statement of operations for the three profit centers:

| (millions) | Life Insurance | Home Insurance | Auto Insurance | Total |
|---|---|---|---|---|
| Premium revenue | $500.00 | $900.00 | $600.00 | $2,000.00 |
| Investment income | 116.67 | 210.00 | 23.33 | 350.00 |
| Total Revenue | $616.67 | $1,110.00 | $623.33 | $2,350.00 |
| Expenses: | | | | |
| Insurance losses and loss adjustments | ($300.00) | ($540.00) | ($560.00) | ($1,400.00) |
| Policy acquisition expenses | (180.00) | (135.00) | (135.00) | (450.00) |
| Operating and Administrative expenses | | | | |
| Underwriting and claims | ($18.00) | ($45.00) | ($27.00) | ($90.00) |
| Accounting and IT | (14.00) | (35.00) | (21.00) | (70.00) |
| Human resources | (15.50) | (12.50) | (12.00) | (40.00) |
| Advertising | (30.00) | (54.00) | (36.00) | (120.00) |
| Profit center expenses | (6.00) | (15.00) | (9.00) | (30.00) |
| Corporate office | (12.50) | (22.50) | (15.00) | (50.00) |
| Total O&A expenses | ($96.00) | ($184.00) | ($120.00) | ($400.00) |
| Net income before taxes | $40.67 | $251.00 | ($191.67) | $100.00 |

b. The first point to recognize is that FMC's business strategy involves selling three insurance products to the same client in a specialized market niche (the Hispanic community). FMC is selling convenience to its customers – dealing with a single insurance agent and company to satisfy all their insurance needs. FMC offers one-stop shopping. Also, FMC captures economies of scope in its advertising and policy processing (selling, underwriting, claims, and accounting). It is probably cheaper for one company to provide these transactions processing than three separate companies. Neither allocation methodology captures these synergies.

The following table compares the profit center net incomes before taxes of the two methodologies:

| Net income before taxes: | Life | Home | Auto | Total |
|---|---|---|---|---|
| Original calculations | $75.00 | $135.00 | ($110.00) | $100.00 |
| ABC calculations | 40.67 | 251.00 | (191.76) | 100.00 |

Here we see that the Home Insurance profit center is the big winner in the sense that its net income rises by $116 million, whereas the other two profit centers (Life and Auto) fall by $34.33 million and $81.76 million, respectively. Hence, changing allocation methods creates winners and losers among the profit center managers, and without corresponding changes in the compensation plans (particularly how bonuses are calculated) wealth transfers are generated among the three profit center managers. Changing the allocation methodology generates influence costs when the profit center managers start lobbying for and against the new methodology. Moreover, each profit center manager will propose a continuous stream of "new and improved" methods for allocating the various revenue and expense items beyond those suggested by the consultant.

The advantages and disadvantages of the two methods can be summarized as:

**Current Method:**

Advantages:

- Simple calculations
- Lower influence costs
- No need to adjust current compensation plans

Disadvantages:

- Less accurate representation of the cause-and-effect relation between cost drivers and resource consumption
- Does not capture the synergies among insurance lines
- Does not capture the economies of scope in processing transactions

**Revised (ABC) Method:**

Advantages:

- More accurate representation of the cause-and-effect relation between cost drivers and resource consumption

Disadvantages:

- Does not capture the synergies among insurance lines
- Does not capture the economies of scope in processing transactions
- More complex calculations
- Higher influence costs
- Current compensation plans require adjustment

Since neither method captures the various synergies, there is little reason to change the allocation method methodology.

**P 11-19:** **Solution to Brickley Chains** (60 minutes)
[Batch-level costs and ABC]

a. Absorption costing:

| Product | Annual Volume | DL$ per unit | DM per unit | Total Direct Labor | OH based on DL $ | OH per unit | Total unit cost |
|---|---|---|---|---|---|---|---|
| A | 5000 | $2.00 | $4.00 | $10000 | $30534 | $6.11 | $12.11 |
| B | 3000 | 2.50 | 4.50 | 7500 | 22901 | 7.63 | 14.63 |
| C | 1000 | 3.00 | 5.00 | 3000 | 9160 | 9.16 | 17.16 |
| D | 800 | 4.00 | 6.00 | 3200 | 9771 | 12.21 | 22.21 |
| E | 500 | 5.00 | 7.00 | 2500 | 7634 | 15.27 | 27.27 |
| | | | | $26200 | $80000 | | |

b. Activity-Based-Costing:

| Product | Annual Volume | Batch Size | Number of batches | OH based on # of batches | OH per unit | Total unit cost |
|---|---|---|---|---|---|---|
| A | 5000 | 100 | 50 | $28571 | $5.71 | $11.71 |
| B | 3000 | 100 | 30 | 17143 | 5.71 | 12.71 |
| C | 1000 | 50 | 20 | 11429 | 11.43 | 19.43 |
| D | 800 | 40 | 20 | 11429 | 14.29 | 24.29 |
| E | 500 | 25 | 20 | 11429 | 22.86 | 34.86 |
| | | | 140 | $80000 | | |

c. Analysis of absorption and ABC:

| Product | Total ABC Cost | Total Absorption Cost | ABC/Absorption Cost |
|---|---|---|---|
| A | $11.71 | $12.11 | 97% |
| B | 12.71 | 14.63 | 87% |
| C | 19.43 | 17.16 | 113% |
| D | 24.29 | 22.21 | 109% |
| E | 34.86 | 27.27 | 128% |

As the preceding table illustrates, the cost of high volume chains (A & B) falls whereas the cost of low volume chains (C, D, & E) rise. The reason for this is that in part (a) overhead is allocated based on direct labor, which varies with volume. High volume products received relatively more overheads than low volume products. Under ABC, overhead is allocated based on batches. Low volume products have relatively more batches (given their smaller batch size) and hence receive relatively more overhead than high volume products.

**Case 11-1: Solution to Tilist Golf** (35 minutes)
[Traditional absorption costing vs. ABC and synergies]

a. The following table presents the income statement for the two balls after allocating the $61.429 million of overhead based on revenue.

Tilist Golf
Ball Division
Divisional Profits
Overhead Allocated Based on Sales Revenues

| | **Masters** | **Distance** | **Total** |
|---|---|---|---|
| Revenue | $7,800,000 | $175,000,000 | $182,800,000 |
| % of revenue | 4.27% | 95.73% | 100.00% |
| | | | |
| Revenue | $7,800,000 | $175,000,000 | $182,800,000 |
| Variable cost | 3,600,000 | 75,000,000 | 78,600,000 |
| Allocated overhead | 2,621,150 | 58,807,850 | 61,429,000 |
| Divisional profits | $1,578,850 | $41,192,150 | $42,771,000 |

b. Profits of the two balls based on ABC overhead allocations.

Tilist Golf
Ball Division
Divisional Profits
ABC Overhead Allocations

| | **Masters** | **Distance** | **Total** |
|---|---|---|---|
| Revenue | $7,800,000 | $175,000,000 | $182,800,000 |
| Variable cost | 3,600,000 | 75,000,000 | 78,600,000 |
| Promotional samples | 950,000 | 125,000 | 1,075,000 |
| Sponsorships | 219,368 | 18,280,632 | 18,500,000 |
| Advertising | 1,350,000 | 33,487,000 | 34,837,000 |
| R&D | 1,150,000 | 2,300,000 | 3,450,000 |
| Ball division headquarter expenses | 1,426,800 | 2,140,200 | 3,567,000 |
| Divisional profits | ($896,168) | $43,667,168 | $42,771,000 |

c. The Masters ball shows a profit of $1,578,850 if overhead is allocated based on revenues (part a). The Masters ball shows a loss of $896,168 if overhead is allocated using the ABC Task Force recommendations (part b). One might be tempted to conclude that Tilist is loosing money on the Masters ball. But this ignores the large and important synergies created, not just for the Distance ball, but also for the rest of Tilist Golf of the brand-name recognition created from the professional golfer sponsorships. These sponsorships cannot exist without providing the pros a high quality professional ball. This problem vividly illustrates why multi-product firms exist and the conundrum created by attempting to evaluate the relative profitability of individual product lines.

Suppose one is tempted to look at the contribution margin of each type of ball under the assumption that promotional samples and advertising expenses can be directly traced to each ball. Under this assumption, the following contribution statement can be prepared:

Tilist Golf
Ball Division
Divisional Profits
Contribution Margins

| | Masters | Distance | Total |
|---|---|---|---|
| Revenue | $7,800,000 | $175,000,000 | $182,800,000 |
| Variable cost | 3,600,000 | 75,000,000 | 78,600,000 |
| Promotional samples | 950,000 | 125,000 | 1,075,000 |
| Advertising | 1,350,000 | 33,487,000 | 34,837,000 |
| Contribution margin | $1,900,000 | $66,388,000 | 68,288,000 |

In this statement, both balls are yielding positive profits. The Masters ball reports a positive contribution of $1.9 million. But this does not account for the likely increase in demand for Distance balls created when a Masters ball advertisement is run. When ads for either ball are run, the ads create brand-name recognition for the other ball and for all Tilist products.

We can say that the Ball Division is generating incremental cash flows of $68,288,000, but cannot allocate this between the two divisions in any meaningful way to assess the relative profitability of each ball. And even this $68,288,000 profits for the division does not capture the synergies that exist between the Ball Division and the other Tilist divisions.

## Case 11-2: **SnapOn Fasteners** (75 minutes)

[ABC does not capture synergies between product lines]

a. Net income based on a simple cost allocation methodology:

| | Machines | Fasteners | Total |
|---|---|---|---|
| Percent of direct labor | 34.15% | 65.85% | 100.00% |
| Perecent of revenue | 41.88% | 58.12% | 100.00% |

| | Machines | Fasteners | Total |
|---|---|---|---|
| Revenue | $95.750 | $132.895 | $228.645 |
| Direct labor | 22.650 | 43.680 | 66.330 |
| Direct material | 24.640 | 21.840 | 46.480 |
| Manufacturing overhead | 20.357 | 39.258 | 59.615 |
| Selling and service | 19.770 | 27.440 | 47.210 |
| Net income | $8.333 | $0.677 | $9.010 |

b. The first step is to use the task force analysis and develop a set of ABC allocations for manufacturing overhead:

| ABC Manufacturing Overhead: | | | |
|---|---|---|---|
| Purchasing | $5.202 | $4.610 | $9.812 |
| Depreciation of machinery | 12.328 | 5.283 | 17.611 |
| Supervision | 1.252 | 2.413 | 3.665 |
| Occupancy | 14.905 | 4.968 | 19.873 |
| Engineering | 5.192 | 3.462 | 8.654 |
| Total | $38.878 | $20.737 | $59.615 |

The next step is to recompute the net incomes of the two product lines:

| | **Machines** | **Fasteners** | **Total** |
|---|---|---|---|
| Revenue | $95.750 | $132.895 | $228.645 |
| Direct labor | 22.650 | 43.680 | 66.330 |
| Direct material | 24.640 | 21.840 | 46.480 |
| Manufacturing overhead | 38.878 | 20.737 | 59.615 |
| Selling | 14.808 | 20.552 | 35.360 |
| Service | 11.850 | 0.000 | 11.850 |
| Net income | ($17.076) | $26.086 | $9.010 |

c. Attaching machines was the more profitable of the two product lines in part (a), but in part (b) the attaching machines are now losing about $17 million and the fasteners are now making about $26 million.

d. The new methodology based on the task force's analysis (part b) appears to capture more accurately the consumption of the indirect costs of manufacturing and selling and service. However, SnapOn's two product lines are highly interdependent. Ask the question, "What is SnapOn's business (or strategy)?" The answer is: "Providing fashion designers the ability to deliver high quality garments with distinctive fasteners in a timely manner." To do this, SnapOn must have fasteners, attaching machines, and service — all coordinated as a seamless operation. Moreover, SnapOn is price discriminating. They lease the machines fairly inexpensively, and then charge high prices for the fasteners. In this way, designers who use more fasteners pay more than designers using fewer fasteners. It is the same strategy used by Hewlett Packard in their desk-top printers. The printers are cheap, but the ink cartridges are expensive.

The current costing methodology allocates more of the indirect costs of manufacturing and selling and service to the fasteners, making it appear that fasteners are costly to manufacture. This forces the fastener line of business manager to charge high prices for the fasteners. Likewise, the attaching machines appear inexpensive to manufacture which allows the attaching machine line of business manager to set lower lease prices to encourage the placement of more machines in the field.

Hence, while the current costing methodology appears to be inaccurate, it supports the current SnapOn strategy of price discrimination. If the new costing methodology is adopted, it will likely NUKE the exisiting SnapOn strategy of price discrimination. SnapOn is currently profitable. "If it ain't broke, don't fix it!"

In summary, what appears to be a bad costing system in fact is perfectly consistent with SnapOn's strategy of price dissemination. In terms of Figure 1-3, the performance measurement system supports SnapOn's business strategy.

**Case 11-3:** **Solution to Dyna Golf**[2] (90 minutes)
[ABC, pricing, and inaccurate product costs]

This case allows a good discussion of the problems of cost-based pricing. It also allows students to design and implement an ABC system.

**Cost-Based Pricing**

The first thing to note in this case is Dyna Golf's pricing policy of marking up cost 35 percent and seeing if they can sell the product at that price. If they can, they try to set higher prices. There is no attempt to set prices where marginal costs and marginal revenues are equated, which is the profit-maximizing price. If Dyna's product costs are wrong then their prices are wrong. Competitors with more accurate estimates of their costs can offer more competitive prices. Given the highly aggregated nature of their overhead cost allocations, Dyna doesn't know if they are making or loosing money on a product.

Peter Drucker describes the problems with cost-driven pricing as:[3]

> "Most American and practically all European companies arrive at their prices by adding up costs and then putting a profit margin on top. And then, as soon as they have introduced the product, they have to start cutting price, have to redesign the product at enormous expense, have to take losses – and, often, have to drop a perfectly good product because it is priced incorrectly. Their argument? 'We have to recover our costs and make a profit.'"
>
> "This is true but irrelevant: Customers do not see it as their job to ensure manufacturers a profit. The only way to price is to start out with what the market is willing to pay – and thus, it must be assumed, what the competition will charge – and design to that price specification."

Not only is Dyna ignoring marginal revenue information (they do not know the price elasticity of demand), they also are not taking advantage of any cross elasticities of demand among their products. For example, are consumers more likely to purchase a Dyna wedge or putter if they already own a Dyna driver? If this is the case, driver prices should be lowered to sell more, thus eventually increasing the sales of wedges and putters.

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2 This case is based on J Shank and V Govindarajan, "The Perils of Allocation Based on Production Volumes" *Accounting Horizons* (December 1988), pp. 71-79

3 Peter F. Drucker, The Five Deadly Sins," *The Wall Street Journal* (October 21, 1993).

**Current Accounting System**

Before evaluating the controller's (Phil Meyers) revised accounting system, it is useful to replicate Dyna's current accounting system's computation of product costs. Begin by calculating the overhead rate based on direct labor dollars.

**Overhead Rate Calculation — Direct Labor**

| | Drivers | Wedges | Putters | Total |
|---|---|---|---|---|
| Production | 10,000 units | 15,000 units | 5,000 units | |
| Run labor | 1/2 hr per driver | 1/3 hr per wedge | 1/4 hr per putter | |
| Total direct labor hours | 5,000 | 5,000 | 1,250 | 11,250 |
| Labor cost per hour | | | | $20 |
| Direct labor dollars | | | | $225,000 |

**Overhead Rate Calculation**

| | Drivers | Wedges | Putters | Total |
|---|---|---|---|---|
| Setup | 10 hrs per production run | 10 hrs per production run | 11 hrs per production run | |
| Number of runs | 1 | 3 | 10 | |
| Setup labor hours | 10 | 30 | 110 | 150 |
| Labor cost per hour | | | | $20 |
| Setup overhead | | | | $3,000 |
| Machine overhead | | | | 700,000 |
| Receiving | | | | 300,000 |
| Engineering | | | | 500,000 |
| Packing | | | | 200,000 |
| Total overhead | | | | $1,703,000 |
| Direct labor dollars | | | | $ 225,000 |
| Overhead rate/DL$ | | | | 757% |

Given the overhead rate is 757 percent of direct labor dollars, each product's cost and product profitability can be calculated as:

**Product Cost Calculation**

| | Drivers | Wedges | Putters |
|---|---|---|---|
| Raw material | $20.00 | $30.00 | $10.00 |
| Direct labor | 10.00 | 6.67 | 5.00 |
| Overhead (757%) | 75.70 | 50.49 | 37.85 |
| Total | $105.70 | $87.16 | $52.85 |

## Product Profitability

| | Drivers | Wedges | Putters |
|---|---|---|---|
| Product cost | $105.70 | $87.16 | $52.85 |
| Target selling price | $162.61 | $134.09 | $81.31 |
| Planned gross margin | 35% | 35% | 35% |
| Actual selling price | $162.61 | $125.96 | $105.70 |
| Actual gross margin | 35% | 31% | 50% |

**Proposed Accounting System**

Phil Meyers' refined cost system contains the following changes:

1. Break out setup labor
2. Trace receiving costs to products based on raw material cost
3. Allocate remaining overhead using machine hours

The overhead rate now becomes:

| | |
|---|---|
| Machines | $700,000 |
| Engineering | 500,000 |
| Packing | 200,000 |
| | $1,400,000 |
| Machine hours | ÷ 10,000 |
| Overhead rate* | $ 140 |

- 10,000 = 10,000×1/4 + 15,000x1/3 + 5,000x1/2

## Proposed Product Cost Calculation

| | Drivers | Wedges | Putters |
|---|---|---|---|
| Raw material | $ 20.00 | $30.00 | $10.00 |
| Direct labor | 10.00 | 6.67 | 5.00 |
| Receiving Overhead ($300,000÷$700,000* per raw material dollar) | 8.60 | 12.90 | 4.30 |
| Setup labor | .02 | .04 | .44 |
| Other overhead ($140/machine hr) | 35.00 | 46.67 | 70.00 |
| Total proposed cost | $ 73.62 | $96.28 | $89.74 |
| Current cost | $105.70 | $87.16 | $52.85 |

* $700,000 = $20×10,000 + $30×15,000 + $10×5,000

The proposed system causes drivers' costs to fall, but raises the costs of wedges and putters. However, Phil Meyers' improvements might not accurately capture all the costs of making clubs as revealed in an ABC analysis, presented next.

**Activity-Based Costs**

Given the data in the case, an ABC analysis can be conducted. Each of the overhead categories can be allocated to each product. Machine hours are used to allocate machining costs. The number of component orders are used to allocate receiving costs. The number of change orders are used to allocate engineering costs. And the number of shipments are used to allocate packing costs. These calculations are performed below.

**ABC Costs — Machining**

| | Drivers | Wedges | Putters | Total |
|---|---|---|---|---|
| Machine Department overhead | | | | $700,000 |
| Production (units) | 10,000 | 15,000 | 5,000 | |
| Machine usage/unit (hrs) | 0.25 | 0.333 | 0.50 | |
| Machine hours | 2,500 | 5,000 | 2,500 | 10,000 |
| Machine hour rate | | | | $70.00 |
| Machine cost/unit | $17.50 | $23.33 | $35.00 | |

**ABC Costs — Receiving**

| | Drivers | Wedges | Putters | Total |
|---|---|---|---|---|
| Receiving overhead | | | | $300,000 |
| Number of components | 5 | 6 | 10 | |
| Number of runs | 1 | 3 | 10 | |
| Number of orders | 5 | 18 | 100 | 123 |
| Cost per order | | | | $2,439.02 |
| Receiving cost | $12,195 | $43,902 | $243,902 | |
| Production (units) | 10,000 | 15,000 | 5,000 | |
| Receiving cost/unit | $1.22 | $2.93 | $48.78 | |

**ABC Costs — Engineering**

| | Drivers | Wedges | Putters | Total |
|---|---|---|---|---|
| Engineering overhead | | | | $500,000 |
| Percent of change orders | 25% | 35% | 40% | |
| Engineering cost per product | $125,000 | $175,000 | $200,000 | |
| Production (units) | 10,000 | 15,000 | 5,000 | |
| Engineering cost/unit | $12.50 | $11.67 | $40.00 | |

**ABC Costs — Packing**

| | Drivers | Wedges | Putters | Total |
|---|---|---|---|---|
| Packing overhead | | | | $200,000 |
| Number of shipments | 1 | 5 | 20 | 26 |
| Cost per shipment | | | | $7,692 |
| Cost per product line | $7,692 | $38,460 | $153,840 | |
| Production (units) | 10,000 | 15,000 | 5,000 | |
| Packing cost/unit | $0.77 | $2.56 | $30.77 | |

Given the preceding ABC cost allocations for each overhead account, ABC product costs are:

**ABC Product Cost Calculation**

| | Drivers | Wedges | Putters |
|---|---|---|---|
| Raw material | $20.00 | $30.00 | $10.00 |
| Direct labor | 10.00 | 6.67 | 5.00 |
| Machine overhead (@$70/hr) | 17.50 | 23.33 | 35.00 |
| Setup labor | .02 | .04 | .44 |
| Receiving | 1.22 | 2.93 | 48.78 |
| Engineering | 12.50 | 11.67 | 40.00 |
| Packing | 0.77 | 2.56 | 30.77 |
| Total ABC cost | $ 62.01 | $77.20 | $169.99 |
| Existing product cost | $105.70 | $87.16 | $ 52.85 |

**Comparison of Existing Cost System, Proposed Cost System, ABC Product Costs, and Market Prices**

| | Drivers | Wedges | Putters |
|---|---|---|---|
| Existing product cost | $105.70 | $87.16 | $52.85 |
| Proposed product cost | $73.62 | $96.28 | $89.74 |
| ABC product cost | $62.01 | $77.20 | $169.99 |
| Selling Prices: | | | |
| Target | $162.61 | $134.09 | $81.31 |
| Actual | $162.61 | $125.96 | $105.70 |

From this table we can begin to see why Dyna has not been able to maintain the price of wedges. The cost of wedges is lower than Dyna believed. If ABC product costs are representative of our competitors' costs, then the additional price competition on wedges is expected. But the big change is in the cost of putters. Putters appear to be costing Dyna roughly three times what they originally thought. Under the existing system, which allocates overhead at 757 percent of direct labor, putters only receives \$37.85 of overhead. Under ABC putters receive \$154.99 of overhead. The real question to address is, "Does each additional putter generate about \$155 of overhead? Answering this question depends on whether receiving costs vary with orders placed, machine costs vary with machine hours, packing costs vary with shipments, and so forth. Or, does the ABC system better capture how overhead costs vary with individual club production? Suppose that receiving costs are largely fixed. Then, the ABC analysis is not more accurate.

Moreover, the ABC system does not help Dyna better understand the interdependencies (synergies) in either production or demand. Selling putters, even at a loss, might generate additional driver and/or wedge sales. Or, it might allow Dyna to produce better or cheaper wedges by training workers in slightly different production techniques.

Finally, the Dyna case focuses almost exclusively on using product costs for decision making (pricing). The case is silent on how Dyna uses product costs for decision control (performance measurement and incentives). If either Phil Meyers' proposed system or the ABC system is adopted, what organizational architecture ramifications occur?

Some additional issues Mr. Bell might wish to consider include:

• Engineering should work with suppliers to improve the quality of the club components to reduce the number of engineering change orders, thereby reducing engineering costs and improving gross margins. Dyna might want to consider paying more for its components to improve their quality and reduce the number of change orders.

• Dedicate a machine to putters to avoid setup costs and reduce the number of production runs.

• Investigate the possibility of raising putter prices even further.

# CHAPTER 12
## STANDARD COSTS: DIRECT LABOR AND MATERIALS

**P 12-1:** **Solution to Medical Instruments** (10 minutes)
[Price and quantity variances for materials]

a.

| | |
|---|---|
| Purchase price of silver tubing: | |
| $4,680 ÷ 1200 inches | $3.90 |
| Price variance (at purchase) | |
| ($3.90 - $4) × 1,200 inches | $120F |
| Quantity variance | |
| (1,100 inches - 5 × 200 inches) × $4 | $400U |
| Total silver tubing variance | $280U |

b. The favorable price variance indicates that by purchasing the tubing at 10¢ below the standard cost of $4 the firm saved $120. However, 100 inches too many were used in production and this cost the firm $400. One possible reason for the extra usage of tubing might be that substandard quality tubing was acquired and therefore more waste occurred.

**P 12-2:** **Solution to Mickles Ltd.** (10 minutes)
[Direct labor efficiency variance]

The formula for the direct labor efficiency variance is:

= (Actual direct labor hours – Standard direct labor hours)
× Standard direct labor wage rate

The problem says the June direct labor efficiency variance is $1,470 unfavorable. Actual direct labor hours worked in June is 980 hours. 460 batches were produced and each batch calls for 2 direct labor hours per batch. Therefore, standard direct labor hours in June were 920 hours (460 batches × 2 direct labor hours per batch). Substituting these amounts into the above equation yields:

$1,470 = (980 – 920) × Standard labor wage rate

Solving for the standard wage rate yields

Standard direct labor wage rate = $1,470 / 60 hours = $24.50

**P 12-3:** **Solution to Alexander Products** (15 minutes)
[Finding unknown variables in standard costs]

Given the unfavorable raw material variance of \$3,000, and $Q_a$ = 8,500 and $Q_s$ = 8,000 we know that

$$\$3{,}000 = (Q_a - Q_s) \times P_s$$
$$\$3{,}000 = 500\ P_s$$
$$P_s = \$6.00 \text{ meter}$$

Equivalently, we know that the stainless steel in WIP is \$48,000 and

$$WIP = \$48{,}000 = Q_s \times P_s$$
$$\$48{,}000 = 8{,}000\ P_s$$
$$P_s = \$6.00 \text{ per meter}$$

Since the price variance is \$2,000 unfavorable

$$\$2{,}000 = (P_a - P_s) \times Q_b$$
$$\$2{,}000 = (\$6.20 - \$6.00) \times Q_b$$
$$\$2{,}000 = \$0.20\ Q_b$$
$$Q_b = 10{,}000 \text{ meters}$$

**P 12-4:** **Solution to Oaks Auto Supply** (15 minutes)
[Target costing]

| | | |
|---|---|---|
| Target Price | | \$2,500 |
| Less: | | |
| Required ROI* | \$1,000 | |
| Variable Selling Commissions | 500 | |
| Parts | 750 | \$2,250 |
| Target Conversion Costs | | \$ 250 |

* Required ROI:

| | |
|---|---|
| Investment (\$12.6 + \$2.2) | \$14.8 million |
| ROI | 20% |
| | \$2.96 million |
| Expected number of units | ÷ 2,960 |
| Return on investment per unit | \$1,000 |

Annual depreciation is included as part of Target Conversion Costs.

**P 12–5:** **Solution to AN7-X1**(15 minutes)
[Raw material price and quantity variances]

Actual price = $17,200 ÷ 8,000 ounces = $2.15

| | | |
|---|---|---|
| Price Variance | ($2.15 – $2.00) × 8,000 | $ 1,200 U |
| Quantity Variance | (4,600 – 1,000 × 4.5) × $2 | 200 U |
| Total Material Variance | | $1,400 U |
| | | |
| WIP | 4.5 × 1,000 × $2.00 | 9,000 |
| Raw Material inventory | [8,000 – 4,600] × $2.00 | 6,800 |
| | | $17,200 |

**P 12–6:** **Solution to Changing Standards** (15 minutes)
[Decision management and control of standard costs]

a. The policy does make sense because most standard cost systems are used primarily for decision control. If firms changed their standards frequently, managers being held responsible for the standards would argue for standard changes whenever their performance fell short of the standard. This destroys the standard cost system as a decision control mechanism and increases influence costs. On the other hand, because the standard costs are also used for decision management, if the standard costs become grossly out of line, non-firm-value-maximizing decisions (such as pricing, and outsourcing) start to occur. Thus, some exceptions to the general rule of never changing standards also makes sense — but only when there are extremely large variances. Changing standards during the year when extremely large variances exist does not create the precedence for changing standards when small variances exist.

b. Firms are likely to change standards when there has been a significant unexpected change that causes the standard to be grossly in error thereby creating costly decision errors. Also, changing the standards when there are very large shocks does not set a precedent for standard changes from small shocks.

**P 12-7:** **Solution to Standard Cost Systems** (15 minutes)
[Which firms are more likely to choose standard costing]

a. The firm making the flexible packaging films is more likely to be using a standard cost system to control labor costs than the firm manufacturing printed circuit boards. Establishing direct labor standards is costly. Engineers and cost accountants must estimate the standard labor time for each process. The benefits from these standards arising from the incentives created by these standards in terms of better cost control accrue over the time the standards are expected to be used. The printed circuit board firm has shorter product life cycles and rapid process technology changes, which reduce the time the standards are in use. Assuming the cost of establishing the standards are roughly the same in the both firms, the shorter period over which the standards can be used makes it less likely that establishing standards in the printed circuit board company is a positive net present value investment.

b. Because the printed circuit board firm is unlikely to be using a standard cost system to control costs, other mechanisms must be used to create incentives for their first-line supervisors to control costs. No longer can standard labor cost variances be used to monitor managers' labor efficiency. The printed circuit board firm is therefore more likely to increase the sensitivity of pay-for-performance of its manufacturing managers. These managers are likely to have more of their compensation tied to reported costs than managers in the flexible packaging film company.

**P 12-8** **Solution to Smythe and Yves** (20 minutes)
[Distribution of material purchase cost across the accounts]

a. The following table shows the distribution of the 9,225 CHF purchase cost across S&Y's various manufacturing accounts.

| | | |
|---|---|---|
| Liters of VBN032 purchased | 15 | |
| Standard price (CHF) | 600 | |
| Actual price (CHF) | 615 | |
| Total paid (CHF) | 9,225 | |
| | | |
| Products Produced | Actual quantity | Standard quantity |
| #K8925 | 4.38 | 4.19 |
| #G1342 | 6.46 | 6.35 |
| #R9823 | 3.78 | 3.61 |
| Total | 14.62 | 14.15 |
| | | |
| Ending inventory | 0.38 | |
| | | |
| Price variance | | 225 U |
| Quantity variances | | |
| #K8925 | 114 U | |
| #G1342 | 66 U | |
| #R9823 | 102 U | 282 U |
| VBN032 in WIP | | 8,490 |
| VBN032 inventory | | 228 |
| Total (CHF) | | 9,225 |

b. All the variances are unfavorable and total 507 CHF or about 5 percent of the purchase price. These unfavorable variances might indicate that either management is operating inefficiently or that the standard costs being used are out of date.

## P 12–9: Solution to Healing Touch (20 minutes)
[Labor and material variances]

a. The following table presents the price and quantity variances of the inputs used to manufacture the 500 massage chairs:

**Massage Chair**
**Standard Cost Variances for the Current Month**

| | Price Variance | Quantity Variance | Total |
|---|---|---|---|
| Metal tubing | ($3.05-3.00)3100= $155U | (3100-3000)$3= $300U | $455U |
| Leather | ($7.02-7.00)1100= 22U | (1100-1000)$7= 700U | 722U |
| Padding | ($4.10-4.00)1600= 160U | (1600-1500)$4= 400U | 560U |
| Direct labor | ($15.15-15)1800= 270U | (1800-2000)$15= $3000F | 2730F |
| Total | $607U | $1600F | $993F |

b. For the month just ending Manufacturing purchased tubing, leather, and padding at prices that exceeded standard prices by a small amount. Moreover, Manufacturing used more of each of theses direct materials than called for in the standard quantities. Direct labor was paid $0.15 more per hour than the standard wage rate. However, these additional quantities and higher quality labor allowed a significant reduction in the number of direct labor hours. The total net favorable variance in manufacturing of $993 for the month was the result of a substitution of materials and higher priced labor for fewer direct labor hours.

## P 12-10: Solution to Marian Health Care System (20 minutes)
[Direct labor variances]

a. The following table summarizes the direct labor variances for the admissions office.

| | In-patients | Out-patients | |
|---|---|---|---|
| Standard labor rate per hour | | | $ 14.50 |
| Standard labor time/patient | 15 | 9 | |
| × Number of patients admitted | 820 | 2,210 | |
| Standard labor minutes for admissions | 12,300 | 19,890 | 3,2190 |
| ÷ Minutes per hour | | | 60 |
| Standard labor hours of admissions | | | 536.5 |

| | |
|---|---|
| Standard labor cost | $ 7,779.25 |
| Actual labor cost | 8,235.00 |
| Total labor variance | $ 455.75 Unfav |
| | |
| Actual labor cost | $ 8,235.00 |
| ÷ Actual hours | 540 |
| Actual wage rate | $15.25 |
| | |
| Wage rate variance: | |
| ($15.25 - $14.50) × 540 | $405.00 Unfav |
| Labor Efficiency Variance: | |
| (540 - 536.5) × $14.50 | 50.75 Unfav |
| Total labor variance | $455.75 Unfav |

b. The data from last week indicate that the admissions office had an unfavorable labor variance of $455.75, most of which is due to an unfavorable wage variance of $405. Instead of paying $14.50 per hour, the actual wage rate was $15.25, or 5 percent higher than the standard. Even though we paid $0.75 per hour more than standard, the actual number of admission hours required was still about the same as standard. Thus, the higher wages did not produce more efficient admissions. While the total unfavorable wage rate variance of $405 appears small, it might indicate an unfavorable trend. For example, labor markets might be tighter than previously expected. If all our other labor wage rate standards are similarly too low, then the total hospital administrative budget could be understated.

**P 12-11:** **Solution to Zinc Faucets** (20 minutes)
[Raw material price and quantity variances]

Actual price of zinc = $5,530 ÷ 1,000 pounds = $5.53

| | | |
|---|---|---|
| Price variance | ($5.53 – $5.10) × 1,000 | $ 430 U |
| Quantity variance | (840 – 80 lbs/ batch × 10 batches) × $5.10 | 204 U |
| Total zinc variance | | $634 U |
| | | |
| WIP | 80 lbs/ batch × 10 batches × $5.10 | 4,080 |
| Raw Material inventory | [1,000 – 840] × $5.10 | 816 |
| Total purchased | | $5,530 |

**P 12-12:** **Solution to Howard Binding** (20 minutes)
[Calculating the price variance at purchase instead of when materials used]

a. Actual price of purchases = $10,850 ÷ 35,000 = $.31/foot
Price variance (@ purchase) = (actual price-standard price) x quantity purchased
($.31 - $.30) × 35,000 = $350 unfavorable

Price variance (@ use) = (actual price-standard price) x quantity used

| | Large | Small | Total |
|---|---|---|---|
| Change in price | $.01 U | $.01 U | |
| Actual quantity used | 16,000 ft | 15,500 ft | |
| Variance | $ 160 U | $ 155 U | $315 U |

b. The price variance at purchase is larger by $35 than if the price variance is computed based on actual materials used. They differ because purchases are larger than the amount used in this example. If there were beginning inventories and purchases were less than consumption, the price variance at purchase would be less than the price variance at use.

Most firms calculate the price variance at purchase for two reasons. First, this results in a more complete measure of the performance of the purchasing manager. Since all the materials were purchased in the current reporting period, all of the price variance is reported at the time of purchase. Second, reporting price variances at the time of purchase results in a more timely measure of the purchasing manager. If price variances are computed at time of use, reported price variances would not be reported until the material is used. Suppose materials are purchased and held in inventory for six months until they are used. The purchasing manager's current performance would not be reported for six months. This delays any corrective action senior management can undertake.

**P 12-13:** **Solution to Fast Fax** (20 minutes)
[Adapting variance analysis to a marketing department]

This problem allows the instructor to illustrate how variance analysis can be applied to non-manufacturing settings such as a marketing organization. A more thorough treatment of the topic is provided in chapter 13.

| | | Model 700 | Model 800 | Total |
|---|---|---|---|---|
| Variance in units sold from budget | | 50 F | 20 U | 30 F |
| Variance in contribution margin per unit from budget | | $50 U | $50 F | 0 |
| Difference in margin from budget | | $2,500 F | $2,000 U | $500 F |
| broken down as: | | | | |
| Mix variance | | | | |
| ($\Delta Q \times CM_S$) | 50 F × $200 | $10,000 F | | |
| | 20 U × $300 | | $6,000 U | $4,000 F |
| Contribution margin variance | | | | |
| ($\Delta CM \times Q_A$) | $50 U × 150 | $7,500 U | | |
| | $50 F × 80 | | $4,000 F | $3,500 U |
| Total Variance | | $2,500 F | $2,000 U | $ 500 F |

Sue Young's budgeted performance ($50,000 margin) and actual performance ($50,500) compare favorably. On model 700, she sold 50 more units producing $10,000 additional margin, but the lower contribution margin per unit reduced the overall margin by $7,500. Likewise, on the model 800, the higher price produced $4,000 additional but reduced sales that caused total margin to fall $6,000.

**P 12-14:** **Solution to Flower City Cartridges** (20 minutes)
[Decomposing purchase price into variances, WIP, and ending inventory]

The following table details the financial disposition of the $385.20 spent on blue ink in June:

| | | |
|---|---|---|
| Actual price paid per gallon ($385.20/18) | $21.40 | |
| Standard price | 20.00 | |
| Difference | $1.40 | |
| Gallons purchased | 18 | |
| Blue ink price variance | | $25.20 |
| Material usage variances | | |
| CJ120 (-.20 gal. × $20) | $4.00U | |
| HP9X2 (+.10 gal. × $20) | 2.00F | |
| CN417 (+.20 gal. × $20) | 4.00F | |
| XRX776 (-.40 gal. × $20) | 8.00U | |
| Unfavorable material usage variance | | $6.00 |
| WIP (4 jobs x 4 gallons/job × $20/gallon) | | $320.00 |
| Ending blue ink inventory (1.7 gallons × $20) | | $34.00 |
| Total amount paid for blue ink | | $385.20 |

**P 12-15:** **Solution to Great Southern Furniture** (25 minutes)
[Labor variances]

This question involves calculating the total labor variance and decomposing it into a wage rate and an efficiency variance.

The following data are given or can be derived from the problem:

Standard labor hours: 500 rooms × 4.5 hours per room = 2,250 hours
Standard wage rate: $22.00 per hour

Actual labor hours: 2,170 hours
Actual labor rate: $49,693 ÷ 2,170 hours = $22.90

| | |
|---|---|
| Wage rate variance ($22.90 - $22.00) × 2,170 | $1,953 U |
| Labor efficiency variance (2,170 - 2,250) × $22.00 | $1,760 F |
| **Total Variance** | $ 193 U |

The Hyatt team was over budget by $193 (which is less than 1 percent of the budget amount). The site supervisor spent $1,953 more on slightly higher paid workers ($22.90 vs. $22), but these workers were more productive and completed the work in 80 fewer hours, saving Great Southern $1,760 of wages.

Overall, the site supervisor did a good job.

**P 12-16:** **Solution to Cibo Leathers** (30 minutes)
[Setting and revising standards]

a. Based on the following table that calculates the various leather quality and labor time combinations, the standard quantity of leather is 11 and the standard price is $0.5909 per square foot. These standards minimize the total cost of the leather and labor time required to cut the leather for one strap.

| Leather Price per Square Foot | Leather Quality | Leather Quantity | Labor (minutes) | Total Cost |
|---|---|---|---|---|
| $1.4375 | Very high | 8 | 5 | $14.00 |
| 1.0000 | High | 9 | 8 | 13.00 |
| .7700 | Medium | 10 | 11 | 13.20 |
| .5909 | Low | 11 | 12 | 12.50 |
| .4583 | Very low | 12 | 15 | 13.00 |

b. Standard labor minutes is 12 per strap and the standard wage is $.50 per minute ($30/60).

c. To minimize the total cost of the leather and labor to cut the leather, the following table presents the various combinations.

| Leather Price | Leather Quality | Leather Quantity | Labor (minutes) | Total Cost |
|---|---|---|---|---|
| $1.1500 | Very high | 8 | 5 | $11.70 |
| .8000 | High | 9 | 8 | 11.20 |
| .6930 | Medium | 10 | 11 | 12.43 |
| .5318 | Low | 11 | 12 | 11.85 |
| .4125 | Very low | 12 | 15 | 12.45 |

Based on the preceding table:

| | |
|---|---|
| Standard leather quantity: | 9 square feet |
| Standard price of leather for shoulder straps: | $0.800 per square foot |
| Standard minutes to cut shoulder strap leather: | 8 minutes |

d. If Cibo is like most firms, it will not raise standards in mid year unless there is a drastic cost change. The current labor and leather cost at revised leather prices is:

| | | |
|---|---|---|
| Leather quantity | 11 square feet | |
| Price per square foot | $0.5318 | |
| Leather cost | | $5.85 |
| Labor time | 12 minutes | |
| Cost per minute | $0.50 | $6.00 |
| Total cost at inefficient leather quality | | $11.85 |
| Total cost at efficient Leather quality | | $11.20 |
| Extra cost per shoulder strap | | $ .65 |

By not revising the standards for the remainder of the current year, Cibo is losing about $.65 per strap, which is trivial in terms of the final selling price. By not changing the standards during the year, Cibo (i) maintains the integrity of the standard cost system as a control device, (ii) reduces influence costs of managers trying to get standards changed before they report unfavorable variances, and (iii) reduces the time managers spend revising standards.

e. The cost of scrapped leather, in this case 6 square feet @ $0.4583 or about $2.75 per strap, is built into the standard cost of the strap. In other words, the efficient amount of leather is 12 square feet, even though 6 square feet is discarded. Hence, the standard cost of leather is $5.50 which contains $2.75 of scrap.

**P 12-17:** **Solution to Software Associates** (30 minutes)
[Using labor variances to evaluate performance in a consulting firm]

a. Performance report:

| | Budgeted Cost | Actual Cost | Total Variance | Wage Variance[1] | Efficiency Variance[2] |
|---|---|---|---|---|---|
| Partner | $17,500 | $ 15,750 | $ 1,750F | $ 0U | $ 1,750F |
| Associate | 36,000 | 35,000 | 1,000F | 1400U | 2,400F |
| Senior analyst | 54,000 | 63,750 | 9,750U | 3750F | 13,500U |
| Analyst | 40,000 | 49,000 | 9,000U | 7000F | 16,000U |
| Programmer | 75,000 | 82,800 | 7,800U | 7200F | 15,000U |
| Total | $222,500 | $246,300 | $23,800U | $16,550F | $40,350U |

[1]Wage variances:

| | |
|---|---|
| Partner | ($15,750÷90 - $175) × 90 |
| Associate | ($35,000÷280- $120) × 280 |
| Senior analyst | ($63,750÷750- $90) × 750 |
| Analyst | ($49,000÷1400- $40) × 1400 |
| Programmer | ($82,800÷3600- $25) × 3600 |

[2]Efficiency variances:

| | |
|---|---|
| Partner | (90 - 100) × $175 |
| Associate | (280- 300) × $120 |
| Senior analyst | (750- 600) × $90 |
| Analyst | (1400- 1,000) × $40 |
| Programmer | (3600- 3,000) × $25 |

b. It is likely that less qualified senior analysts, analysts, and programmers were assigned to this project (see the favorable wage variances) and they took more hours than budgeted (see unfavorable efficiency variances).

**P 12-18:** **Solution to Starling Coatings** (30 minutes)
[Infrequent standard revisions adversely affects decision making]

a. The standard quantities of magna45 and zelon will be set where the total cost of manufacturing a batch of zurtan is minimized. From the table below, we see that 6 gallons of magna45 and 5 gallons of zelon minimize the cost of producing a batch.

Cost of Producing One Batch of
Zurtan Using Various Combinations
of Magna45 and Zelon

| magna45 | zelon | Total Cost |
|---|---|---|
| 1.00 | 30.00 | $154.00 |
| 2.00 | 15.00 | $83.00 |
| 3.00 | 10.00 | $62.00 |
| 4.00 | 7.50 | $53.50 |
| 5.00 | 6.00 | $50.00 |
| 6.00 | 5.00 | $49.00 |
| 7.00 | 4.30 | $49.50 |
| 8.00 | 3.75 | $50.75 |
| 9.00 | 3.33 | $52.65 |
| 10.00 | 3.00 | $55.00 |

b. After the prices for magna45 and zelon change, the cost minimizing combination of the two inputs consist of 8 gallons of magna45 and 3.75 gallons of zelon.

Cost of Producing One Batch of Zurtan
Using Various Combinations of
Magna45 and Zelon

| magna45 | zelon | Total Cost |
|---|---|---|
| 1.00 | 30.00 | $213.00 |
| 2.00 | 15.00 | $111.00 |
| 3.00 | 10.00 | $79.00 |
| 4.00 | 7.50 | $64.50 |
| 5.00 | 6.00 | $57.00 |
| 6.00 | 5.00 | $53.00 |
| 7.00 | 4.30 | $51.10 |
| 8.00 | 3.75 | $50.25 |
| 9.00 | 3.33 | $50.31 |
| 10.00 | 3.00 | $51.00 |

c. Because the zurtan production manager is compensated (in part) for eliminating unfavorable quantity variances of magna45 and zelon, he/she will continue to attempt to stay as close to the old standard quantities of 6 gallons of magna45 and 5 gallons of zelon as possible. Since the quantity standards are not changed when the prices of the inputs change, the manager will be penalized if he/she deviates from the standards of 6 gallons of magna45 and 5 gallons of zelon.

d. This problem illustrates that Starling bears a cost by not adjusting its standards more frequently than once a year. The nature of the cost is that Starling managers continue to make decisions based on stale prices. However, changing standards more frequently reduces the benefits of the standard cost variances as a control device. Frequent standard changes make it easier for managers to argue that external events outside their control are causing the variance and that the standard should be changed. A policy of frequent standard changes increases influence costs. Hence, Starling, like most companies, is willing to tradeoff decision making errors in order to maintain the integrity of the standard cost system as a control device.

**P 12-19:** **Solution to Trevino Golf Balls** (40 minutes)
[Distorted product costs and incentives]

a. *Effects of the accounting for value packs*

Product profitability is distorted
The above system clearly distorts the profitability of the product lines. As the chart below shows, writing the three balls off to a promotion account overstates gross margin on the value packs by over 10 percent.

Gross Margin based on current standards:

| | List Price | Standard Mfg. Cost | Gross Margin $ | Gross Margin % |
|---|---|---|---|---|
| Current treatment | $17.00 | $6.75 | $10.25 | 60.3% |
| Standard cost based on 15 balls | $17.00 | $8.4375* | $8.5625 | 50.4% |

*Assumes costs evenly distributed among balls, therefore (6.75/12) × 15 = $8.4375

Since the current costing system makes the value pack look more profitable than it "actually" is, dysfunctional decisions likely result. Resources may be expended on this product line (given that they are expecting a 60 percent margin to result) that could be used more effectively elsewhere. In a sense, by distorting profitability analysis, this system misrepresents opportunity costs and could lead to poor investment decisions. This is evidenced by the senior product manager's comments suggesting that their commitment of promotional dollars to this line is appropriate given its profitability. The accounting system is not allocating/metering direct costs of marketing to product lines, but rather is assigning them to one big pool.

Distorted Overhead Allocation

By allocating overhead on "units," the implicit assumption is that each unit is equivalent. Clearly, while that once was true, it no longer is. Comparatively speaking, the Value Pack containing 15 balls requires more manufacturing resources, and should be assigned more manufacturing costs than a standard 12-ball unit. Since it is not, costs are underassigned to the Value Packs.

Externalities are Imposed on the Firm

The current treatment of the Value Pack does not reflect the externalities that it imposes on the firm. The special hand packing of the Value Packs requires additional labor.

Inventory and Net Income Understated

By treating the cost of 15 balls as 12, and writing off the additional 3 balls as a period expense during the period of manufacture, inventory is understated. Unsold units in inventory are recorded as having the value of 12 balls, since the value of the three promotional balls was written off as a period expense when they were manufactured. The inventory number should actually reflect the cost of 15 balls. In the event production exceeds sales, the expense account erroneously includes the cost of three unsold, inventoried balls per unit. As a result, period expenses are overstated.

The Marketing Budget is Overstated

The "Value Packs Sales Program Expense" component of the marketing budget is based on the *expected* number of Value Packs sold. Therefore, marketing has an incentive to overstate the number of units they expect to sell, thereby ensuring that there will be excess money in their budget that may be used elsewhere.

b. *Why Did They Implement This Cost System?*

Manufacturing's Incentive Would be Adversely Affected

Since a component of the manufacturing group's compensation is based on their ability to keep high gross margins, they did not want to bear the consequences of marketing's decision to sell 15 balls for the price of 12. They likely demanded that marketing "take the hit" for the three "free" balls.

Since marketing is a cost center, they would not have a problem with absorbing the extra costs associated with the Value Packs, as long as they were provided for in the budget. Manufacturing, on the other hand, is a profit center, and would not take kindly to an increase in cost that would affect their margins.

Empire Building

Marketing seized the opportunity to have their budget increased dramatically, with minimal down-side risk. The senior product manager liked being in charge of a larger budget, since budgets often proxy for status in corporations. This coupled with marketing's ability to further "pad their budget" through overestimating Value Pack sales, as described above, created incentives for marketing to accept manufacturing's demands.

<u>It Was a Short-Run Solution</u>
Trevino did not anticipate the longevity of the Value Pack, and only expected it to be a short-run, promotional item. They did not expect any of the problems described above since they are all more long-run in nature.

c. *Should They Change the Accounting Treatment?*

*Yes*. Since the Value Pack has become a permanent product line, Trevino must take the appropriate actions, and revise their cost standards to reflect the cost of 15 golf balls, including the higher packaging costs. This must be done not only to ensure profit-maximizing decisions, but to avoid problems with their auditors. The auditors likely agreed to the above system when the Value Pack was only promotional and short-term in nature. However, given that this is now a stock item being inventoried, they are likely to demand that the inventory be accurately valued. The Internal Revenue Service will likely question the treatment of period expenses containing product costs.

In order to implement a new system, they will have to revise the standard by which manufacturing is evaluated. Specifically, they would have to move away from evaluating manufacturing on gross margin.

**Case 12-1: Solution to Domingo Cigars** (55 minutes)
[Computing and analyzing labor and material variances]

a. Piece rates:

| | **Panatella** | **Corona** | **Churchill** |
|---|---|---|---|
| Standard minutes per cigar | 3 | 4 | 6 |
| Number of cigars per hour (60 ÷ standard) | 20 | 15 | 10 |
| Piece rate ($3.00 ÷ cigars/hour) | $0.15 | $0.20 | $0.30 |

b. Tobacco price variance:

| | | |
|---|---|---|
| Actual price/gram | = | $805,000 ÷ 3.5 million grams |
| | = | $0.23 |
| Price variance | = | ($0.23 – $0.20) × 3.5 million grams |
| | = | $105,000 (U) |

c. Tobacco Quantity variances:

| | Panatella | Corona | Churchill |
|---|---|---|---|
| Actual tobacco used | 740,000 | 1,360,000 | 1,400,000 |
| Actual cigars produced | 115,000 | 125,000 | 60,000 |
| × Standard grams/cigar | 6 | 10 | 20 |
| Standard quantity | 690,000 | 1,250,000 | 1,200,000 |
| Quantity difference | 50,000 (U) | 110,000 (U) | 200,000 (U) |
| × Standard price | $0.20 | $0.20 | $0.20 |
| Quantity variance | $10,000(U) | $22,000(U) | $40,000(U) |
| Quantity difference as a percent of standard | 7.25% | 8.80% | 16.67% |

d. Labor efficiency variances:

| | Panatella | Corona | Churchill |
|---|---|---|---|
| Actual labor minutes | 294,000 | 420,000 | 336,000 |
| Actual cigars produced | 115,000 | 125,000 | 60,000 |
| × Standard minutes/cigar | 3 | 4 | 6 |
| Standard minutes | 345,000 | 500,000 | 360,000 |
| Labor difference | 51,000(F) | 80,000(F) | 24,000(F) |
| × Standard labor rate per minute | $ 0.05 | $ 0.05 | $ 0.05 |
| Labor efficiency variance | $2,550(F) | $4,000(F) | $1,200(F) |
| Labor difference as a % of standard | 14.78% | 16.00% | 6.67% |

Alternatively, if hours are used:

| | Panatella | Corona | Churchill |
|---|---|---|---|
| Actual labor hours | 4,900 | 7,000 | 5,600 |
| Actual cigars produced | 115,000 | 125,000 | 60,000 |
| × Standard minutes/cigar | 3 | 4 | 6 |
| Standard minutes | 345,000 | 500,000 | 360,000 |
| ÷ 60 minutes/hour | 60 | 60 | 60 |
| Standard hours | 5,750 | 8,333 | 6,000 |
| Labor difference (hours) | 850(F) | 1,333(F) | 400(F) |
| × Standard labor rate per hour | $ 3.00 | $ 3.00 | $ 3.00 |
| Labor efficiency variance | $2,550(F) | $4,000(F) | $1,200(F) |

e. The employees are producing cigars at a higher than expected rate of output. The piece-rate system is allowing them to earn substantially more than $3 per hour. In particular, the actual wages per hour per cigar type are:

| | Panatella | Corona | Churchill |
|---|---|---|---|
| Actual cigars produced | 115,000 | 125,000 | 60,000 |
| Piece Rate | × $0.15 | × $0.20 | × $0.30 |
| Actual payment | $17,250 | $25,000 | $18,000 |
| Actual hours | 4,900 | 7,000 | 5,600 |
| Effective wage rate | $ 3.52 | $ 3.57 | $ 3.21 |

The favorable labor efficiency variances reflect that employees earned more than $3.00 per hour. They captured the benefits of their higher efficiency, Domingo Cigars did not. The favorable labor efficiency variances reflect the gains that accrued to the employees due to their higher than standard output rates.

The unfavorable tobacco quantity variances reflect the rollers' inefficient use of tobacco or theft. They are not charged directly for the tobacco used; hence, it appears they have substituted more tobacco for less labor. Since Domingo paid above standard cost for the tobacco, it is unlikely they received below standard quality tobacco. One student who visited an actual Cuban cigar factory reported that employee theft of tobacco is common.

The large unfavorable tobacco price variance is troubling.

There is also a difference between churchills and the other two cigars. The favorable labor efficiency variance was smaller and the unfavorable material variance was larger on churchills than the other two cigars. This suggests that churchills were more difficult to produce and rollers wasted more tobacco making churchills.

f. Management must investigate further the causes of the large unfavorable tobacco price variance.

Charge rollers for the tobacco they use. Either increase the piece rate and charge them for tobacco used or just penalize them for excess tobacco used. If it is too costly to meter tobacco use to each roller, then all the rollers in each room can share the cost of excess tobacco use. This could be calculated by taking the excess tobacco cost (at standard price) divided by total cigars produced. This average excess tobacco cost per cigar is then charged to each roller by using the number of good cigars the roller made. However, this scheme, while requiring less metering, suffers from the free-rider problem.

Also, management should reevaluate the labor standard on churchills. Relative to the other two cigars, it looks low. Rollers likely try to avoid making churchills. Influence costs likely exist as employees jockey to make the other cigar types.

Finally, management probably should investigate additional security measures to reduce employee theft of tobacco.

**Case 12-2: Solution to Rust Belt Mufflers** (90 minutes)
[Using labor and material standards as performance measures]

a. Materials and labor variances:

Materials Variance. Since no specific quantity figures are provided for installations, the total materials variance cannot be decomposed into its price and quantity components. Total materials variance equals the actual price paid for the materials used in installations minus the standard cost per installation times the number of installations performed. Favorable and unfavorable variances are denoted as F and U, respectively.

| | $P_a \times Q_a$ | | $P_s$ | | $Q_s$ | | *Variance* |
|---|---|---|---|---|---|---|---|
| State | $ 710,500 | – | $60 | x | 14,500 | = | $159,500F |
| Dewey | 1,346,125 | – | 60 | x | 22,250 | = | 11,125U |
| Mt. Hope | 759,000 | – | 60 | x | 11,500 | = | 69,000U |

The State manager is spending much less on materials relative to both the standards and the other Buffalo shops. Since the standard costing system was implemented to encourage cost containment, State's favorable variance is, at face value, encouraging. However, since the Dewey and Mt. Hope variances tend to confirm that the standards are accurate or even somewhat low, an actual cost figure in the State Street store that is 18.3% [159,500 ÷ (60 × 14,500)] below standard should arouse some suspicion.

Dewey's unfavorable variance is only 0.8% [$11,125 ÷ ($60 × $22,250)] above standard and should be interpreted as differing only negligibly. At 10 percent [$69,000 ÷ ($60 × $11,500)] over standard, there should be some concern over Mt. Hope's commitment to meeting cost containment objectives with regard to materials purchases.

<u>Total Direct Labor Variance.</u> Direct labor is treated in the same manner as materials. However, enough data exist to disaggregate the total direct labor variance into its price and quantity components. The total direct labor variance is equal to the amount spent on direct labor minus the amount that should have been spent according to the standards. In the terminology of the text, this is $W_a \times H_a - W_s \times H_s$. Note that $H_s$ is the standard number of hours given the actual number of installations. For example, $H_s$ for State is 14,500 actual installations times one standard hour per installation. The total direct labor variances follow.

| | $W_a$ | | $H_a$ | | $W_s$ | | $H_s$ | | | | Variance |
|---|---|---|---|---|---|---|---|---|---|---|---|
| State | $11 | × | 11,600 | - | $11.80 | × | 14,500 | × | 1 | = | $43,500F |
| Dewey | 12 | × | 21,138 | - | 11.80 | × | 22,250 | × | 1 | = | 8,894F |
| Mt. Hope | 13 | × | 12,650 | - | 11.80 | × | 11,500 | × | 1 | = | 28,750U |

As with the total materials variance, the percentage by which actuals vary from standards is valuable for interpretation.

| | $W_S$ x $H_S$ | *Variance* | *Variation from Standard* |
|---|---|---|---|
| State | $171,100 | $43,500F | 25.4%F |
| Dewey | 262,550 | 8,894F | 3.4%F |
| Mt. Hope | 135,700 | 28,750U | 21.2%U |

The interpretation of the total direct labor variance yields conclusions similar to those drawn from the materials variances. State has spent suspiciously little on direct labor, Dewey is roughly in line with standards and Mt. Hope is again the big spender. Disaggregation into the direct labor price and quantity variances provides further confirmation of this pattern.

<u>Direct Labor Price and Quantity Variances.</u> The price variances [$(W_s - W_s) \times H_a$] for the Buffalo shops follow.

| | $W_a$-$W_s$ | | $H_a$ | | Variance |
|---|---|---|---|---|---|
| State | (\$11.00 - \$11.80) | × | 11,600 | = | \$9,280F |
| Dewey | (\$12.00 - \$11.80) | × | 21,138 | = | 4,228U |
| Mt. Hope | (\$13.00 - \$11.80) | × | 12,650 | = | 15,180U |

The quantity variances [$(H_a - H_s) \times W_s$] follow.

| | $H_a$ - $H_s$ | | $W_s$ | | Variance |
|---|---|---|---|---|---|
| State | (11,600 - 14,5001) | × | \$11.80 | = | \$34,220F |
| Dewey | (21,138 - 22,2501) | × | 11.80 | = | 13,122F |
| Mt. Hope | (12,650 - 11,5001) | × | 11.80 | = | 13,570U |

State is spending less than the standard per direct labor hour and using far fewer hours of direct labor per installation than expected by the standard. Mt. Hope has both an unfavorable price variance and an unfavorable quantity variance; in comparison with the established standards, it is spending too much per hour of direct labor and using too many hours of direct labor per installation. Dewey pays direct labor 1.7% [(\$12.00 - \$11.80) ÷ \$11.80] above the standard rate, which is hardly noteworthy here. Dewey's direct labor quantity varies favorably from standard by 5% [(21,138 - 22,250) × 22,250], a number that, when considered within the context of Dewey's other variances, should probably be viewed as good cost containment rather than an indicator of trouble.

<u>Summary.</u> The total variances for the Buffalo shops are:

| | *Materials* | *Direct Labor* | *Total Variances* |
|---|---|---|---|
| State | \$159,500F | \$43,500F | \$203,000F |
| Dewey | 11,125U | 8,894F | 2,231U |
| Mt. Hope | 69,000U | 28,750U | 40,250U |

The findings throughout have been relatively consistent. State has been able to produce for an incredibly low cost, Dewey has been at or near the established standards, and Mt. Hope has continued to be the kind of big spender that the standards were devised to eliminate. Dr. Madison should probably view Dewey's performance favorably and Mt. Hope's unfavorably. State's "success" merits serious investigation and should not be immediately accepted at face value.

b. Given the basic correctness of the standards, any large deviation, even if it is favorable, should be interpreted as problematic. The warranty information should not fundamentally change the interpretation in (a), but it serves to answer some of the questions raised by the variance data. Milty's report does indicate a flaw within the standard costing system. The warranty information suggests that the system inherently provides incentives for some managers to impose negative externalities on the firm. Consider the percentage of jobs requiring warranty replacement and the total variances for each shop:

| | *State* | *Dewey* | *Mt. Hope* |
|---|---|---|---|
| Installations performed | 14,500 | 22,250 | 11,500 |
| Replacements caused | 500 | 100 | 8 |
| Percentage of defects | 3.45% | 0.45% | 0.07% |
| Total variances | $257,350 | $14,235U | $92,725U |

The Buffalo data indicate that there is a correlation between spending and quality of work. Shoddy work is not costless, yet the externality produced by inferior work does not appear to be adequately captured within the variance data. Therefore, if the shop manager is told merely to achieve more favorable variances, there is considerable incentive to produce good cost figures through bad installations.

Although it has provided Madison with some useful information, the standard costing system as currently implemented has not met its goal of benefiting the firm by providing managers with incentives to lower their cost structure. In broad terms, the standard costing system needs to better incorporate the costs of poor quality and provide better incentives to managers to meet the improved cost objectives. The correlation between spending and quality must be captured in a standard cost system. One way to do this would be to design a standard for "normal" warranties (say 1 percent of all installations). Each installation requiring warranty work would then be tracked to the store performing the original installation. The standard cost system would then calculate and report a dollar variance for warranty work above or below standard. For example, if a store installed 14,500 mufflers, it would be allowed 145 normal replacements (1% × 14,500). If 175 installations required warranty work at this or any other store, then an unfavorable variance of 30 installations times the standard cost per installation would be charged back to the store that performed the original installations.

# CHAPTER 13
## OVERHEAD AND MARKETING VARIANCES

**P 13-1:** **Solution to On-Call** (15 minutes)
[Volume variance measures excess capacity]

Let SV = Standard volume (in message packets)
BV = Budgeted volume (in message packets)
VOH = Variable overhead per message packet
FOH = Fixed overhead per quarter

Using this notation and the definition of the volume variance, then the following equation can be written:

Volume Variance = $1.3 = flexible budget at std. volume – Overhead absorbed

$$1.3 = \$6.5 + \text{VOH} \times \text{SV} - \left[\frac{6.5}{.8} + \text{VOH}\right]\text{SV}$$

$$1.3 = 6.5 + \text{VOH} \times \text{SV} - \frac{6.5}{.8}\text{SV} - \text{SV} \times \text{VOH}$$

$$-5.2 = -8.125 \times \text{SV}$$

$$\text{SV} = .64$$

$$\text{Excess Capacity} = \left[\frac{\text{BV} - \text{SV}}{\text{BV}}\right] = \frac{.80 - .64}{.80}$$

Excess Capacity = 20%.

An alternative simpler solution is:

$$\text{Volume Variance} = \left[\frac{\text{BV} - \text{SV}}{\text{BV}}\right] \times \text{FOH}$$

$$\frac{\text{Vol Var}}{\text{FOH}} = \text{\% excess capacity}$$

$$= \frac{\$1.3\text{M}}{6.5\text{M}} = 20\%$$

**P 13-2** **Solution to Purchasing Department** (20 minutes)
[Using variances to analyze a purchasing department]

a. Overhead rate per purchase order (PO):

$$\frac{\$300{,}000 + \$50 \times 15{,}000 \text{ POs}}{15{,}000 \text{ POs}} = \frac{\$1{,}050{,}000}{15{,}000} = \$70 \text{ per PO}$$

**Purchasing Department**
Performance Evaluation Report
Current Year

| | |
|---|---|
| Actual Purchasing Department costs incurred | \$1,180,000 |
| less: Purchasing Department costs absorbed | 1,120,000* |
| Underabsorbed Purchasing Department costs | \$ 60,000 |

* \$1,120,000 = 160,000 × \$70

| | | | |
|---|---|---|---|
| Actual Purchasing Department costs incurred | \$1,180,000 | | |
| less: expected costs at 16,000 POs (\$300,000 + 16,000 × \$50) | 1,100,000 | | |
| Spending variance | | \$80,000 | Unfavorable |
| Expected costs at 16,000 POs | \$1,100,000 | | |
| less: Purchasing Department costs absorbed | 1,120,000 | | |
| Volume variance | | \$20,000 | Favorable |
| Total variance in purchasing | | \$60,000 | Unfavorable |

b. The purchasing department charged each PO \$70. At this rate there was still \$60,000 left uncharged to other divisions at the end of the year. This \$60,000 can be decomposed into a spending variance of \$80,000U and a volume variance of \$20,000F. The spending variance represents the overspending even after adjusting for the higher number of POs. The favorable volume variance of \$20,000F reflects the overutilization of capacity when purchasing exceeded its expected capacity (15,000 POs).

c. While the department processed more than the expected number of purchase orders, its costs were higher than expected after adjusting for the higher volumes. The department did not do a good job in controlling costs.

d. Besides reporting the spending and volume variances, several other measures should be reported, including:

Price variances of purchased items - indicates if purchasing sought out low cost suppliers

Materials usage variances - indicates if materials purchased met quality specifications

Delivery schedule delays - indicates if POs issued and purchases received in a timely fashion

**P 13-3:** **Solution to Spectra Inc.** (20 minutes)
[Timeliness of adjusting standards]

Both the president and auditor are right. The president is right to want to review cost data and pricing quarterly. But basing overhead rates on actual costs divided by actual volume causes unit costs to rise in the slack periods and fall in boom periods. The overhead rates reported in the problem behave in precisely this way. If managers with decision rights over pricing are influenced to raise prices when unit overhead costs rise and lower prices when unit overhead costs are low, then the pricing strategy of the firm is adversely affected by the accounting for overhead costs. Also, changing standards too frequently can reduce their value as a control measure.

One change that should be made is to choose a constant-denominator volume (i.e., direct labor) at the beginning of the year and stop changing overhead rates each quarter.

**P 13–4:** **Solution to Logical Solutions** (20 minutes)
[Solving for unknown variables given overhead variances]

First, start by writing down the formulas for the overhead variances and then substitute in the given data.

| | | |
|---|---|---|
| OH Spending Variance | = | AOH – FOH – VOH × AV |
| OH Efficiency Variance | = | VOH(AV – SV) |
| OH Volume Variance | = | FOH[(EV – SV) ÷ EV] |

(All data is in thousands.)

| | | | | | |
|---|---|---|---|---|---|
| (a) | OH Spending Variance | = | –100 | = | 1,000 – (600 – VOH × AV) |
| (b) | OH Efficiency Variance | = | –100 | = | VOH(AV – SV) |
| (c) | OH Volume Variance | = | –300 | = | 600[(40 – SV) ÷ 40] |

Solve (c) for SV:

$$
\begin{aligned}
-0.5 &= (40 - SV) \div 40 \\
-20 &= 40 - SV \\
-60 &= -SV
\end{aligned}
$$

$$SV = 60$$

Next, substitute SV = 60 into (b):

$$\begin{aligned} -100 &= VOH(AV - 60) \\ -100 &= VOH \times AV - 60\ VOH \\ VOH \times AV &= -100 + 60\ VOH \end{aligned}$$

Next, substitute VOH × AV into (a):

$$\begin{aligned} -100 &= 1{,}000 - [600 - (-100 + 60\ VOH)] \\ -100 &= 1{,}000 - 600 + (-100 + 60\ VOH) \\ -500 &= -100 - 60\ VOH \\ -600 &= -60\ VOH \\ VOH &= 10 \end{aligned}$$

Finally, solve for AV using (b):

$$\begin{aligned} -100 &= 10(AV - 60) \\ 10\ AV &= -100 + 60 \times 10 \\ AV &= 50 \end{aligned}$$

**P 13-5:** **Solution to Oneida Metal** (20 minutes)
[Labor and overhead variances and solving for unknowns]

a. Direct labor efficiency variance = $9,300 unfav
b. Direct labor wage rate variance = $17,300 fav
c. Budgeted annual fixed manufacturing overhead = $228,000
d. Manufacturing overhead spending variance = $40,000 unfav
e. Manufacturing overhead efficiency variance = $2,400 unfav
f. Manufacturing overhead volume variance = $24,000 unfav

These answers are computed below.

The first step is to calculate standard and actual volume based on actual jobs completed:

| **Job #** | **Number of units in the job** | **Standard direct labor hours per unit** | **Standard DL Hours Per job** | **Actual direct labor hours used in the job** |
|---|---|---|---|---|
| 1 | 1,000 | 2 | 2,000 | 2,100 |
| 2 | 2,000 | 3 | 6,000 | 6,200 |
| 3 | 1,000 | 1 | 1,000 | 900 |
| 4 | 2,000 | 4 | 8,000 | 8,100 |
| **Total** | | | 17,000 | 17,300 |

The following formulas are used to compute the variances:

a. Direct labor efficiency variance = $(H_a - H_s) \times W_s$
$= (17{,}300 - 17{,}000) \times \$31$
$= \$9{,}300$ unfav

b. Actual wage rate was $30 per DL hour ($519,000 ÷ 17,300 direct labor hours).

Direct labor wage rate variance = $(W_a - W_s) \times H_a$
$= (\$30 - \$31) \times 17{,}300$
$= \$17{,}300$ fav

c. To calculate budgeted annual fixed manufacturing overhead, take the formula for the overhead rate, substitute in the known values and solve for FOH:

OH rate = FOH/BV + VOH
OH rate = $20 = FOH/19,000 DL hours + $8
$12 = FOH/19,000
FOH = $228,000

d. Mfg overhead spending variance = AOH – (FOH + VOH x AV)
= $406,400 – ($228,000 + $8 × 17,300)
= $40,000 unfav

e. Mfg overhead efficiency variance = VOH × (AV – SV)
= $8 × (17,300 – 17,000)
= $2,400 unfav

(Note: standard volume (SV) is $H_s$ and actual volume (AV) is $H_a$)

f. Mfg overhead volume variance = FOH + VOH x SV – OHR × SV
= $228,000 + $8 × $17,000 - $20 × 17,000
= $24,000 unfav

**P 13–6:** **Solution to Beanie Babies** (25 minutes)
[Interpreting volume variances based on expected vs. normal volume]

a. Calculation of overhead rates based on normal and expected volume.

| | **Normal Volume** | **Expected Volume** |
|---|---|---|
| Number of workers | 180 | 240 |
| Hours per worker | × 2,000 | × 2,200 |
| Budgeted volume | 360,000 | 528,000 |
| | | |
| Fixed Overhead | $2,300,000 | $2,300,000 |
| Variable Overhead rate | $3.50 | $3.50 |

| | | |
|---|---|---|
| Budgeted OH | 3,560,000 | 4,148,000 |
| Overhead rate | $ 9.89 | $ 7.86 |

b. and c. Volume variances based on normal and expected volumes.

| | Normal Volume | Expected Volume |
|---|---|---|
| Overhead rate (from above) | $ 9.89 | $ 7.86 |
| Standard volume | 480,000 | 480,000 |
| Flexible budget at standard | $3,980,000 | $3,980,000 |
| Overhead absorbed at standard volume | $4,747,200 | $3,772,800 |
| Volume Variance | $ 767,200F | $ 207,200U |

d. The interpretation of favorable and unfavorable volume variances is relative to whether standard volume is greater than or less than normal volume or next year's volume. Standard volume exceeded normal volume and hence the volume variance is favorable. The plant had more volume than its long-run average volume. Relative to when the plant was built, this last year had 33 percent more volume than originally expected when the plant was built. Relative to the plan for the year, standard volume fell short of planned or expected volume by 9 percent. Hence, based on expected volume, the volume variance is unfavorable.

**P 13-7:** **Solution to Printers, Inc**. (25 minutes)
[Relation among standard, expected, and actual volume]

a., b., & c. (Volume is stated in direct labor hours):

| Products | Standard Volume per Unit | Budgeted Units | Expected Volume | Actual Units | Standard Volume | Hours +/- Std hrs | Actual Hours |
|---|---|---|---|---|---|---|---|
| MC | 100 | 700 | 70,000 | 720 | 72,000 | 1,400 | 73,400 |
| HC | 150 | 500 | 75,000 | 510 | 76,500 | (3,000) | 73,500 |
| | | | 145,000 hrs. | | 148,500 hrs. | | 146,900 hrs |

d. Overhead rate = $\dfrac{\$2{,}900{,}000 + \$10 \times 145{,}000}{145{,}000}$ = $30 per direct labor hour

e. Volume variance = flexible budget at standard volume - overhead applied

$$= \$2,900,000 + \$10 \times 148,500 - (148,500 \times \$30)$$

$$= \$4,385,000 - \$4,455,000 = \$70,000 \text{ F}$$

In order to provide the fixed capacity to produce expected volume of 145,000 direct labor hours, fixed costs of $2.9 million are incurred. More hours than expected were produced. This extra production of about 2.4 percent means that $70,000 of extra capacity (as measured by the fixed overhead costs) was generated. The volume variance is a measure of whether the capacity was utilized as expected.

**P 13-8:** **Solution to Galt Electric Motors** (25 minutes)
[Intuition behind overhead variances]

a. Budgeted machine hours is (30,000 × 20/60) + (20,000 × 30/60) = 20,000 machine hours, yielding a budgeted overhead rate of $1,800,000/20,000 hours = $90 per machine hour. This implies that each small motor is allocated overhead of $90 × 20/60 = $30 and each large motor is allocated overhead of $90 × 30/60 = $45.

b. $1,900,000 – (27,000 × $30) – (24,000 × $45) = 10,000 under absorbed (unfavorable).

c. If all overhead is variable, the overhead flexible budget is: OH = $90 × MH. Actual machine hours of 21,600 implies that overhead should have been $1,944,000 (flexible budget at actual volume.) That it was only $1,900,000 implies a favorable spending variance of $44,000. The efficiency variance is $90 × [21,600 – (27,000 × 20/60) – (24,000 × 30/60)] = 54,000 U. There is no volume variance because overhead absorbed is the same as the flexible budget at standard volume when all overhead is variable.

If all overhead is fixed, the overhead flexible budget is: OH = $1,800,000. Actual overhead of $1,900,000 implies an unfavorable spending variance of $100,000. There is no efficiency variance because the flexible budget of $1,800,000 does not vary with volume. Finally, there is a favorable volume variance of $90,000 because overhead absorbed of (27,000 × $30) + (24,000 × $45) exceeds the flexible budget by $90,000.

d. The spending variances are of different signs because the benchmarks against which actual overhead spending of $1,900,000 is compared differ, increasing with machine hour volume in the first case (all overhead is variable) but staying at $1,800,000 in the second case (all overhead is fixed.) There is no volume variance in the first case because the volume variance is driven by fixed costs FOH[(BV-

SV)/BV] and overhead is zero in this first case. There is no efficiency variance in the second case because the efficiency variance is driven by variable costs [VOH(AV-SV)] and VOH is zero in the second case.

**P 13-9:** **Solution to Western Sugar** (30 minutes)
[Choosing the right standard for fixed overhead]

a. *Beware of unitized costs!* The procedure of taking the fixed overhead adjusted for inflation and dividing by units produced as the standard cost for next year unitizes a fixed cost. If these costs are truly fixed, they should not be adjusted for volume changes in deriving next year's standard cost.

The correct analysis of Western Sugar is to take this year's fixed costs adjusted for inflation ($43 million × 1.02 = $43.86) as the standard for next year. Recasting the variance report yields:

**Western Sugar**
Actual Results compared to Standard
Next Year
(thousands of dollars)

| | Actual cost | Standard cost per bushel | Standard cost | Variance |
|---|---|---|---|---|
| Direct labor | $38,100 | $.544 | $36,992 | 1,108U |
| Sugar beets | 64,829 | .953 | 64,804 | 25U |
| Variable overhead | 28,211 | .400 | 27,200 | 1,011U |
| Fixed overhead | 45,227 | na | 43,860 | 1,367U |
| Total | $176,367 | | $172,856 | $3,511U |

Instead of showing a small, insignificant overall cost variance, the report shows a $3,511 million unfavorable variance. Therefore, management did not do such a good job in controlling costs.

b. The problem with using last year's costs to set standards is that this procedure institutionalizes past inefficiencies. Standards should reflect achievable minimum costs given current technology. If managers know that next year's standards will be this year's costs, they are reluctant to find large cost savings this year because doing so makes achieving next year's standards more difficult.

**P 13-10:** **Solution to Soldering Department** (35 minutes)
[Relation among overhead volume and efficiency variances and normal capacity]

a. Overhead rate:

$$\text{OHR} = \frac{\$160{,}000 + 2{,}000 \times \$110}{2{,}000}$$

$$= \$190/\text{machine hour}$$

b. Efficiency variance:

$$= \$110 \times (\text{Actual Volume} - \text{Standard Volume})$$
$$= \$110 \times (2{,}400 - 2{,}200)$$
$$= \$22{,}000 \text{ U}$$

Volume variance:

$$= (\$160{,}000 + 2{,}200 \times \$110) - \$190 \times 2{,}200$$
$$= 16{,}000 \text{ F}$$

c. There are two obvious patterns in the data:

(i) The overhead rate and budgeted volume are based on normal volume (2,000 hours per month). It took the Soldering Department six months to build production to normal volume. During this start-up period, both the volume and efficiency variances are unfavorable. The volume variance is always unfavorable whenever standard volume is below normal volume, which was the case in the start-up period. During this period, the equipment was being debugged, workers trained, and more machine hours were required to produce the volume than were planned.

(ii) Whenever standard volume exceeds normal volume, the overhead efficiency variance tends to be unfavorable. When the department is operating above normal capacity, the efficiency variance is unfavorable, indicating that more machine hours per unit are required to produce the high volume. This probably occurs because the department becomes congested and less efficient above normal capacity levels.

Another way to say the same thing is the flexible overhead budget isn't really linear in volume once volume exceeds normal levels. Variable overhead per machine hour increases above normal volume levels.

**P 13-11: Solution to Commando Force** (35 minutes)
[Marketing variances]

a. & b. The following table contains the computations for the price variances in part a and the mix and sales variances in part b. Note: Negative numbers denote unfavorable variances.

| | Matt | Kim | MTV | Total |
|---|---|---|---|---|
| Standard sale price | $8.00 | $8.00 | $12.00 | |
| × Standard quantity | 24,000 | 20,000 | 6,000 | 50,000 |
| Standard revenue | $192,000 | $160,000 | $72,000 | $424,000 |
| | | | | |
| Actual sale price | $7.50 | $8.20 | $11.80 | |
| × Actual quantity | 23,000 | 22,000 | 7,000 | 52,000 |
| Actual revenue | $172,500 | $180,400 | $82,600 | $435,500 |
| | | | | |
| Total revenue variance | ($19,500) | $20,400 | $10,600 | $11,500 |
| | | | | |
| Price variance | ($11,500) | $4,400 | ($1,400) | ($8,500) |
| Quantity variance | ($8,000) | $16,000 | $12,000 | $20,000 |
| Total revenue variance | ($19,500) | $20,400 | $10,600 | $11,500 |
| | | | | |
| Standard mix percentage | 48.00% | 40.00% | 12.00% | 100.00% |
| Actual mix-percentage | 44.23% | 42.31% | 13.46% | 100.00% |
| | | | | |
| Mix variance | ($15,680) | $9,600 | $9,120 | $3,040 |
| Sales variance | $7,680 | $6,400 | $2,880 | $16,960 |
| Quantity variance | ($8,000) | $16,000 | $12,000 | $20,000 |

c. Total revenues were $11,500 above plan for the quarter. However, the Matt doll fell short of its revenue goals by $19,500. It had both unfavorable price ($11,500) and quantity ($8,000) variances. It did not sell as well as expected and its price was discounted. Kim and the MTV did much better than expected, $20,400 and $10,600, respectively. Kim had both favorable price and quantity variances whereas the MTV's favorable quantity variance ($12,000) was offset by a small unfavorable price variance ($1,400).

The mix variance illustrates that $3,040 of the total favorable quantity variance of $20,000 resulted from buyers substituting Kim for Matts. However, $16,960 of the favorable $20,000 quantity variance is due to the increase in the total number of units sold. We expected to sell 50,000 units, we sold 52,000 more.

These data indicate that we overforecasted the sales of Matt and underforecasted Kim and MTVs. The market acceptance of Kim is stronger than expected. If these trends persist over several quarters, we should re-examine our basic marketing strategy of Commando Force.

**P 13-12:** **Solution to Wine Distributors** (35 minutes)
[Marketing variances]

The table below summarizes the sales data for April. (Note: negative numbers denote unfavorable variances.)

Total sales revenues were almost exactly as budgeted; standard revenue was $184,000 and actual revenue was $184,700. But this belies some rather dramatic shifts in both prices and quantities.

Both chablis and riesling had favorable price variances of $2,000 and $3,850 whereas chardonnay had an unfavorable $900 price variance. But the favorable price variances were more than offset by unfavorable quantity variances causing the total variance on chablis to be unfavorable by $12,000 and on riesling to be unfavorable by $2,900. The highly favorable total variance on chardonnay of $15,600 just offset the unfavorable total variances of riesling and chardonnay. From the mix variances, it appears there has been substantial substitution of chablis and riesling for chardonnay. The sales variance indicates that while total cases sold are down, the largest dollar impact was on riesling and chablis.

| | **Chablis** | **Chardonnay** | **Riesling** | **Total** |
|---|---|---|---|---|
| Standard sale price | $7.00 | $8.25 | $6.75 | |
| × Standard quantity | 10,000 | 4,000 | 12,000 | 26,000 |
| Standard revenue | $70,000 | $33,000 | $81,000 | $184,000 |
| | | | | |
| Actual sale price | $7.25 | $8.10 | $7.10 | |
| × Actual quantity | 8,000 | 6,000 | 11,000 | 25,000 |
| Actual revenue | $58,000 | $48,600 | $78,100 | $184,700 |
| | | | | |
| Total variance | ($12,000) | $15,600 | ($2,900) | $700 |
| | | | | |
| Price variance | $2,000 | ($900) | $3,850 | $4,950 |
| Quantity variance | ($14,000) | $16,500 | ($6,750) | ($4,250) |
| Total variance | ($12,000) | $15,600 | ($2,900) | $700 |
| | | | | |
| Standard mix percentage | 38.46% | 15.38% | 46.15% | 100.00% |
| Actual mix-percentage | 32.00% | 24.00% | 44.00% | 100.00% |
| | | | | |
| Mix variance | ($11,308) | $17,769 | ($3,635) | $2,827 |
| Sales variance | ($2,692) | ($1,269) | ($3,115) | ($7,077) |
| Total quantity variance | ($14,000) | $16,500 | ($6,750) | ($4,250) |

**P 13-13:** **Solution to Auden Manufacturing** (40 minutes)
[Standard costs and variable costing]

a. $$\text{OH rate} = \frac{\$60{,}000 + \$4 \times \$20{,}000}{\$20{,}000} = \$7\text{/direct labor dollar}$$

b. All direct labor and direct material variances are zero.

OH variances:

flexible budget at standard volume = flexible budget at actual volume (since both standard and actual direct labor cost = $18,000)

= flexible budget @ 9,000 units = $60,000 + $4 × $18,000 = $132,000.

| | | |
|---|---|---|
| Efficiency variance | = | $0 |
| Spending variance = $135,000 – $132,000 | = | 3,000 U |
| Volume variance = $132,000 – $7 × $18,000 | = | 6,000 U |
| Underabsorbed overhead | | $9,000 U |

c. Net Income – Absorption Costing

| | | |
|---|---|---|
| Sales | | $220,000 |
| Cost of Goods Sold: | | |
| Beginning Inventory (2,000 units × $19) | $38,000 | |
| Direct Labor & Materials (9,000 units × $5) | 45,000 | |
| Overhead ($18,000 × $7) | 126,000 | |
| Variances | 9,000 | 218,000 |
| Net Income | | $ 2,000 |

d. Net Income – Variable Costing

| | | |
|---|---|---|
| Sales | | $220,000 |
| Cost of Goods Sold: | | |
| Beginning Inventory (2,000 × $5) | $10,000 | |
| Direct Labor & Materials (9,000 × $5) | 45,000 | |
| Variable overhead | 75,000 | 130,000 |
| Contribution Margin | | 90,000 |
| less: Fixed Costs | | 60,000 |
| Net Income | | $ 30,000 |

e. The difference between absorption costing and variable costing net income of $28,000 is due to the fixed costs in the beginning inventory that are written off in the current year under absorption costing but were written off last year under variable costing (2,000 × $14) .

**P 13-14: Solution to Turow Trailers** (40 minutes)
[Calculating overhead variances and assigning responsibility]

a.

| | | 2010 | | 2011 |
|---|---|---|---|---|
| a. Overhead rate: | | | | |
| flexible budget | | | | |
| @ expected volume | (2.1+7×1 m) | $9,100,000 | (2.2+8×1 m) | $10,200,000 |
| ÷ denominator volume | | 1,000,000 | | 1,000,000 |
| Overhead rate | | $ 9.10 | | $ 10.20 |

| | | 2010 | | 2011 |
|---|---|---|---|---|
| Overhead Variances: | | | | |
| Spending variance | | | | |
| Actual overhead | | $ 9.0 | | $ 8.1 |
| Flexible budget @ actual hours | (2.1+7×1) | 9.1 | (2.2+8×.7) | 7.8 |
| Spending variance | | $ .1F | | $ .3U |
| Efficiency variance: | | | | |
| Flexible budget @ actual hours | (2.1+7×1) | $ 9.10 | | $ 7.80 |
| Flexible budget @ standard hours* | | 9.38 | | 7.16 |
| Efficiency variance | | $ .28F | | $ .64U |
| Volume variance: | | | | |
| Flexible budget @ standard hours* | | $ 9.380 | | $ 7.160 |
| Overhead absorbed | (9.10 × 1.04) | 9.464 | (10.2 × 0.62) | 6.324 |
| Volume variance | | $ .084F | | $ .836U |
| Over/underabsorbed overhead | | $ .464F | | $1.776U |

| | | Standard Hours (millions) | | |
|---|---|---|---|---|
| * Calculate standard hours | G7 (40 × 11,000) | .44 | (40 × 8,000) | .32 |
| | V8 (50 × 12,000) | .60 | (50 × 6,000) | .30 |
| | | 1.04 | | .62 |

Flexible budget at standard hours $2.1+7 × 1.04 = $9.38 $2.2+8 × .62 = $7.16

b. Managers responsible for variances:

Spending variance: Managers responsible for the individual overhead departments (personnel, accounting, etc.). Disaggregate overhead into individual departmental overhead and hold the department managers responsible for their spending variances.

Efficiency variance: Because the foremen have the decision rights to supervise the assembly teams, they should be charged with the overhead efficiency variance as well as with the direct labor usage variance. For each trailer completed, the actual labor hours can be compared to standard hours. Any difference in hours between the two will cause an overhead efficiency variance.

Volume variance: Either the plant superintendent or marketing. What were the reasons volumes were higher or lower than expected? Either marketing was unable to generate sales or the plant managers were unable to provide workers. Or, no one is responsible if the decline or increase was due to economy-wide influences.

**P 13-15:** **Solution to Betterton Corporation** (40 minutes)
[Summary problem of variances and isolating price variance at purchase]

a. The following data are used in calculating the variances:

105,000 lens = 1,050 batches
Standard (earned) volume = 1,050 batches × 5 hours/batch
= 5,250 direct labor hours

$W_s$ = \$18/ hour
$W_a$ = \$99,900/5,400 = \$18.50 / hour
$H_a$ = 5,400 direct labor hours
$H_s$ = 1,050 × 5 = 5,250 direct labor hours
$Q_a$ = 102,000 lbs.
$Q_s$ = 1,050 × 100 = 105,000 lbs.
$Q_b$ = 110,000 lbs.
$P_s$ = \$2/lb
$P_a$ = \$209,000/110,000 = \$1.90/lb

Fixed overhead = \$4/hour × 5,000 hours = \$20,000 month
Flexible overhead budget = \$20,000 + \$6/direct labor hour
Overhead rate = (\$20,000 + \$6 × 5,000hours)/5,000 hours = \$10/ direct labor hour
Flexible budget @ standard volume = \$20,000 + \$6 × (1,050 × 5) = \$51,500
Overhead absorbed = 1,050 × \$10 × 5 hours = \$52,500

(i) Overhead spending variance = Actual overhead – flexible budget @ actual volume = \$59,000 – (\$20,000 + \$6 × 5,400 hours) = \$6,600 U

(ii) Volume variance = flexible budget @ standard – overhead absorbed = (\$20,000 + \$6 × 5,250 hours) – \$52,500 = 1,000 F

(iii) Over/underabsorbed overhead = overhead incurred – overhead absorbed = \$59,000 – \$52,500 = \$6,500 underabsorbed

(iv) Direct materials price variance at purchase = $(P_a – P_s) \times Q_b$ = (\$1.90 –\$2.00) × 110,000 lbs = \$11,000 F

(v) Direct labor efficiency variance = $(H_a - H_s) \times W_s$ = (5,400 – 5,250) × \$18 = \$2,700 U

(vi) Direct materials quantity variance = $(Q_a - Q_s) \times P_s$ = (102,000 – 105,000) × \$2 = \$6,000 F

b. The price variance at purchase includes all the raw materials purchased, not just those used in production. Thus, it is a more timely and accurate measure of the purchasing department's performance <u>this period</u>. Raw material inventories are stated at standard cost and as they are used, work-in-process is charged at standard cost. Removing all the price variance at the time of purchase simplifies having to keep the raw materials at different actual costs.

**P 13-16: Solution to UOP** (40 minutes)
[Over/underabsorbed overhead, standard vs. actual volume, and units-of-production depreciation]

a. There is no fixed overhead because depreciation is calculated using units-of-production depreciation:

$$\text{Variable overhead} = \frac{\$600{,}000}{10{,}000 \text{ hrs.}}$$

$$= \$60/\text{machine hour}$$

[Note: \$60 per hour is also the depreciation rate on the machine.]

| **Expected machine hours:** | **A** | **B** | **Total** |
|---|---|---|---|
| Forecasted production | 100 | 200 | |
| Standard machine hours/unit | 5 | 3.5 | |
| Budgeted machine hours | 500 | 700 | 1,200 |

Budgeted overhead = \$60 × 1,200 = \$72,000
Overhead rate = \$72,000 ÷ 1,200 = \$60

b. Overhead absorbed

| | **A** | **B** | **Total** |
|---|---|---|---|
| Actual production | 110 | 220 | |
| Standard machine hours/unit | 5 | 3.5 | |
| | 550 | 770 | 1,320 |
| Overhead rate/machine hour | \$ 60 | \$ 60 | |
| Overhead absorbed to products | \$33,000 | \$46,200 | \$79,200 |

c. Standard machine hours of actual production

| | |
|---|---|
| Standard machine hours of actual production | 1,320 |
| Depreciation per machine hour | $ 60 |
| Overhead incurred | $79,200 |
| Overhead absorbed to products | $79,200 |
| Under/overabsorbed overhead | $ 0 |

d. Under/overabsorbed overhead

| | A | B | Total |
|---|---|---|---|
| Actual machine hours | 600 | 800 | 1,400 |
| Units-of-production depreciation/hour | | | $ 60 |
| Overhead incurred (actual hours) | | | $84,000 |
| Overhead absorbed (standard hours) | | | 79,200 |
| Underabsorbed overhead | | | $ 4,800 |

e. In question (c), standard machine hours are used to calculate both overhead incurred and absorbed, thus there can never be any over/underabsorbed overhead unless the depreciation rate ($60) is changed during the year. In part (d), overhead incurred is based on actual, not standard, machine hours. Any efficiency variance in the use of machine hours causes overhead to be over/underabsorbed.

UOP might prefer to use actual machine hours to calculate overhead incurred and standard hours to absorb overhead to products because this: (1) doesn't cause efficiency variances to enter product costs, but at the same time (2) accumulated depreciation on the balance sheet more accurately reflects the cumulative actual use of the machine.

## P 13-17: **Solution to Artco Planters** (40 minutes)

[Total overhead variance with multiple products]

a. Total overhead variance based on standard pounds:
The first step is to calculate the overhead rate

| Product | Standard Pounds/Planter | Expected Units | Budgeted Pounds of Fiberglass |
|---|---|---|---|
| 24” planter | 2.3 | 1,200 | 2,760 |
| 30” planter | 3.7 | 2,100 | 7,770 |
| 36” planter | 4.6 | 1,400 | 6,440 |
| Total pounds | | | 16,970 |

| | | |
|---|---|---|
| Fixed overhead budget | | $593,950 |
| Variable overhead per pound | $2.10 | |
| Budgeted pounds of fiberglass | × 16,970 | |
| Budgeted variable overhead | | 35,637 |
| Budgeted Overhead | | $629,587 |
| | | |
| ÷ budgeted pounds of fiberglass | | 16,970 |
| Overhead rate | | $ 37.10 |

The next step is to calculate the standard pounds of fiberglass based on actual production.

| Product | Standard Pounds/Planter | Actual Units | Standard Pounds of Fiberglass |
|---|---|---|---|
| 24” planter | 2.3 | 1,400 | 3,220 |
| 30” planter | 3.7 | 2,000 | 7,400 |
| 36”planter | 4.6 | 1,500 | 6,900 |
| Totals | | | 17,520 |

| | |
|---|---|
| Overhead rate | $37.10 |
| Standard pounds | 17,520 |
| Applied overhead | $649,992 |
| | |
| Actual overhead incurred | 633,805 |
| | |
| Total overhead variance (over absorbed) | $ 16,187 |

b. Total overhead variance based on actual pounds:

| **Product** | **Actual Pounds Used** |
|---|---|
| 24” planter | 3,570 |
| 30” planter | 7,040 |
| 36” planter | 7,120 |
| | 17,730 |
| × overhead rate | $ 37.10 |
| Applied overhead | 657,783 |
| Actual overhead | (633,805) |
| Total overhead variance | $ 23,978 (overabsorbed) |

c. More fiberglass was used than should have been used given the standards. Thus, more overhead is absorbed to products using actual fiberglass as the allocation base and the over-absorbed overhead is thus larger.

**P 13-18:** **Solution to Shady Tree Manufacturing** (45 minutes)
[Prorating the volume variance with two products]

a. The overhead rate is computed by using the flexible budget:

$$\text{OHR} = \frac{\text{FOH} + \text{VOH} \times \text{EV}}{\text{EV}}$$

$$= \frac{\$3{,}000{,}000 + \$20 \times 200{,}000}{200{,}000}$$

= $35 per standard direct labor hour

b. Before we can calculate the volume variance, standard volume must be computed as follows:

| **Shady Tree Manufacturing**<br>Standard (Earned) Volume for the Year | | | |
|---|---|---|---|
| | M1 | M2 | Total |
| Standard direct labor hours per unit | 3 | 5 | |
| Units produced | 30,000 | 12,000 | |
| Earned volume | 90,000 | 60,000 | 150,000 |

The formula for the volume variance is:

Volume variance = (FOH + VOH × SV) – OHR × SV

= ($3,000,000 + $20 × 150,000 hrs) - $35 × 150,000 hrs.

= $6,000,000 - $5,250,000

= $750,000 Unfavorable

c. The unfavorable volume variance says that too little fixed overhead was absorbed to products. Therefore, writing off the volume variance to cost of goods sold causes cost of goods sold to rise and earnings to fall by $750,000.

d. If the volume variance is prorated to cost of goods sold and inventories, first it must be allocated between the two products and then prorated between cost of goods sold and finished goods inventory. The following table illustrates the computations:

| **Shady Tree Manufacturing**<br>Prorating the Volume Variance<br>(000s) | | | |
|---|---|---|---|
| | M1 | M2 | Total |
| % of earned volume | 90/150 | 60/150 | |
| Volume variance allocated | | | |
| between M1 & M2 | $450 | $300 | $750 |
| % prorated to CGS | 2/3 | 10/12 | |
| % prorated to ending inventory | 1/3 | 2/12 | |
| Volume variance: | | | |
| Prorated to CGS | $300 | $250 | $550 |
| Prorated to ending inventory | $150 | $50 | $200 |
| Total prorated | $450 | $300 | $750 |

From the preceding table, $550,000 is written off to cost of goods sold thereby reducing earnings by $550,000.

**P 13-19:** **Solution to Ultrasonic** (45 minutes)
[Overhead variances]

a. The overhead rate for the year is calculated as:

| | **Avex** | **AvexII** | **Mel** | **Total** |
|---|---|---|---|---|
| a. Projected production (units) | 1200 | 650 | 350 | |
| b. Standard direct materials per unit | $2,600 | $3,300 | $4,800 | |
| c. Budgeted direct materials (a × b) | $3,120,000 | $2,145,000 | $1,680,000 | $6,945,000 |
| d. Fixed overhead | | | | $7,500,000 |
| e. Variable overhead per material dollar | | | | $0.30 |
| f. Budgeted overhead (d + e × c) | | | | $9,583,500 |
| g. Overhead rate per material dollar (f ÷ c) | | | | $1.38 |

b. Calculation of over- underabsorbed overhead:

| | Avex | AvexII | Mel | Total |
|---|---|---|---|---|
| Standard materials per unit | $2,600 | $3,300 | $4,800 | |
| Actual units produced | 1,400 | 530 | 410 | |
| Standard volume (material dollars) | $3,640,000 | $1,749,000 | $1,968,000 | $7,357,000 |
| Overhead rate per direct material dollar | | | | $1.38 |
| Standard overhead absorbed to actual units produced | $5,023,200 | $2,413,620 | $2,715,840 | $10,152,660 |
| Actual OH incurred | | | | 10,280,000 |
| Total under absorbed OH | | | | $127,340 |

c. Calculation of overhead variances

The first step is to write down actual volume and standard volume (both stated in terms of direct material dollars). Actual volume is given in the problem as $7,673,680 ($3,967,600 + $1,679,040 + $2,027,040). Standard volume was computed in part (a) as $7,357,000. These two volume measures are used to compute the flexible budgets at actual and standard volume:

Flexible budget at actual volume = $7,500,000 + $0.30 × $7,673,680
= $9,802,104

Flexible budget at standard volume = $7,500,000 + $0.30 ×$7,357,000
= $9,707,100

These two flexible budget variances are then used to compute the three overhead variances:

Spending variance = Actual OH incurred – flexible budget at actual volume
= $10,280,000 – $9,802,104
= $477,896 Unfav.

Efficiency variance = flexible budget at actual volume – flexible budget at std volume
= $9,802,104 – $9,707,100
= $95,004 Unfav.

Volume variance = flexible budget at std volume – OH absorbed to products
= $9,707,100 – $10,152,660
= $445,560 Fav.

Sum of 3 variances = $127,340 Unfav (under absorbed)

Notice that the sum of the three overhead variances equals the under absorbed overhead ($127,340).

**P 13-20:** **Solution to Megan Corp.** (50 minutes)
[Calculating labor and overhead variances]

To solve this problem, the sequence of calculating the numbers is different from the sequence as stated in the problem.

a. Expected volume = 30,000 direct labor hours

Standard volume, $H_S$ = 33,000 direct labor hours (11,000 × 3)

(iii) Direct Labor Efficiency Variance = $(H_A – H_S) \times W_S$

$\$15,000 = (H_A – 33,000) \times 15$

Actual number of direct labor hours = $H_A$ = 34,000 hours

(iv) Variable Overhead:

OH Eff. Variance = VOH $(H_A – H_S)$

$4,000 U = VOH (34,000 – 33,000)

VOH = $4/direct labor hour

(v) Overhead Rate, OHR = (FOH + VOH × EV)/EV
= ($900,000 + $4 × 30,000)/30,000 = $34

(vi) Direct labor wage rate variance. This variance cannot be calculated because not enough information is provided.

(vii) OH Volume Variance = Flexible Budget @ Standard hours – OH absorbed

= $900,000 + $4 × 33,000 – $34 × 33,000
= $90,000 F

(ii) OH Spending Var. = Total OH Var. – OH Efficiency Var. – OH Vol. Var.

= $92,000 F – $90,000 F + $4,000 U = $6,000 F

(i) Actual Overhead: Spending Variance = AOH – flexible budget @ actual hours

$6000 F = AOH – ($900,000 + 4 × 34,000)
AOH = $1,030,000

b. Too much direct labor was used for the output produced. This resulted in an unfavorable labor efficiency variance. Finally, factory volume was above normal, thus producing a favorable volume variance.

**P 13-21: Solution to MRI Department** (55 minutes)
[Overhead variance]

a. The predetermined cost per minute of scan time in the MRI Department is calculated using the flexible budget:

| **Scan Types** | **Expected Procedures** | **Total Expected Time (Minutes)** |
|---|---|---|
| 15 | 500 | 7,500 |
| 30 | 1,200 | 36,000 |
| 45 | 300 | 13,500 |
| 60 | 2,200 | 132,000 |
| 90 | 150 | 13,500 |
| Total | 4,350 | 202,500 |

Flexible budget (expected minutes) = $700,000 + ($300/60) × 202,500 minutes
= $1,712,500
Predetermined cost/minute = $1,712,500 / 202,500 minutes
= $8.4568

b. Based on the number of scans of various times, and the standard time per scan, the MRI Department generated 206,400 minutes of charges computed as:

| **Scan Types** | **Actual Procedures** | **Standard time** |
|---|---|---|
| 15 | 400 | 6,000 |
| 30 | 1,300 | 39,000 |
| 45 | 280 | 12,600 |
| 60 | 2,300 | 138,000 |
| 90 | 120 | 10,800 |
| Total | 4,400 | 206,400 |

The actual charges of the MRI Department to the other patient units were:

206,400 minutes × $8.4568 = $1,745,484

c. The MRI Department's actual costs totaled \$1,750,000. So, the MRI Department charged the patient units \$4,516 less than the Department actually incurred (under absorbed). This \$4,516 unfavorable variance can be decomposed into the following variances:

| | |
|---|---|
| Spending Variance | = Actual costs – flexible budget @ actual minutes |
| | = \$1,750,000 – (\$700,000 + \$5.00 × 209,200) |
| | = \$1,750,000 - \$1,746,000 |
| | = \$4,000 unfav. |
| Efficiency Variance | = flexible budget @ actual minutes – flexible budget @ standard |
| | = \$1,746,000 – (\$700,000 + \$5.00 × 206,400) |
| | = \$1,746,000 - \$1,732,000 |
| | = \$14,000 unfav. |
| Volume variance | = flexible budget @ standard – MRI charges |
| | = \$1,732,000 - \$8.4568 ×206,400 |
| | = \$1,732,000 - \$1,745,484 |
| | = \$13,484 fav |

Performance Report:

| | |
|---|---|
| Spending variance | \$4,000 unfav |
| Efficiency variance | 14,000 unfav |
| Volume variance | 13,484 fav |
| Total variance | \$4,516 unfav |

d. The MRI Department incurred \$4,516 more costs than it recharged the patient care units. This under charging was due to three offsetting factors. First, it incurred \$4,000 more costs than it should have given the actual number of minutes of MRI scan time (spending variance). Second, the MRI department was inefficient in terms of the actual minutes it used compared to the number of minutes each scan should have taken. This inefficiency resulted in an additional cost of \$14,000 (efficiency variance). Third, the MRI department performed more scan minutes than expected (206,400 minutes vs. 202,500 minutes). These extra minutes resulted in an additional utilization of the MRI capacity of \$13,484. In other words, the MRI Department used more of the MRI's capacity than originally planned (volume variance).

Overall, the MRI Department did a reasonably good job of controlling costs, but was inefficient in the sense that more time was spent on each scan than should have been spent (\$14,000U). This inefficiency was made up by over-utilizing the MRI (\$13,484F).

**P 13-22:** **Solution to Anpax, Inc.** (60 minutes)
[Comprehensive variance problem with two products]

a. Overhead rate:

| | |
|---|---|
| Expected number of machine hours: | |
| L7 4 hours/unit × 25,000 units | 100,000 hours |
| Q2 5 hours/unit × 35,000 units | 175,000 |
| Budgeted (denominator) volume | 275,000 hours |

| | |
|---|---|
| Flexible budget at 275,000 machine hours: | |
| Fixed overhead | \$2.75 million |
| Variable overhead 275,000 hours × \$20/hr | \$5.50 million |
| Flexible budget at budgeted volume | \$8.25 million |

Overhead rate: (\$8.25 million ÷ 275,000 hours) \$30/hour

b. Direct materials and labor variances:

Calculate standard quantities using actual units produced:

| | Materials | Labor |
|---|---|---|
| L7 | 20,000 × 85 = 1,700,000 lbs. | 20,000 × 10 = 200,000 hrs |
| Q2 | 40,000 × 95 = 3,800,000 lbs. | 40,000 × 12 = 480,000 hrs |
| | 5,500,000 lbs. | 680,000 hrs |

| | Materials Variances | Labor Variances |
|---|---|---|
| Price var. | (\$1.1-1) × 5,000,000 =\$500,000U | (\$14-15) ×700,000 = \$700,000F |
| Quantity var. | (5,000,000-5,500,000) ×\$1=\$500,000F | (700K-680,000) ×\$15 = \$300,000U |
| | \$0 | \$400,000F |

c. Overhead variances:

Calculate standard (earned) volume (in terms of machine hours):

| | units | standard volume/unit | standard volume |
|---|---|---|---|
| L7 | 20,000 | 4 hours/unit | 80,000 hours |
| Q2 | 40,000 | 5 hours/unit | 200,000 hours |
| Total standard volume | | 280,000 hours | |

Flexible budget at actual volume=\$2.75M+270K × \$20 = \$8.15M

Flexible budget at standard volume=\$2.75M+280K × \$20 = \$8.35M

Overhead absorbed = 280K hours × \$30/hour = \$8.40M

Volume variance = flex. budget @ standard - overhead absorbed
\$8.35M - \$8.4M = \$50,000F

| | | | | |
|---|---|---|---|---|
| Efficiency variance | = | flex. budget @ actual - flex. budget @ std | | |
| | | \$8.15M - \$8.35M | = | \$200,000F |
| Spending variance | = | actual overhead - flexible budget @ actual | | |
| | | \$8.4 - \$8.15M | = | <u>\$250,000U</u> |
| Total overhead variances | | | | <u>\$0</u> |

d. <u>Volume variance</u> (\$50,000F) indicates that the plant produced more output than was forecast at the beginning of the year. The firm incurs fixed factory overhead to provide the plant capacity. The \$50,000 is the dollar amount of the capacity of the overproduction.

<u>Efficiency variance</u> (\$200,000F) is the amount of variable manufacturing overhead saved because fewer machine hours were used to produce the actual output than were called for by the standards.

<u>Spending variance</u> (\$250,000U) indicates that given the actual machine hours, the plant incurred more overhead than the flexible budget predicts. Either the flexible budget is inaccurate or overhead incurred was above expectations.

**P 13-23:** **Solution to Mopart Division** (90 minutes)
[Standard costs and variable costing]

This is a difficult problem that combines standard costing and variable costing. It forces students to think about which standards are fixed and which are variable.

Variances:

| | Price Variance | Quantity Variance |
|---|---|---|
| Direct materials | \$14,000U | \$5,000U |
| Direct labor | 1,900U | 4,000U |
| Revenues | 6,600F | 45,600U |

Overhead Variances:

Fixed overhead = $\$4 \times 4{,}000$ hours = \$16,000

Flexible budget = $\$16{,}000 + \$6 \times$ direct labor hours

Standard hours = $9{,}000 \times 0.04 = 3{,}600$ hours

Volume variance = $(\$16{,}000 + \$6 \times 3{,}600) - \$10 \times 3{,}600$

$= \$37{,}600 - \$36{,}000$

= $1,600U

Spending variance: $1,500F (1,300F variable OH + 200F fixed OH)

$1,300F variable OH spending variance = $21,500 - $6 × 3,800 hours

$200F fixed OH spending variance = $15,800 - $4 × 4,000 hours

Efficiency variance: $1,200U

a. Analysis of operations: The firm operated below planned capacity of 10,000 units for both sales and production. Even controlling for this lower volume, almost all the production variances are unfavorable. The selling price was raised, but overall revenues fell. The firm should investigate further the wisdom of raising prices $.75 per unit and consider a price roll-back.

The large variances are the materials price and quantity variances and the labor efficiency variance. They warrant further investigation. Something is amiss in direct materials. These variances are about 15 percent of direct materials cost at standard. For a one-month period, this looks high. Standards may be out of line or purchasing may be doing a very bad job. What are the variances in previous months?

OH variances are probably within the range of average variability.

b. Absorption versus variable costing: There are two solutions. One writes off all the variances to cost of goods sold:

| | | Absorption Costing | | Variable Costing |
|---|---|---|---|---|
| Revenue | | $341,000 | | $341,000 |
| Less: Cost of goods sold @ std | (8800×$27) | (237,600) | (8,800×$25.40) | (223,520) |
| plus variances | | (26,200) | | (24,800)† |
| Margin | | 77,200 | | 92,680 |
| Less: | | | | |
| Fixed costs | | | | (15,800) |
| S&A | | (62,500) | | (62,500) |
| Net income | | $14,700 | | $14,380 |

† The fixed portion of the spending and volume variances is excluded because all fixed costs are written off as a separate line item and never enter the variance accounts. $24,800U = $26,200U - 1,600U - 200F.

The other solution uses actual costs directly and allocates the costs based on production.

c. Reconcile:

$14,700 - $14,380= $320= 200 units × $1.60 (fixed OH rate)

The difference is due to the fixed OH that is inventoried.

d. Opportunity cost of excess capacity: One measure is the volume variance of 1,600U. An alternative measure is the lost contribution margin ($38-15-8-2.40-34,500/8800) × (10,000-9000) = $8,680. The second measure assumes that the unused capacity could have been used to produce and sell more units.

## Case 13-1: Solution to Lancaster Chamber Orchestra (120 minutes)

[Variance analysis in a non-profit organization]

a. Flexible Budget Calculation: Musician Costs

**Series A**

| | Woodwinds | Brass | Percussion | Strings | Totals |
|---|---|---|---|---|---|
| **Static Budget** | | | | | |
| Average Rate | $65 | $62 | $58 | $55 | |
| Number Musicians | 11 | 10 | 3 | 25 | |
| Number Services | 60 | 55 | 50 | 60 | |
| Total Services | 660 | 550 | 150 | 1,500 | 2,860 |
| Total Budget | $42,900 | $34,100 | $8,700 | $82,500 | $168,200 |
| | | | | | |
| **Actual** | | | | | |
| Number Musicians | 10 | 12 | 3 | 28 | |
| Number Services | 56 | 53 | 52 | 59 | |
| Total Services | 560 | 636 | 156 | 1,652 | 3,004 |
| Total Actual | $36,400 | $39,432 | $9,048 | $90,860 | $175,740 |
| | | | | | |
| **Flexible Budget*** | | | | | |
| Number Musicians | 11 | 10 | 3 | 25 | |
| Number Services | 54 | 49.5 | 45 | 54 | |
| Total Services | 594 | 495 | 135 | 1,350 | 2,574 |
| Flexible Budget | $38,610 | $30,690 | $7,830 | $74,250 | $151,380 |

**Series B**

| | Woodwinds | Brass | Percussion | Strings | Totals |
|---|---|---|---|---|---|
| **Static Budget** | | | | | |
| Average Rate | $65 | $62 | $58 | $55 | |
| Number Musicians | 8 | 14 | 5 | 22 | |
| Number Services | 21 | 24 | 24 | 21 | |
| Total Services | 168 | 336 | 120 | 462 | 1,086 |
| Total Budget | $10,920 | $20,832 | $6,960 | $25,410 | $64,122 |
| | | | | | |
| **Actual** | | | | | |
| Number Musicians | 10 | 12 | 3 | 28 | |
| Number Services | 23 | 24 | 24 | 19 | |
| Total Services | 230 | 288 | 72 | 532 | 1,122 |
| Total Actual | $14,950 | $17,856 | $4,176 | $29,260 | $66,242 |

**Flexible Budget**

| | | | | | |
|---|---|---|---|---|---|
| Number Musicians | 8 | 14 | 5 | 22 | |
| Number Services | 21 | 24 | 24 | 21 | |
| Total Services | 168 | 336 | 120 | 462 | 1,086 |
| Flexible Budget | $10,920 | $20,832 | $6,960 | $25,410 | $64,122 |

| | |
|---|---|
| Static Budget | $232,322 |
| Actual Budget | $241,982 |
| Flexible Budget | $215,502 |

* Note: Flexible budget services are calculated by taking the expected number of services per musician per concert and multiplying by the actual number of concerts performed. (60/10) × 9 = 54

## Flexible Budgets: Revenues

**Sales – Series A**

| | | Budget (10 Concerts) | | Actual (9 Concerts) | | Flexible Budget (9 Concerts) | |
|---|---|---|---|---|---|---|---|
| Price | Capacity/ Concert | Attendance | Revenue | Attendance | Revenue | Attendance | Revenue |
| $12.00 | 800 | 7,500 | $90,000 | 6,030 | $72,360 | 6,750 | $81,000 |
| $15.00 | 300 | 2,800 | $42,000 | 2,475 | $37,125 | 2,520 | $37,800 |
| $20.00 | 150 | 1,300 | $26,000 | 1,260 | $25,200 | 1,170 | $23,400 |
| Totals | 1,250 | 11,600 | $158,000 | 9,765 | $134,685 | 10,440 | $142,200 |

**Sales – Series B**

| | | Budget (6 Concerts) | | Actual (6 Concerts) | | Flexible Budget (6 Concerts) | |
|---|---|---|---|---|---|---|---|
| Price | Capacity/ Concert | Attendance | Revenue | Attendance | Revenue | Attendance | Revenue |
| $14.00 | 800 | 4,680 | $65,520 | 4,734 | $66,276 | 4,680 | $65,520 |
| $16.00 | 300 | 1,680 | $26,880 | 1,704 | $27,264 | 1,680 | $26,880 |
| $25.00 | 150 | 900 | $22,500 | 852 | $21,300 | 900 | $22,500 |
| Totals | 1,250 | 7,260 | $114,900 | 7,290 | $114,840 | 7,260 | $114,900 |

**<u>Income Statement</u>**

| | Static Budget | **Flexible Budget** | Actual | **Variance** (Actual-Flexible Budget) |
|---|---|---|---|---|
| **Earned Income** | | | | |
| Ticket Revenue | $272,900 | **$257,100** | $249,525 | **$7,575(U)** |
| **Expenses** | | | | |
| Musicians | 232,322 | **215,502** | 241,982 | **26,480(U)** |
| Hall Rental | 12,800 | **12,800** | 12,800 | **0** |
| Conductors | 42,200 | **42,200** | 42,200 | **0** |
| Guest Artists | 24,000 | **24,000** | 24,000 | **0** |
| Music Rental | 1,250 | **1,250** | 1,100 | **(150)(F)** |
| Advertising | 16,000 | **16,000** | 16,200 | **200(U)** |
| Variable Production | 59,190 | **54,900**** | 63,953 | **9,053(U)** |
| **Total Expenses** | 387,762 | **366,652** | 402,235 | **35,583(U)** |

| | | | | |
|---|---|---|---|---|
| **Operating Income** | (114,862) | **(109,552)** | (152,710) | **43,158(U)** |
| | | | | |
| **Other Income** | | | | |
| Private Contributions | 100,000 | **100,000** | 95,000 | **5,000(U)** |
| Public Funding | 25,000 | **25,000** | 20,000 | **5,000(U)** |
| **Total Other Income** | 125,000 | **125,000** | 115,000 | **10,000(U)** |
| | | | | |
| **Net Surplus(Deficit)** | $10,138 | **$15,448** | ($37,710) | **$53,158(U)** |

** $15 per musician service × 3,660 services (2,574 + 1,086)

## b. Variance Calculations

| | | Variances |
|---|---|---|
| **i. Ticket Revenue Variance =** | | |
| [attendance(s) -attendance(a)] Price(s) | | |
| Series A: | | |
| (6,750-6,030)$12 = | | $8,640 |
| (2,520-2,475)$15 = | | 675 |
| (1,170-1,260)$20 = | | -1,800 |
| Series B: | | |
| (4,680-4,734)$14 = | | -756 |
| (1,680-1,704)$16 = | | -384 |
| (900-852)$25 = | | 1,200 |
| | | **$7,575** |
| **Other Income Variance** | | |
| (125,000-115,000) = | | **$10,000** |
| | | |
| **ii. Labor Efficiency Variance** | | |
| (Actual Total Services- Standard Total Services)W(s) | | |
| | | |
| **Series A:** | | |
| Woodwind | (560-594)$65 = | -$2,210 |
| Brass | (636-495)$62 = | 8,742 |
| Percussion | (156-135)$58 = | 1,218 |
| Strings | (1,652-1,350)$55 = | 16,610 |
| | | |
| **Series B:** | | |
| Woodwind | (230-168)$65 = | 4,030 |
| Brass | (288-336)$62 = | -2,976 |
| Percussion | (72-120)$58 = | -2,784 |
| Strings | (532-462)$55 = | 3,850 |
| | **Total** | **$26,480** |

**iii. Overhead Variances**

| **Series A:** | Standard Services per concert | Budgeted Concerts | Expected Volume | Actual Concerts | Standard Volume | Actual Volume |
|---|---|---|---|---|---|---|
| Woodwind | 66 | 10 | 660 | 9 | 594 | 560 |
| Brass | 55 | 10 | 550 | 9 | 495 | 636 |
| Percussion | 15 | 10 | 150 | 9 | 135 | 156 |
| Strings | 150 | 10 | 1,500 | 9 | 1,350 | 1,652 |
| **Series B:** | Standard Services per concert | Budgeted Concerts | Expected Volume | Actual Concerts | Standard Volume | Actual Volume |
| Woodwind | 28 | 6 | 168 | 6 | 168 | 230 |
| Brass | 56 | 6 | 336 | 6 | 336 | 288 |
| Percussion | 20 | 6 | 120 | 6 | 120 | 72 |
| Strings | 77 | 6 | 462 | 6 | 462 | 532 |
| Total | | | | | 3.660 | 4,126 |

**iii(1) OH Efficiency Variance**

VOH(AV-SV)

| **Series A:** | | | |
|---|---|---|---|
| Woodwind | $15(560-594) = | | -510 |
| Brass | $15(636-495) = | | 2,115 |
| Percussion | $15(156-135) = | | 315 |
| Strings | $15(1,652-1,350) = | | 4,530 |
| **Series B:** | | | |
| Woodwind | $15(230-168) = | | 930 |
| Brass | $15(288-336) = | | -720 |
| Percussion | $15(72-120) = | | -720 |
| Strings | $15(532-462) = | | 1,050 |
| | | **Total** | **$6,990** |

**iii(2) OH Spending Variance**

AOH - (FOH+VOH × AV)

| | |
|---|---|
| Total AV = | 4,126 |
| AOH = | 160,253 |
| FOH = | 96,250 |
| VOH = | 15 |

160,253 - (96,250+15 × 4,126)

| | | |
|---|---|---|
| | **Total** | **2,113** |
| **TOTAL Variance** | | **$53,158** |

c. Randall Nobucs is not taking the demand for tickets into account when he suggests that raising prices will result in a balanced budget for the next season. The price should be set at the point where marginal cost equals marginal revenue. In examining the variance in attendance at various ticket price levels, it is evident that, at least in this season, demand per concert for $20 tickets for Series A exceeded the forecast, while demand for the less expensive seats was less than forecasted. The opposite was true for Series B. Demand for concert tickets is not only a function of price, but also depends heavily on programming, availability of certain seats, guest artists, competing performances, and even weather. By raising the price when demand drops and per-unit costs rise, the orchestra is, in effect, creating a downward-sloping supply curve.

d. Responsibility for each variance falls on the various department directors:

(i) Revenue variance is the responsibility of the Director of Marketing, Alan Voit, since he has the specialized knowledge to forecast demand for tickets for particular programs offered by the orchestra and the knowledge of the price elasticities of various types of patrons. If the Director of Finance, Randall Nobucs, shares the decision rights for pricing, he may share responsibility for this variance.

(ii) Other revenue variances are those connected with contributions to the orchestra. The Director of Development, Lydia Givme, is responsible for these variances, and although exogenous variables caused a reduction in gifts to the orchestra, it is her responsibility to successfully compete with other non-profit organizations for charitable dollars.

(iii) Labor efficiency variances are the shared responsibility of Maestro Jünger and the Director of Production, Candice Wrightway. Although Jünger has the specialized knowledge to select the programming which drives the particular instrumentation required, and to decide on when each piece will be rehearsed, Wrightway has the power to impose cost constraints when she observes that utilization will exceed the budget. Better forecasting in the budgeting stage is required here.

(iv) Since variances in overhead spending are driven by the number of performances, responsibility for these variances are again shared by the Conductor and Director of Production.

# CHAPTER 14
## MANAGEMENT ACCOUNTING IN A CHANGING ENVIRONMENT

**P 14–1:** **Solution to British Airways** (10 minutes)
[Match performance indicators to balanced scorecard perspectives]

Financial:
- Return on invested capital
- Earnings growth
- Percent empty seats

Innovation and learning:
- Employee training hours
- Employee turnover

Customer:
- Lost baggage
- On-time arrivals
- Number of frequent flyers

Internal business processes:
- Lost baggage
- On-time arrivals

**P 14-2:** **Solution to Chateau Napa** (15 minutes)
[Balanced Scorecard and maximizing over multiple dimensions]

a. The following table calculates the expected profit at various quality levels and the expected bonus payouts for quality and profits for these levels:

| Cost of quality | Expected Quality | Wholesale Price Received | Profit | Quality Bonus | Profit Bonus | Total Bonus |
|---|---|---|---|---|---|---|
| $90 | 90.00 | 570.20 | $30.20 | 0.000 | 0.020 | 0.020 |
| 95 | 91.08 | 576.44 | 31.44 | 0.054 | 0.144 | 0.198 |
| 100 | 92.10 | 582.34 | 32.34 | 0.105 | 0.234 | 0.339 |
| 105 | 93.08 | 588.00 | 33.00 | 0.154 | 0.300 | 0.454 |
| 110 | 94.01 | 593.38 | 33.38 | 0.201 | 0.338 | 0.539 |
| 115 | 94.90 | 598.52 | 33.52 | 0.245 | 0.352 | 0.597 |
| 120 | 95.75 | 603.44 | 33.44 | 0.288 | 0.344 | 0.632 |
| **125** | **96.57** | **608.17** | **33.17** | **0.329** | **0.317** | **0.646** |
| 130 | 97.35 | 612.68 | 32.68 | 0.368 | 0.268 | 0.636 |
| 135 | 98.11 | 617.08 | 32.08 | 0.406 | 0.208 | 0.614 |
| 140 | 98.83 | 621.24 | 31.24 | 0.442 | 0.124 | 0.566 |
| 145 | 99.53 | 625.28 | 30.28 | 0.477 | 0.028 | 0.505 |

From this table we see that the managers maximize their total bonus by spending $125 per two-bottle set on quality. This yields an expected quality level of 96.57 points, a wholesale price of $608.17, profits of $33.17 per two-bottle set, and an expected bonus of 64.6 percent.

b. From the preceding table we see that profits are maximized at $33.52 by spending $115 on quality, thereby yielding an expected rating of 94.90 points and a wholesale price of $598.52

c. The answers in (a) and (b) differ because of the way the managers are rewarded. They are willing to trade off some profits to achieve higher quality ratings.

d. The managers can not simultaneously maximize both quality and profits because by spending more to maximize quality reduces profits. To maximize profits, there is an optimal amount to spend on quality. In general, you can maximize multiple dimensions simultaneously only if the dimensions are completely independent of each other (i.e., the resources used to maximize in one dimension do not depend on the resources required to maximize in another dimension.) If a manager has limited time and it takes time to maximize various performance measures, then time spent maximizing one performance measure comes at the expense of maximizing other performance measures.

**P 14-3:** **Solution to Fiedler International** (20 minutes)
[Gaming balanced scorecards]

a. The balanced scorecard (BSC) helps articulate the firm's strategy throughout the organization. The BSC uses a number of financial and non-financial performance measures to help guide and motivate managers. A BSC converts an organization's value drivers — such as customer service and financial performance — to a series of defined metrics. Companies record and analyze these metrics to help determine if they're achieving strategic goals.

b. Analyzing Lush's balanced scorecard metrics over the last three years shows that the average bonus payout from the four metrics has been increasing, but at the expense of financial performance.

| | **Customer Service** | **Human Resources and Innovation** | **Operational Efficiency** | **Financial Performance** | **Average** |
|---|---|---|---|---|---|
| 2009 | 0.86 | 0.77 | 0.75 | 0.79 | 0.79 |
| 2010 | 0.92 | 0.91 | 0.82 | 0.73 | 0.85 |
| 2011 | 0.95 | 0.94 | 0.94 | 0.69 | 0.88 |

The managers' bonuses are tied to all four metrics. In fact, each metric contributes 25 percent of the total bonus. Financial performance appears to have been sacrificed while the other three have increased. The senior managers at Lush appear to have been gaming the balanced scorecard bonus system. It appears easier for these managers to increase the reported metrics on customer service, human resources and innovation, and operational efficiency, than to increase EVA. So the managers have sacrificed firm value for these other non-financial metrics. These findings have some important implications for Fiedler's possible acquisition of Lush:

- Lush's current management team is not above gaming performance measures.
- The reported earnings potential of Lush is likely below what it could be if management focused more energy on increasing firm value. Hence, there might be possible value increases in Lush (over and above any synergies between Fiedler and Lush) that can be captured by Fiedler by focusing Lush managers on increasing firm value.
- There has probably been an over investment in customer service, employee training, and product development.

**P 14-4:** **Solution to Guest Watches** (25 minutes)
[Costs and Benefits of increased quality]

a. This problem illustrates that there is an optimum, value maximizing level of quality. Based on the data presented in the problem, Guest Watches should adopt Level III, and thereby increase its annual cash flow by $355,000. Going all the way to Level IV causes the watch division's annual cash flows to fall from what they would be under Level III. The following table estimates the annual <u>net</u> cash flows for each alternative level.

| | Additional Training Cost | Additional Prevention/ Compliance | Total Rework/ Scrap Cost | Total Warranty Costs | Contribution Margin on Additional Sales | Net Benefits |
|---|---|---|---|---|---|---|
| Status quo | $0 | $0 | $500 | $350 | $0 | $(850) |
| Level I | 80 | 180 | 300 | 280 | 600 | (240) |
| Level II | 200 | 240 | 150 | 140 | 1000 | 270 |
| Level III | 350 | 340 | 75 | 80 | 1200 | 355 |
| Level IV | 550 | 490 | 25 | 0 | 1300 | 235 |

b. One serious problem with the analysis done by Guest Watches is that it does not incorporate any spillover effects from the poor quality of Guest Watches to the other product lines of Guest Fashions. The contribution margin of additional sales only focuses on Guest Watches additional sales, not Guest Fashions' additional sales.

Because Guest Watches' management is only compensated on watch profits, they will underinvest in quality. Given spillover effects to other Guest products, there are additional benefits of quality beyond that in the watch division. Senior management will take these additional benefits into account because they are paid on firm-wide profits, not just the costs and benefits inside the watch division.

Another problem with the analysis has to do with whether a single period analysis really can capture the problem. Low quality has a cumulative effect that takes several years to gather momentum as consumers relay their negative experiences to friends and relatives. This word-of-mouth negative publicity is hard to capture as a single period phenomenon.

**P 14–5: Solution to Applying TQM in Manufacturing versus Administration** (25 minutes) [Costs of measuring output and TQM]

The ability of TQM to deliver cost savings and performance enhancements depends directly on how easy it is to measure and observe the output of the process. If a TQM team's output is easy to measure, it is easier to hold the team members responsible for improving quality. If quality improvements are difficult to observe, then holding team members responsible imposes more risk on them. It is easier for them to argue that they didn't achieve their goals because they were hard to observe. If the benefits from TQM are lower because it is more difficult to observe the TQM output, less will be invested in such activities.

Measuring quality improvements in a manufactured process tends to be easier than a service. Engineering standards can be set for a manufactured good and conformance to the standards can be relatively easy to measure. But the output of many administrative departments is multidimensional and often hard to observe. Manufacturing involves repetitive processes with few exceptions. Administrative functions often involve handling numerous exceptions. It is likely to be easier to observe quality improvements in a television set than it is in a human resources department or a legal department.

**P 14-6: Solution to Old Town Roasters** (25 minutes) [Design a balanced scorecard]

The balanced scorecard should have four perspectives:

- Financial perspective (Return on assets to capture the manager's investment in Internet equipment)
- Customer perspective (customer satisfaction as measured by survey cards asking feedback on the store's appearance, availability of internet access, friendliness of service providers, and so forth).
- Internal business perspective (time customers wait for service)
- Learning and growth perspective (employee turnover)

**P 14-7:** **Solution to The Pottery Store** (30 minutes)
[Design a balanced scorecard]

a. The balanced scorecard should have four measures:

Financial perspective. Sales less the cost of labor and any other expenses the store manager controls (such as utilities and maintenance)

Customer perspective. Customer satisfaction as measured by survey cards asking feedback on the store's appearance, service, friendliness of service providers, and so forth. Sales growth.

Internal business perspective. Breakage and shrinkage.

Learning and growth perspective. Employee turnover.

b. If the manager has decision-making responsibilities over inventory and pricing, the financial perspective should include either return on assets or economic value added. These metrics create better incentives to control excessive inventory and also reward managers for setting prices that maximize firm value.

**P 14-8:** **Solution to Software Development, Inc.** (30 minutes)
[Is quality free?]

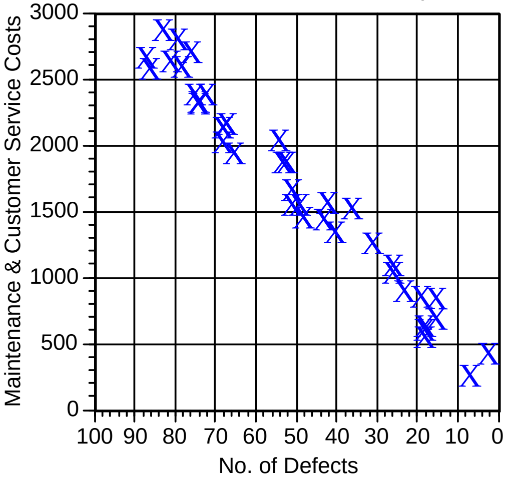
One often hears that "quality is free." In fact a well-known quality expert has a best-selling book, P. Crosby, *Quality is Free* (New York: McGraw-Hill, 1979). This question allows the student to explore this issue by analyzing some data.

There are a number of problems with the VP's analysis. One set of criticisms involves the integrity of the data being used to reach the conclusion that quality pays. Clearly, SDI does not track or report the opportunity cost of poor quality. SDI does not report the lost sales for each program and for other SDI packages due to this package's reputation for error-free operation. Therefore, the reported cost of quality ignores a major component of quality costs. Other data issues involve whether training costs are measured appropriately. Do maintenance and customer service costs include allocated costs or are these direct costs? These issues require further follow-up.

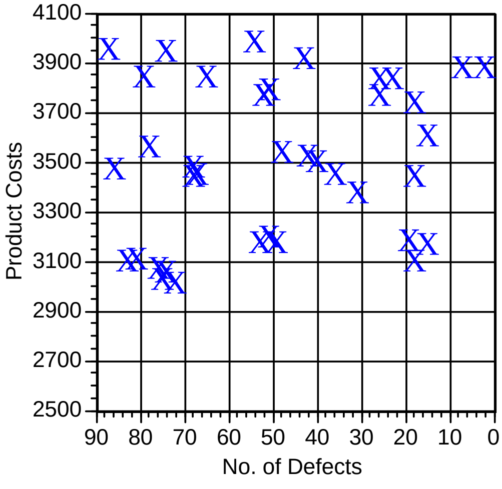
Irrespective of the data integrity issues raised above, the VP's conclusion is *not* supported by the data. The data plotted in the figure in the problem certainly portrays a negative relation between quality and total costs. But from statistics, we know that statistical association does not imply causality. In fact, in this company the causality is just the reverse: low quality causes higher costs.

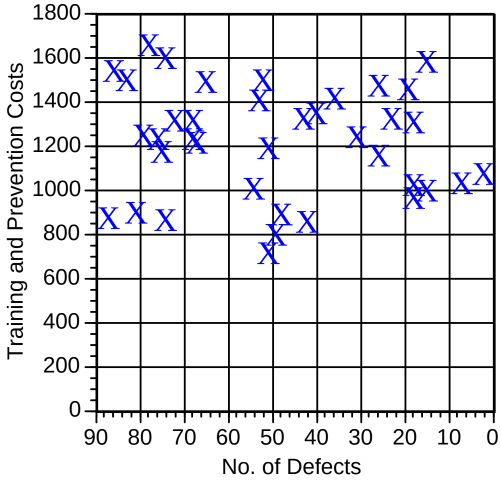
The figure below plots maintenance and customer service costs by defects. Here we see that computer programs with few defects require less maintenance and customer service costs. Programs with lots of bugs cost more to maintain and service than ones with few defects.

SDI
Maintenance and Customer Service Costs by Defects




The next two figures plot product costs and training plus prevention costs by number of defects. It is clear from these two graphs that there is no relation between product costs or training and prevention costs and number of defects. Quality does not appear to be inversely related to spending on training nor prevention.




The downward-sloping relation between quality and costs observed in the figure in the problem is induced solely because of the higher after-sale costs (customer service and maintenance) required to service the low-quality products. In fact, the above two graphs do not indicate that spending more money on the product or on quality enhancements improves quality.

From the data presented, can one conclude that quality does *not* pay? Again, the answer is no. The data presented is consistent with the need for SDI to optimize the amount spent on quality for each software release. Presumably, for those computer programs for which quality is expected to be a problem, SDI would spend more on training and prevention than on programs for which quality is expected to be less of a problem. In fact, we would expect that in determining how much to spend on quality for each computer program, the total spending on quality is determined at the point where the marginal return from quality spending is equal to its marginal cost. The expected number of defects is unlikely to be driven to zero. Once the computer program is released, bugs are discovered. For each program, there is a random, uncontrollable number of defects. The actual number of defects then drives the maintenance and customer service costs.

The major point of this problem is to beware of causality statements based on statistical tests of association. Associations (or the lack of them) do not prove (or disprove) causality. It is certainly the case that the VP of quality has an incentive to lobby for larger budgets. If the quality of the VP's analysis of this data set is at all indicative of her department's statistical powers in improving SDI's product quality, then one should be skeptical of their value to the firm.

**P 14-9:** **Solution to Stirling Acquisition** (30 minutes)
[Analyzing the financial effects of JIT]

Adopting Just-in-Time (JIT) will affect Stirling's cash flows and firm value in a number of ways, including:

- Reduced inventory levels: leading to higher return on investment. Excess investments in inventories do not yield returns. Reducing inventory levels will free-up these non-interest bearing investments and allow these funds to be put to more productive uses inside or outside the firm. (Data required — total dollars invested in inventories and an estimate of the minimum amount of inventories needed to operate an efficient JIT plant. These last data will probably require outside expert/benchmarking.)
- Lower inventory handling costs: Operating costs of material handling, warehousing, and so forth can be cut, thereby increasing operating margins. (Data required — total dollars spent on material handling functions.)
- Simplified accounting system: JIT reduces/eliminates the need for numerous accounting entries to track detailed inventory transactions from raw materials, through W-I-P, and finished goods. (Data required — payroll of accounting department.)
- Additional data processing costs: Adopting JIT accounting procedures requires changing the data processing software. (Data required — can the current accounting software run JIT? If not, what are the acquisition or conversion costs?)
- Inspection costs: JIT systems require a change in quality control techniques. Instead of inspecting quality of incoming materials and parts, supplier quality is certified at the supplier's site, not when parts are received. Also, the quality of Stirling's production process should be improved to eliminate/reduce the need of production line quality inspections. (Data required — the amounts currently being spent on inspection and how much is required to be spent on customer certification and process improvements.)

- Purchasing department savings: JIT plants rely on fewer suppliers and long-term sole-sourcing contracts to better manage quality of supplied materials. This leads to fewer purchase orders and fewer purchasing agents. (Data required — purchasing department costs and benchmark data on purchasing department savings of other firms adopting JIT.)

**P 14-10:** **Solution to TQM at the Stowbridge Division** (35 minutes)
[Evaluating a TQM proposal]

This problem drives home the point that the decision to increase product quality is like all other business decisions. It requires a careful analysis of the costs and benefits.

Stowbridge should seek ISO 9000 certification because it increases the firm's net cash flows. The table below calculates the incremental sales and costs of ISO 9000. Notice that the higher direct labor and material costs apply to all the units manufactured, not just those to Amlan and the new sales. This is because the production process is changed for all units produced.

The manufacturing overhead cost of $2.05 per unit is fixed and since the firm has excess capacity, these fixed costs are irrelevant in the decision to seek ISO 9000 certification and expand capacity.

| | | |
|---|---|---|
| Amlan sales (units) | 120,000 | |
| Additional sales (units) | 14,000 | |
| Total sales (units) | 134,000 | |
| Contribution margin* | × $ 5.70 | |
| Additional revenues | | $763,800 |
| | | |
| Additional costs: | | |
| Training | $74,000 | |
| Inspection | 96,000 | |
| Prevention | 62,000 | |
| Direct materials | | |
| (10% × $4.30 × 494,000†) | 212,420 | |
| Direct labor | | |
| (15% × $2.40 × 494,000†) | 177,840 | |
| Total additional costs | | -$622,260 |
| Net additional contribution | | $141,540 |

*$5.70 = $14.00 - ($4.30 + $2.40 + $1.60)
†494,000 = 480,000 + 14,000

An alternative presentation of the analysis is to compare Stowbridge without ISO 9000 certification to Stowbridge with ISO 9000 certification.

| | Without ISO 9000 | With ISO 9000 |
|---|---|---|
| Total units sold | 360,000 | 494,000 |
| | | |
| Revenue | $5,040,000 | $6,916,000 |
| Costs: | | |
| Training | | $74,000 |
| Inspection | | 96,000 |
| Prevention | | 62,000 |
| Direct materials | | |
| (100% × $4.30 × 360,000) | $1,548,000 | |
| (110% × $4.30 × 494,000) | | 2,336,620 |
| Direct labor | | |
| (100% × $2.40 × 360,000) | 864,000 | |
| (115% × $2.40 × 494,000) | | 1,363,440 |
| Manufacturing Overhead | 984,000 | 984,000 |
| Selling and administration | 576,000 | 790,400 |
| Net income | $1,068,000 | $1,209,540 |
| | | |
| Increase in net income | | $ 141,540 |

**P 14-11:** **Solution to Winter Games** (45 minutes)
[Opportunity costs of a special order]

Assumption — Sports Palace will continue purchasing their standard order of 500 skis if we reject their proposal. If this assumption holds, then we have the following analysis:

| | | |
|---|---|---|
| Additional Revenue from sale 500 × $200 | | $100,000 |
| less: revenue lost on 500 × ($225 -$200) | | (12,500) |
| Incremental revenue | | 87,500 |
| | | |
| Incremental costs: | | |
| Labor 500 × 1.5 × $75 | 56,250 | |
| Materials 500 × $60 | 30,000 | |
| Variable Overhead $56,250 × 0.4 | 22,500 | (108,750) |
| | | |
| Incremental profit | | ($21,250) |

Therefore, reject the order (assuming there are no other supply/demand interdependencies).

If we will lose all Sports Palace business from rejecting their special order, then treat the 1,000 as a new order.

| | | |
|---|---|---|
| Revenue from sale of 1,000 @ $200 | | $200,000 |
| Costs: | | |
| Labor 500 × $75 | 37,500 | |
| 500 × $75 × 1.5 | 56,250 | |
| Material 1,000 × $60 | 60,000 | |
| Variable Overhead .4 × $93,750 | 37,500 | 191,250 |
| Incremental profit | | $ 8,750 |

Therefore, accept the order (assuming there are no other supply/demand interdependencies).

**P 14-12: Solution to Warren City Parts Manufacturing** (50 minutes)
[JIT production, internal audits, and incentives]

The basic premise of the problem that the absolute value of the inventory adjustment is increasing is false.

Throughout the course, the warning "beware of unit costs" has been raised a number of times. A unit cost is the total cost divided by the number of units; this ratio can change because either the numerator or denominator changes. Warren City extends the caution against unit costs to any ratio measure. In this case, the ratio measure is the inventory adjustment: dollar inventory adjustment ÷ ending WIP balance.

a. Two major reasons are likely causing the trend of higher inventory adjustments: larger throughput, and smaller WIP inventories caused by JIT. Larger throughput will cause larger dollar inventory adjustments because there are more batch size changes. As JIT causes smaller ending WIP balances (the denominator used to deflate the dollar inventory adjustment), the ratio becomes larger.

The larger dollar magnitude of the adjustment is most likely the result of larger throughput. As production in a department increases, the dollar magnitude of the adjustment increases. For example, the table below calculates the dollar magnitude of the adjustment and the inventory adjustment as a percentage of throughput.

| Warren City<br>Steel Castings Department | | | | | |
|---|---|---|---|---|---|
| Year | WIP (as of 12/31) | Inventory Adjustment† | Dollar Adjustment | Throughput | Inventory Adjustment* |
| | I | II | III=I×II | IV | V=III÷IV |
| 2002 | $1,920,000 | 12.00% | $230,400 | $76,550,000 | 0.30% |
| 2003 | $1,780,000 | -12.90% | ($229,620) | $82,130,000 | -0.28% |
| 2004 | $1,690,000 | 13.20% | $223,080 | $69,780,000 | 0.32% |
| 2005 | $1,550,000 | 13.60% | $210,800 | $73,290,000 | 0.29% |
| 2006 | $1,480,000 | 17.90% | $264,920 | $88,360,000 | 0.30% |
| 2007 | $1,430,000 | -17.80% | ($254,540) | $91,080,000 | -0.28% |
| 2008 | $1,390,000 | 19.50% | $271,050 | $93,960,000 | 0.29% |

†Deflated by 12/31 WIP
*Deflated by throughput

As seen in column V of the above table, the inventory adjustment as a percentage of throughput has remained relatively constant over the seven years at about ±0.30 percent.

b. There are a number of problems with the current measure of the inventory adjustment as a measure of performance.

(i) The inventory adjustment contains several factors that are beyond the managers' control: internal audit mistakes, changes in standard costs, and timing differences. These factors impose added risk on the managers. For example, internal audit mistakes cause the inventory adjustment and thus the manager's bonus to become more variable. This added risk makes these managers worse off. Warren City will have to pay these managers for bearing this risk via a compensating wage differential.

(ii) Deflating the dollar difference between the WIP account and the physical audit of ending WIP encourages managers to hold larger WIP inventories. A larger WIP inventory balance reduces the percentage inventory adjustment for any given dollar adjustment. Since the firm employs a JIT production environment, the current policy of using the WIP balance as the deflator creates inconsistent incentives with those of JIT. In the extreme, if a manager has a near-zero WIP inventory balance, then even small dollar inventory adjustments can cause a very large percentage inventory adjustment. The inventory adjustment should be divided by throughput, not ending WIP balance.

**P 14-13:** **Solution to Secure Servers Inc.** (60 minutes)
[Balanced scorecard produces incentives inconsistent with maximizing shareholder wealth]

a. In choosing the amount of additional spending on customer satisfaction, the senior managers will trade off the additional benefits they get from increasing the customer satisfaction index against the cost from lowering the firm's net income. The following table illustrates this tradeoff.

| Additional Expenditure | Customer Satisfaction | Additional Cash Flow | Net Cash Flow | Increase in Customer Satisfaction | Increase in Corp. Profit Index |
|---|---|---|---|---|---|
| $0.5 | 60% | $0.9 | $0.4 | | |
| 1.0 | 75% | 1.5 | 0.5 | 15% | 0.50% |
| 1.5 | 80% | 2.1 | 0.6 | 5% | 0.50% |
| 2.0 | 85% | 2.7 | 0.7 | 5% | 0.50% |
| 2.5 | 90% | 3.1 | 0.6 | 5% | -0.50% |
| 3.0 | 95% | 3.5 | 0.5 | 5% | -0.50% |

By spending an additional $1 million on customer satisfaction instead of $0.5 million, SSI raises its customer satisfaction to 75 percent from 60 percent, or an increase of 15 percent. At the same time net cash flow increases from $0.4 million ($0.9 - $0.5) to $0.5 million ($1.5 - $1.0). This increase in cash flow actually increases the BSC corporate profit metric by 0.50 percent ([-3+.05 × $0.5] - [-3+.05 × $0.4]). So in this case, increasing customer satisfaction expenditures from $0.5 million to $1 million raises both the BSC metrics for customer satisfaction and corporate profit. Management will continue to compare the change in the customer satisfaction index and the corporate profit index. Notice, by spending $3 million on customer satisfaction, the customer satisfaction increases by 5 percent, but the corporate profit index only decreases by 0.5 percent, so management is better off by spending the maximum amount on customer satisfaction.

Management maximizes its overall BSC metric by spending $3 million on customer satisfaction.

By similar logic, the following table demonstrates that management maximizes its overall BSC metric by spending $3 million on community engagement.

| Additional Expenditure | Community Rating | Additional Cash Flow | Net Cash Flow | Increase in Community Rating | Increase in Corp. Profit Index |
|---|---|---|---|---|---|
| $0.5 | 40% | $0.75 | $0.25 | | |
| 1.0 | 50% | 1.50 | 0.50 | 10% | 1.25% |
| 1.5 | 60% | 2.25 | 0.75 | 10% | 1.25% |
| 2.0 | 70% | 3.00 | 1.00 | 10% | 1.25% |
| 2.5 | 80% | 4.00 | 1.50 | 10% | 2.50% |
| 3.0 | 90% | 4.00 | 1.00 | 10% | -2.50% |

Again we see that by spending $3 million instead of $2.5 million increases the community rating index by 10 percent, but only lowers the corporate profit index by 2.5 percent.

Finally, spending $3 million on employee satisfaction enhancement programs maximizes the BSC metric after taking into account the effect on corporate profit. Spending $3 million instead of $2.5 million increases the employee satisfaction index by 5 percent, but although corporate profit falls by $0.5 million, this translates into a corporate profit index drop of only 2 percent. So, management gains a net 3 percent index boost.

| Additional Expenditure | Employee Satisfaction | Additional Cash Flow | Net Cash Flow | Increase in Employee Satisfaction | Increase in Corp. Profit Index |
|---|---|---|---|---|---|
| $0.5 | 75% | $0.7 | $0.2 | | |
| 1.0 | 80% | 1.3 | 0.3 | 5% | 0.50% |
| 1.5 | 85% | 1.5 | 0.0 | 5% | -1.50% |
| 2.0 | 90% | 1.8 | -0.2 | 5% | -1.00% |
| 2.5 | 95% | 2.0 | -0.5 | 5% | -1.50% |
| 3.0 | 100% | 2.1 | -0.9 | 5% | -2.00% |

b. The following table documents that the expected BSC index will be 87 percent if management spends $3 million each on customer satisfaction, employee satisfaction, and community projects, and net income before taxes will be $72.6 million.

| BSC Indexes | Additional Expenditure | Additional Net Income | Index |
|---|---|---|---|
| Customer satisfaction | $3 | $0.5 | 95.00% |
| Employee satisfaction | 3 | -0.9 | 100.00% |
| Community engagement | 3 | 1.0 | 90.00% |
| Corporate profit* | | 72.6 | 63.00% |
| Average index | | | 87.00% |

* 72.6 = $72 + $0.5 - $0.9 + $1.0
63.00% = -3 + .05 × 72.6

c. The tables presented in the solution to (a) indicate that firm net cash flow (and hence net income before taxes) is maximized at the following expenditure levels:

| | Additional Expenditure | Additional Net Income | BSC Index |
|---|---|---|---|
| Customer satisfaction | $2.0 | $0.7 | 85.00% |
| Employee satisfaction | 1.0 | 0.3 | 80.00% |
| Community engagement | 2.5 | 1.5 | 80.00% |
| Total Profit | | 74.5 | 72.50% |
| weighted index | | | 79.38% |

In other words, a profit maximizing owner would elect to spend $2 million on customer satisfaction enhancements, $1 million on employee satisfaction, and $2.5 million on community projects, thereby yielding $74.5 million of net income, instead of the $72.6 million of net income produced by spending $9 million in total on these three areas. Hence, maximizing the BSC does not lead to maximum firm value.

This problem illustrates how the balanced scorecard can lead to lower firm value and shareholder value than a strict adherence to performance measures that better capture firm value (EVA, ROA, or net income).

**P 14-14:** **Solution to Kollel Hospital** (60 minutes)
[Length of stay, quality, and profits in a hospital]

Notice, that to reduce length of stay requires Kollel to deny those private doctors with high lengths of stay admitting privileges. This causes the "regular" patients admitted to increase as the regular doctors handle some of the case load of the dropped private doctors.

a. Average length of stay equals:

$$\frac{(\text{Average stay of regulars} \times \text{Number of regulars}) + (\text{Average stay of privates} \times \text{Number of privates})}{\text{Number of regular patients} + \text{Number of private patients}}$$

Occupancy rate equals:

$$\frac{(\text{Average stay of regulars} \times \text{Number of regulars}) + (\text{Average stay of privates} \times \text{Number of privates})}{\text{Number of available beds} \times 365 \text{ days}}$$

The number of beds times 365 is the total number of bed days available per year. This number is constant at 5,840.

| | | **Reducing Private Patient's Stay** | | | |
|---|---|---|---|---|---|
| | *Status Quo* | *1 day* | *2 days* | *3 days* | *4 days* |
| Average length of stay | 19.00 | 18.43 | 17.83 | 17.21 | 16.68 |
| Occupancy rate | 97.60% | 94.06% | 90.07% | 85.46% | 79.97% |

As average length of stay falls, so does the occupancy rate. The drop in occupancy rate occurs for two reasons. First, because the total number of patients treated is decreasing (by three patients if length of stay falls one day, five for a two-day reduction in stay, 10 for three days, and 20 for four days). Since fewer patients are treated but the same number of beds is available, the occupancy rate must drop. Second, even if the number of patients treated does not decrease, discharging the same number of patients faster, leaves more beds open. For example, if one bed were available for 10 days and one patient occupied the bed for nine days, there would be a 90 percent occupancy rate. If the length of stay dropped to seven days, the occupancy rate would drop to 70 percent.

b. Income statement for various reduced lengths of stay:

| | | Reducing Private Patient's Stay | | | |
|---|---|---|---|---|---|
| | *Status Quo* | *1 day* | *2 days* | *3 days* | *4 days* |
| Regular patient revenue | $1,500,000 | $1,530,000 | $1,600,000 | $1,730,000 | $1,850,000 |
| Variable expense, regular | 360,000 | 367,200 | 384,000 | 415,200 | 444,000 |
| Margin | $1,140,000 | $1,162,800 | $1,216,000 | $1,314,800 | $1,406,000 |
| Private patient revenue | $1,500,000 | $1,450,000 | $1,350,000 | $1,170,000 | $950,000 |
| Variable expense, private | 495,000 | 456,750 | 405,000 | 333,450 | 256,500 |
| Margin | $1,005,000 | $993,250 | $945,000 | $836,550 | $693,500 |
| Fixed expense | 1,752,000 | 1,752,000 | 1,752,000 | 1,752,000 | 1,752,000 |
| Net income | $393,000 | $404,050 | $409,000 | $399,350 | $347,500 |

Profit is maximized when private patients' stays are reduced by two days. If length of stay is reduced two days, net income rises $16,000 ($409,000 – $393,000). This can be broken down as follows. Fifteen private patients are replaced by 10 regular patients relative to the status quo. The regular patients have a constant margin of $7,600 per patient ($10,000 - $150 × 16), which adds $76,000 to net income. The private patients' margin increases as the length of stay decreases. Therefore, the effect of the private patients must be divided into two additional components, the effect of fewer patients and the effect of the higher margin on the remaining private patients. At the status quo, the private patients have a margin of $6,700 ($10,000 - $150 × 22), making the effect of 15 fewer patients a decrease in net income of $100,500. Reducing the length of stay for private patients to 20 days raises the margin on private patients to $7,000, making the effect of increased margin an increase in net income of $40,500 ((7,000 – 6,700) × 135). The sum of these effects is:

| | |
|---|---|
| Additional margin from new regular patients | $ 76,000 |
| Lost margin on 15 private patients displaced | –100,500 |
| Additional margin on private patients reducing their length of stay | 40,500 |
| Change in net income | $ 16,000 |

**P 14-15:** **Solution to Tagway 4000** (70 minutes)
[Incentives and trade-offs among quality and costs]

a. Production costs given delivery time and defects

**Production, Quality, and Delivery Costs**
**Battery Division**

| | Delivery Time in Days | | | |
|---|---|---|---|---|
| Defects | 1 | 2 | 3 | 4 |
| 1,032 | $1,850,000 | $1,735,000 | $1,640,000 | $\boxed{\$1{,}550{,}000}$ |
| 500 | $2,089,400 | $1,974,400 | $1,879,400 | $1,789,400 |
| 100 | $2,269,400 | $2,154,400 | $2,059,400 | $1,969,400 |
| 50 | $2,291,900 | $2,176,900 | $2,081,900 | $1,991,900 |
| 32 | $2,300,000 | $2,185,000 | $2,090,000 | $2,000,000 |

Minimum reported cost: $1,550,000 at 4 days and 1,032 defects.

Sample calculation for 1 day & 32 defects and 4 days & 50 defects.

| | | |
|---|---|---|
| Production costs | $1,550,000 | $1,550,000 |
| Quality costs | $450,000 | $441,900 |
| Delivery costs | $300,000 | $0 |
| Total costs | $2,300,000 | $1,991,900 |

Basic production costs are fixed at $1,550,000 (1,000,000 units x $1.55 per unit).

Quality costs are $450 multiplied by the difference between 1,032 and actual defects. The cost for 32 defects is $450,000 [$450 × (1,032-32)]. The cost for 50 defects is $441,900 [$450 × (1,032-50)].

Delivery costs are given as $300,000 for a 1-day average and $0 for a 4-day average.

b. Compensation given delivery time and defects

**Manager's Compensation**
**Battery Division**

| | Delivery Time in Days | | | |
|---|---|---|---|---|
| Defects | 1 | 2 | 3 | 4 |
| 1,032 | $200,000 | $200,000 | $178,000 | $178,000 |
| 500 | $166,000 | $200,000 | $178,000 | $178,000 |
| 100 | $166,000 | $166,000 | $144,000 | $178,000 |
| 50 | $166,000 | $166,000 | $144,000 | $178,000 |
| 32 | $206,000 | $206,000 | $184,000 | $218,000 |

Maximum compensation: $218,000 at 4 days and 32 defects.

Sample calculation for 1 day & 32 defects and 4 days & 50 defects.

| | | |
|---|---|---|
| Base Salary | $144,000 | $144,000 |
| Meeting costs | $0 | $34,000 |
| Meeting defect target | $40,000 | $0 |
| Meeting delivery | $22,000 | $0 |
| Total | $206,000 | $178,000 |

Base salary is fixed as given at $144,000.

The bonus for meeting costs is $34,000 and is received when total costs are less than or equal to $2,000,000. The bonus is not received when delivery is 1 day and there are 32 defects since total costs are $2,3000,000, $300,000 above the $2,000,000 target level. The bonus is received when delivery is 4 days and there are 50 defects since total costs are $1,991,900, $8,100 below the $2,000,000 target level.

The bonus for meeting the defect target is $40,000 and is received when total defects are less than or equal to 32. The bonus is received when there are only 32 defects, but is not received when there are 50.

The bonus for meeting the delivery target is $22,000 and is received when the average delivery time is 2 days or less. The bonus is received when the average time is 1 day, but is not received when the average time is 4 days.

c. In order to minimize costs the manager would not want to spend any money on decreasing the defect rate or increasing the delivery time. However, the incentives in her compensation package are set such that her compensation is maximized when delivery time is 4 days and there are 32 defects. Interestingly, at 32 defects, if she were to decrease the delivery time by one day her total compensation would drop, but then if she were to decrease the delivery time by a second day her total compensation would increase (but obviously not above the compensation for four days, the maximum).

d. Total costs given delivery time and defects

**Total Firm Costs including**
**Production Costs, Defect Costs, and Compensation**
**Battery Division**

| | Delivery Time in Days | | | |
|---|---|---|---|---|
| Defects | 1 | 2 | 3 | 4 |
| 1,032 | $2,524,720 | $2,909,720 | $3,292,720 | $3,702,720 |
| 500 | $2,485,400 | $2,904,400 | $3,287,400 | $3,697,400 |
| 100 | $2,481,400 | $2,866,400 | $3,249,400 | $3,693,400 |
| 50 | $\boxed{\$2,480,900}$ | $2,865,900 | $3,248,900 | $3,692,900 |
| 32 | $2,520,720 | $2,905,720 | $3,288,720 | $3,732,720 |

Minimum total cost: $2,480,900 at 1 day and 50 defects.

Sample calculation for 1 day & 32 defects and 4 days & 50 defects.

| | | |
|---|---|---|
| Firm cost | | |
| Cost of production | $2,300,000 | $1,991,900 |
| Costs of defects | $14,720 | $23,000 |
| Costs of delays | $0 | $1,500,000 |
| Cost of compensation | $ 206,000 | $ 178,000 |
| Total | $2,520,720 | $3,692,900 |

The cost of production was calculated in question (a) above.

Cost of defects equals the actual number of defects x $460 per defect. For 32 defects the cost is $14,720 (32 × $460). For 50 defects the cost is $23,000 (50 × 460).

Cost of delays equals the number of days delayed (average delivery time minus one) × $500,000 per day delayed. For 1 day delayed the cost is $0 [(1-1) × $500,000]. For 4 days delayed the cost is $1,500,000 [(4-1) × $500,000].

The cost of compensation was calculated in question (b) above.

e. The compensation package is currently set up in such a way that the manager will make sub-optimal decisions. The cost of lowering the delivery time would make the manager ineligible for the bonus for keeping costs down. Since the bonus for costs is higher than the bonus for delivery, the manager allows the delivery time to be longer than desired.

One should note that at the 32-defects level the company is giving the manager some profits associated with low defects. That is the bonus for hitting 32 defects is higher than the marginal savings for the firm of going from 50 defects to 32 defects. This sets the ideal defect level at 50 defects regardless of delivery time.

The simple answer is to lower the bonus awarded the manager for meeting the defect requirement. However, simple math shows that the actual savings per defect removed is only $10 ($460-$450). Therefore the marginal savings for removing the last 18 defects (50-32) is only $180. Any bonus over $180 is a loss to the firm. Secondly, if the bonus is below $22,000 the manager's maximum compensation changes to 2 days and either 500 or 1,032 defects or 1 day and 1,032 defects. This fact stresses that the compensation system is not flexible. There is no bonus for barely missing targets. This means that if the manager thinks she is going to miss, she might as well miss by a lot to make sure that she hits her other targets. Or as in the case just described, if the bonus for meeting the defect target is too small, then there is an advantage to substantially missing the target so that she can hit the delivery target and still meet the cost target. By using a scaled bonus that increases as she approaches the targets, this incentive problem can be avoided.

**Case 14-1: Solution to Global Oil** (50 minutes)
[Balanced scorecard]

The concept of a balanced scorecard (BSC) illustrates how firms are attempting to link the firm's business strategy to one particular leg of the three-legged stool – performance measurement. In the M&R case, Global had already decided to change its strategy and had already reorganized its decision rights assignment. The BSC sought to link strategy to performance measurement.

a. Strengths and weaknesses of BSC

Strengths of the BSC include:

- Helped articulate the new strategy M&R adopted to become a destination stop.
- Helped train managers to become more general managers, not narrow functional managers.
- Focuses managers more externally.
- Blends own-unit and divisional performance to reduce free-rider problems of divisional performance measures only.
- Links business strategy to performance measurement (Figure 14.1) and compensation plans.

Weaknesses of the BSC include:

- The balanced scorecard, per se, does not explicitly address the third leg of the stool – decision rights assignment. M&R had already done this.
- Too many measures. System is overly complicated which increases the data collection costs and increases the opportunity for gaming and influence costs. Multiple measures can conflict causing managers to emphasize one measure

to the exclusion of others. Managers will work on those measures that are easiest to influence and de-emphasize others.

- Not clear that tying compensation to all 32 BSC metrics maximizes firm value. Pilots need to know the plane's altitude, but why base part of their pay on altitude or oil pressure? In other words, are all measures equally important? Should they be weighted equally in determining compensation?
- Basing compensation on Global's performance and on M&R's performance creates free-rider problems for lower-level employees whose individual efforts have little affect on Global's and M&R's performance.

b. M&R changed its strategy and all three legs of its organizational architecture. You can't attribute its success to any one change.

**Case 14-2: Solution to Telephone Computer Corporation (TCC)** (90 minutes)
[Joint costs of a sales force, new product cannibalizing existing lines]

This problem illustrates two important costing issues: first, the costing treatment of cannibalization of sales from an existing product line when a new model is introduced and second, the common cost nature of a fixed sales force selling multiple products and the allocation of such sales force costs across products.

Management has asked for a five-year projection of profits by product line, including the ZETA machine introduction. Based on the analysis in the table below, we see that all three products are profitable. ZETA starts out slowly and grows in profitability over time. The remaining products, ALPHA and BETA, remain profitable.

**Five Year Analysis of ALPHA, BETA AND ZETA**
(all figures except units in $000's)

| Particulars | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
|---|---|---|---|---|---|
| ALPHA | | | | | |
| Unit sales (increasing @ 5%) | 100 | 105 | 110 | 116 | 122 |
| Sales revenue ($100/unit) | $10,000 | $10,500 | $11,000 | $11,600 | $12,200 |
| *Less*: | | | | | |
| Cost of sales ($50 per unit) | 5,000 | 5,250 | 5,500 | 5,800 | 6,100 |
| Sales commission (10% of sales) | 1,000 | 1,050 | 1,100 | 1,160 | 1,220 |
| Sales force salary (*) | 1,778 | 1,765 | 1,746 | 1,744 | 1,736 |
| Profits | $ 2,222 | $ 2,435 | $ 2,654 | $ 2,896 | $ 3,144 |
| BETA | | | | | |
| Unit sales (2% increase) | 25 | 26 | 26 | 27 | 27 |
| Sales revenue ($200/unit) | $5,000 | $5,200 | $5,200 | $5,400 | $5,400 |
| *Less*: | | | | | |
| Cost of sales ($80 per unit) | 2,000 | 2,080 | 2,080 | 2,160 | 2,160 |
| Sales commission (10% of sales) | 500 | 520 | 520 | 540 | 540 |
| Sales force salary (*) | 889 | 874 | 825 | 812 | 769 |
| Profits | $1,611 | $1,726 | $1,775 | $1,888 | $1,931 |
| ZETA | | | | | |
| Unit sales (9% increase) | 25 | 27 | 30 | 32 | 35 |
| Sales revenue ($300/unit) | $7,500 | $8,100 | $9,000 | $9,600 | $10,500 |
| *Less*: | | | | | |
| Cost of sales ($170 per unit) | 4,250 | 4,590 | 5,100 | 5,440 | 5,950 |
| Sales commission (10% of sales) | 750 | 810 | 900 | 960 | 1,050 |
| Sales force salary (*) | 1,333 | 1,361 | 1,429 | 1,444 | 1,495 |
| Additional sales salary | 500 | 500 | 500 | 500 | 500 |
| Profits | $ 667 | $ 839 | $1,071 | $1,256 | $1,505 |
| TOTAL PROFITS | $4,500 | $5,000 | $5,500 | $6,040 | $6,580 |

* Sales force salary is assigned based on sales commissions.

But something is amiss here. Notice in the table given in the problem that firm-wide profits in year one without the ZETA are $5 million. But in the above table, total profits for the firm with ZETA are only $4.5 million. Firm-wide profits fall in year one by half a million dollars if ZETA is introduced. But are they recouped in subsequent years? The following table projects product line profitability with only the ALPHA and BETA.

**Five Year Analysis of**
**ALPHA and BETA**
(all figures except unit sales in $000s)

| Particulars | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
|---|---|---|---|---|---|
| ALPHA | | | | | |
| Unit sales (5% increase) | 100 | 105 | 110 | 116 | 122 |
| Sales revenue ($100 per unit) | $10,000 | $10,500 | $11,000 | $11,600 | $12,200 |
| *Less*: | | | | | |
| Cost of sales ($50 per unit) | 5,000 | 5,250 | 5,500 | 5,800 | 6,100 |
| Sales commission (10% of sales) | 1,000 | 1,050 | 1,100 | 1,160 | 1,220 |
| Sales force salary (*) | 2,000 | 1,953 | 1,897 | 1,856 | 1,821 |
| Profits | $ 2,000 | $ 2,247 | $ 2,503 | $ 2,784 | $ 3,059 |
| BETA | | | | | |
| Unit sales (10% increase) | 50 | 55 | 61 | 67 | 73 |
| Sales revenue ($200 per unit) | $10,000 | $11,000 | $12,200 | $13,400 | $14,600 |
| *Less*: | | | | | |
| Cost of sales ($80 per unit) | 4,000 | 4,400 | 4,880 | 5,360 | 5,840 |
| Sales commission (10% of sales) | 1,000 | 1,100 | 1,220 | 1,340 | 1,460 |
| Sales force salary (*) | 2,000 | 2,047 | 2,103 | 2,144 | 2,179 |
| Profits | $ 3,000 | $ 3,453 | $ 3,997 | $ 4,556 | $ 5,121 |
| TOTAL PROFITS | $ 5,000 | $ 5,700 | $ 6,500 | $ 7,340 | $ 8,180 |

* Sales force salary is assigned based on sales commissions.

In this table we see that profits are higher in every year if ZETA is not introduced. Moreover, the profits on ALPHA are higher when ZETA exists than when it does not exist. The reason is that sales salaries assigned to ALPHA are smaller when ZETA exists because ZETA is assigned some of the sales salaries. This analysis indicates that sales salaries are a common cost. We know that profitability analyses relying on allocated common costs are suspect. The correct way to do the analysis of ZETA is on an incremental basis. Such an analysis follows.

## Incremental Analysis of ZETA

| Particulars | | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
|---|---|---|---|---|---|---|
| ZETA | | | | | | |
| Unit sales (9% increase) | | 25 | 27 | 30 | 32 | 35 |
| Sales revenue ($300 per unit) | | $7,500 | $8,100 | $9,000 | $9,600 | $10,500 |
| *Less* | | | | | | |
| Cost of sales ($170 per unit) | | 4,250 | 4,590 | 5,100 | 5,440 | 5,950 |
| Sales commission (10% of sales) | | 750 | 810 | 900 | 960 | 1,050 |
| Additional sales salary | | 500 | 500 | 500 | 500 | 500 |
| Profits | | $2,000 | $2,200 | $2,500 | $2,700 | $ 3,000 |
| *Less*: | | | | | | |
| Profits from lost BETA sales | | 25 | 29 | 35 | 40 | 46 |
| Sales price per unit | $200 | | | | | |
| *Less*: | | | | | | |
| Sales commission | (20) | | | | | |
| Cost of sales | (80) | | | | | |
| Profits | $100 | 2,500 | 2,900 | 3,500 | 4,000 | 4,600 |
| | | ($ 500) | ($ 700) | ($1,000) | ($1,300) | ($1,600) |

Based on this incremental analysis *and assuming competitors will not enter*, the ZETA should not be introduced. Notice that the incremental profits in the table above are the difference between the total firm profits with and without ZETA.

Four other points should be recognized in the answer to this question.

1. What will the competition do if ZETA is not introduced? If they enter, then the analysis of firm profits without ZETA is unattainable. If we expect competitive entry if the ZETA is not introduced, will we do better introducing ZETA or facing the competition without the ZETA?

2. How likely is it that senior management will walk away from the ZETA after making such a large investment? Even though we teach "sunk costs are irrelevant," management careers and reputations are on the line. It is likely that no matter how careful the analysis, senior managers responsible for committing the firm to the ZETA will find enough "faulty assumptions" in the analysis to allow the ZETA to be introduced.

3. The sales force salary costs assigned to products are common costs.

4. Instead of viewing the introduction of the ZETA as a go/no go decision (which pits you against senior management in charge of the project) think about other changes or issues that will improve the ZETA introduction, such as:

a. Is hiring $500,000 of ZETA system salespersons the right number? What happens to ZETA sales if this number is increased or decreased?

b. How was the pricing of the ZETA determined and is it the profit-maximizing number for the firm?

c. ZETA has a unit cost of $170,000. Is this a variable cost, out of pocket cost, or a fully-absorbed cost with a lot of allocated costs? If there are allocated numbers in this unit cost, then all product line profitability analyses of the ZETA that use this unit cost number are suspect. There are likely common costs among the ALPHA, BETA, and ZETA in the unit cost numbers that are distorting these unit cost figures and product line profitability analysis as well.

**Case 14-3: Solution to Productivity Measures** (120 minutes)
[Performance measures, incentives, organizational architecture]

a. On the surface, it appears as if the firm is better off than it was last year. However, depending on relative price changes, the firm could actually be worse off. For example, output increased 14 percent ($2,850 ÷ 2,500), steel use increased 20 percent (1,200 ÷ 1,000), and labor increased 7 percent (320 ÷ 300). Therefore, the largest reason for the overall gain in productivity is that labor increased at a lower rate than the rate at which output was expanded. But suppose the price of labor increased far faster than the price of steel and that steel and labor are to some extent substitutes in production. Under this set of assumptions, the overall productivity measure still shows improvement, but net cash flows fall.

b. It is important to note that profits can fall even though productivity improves. Managers who are evaluated and rewarded solely on productivity measures will ignore relative price changes in making input mix and output decisions. And this can cause firm value to fall even though productivity increased. The major appeal of productivity measures is to hold managers responsible for physical quantities instead of changes in prices and costs. However, as discussed in chapter 5, even though managers have no control over a variable, if they can influence the *consequences* resulting from it, the incentives to control these consequences should not be eliminated. Even though managers cannot control prices, they can use less of a more expensive input and more of a cheaper substitute. This is likely the single most important reason why productivity measures were not widely adopted.

Another problem with productivity measures involves controlling for quality improvements in output. Personal computers today are faster, have more memory, better screens, and more user-friendly operating systems than three-year-old machines. Merely counting PCs produced ignores quality enhancements. Productivity can decline because PCs are better. Measuring output where quality changes is particularly severe in the service industry. Consider measuring productivity in health care. What is output? Patients seen? Patients cured? Increased life expectancy? There has been enormous technological innovation in health care. Diseases are treatable today that were not 10 years ago. Extremely premature infants now survive whereas 20 years ago they did not. However, such medical advances require large investments in technology and highly trained personnel. It is very difficult to measure productivity without controlling for changes in quality.

Many of the proponents of productivity measures unilaterally dismissed traditional accounting measures as being flawed without understanding the basic reasons that U.S. firms had become less productive than their foreign competitors. Productivity accounting systems were proposed without concurrent changes in the other parts of the firm's organizational architecture, such as the systems to partition decision rights and the systems to reward performance. Because productivity measures focus only on physical quantities, they are not all-purpose measures. They do not capture the effects of marketing, relative price changes, quality changes, and new product development. Productivity measures are at best supplements to existing measures. They can also be misleading and induce dysfunctional decisions.

On the other hand, a carefully chosen productivity ratio that captures the essence of the firm's or a department's key strategic factor can be of great benefit by removing from the manager the distraction of numerous irrelevant factors. Isolating just one or two variables focuses managers' attention on those variables. The real dangers are that the wrong variables may be chosen and that the world is too complex to be reduced to just one or two variables. The biggest problem with using physical measures is that managers ignore relative price changes.

In summary, *comprehensive productivity systems* have been proposed but not widely adopted. These systems promised to focus more on factors that managers can control, such as the physical transformation of inputs into outputs, rather than an all-encompassing profit figure that contains relative price changes. While managers usually cannot affect prices of their inputs and outputs, they can make substitutions among inputs and outputs, and such substitutions are an important part of management. Without concurrent changes in the way decision rights are partitioned and performance is rewarded, it is unlikely that simply adopting productivity measures will have much effect.

| | | | | |
|---|---|---|---|---|
| c. | Direct labor productivity | (1,680 ÷ 722) 2.33 | (1,710 ÷ 701) | 2.44 |

Dear Ms. Burk:

Your idea to reward supervisors and managers based on labor productivity is probably a very bad one. Such a bonus scheme will induce managers to substitute material and capital for labor. Scrap will likely rise. If managers are evaluated and rewarded based only on labor productivity, they will reduce labor content, even at the expense of additional materials, capital, and scrap. Therefore, if you implement your plan, you must install strict controls to limit scrap, additional material, and capital.

Labor productivity is only one factor affecting total productivity and profitability.  If the price of labor falls relative to the price of aluminum, profit maximizing behavior calls for increasing labor and reducing aluminum.  Focusing your managers on only one factor input reduces their incentives to respond to relative price changes.

Finally, you are changing the compensation scheme and evaluation system.  What changes do you propose making with respect to employee decision making authority?  Is employee empowerment changing?  (Note:  Two of the three legs of the stool are being changed.  Why not the third leg?)