Chapter 11
Performance Measurement in Decentralized Organizations

Solutions to Questions

11-1 In a decentralized organization, decision-making authority isn’t confined to a few top executives; instead, decision-making authority is spread throughout the organization.

11-2 The benefits of decentralization include: (1) by delegating day-to-day problem solving to lower-level managers, top management can concentrate on bigger issues such as overall strategy; (2) empowering lower-level managers to make decisions puts decision-making authority in the hands of those who tend to have the most detailed and up-to-date information about day-to-day operations; (3) by eliminating layers of decision-making and approvals, organizations can respond more quickly to customers and to changes in the operating environment; (4) granting decision-making authority helps train lower-level managers for higher-level positions; and (5) empowering lower-level managers to make decisions can increase their motivation and job satisfaction.

11-3 The manager of a cost center has control over cost, but not revenue or the use of investment funds. A profit center manager has control over both cost and revenue. An investment center manager has control over cost and revenue and the use of investment funds.

11-4 Margin is the ratio of net operating income to total sales. Turnover is the ratio of total sales to average operating assets. The product of the two numbers is the ROI.

11-5 Residual income is the net operating income an investment center earns above the company’s minimum required rate of return on operating assets.

11-6 If ROI is used to evaluate performance, a manager of an investment center may reject a profitable investment opportunity whose rate of return exceeds the company’s required rate of return but whose rate of return is less than the investment center’s current ROI. The residual income approach overcomes this problem because any project whose rate of return exceeds the company’s minimum required rate of return will result in an increase in residual income.

11-7 The difference between delivery cycle time and throughput time is the waiting period between when an order is received and when production on the order is started. Throughput time is made up of process time, inspection time, move time, and queue time. Process time is value-added time and inspection time, move time, and queue time are non-value-added time.

11-8 An MCE of less than 1 means that the production process includes non-value-added time. An MCE of 0.40, for example, means that 40% of throughput time consists of actual processing, and that the other 60% consists of moving, inspection, and other non-value-added activities.

11-9 A company’s balanced scorecard should be derived from and support its strategy. Because different companies have different strategies, their balanced scorecards should be different.

11-10 The balanced scorecard is constructed to support the company’s strategy, which is a
theory about what actions will further the company's goals. Assuming that the company has financial goals, measures of financial performance must be included in the balanced scorecard as a check on the reality of the theory. If the internal business processes improve, but the financial outcomes do not improve, the theory may be flawed and the strategy should be changed.
The Foundational 15

1. Last year’s margin is:

\[
\text{Margin} = \frac{\text{Net operating income}}{\text{Sales}} = \frac{\$200,000}{\$1,000,000} = 20\%
\]

2. Last year’s turnover is:

\[
\text{Turnover} = \frac{\text{Sales}}{\text{Average operating assets}} = \frac{\$1,000,000}{\$625,000} = 1.6
\]

3. Last year’s return on investment (ROI) is:

\[
\text{ROI} = \text{Margin} \times \text{Turnover} = 20\% \times 1.6 = 32\%
\]

4. The margin for this year’s investment opportunity is:

\[
\text{Margin} = \frac{\text{Net operating income}}{\text{Sales}} = \frac{\$30,000}{\$200,000} = 15\%
\]

5. The turnover for this year’s investment opportunity is:

\[
\text{Turnover} = \frac{\text{Sales}}{\text{Average operating assets}} = \frac{\$200,000}{\$120,000} = 1.67 \text{ (rounded)}
\]
The Foundational 15 (continued)

6. The ROI for this year’s investment opportunity is:

\[
\text{ROI} = \text{Margin} \times \text{Turnover} \\
= 15\% \times 1.67 = 25\% \text{ (rounded)}
\]

7, 8, and 9.

If the company pursues the investment opportunity, this year’s margin, turnover, and ROI would be:

\[
\text{Margin} = \frac{\text{Net operating income}}{\text{Sales}} \\
= \frac{$200,000 + $30,000}{$1,000,000 + $200,000} \\
= \frac{$230,000}{$1,200,000} = 19.2\% \text{ (rounded)}
\]

\[
\text{Turnover} = \frac{\text{Sales}}{\text{Average operating assets}} \\
= \frac{$1,000,000 + $200,000}{$625,000 + $120,000} \\
= \frac{$1,200,000}{$745,000} = 1.61 \text{ (rounded)}
\]

\[
\text{ROI} = \text{Margin} \times \text{Turnover} \\
= 19.2\% \times 1.61 = 30.9\% \text{ (rounded)}
\]

10. The CEO would not pursue the investment opportunity because it lowers her ROI from 32% to 30.9%. The owners of the company would want the CEO to pursue the investment opportunity because its ROI of 25% exceeds the company’s minimum required rate of return of 15%.
The Foundational 15 (continued)

11. Last year’s residual income is:
   - Average operating assets: $625,000
   - Net operating income: $200,000
   - Minimum required return: 
     \[ 0.15 \times 625,000 = 93,750 \]
   - Residual income: $106,250

12. The residual income for this year’s investment opportunity is:
   - Average operating assets: $120,000
   - Net operating income: $30,000
   - Minimum required return: 
     \[ 0.15 \times 120,000 = 18,000 \]
   - Residual income: $12,000

13. If the company pursues the investment opportunity, this year’s residual income will be:
   - Average operating assets: $745,000
   - Net operating income: $230,000
   - Minimum required return: 
     \[ 0.15 \times 745,000 = 111,750 \]
   - Residual income: $118,250

14. The CEO would pursue the investment opportunity because it would raise her residual income by $12,000.

15. The CEO and the company would not want to pursue this investment opportunity because it does not exceed the minimum required return:
   - Average operating assets: $120,000
   - Net operating income: $10,000
   - Minimum required return: 
     \[ 0.15 \times 120,000 = 18,000 \]
   - Residual income: $(8,000)
Exercise 11-1 (10 minutes)

1. Margin = \( \frac{\text{Net operating income}}{\text{Sales}} \)
   \[ = \frac{\$600,000}{\$7,500,000} = 8\% \]

2. Turnover = \( \frac{\text{Sales}}{\text{Average operating assets}} \)
   \[ = \frac{\$7,500,000}{\$5,000,000} = 1.5 \]

3. ROI = Margin \times Turnover
   \[ = 8\% \times 1.5 = 12\% \]
Exercise 11-2 (10 minutes)

Average operating assets ....................... $2,800,000
Net operating income............................ $ 600,000
Minimum required return:
  18% × $2,800,000............................... 504,000
Residual income................................. $  96,000
**Exercise 11-3** (20 minutes)

1. Throughput time = Process time + Inspection time + Move time + Queue time
   \[ = 2.7 \text{ days} + 0.3 \text{ days} + 1.0 \text{ days} + 5.0 \text{ days} \]
   \[ = 9.0 \text{ days} \]

2. Only process time is value-added time; therefore the manufacturing cycle efficiency (MCE) is:
   \[ \text{MCE} = \frac{\text{Value-added time}}{\text{Throughput time}} = \frac{2.7 \text{ days}}{9.0 \text{ days}} = 0.30 \]

3. If the MCE is 30%, then 30% of the throughput time was spent in value-added activities. Consequently, the other 70% of the throughput time was spent in non-value-added activities.

4. Delivery cycle time = Wait time + Throughput time
   \[ = 14.0 \text{ days} + 9.0 \text{ days} \]
   \[ = 23.0 \text{ days} \]

5. If all queue time is eliminated, then the throughput time drops to only 4 days (2.7 + 0.3 + 1.0). The MCE becomes:
   \[ \text{MCE} = \frac{\text{Value-added time}}{\text{Throughput time}} = \frac{2.7 \text{ days}}{4.0 \text{ days}} = 0.675 \]

   Thus, the MCE increases to 67.5%. This exercise shows quite dramatically how lean production can improve the efficiency of operations and reduce throughput time.
Exercise 11-4 (45 minutes)

1. Students’ answers may differ in some details from this solution.
Exercise 11-4 (continued)

2. The hypotheses underlying the balanced scorecard are indicated by the arrows in the diagram. Reading from the bottom of the balanced scorecard, the hypotheses are:
   - If the percentage of dining room staff that complete the basic hospitality course increases, then the average time to take an order will decrease.
   - If the percentage of dining room staff that complete the basic hospitality course increases, then dining room cleanliness will improve.
   - If the percentage of kitchen staff that complete the basic cooking course increases, then the average time to prepare an order will decrease.
   - If the percentage of kitchen staff that complete the basic cooking course increases, then the number of menu items will increase.
   - If the dining room cleanliness improves, then customer satisfaction with service will increase.
   - If the average time to take an order decreases, then customer satisfaction with service will increase.
   - If the average time to prepare an order decreases, then customer satisfaction with service will increase.
   - If the number of menu items increases, then customer satisfaction with menu choices will increase.
   - If customer satisfaction with service increases, weekly sales will increase.
   - If customer satisfaction with menu choices increases, weekly sales will increase.
   - If sales increase, weekly profits for the Lodge will increase.

Each of these hypotheses can be questioned. For example, the items added to the menu may not appeal to customers. So even if the number of menu items increases, customer satisfaction with the menu choices may not increase. The fact that each of the hypotheses can be questioned does not, however, invalidate the balanced scorecard. If the scorecard is used correctly, management will be able to identify which, if any, of the hypotheses are incorrect. [See below.]
Exercise 11-4 (continued)

3. Management will be able to tell if a hypothesis is false if an improvement in a performance measure at the bottom of an arrow does not, in fact, lead to improvement in the performance measure at the tip of the arrow. For example, if the number of menu items is increased, but customer satisfaction with the menu choices does not increase, management will immediately know that something was wrong with that particular hypothesis.
**Exercise 11-5 (15 minutes)**

<table>
<thead>
<tr>
<th>Division</th>
<th>Alpha</th>
<th>Bravo</th>
<th>Charlie</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>$4,000,000</td>
<td>$11,500,000 *</td>
<td>$3,000,000</td>
</tr>
<tr>
<td>Net operating income</td>
<td>$160,000</td>
<td>$920,000 *</td>
<td>$210,000 *</td>
</tr>
<tr>
<td>Average operating assets</td>
<td>$800,000 *</td>
<td>$4,600,000</td>
<td>$1,500,000</td>
</tr>
<tr>
<td>Margin</td>
<td>4%*</td>
<td>8%</td>
<td>7%*</td>
</tr>
<tr>
<td>Turnover</td>
<td>5*</td>
<td>2.5</td>
<td>2</td>
</tr>
<tr>
<td>Return on investment (ROI)</td>
<td>20%</td>
<td>20%*</td>
<td>14%*</td>
</tr>
</tbody>
</table>

Note that Divisions Alpha and Bravo apparently have different strategies to obtain the same 20% return. Division Alpha has a low margin and a high turnover, whereas Division Bravo has just the opposite.

*Given.
Exercise 11-6 (20 minutes)

1. ROI computations:

\[
\text{ROI} = \frac{\text{Net operating income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Average operating assets}}
\]

Osaka Division:

\[
\text{ROI} = \frac{\$210,000}{\$3,000,000} \times \frac{\$3,000,000}{\$1,000,000} = 7\% \times 3 = 21\%
\]

Yokohama Division:

\[
\text{ROI} = \frac{\$720,000}{\$9,000,000} \times \frac{\$9,000,000}{\$4,000,000} = 8\% \times 2.25 = 18\%
\]

2. 

<table>
<thead>
<tr>
<th></th>
<th>Osaka</th>
<th>Yokohama</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average operating assets (a)</td>
<td>$1,000,000</td>
<td>$4,000,000</td>
</tr>
<tr>
<td>Net operating income</td>
<td>$210,000</td>
<td>$720,000</td>
</tr>
<tr>
<td>Minimum required return on average operating assets: 15% × (a)</td>
<td>$150,000</td>
<td>$600,000</td>
</tr>
<tr>
<td>Residual income</td>
<td>$60,000</td>
<td>$120,000</td>
</tr>
</tbody>
</table>

3. No, the Yokohama Division is simply larger than the Osaka Division and for this reason one would expect that it would have a greater amount of residual income. Residual income can’t be used to compare the performance of divisions of different sizes. Larger divisions will almost always look better. In fact, in the case above, the Yokohama Division does not appear to be as well managed as the Osaka Division. Note from Part (1) that Yokohama has only an 18% ROI as compared to 21% for Osaka.
Exercise 11-7 (45 minutes)

1. Students’ answers may differ in some details from this solution.

- **Financial**
  - Profit margin
  - Revenue per employee
  - Sales

- **Customer**
  - Number of new customers acquired
  - Customer satisfaction with effectiveness
  - Customer satisfaction with efficiency
  - Customer satisfaction with service quality

- **Internal Business Processes**
  - Average number of errors per tax return
  - Ratio of billable hours to total hours
  - Average time needed to prepare a return

- **Learning And Growth**
  - Percentage of job offers accepted
  - Employee morale
  - Amount of compensation paid above industry average
  - Average number of years to be promoted
Exercise 11-7 (continued)

2. The hypotheses underlying the balanced scorecard are indicated by the arrows in the diagram. Reading from the bottom of the balanced scorecard, the hypotheses are:

° If the amount of compensation paid above the industry average increases, then the percentage of job offers accepted and the level of employee morale will increase.

° If the average number of years to be promoted decreases, then the percentage of job offers accepted and the level of employee morale will increase.

° If the percentage of job offers accepted increases, then the ratio of billable hours to total hours should increase while the average number of errors per tax return and the average time needed to prepare a return should decrease.

° If employee morale increases, then the ratio of billable hours to total hours should increase while the average number of errors per tax return and the average time needed to prepare a return should decrease.

° If employee morale increases, then the customer satisfaction with service quality should increase.

° If the ratio of billable hours to total hours increases, then the revenue per employee should increase.

° If the average number of errors per tax return decreases, then the customer satisfaction with effectiveness should increase.

° If the average time needed to prepare a return decreases, then the customer satisfaction with efficiency should increase.

° If the customer satisfaction with effectiveness, efficiency, and service quality increases, then the number of new customers acquired should increase.

° If the number of new customers acquired increases, then sales should increase.

° If revenue per employee and sales increase, then the profit margin should increase.
Each of these hypotheses can be questioned. For example, Ariel’s customers may define effectiveness as minimizing their tax liability which is not necessarily the same as minimizing the number of errors in a tax return. If some of Ariel’s customers became aware that Ariel overlooked legal tax minimizing opportunities, it is likely that the “customer satisfaction with effectiveness” measure would decline. This decline would probably puzzle Ariel because, although the firm prepared what it believed to be error-free returns, it overlooked opportunities to minimize customers’ taxes. In this example, Ariel’s internal business process measure of the average number of errors per tax return does not fully capture the factors that drive the customer satisfaction. The fact that each of the hypotheses mentioned above can be questioned does not invalidate the balanced scorecard. If the scorecard is used correctly, management will be able to identify which, if any, of the hypotheses are invalid and then modify the balanced scorecard accordingly.

3. The performance measure “total dollar amount of tax refunds generated” would motivate Ariel’s employees to aggressively search for tax minimization opportunities for its clients. However, employees may be too aggressive and recommend questionable or illegal tax practices to clients. This undesirable behavior could generate unfavorable publicity and lead to major problems for the company as well as its customers. Overall, it would probably be unwise to use this performance measure in Ariel’s scorecard.

However, if Ariel wanted to create a scorecard measure to capture this aspect of its client service responsibilities, it may make sense to focus the performance measure on its training process. Properly trained employees are more likely to recognize viable tax minimization opportunities.
Exercise 11-7 (continued)

4. Each office’s individual performance should be based on the scorecard measures only if the measures are controllable by those employed at the branch offices. In other words, it would not make sense to attempt to hold branch office managers responsible for measures such as the percent of job offers accepted or the amount of compensation paid above industry average. Recruiting and compensation decisions are not typically made at the branch offices. On the other hand, it would make sense to measure the branch offices with respect to internal business process, customer, and financial performance. Gathering this type of data would be useful for evaluating the performance of employees at each office.
Exercise 11-8 (15 minutes)

1. ROI computations:

   \[ \text{ROI} = \frac{\text{Net operating income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Average operating assets}} \]

   Queensl< including correct spacing and brackets for clarity.>land Division:

   \[ \text{ROI} = \frac{\$360,000}{\$4,000,000} \times \frac{\$4,000,000}{\$2,000,000} = 9\% \times 2 = 18\% \]

   New South Wales Division:

   \[ \text{ROI} = \frac{\$420,000}{\$7,000,000} \times \frac{\$7,000,000}{\$2,000,000} = 6\% \times 3.5 = 21\% \]

2. The manager of the New South Wales Division seems to be doing the better job. Although her margin is three percentage points lower than the margin of the Queensland Division, her turnover is higher (a turnover of 3.5, as compared to a turnover of two for the Queensland Division). The greater turnover more than offsets the lower margin, resulting in a 21% ROI, as compared to an 18% ROI for the Queensland Division.

   Notice that if you look at margin alone, then the Queensland Division appears to be the stronger division. This fact underscores the importance of looking at turnover as well as at margin in evaluating performance in an investment center.
**Exercise 11-9** (15 minutes)

<table>
<thead>
<tr>
<th></th>
<th>Company A</th>
<th>Company B</th>
<th>Company C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>$9,000,000*</td>
<td>$7,000,000*</td>
<td>$4,500,000*</td>
</tr>
<tr>
<td>Net operating income</td>
<td>$540,000</td>
<td>$280,000*</td>
<td>$360,000</td>
</tr>
<tr>
<td>Average operating assets</td>
<td>$3,000,000*</td>
<td>$2,000,000</td>
<td>$1,800,000*</td>
</tr>
<tr>
<td>Return on investment (ROI)</td>
<td>18%*</td>
<td>14%*</td>
<td>20%</td>
</tr>
<tr>
<td>Minimum required rate of return:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage</td>
<td>16%*</td>
<td>16%</td>
<td>15%*</td>
</tr>
<tr>
<td>Dollar amount</td>
<td>$480,000</td>
<td>$320,000*</td>
<td>$270,000</td>
</tr>
<tr>
<td>Residual income</td>
<td>$60,000</td>
<td>$(40,000)</td>
<td>$90,000*</td>
</tr>
</tbody>
</table>

*Given.
Exercise 11-10 (20 minutes)

1. | Sales (a) | Operating Income* (b) | Average Operating Assets (c) | ROI (b) ÷ (c) |
   | $2,500,000 | $475,000 | $1,000,000 | 47.5% |
   | $2,600,000 | $500,000 | $1,000,000 | 50.0% |
   | $2,700,000 | $525,000 | $1,000,000 | 52.5% |
   | $2,800,000 | $550,000 | $1,000,000 | 55.0% |
   | $2,900,000 | $575,000 | $1,000,000 | 57.5% |
   | $3,000,000 | $600,000 | $1,000,000 | 60.0% |

*Sales × Contribution Margin Ratio – Fixed Expenses

2. The ROI increases by 2.5% for each $100,000 increase in sales. This happens because each $100,000 increase in sales brings in an additional profit of $25,000. When this additional profit is divided by the average operating assets of $1,000,000, the result is an increase in the company’s ROI of 2.5%.

Increase in sales ......................................................... $100,000 (a)
Contribution margin ratio............................................... 25% (b)
Increase in contribution margin and net operating income (a) × (b) ......................................................... $25,000 (c)
Average operating assets............................................. $1,000,000 (d)
Increase in return on investment (c) ÷ (d) ............ 2.5%
Exercise 11-11 (30 minutes)

1. Margin = \( \frac{\text{Net operating income}}{\text{Sales}} \)
   \( = \frac{70,000}{1,400,000} = 5\% \)

   Turnover = \( \frac{\text{Sales}}{\text{Average operating assets}} \)
   \( = \frac{1,400,000}{350,000} = 4 \)

   ROI = Margin \times Turnover
   \( = 5\% \times 4 = 20\% \)

2. Margin = \( \frac{\text{Net operating income}}{\text{Sales}} \)
   \( = \frac{70,000 + 18,200}{1,400,000 + 70,000} \)
   \( = \frac{88,200}{1,470,000} = 6\% \)

   Turnover = \( \frac{\text{Sales}}{\text{Average operating assets}} \)
   \( = \frac{1,400,000 + 70,000}{350,000} \)
   \( = \frac{1,470,000}{350,000} = 4.2 \)

   ROI = Margin \times Turnover
   \( = 6\% \times 4.2 = 25.2\% \)
Exercise 11-11 (continued)

3. \[ \text{Margin} = \frac{\text{Net operating income}}{\text{Sales}} \]
\[ = \frac{\$70,000 + \$14,000}{\$1,400,000} \]
\[ = \frac{\$84,000}{\$1,400,000} = 6\% \]

\[ \text{Turnover} = \frac{\text{Sales}}{\text{Average operating assets}} \]
\[ = \frac{\$1,400,000}{\$350,000} = 4 \]

\[ \text{ROI} = \text{Margin} \times \text{Turnover} \]
\[ = 6\% \times 4 = 24\% \]

4. \[ \text{Margin} = \frac{\text{Net operating income}}{\text{Sales}} \]
\[ = \frac{\$70,000}{\$1,400,000} = 5\% \]

\[ \text{Turnover} = \frac{\text{Sales}}{\text{Average operating assets}} \]
\[ = \frac{\$1,400,000}{\$350,000 - \$70,000} \]
\[ = \frac{\$1,400,000}{\$280,000} = 5 \]

\[ \text{ROI} = \text{Margin} \times \text{Turnover} \]
\[ = 5\% \times 5 = 25\% \]
Exercise 11-12 (30 minutes)

1. ROI computations:

   \[ \text{ROI} = \frac{\text{Net operating income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Average operating assets}} \]

   Division A:
   \[ \text{ROI} = \frac{\$600,000}{\$12,000,000} \times \frac{\$12,000,000}{\$3,000,000} = 5\% \times 4 = 20\% \]

   Division B:
   \[ \text{ROI} = \frac{\$560,000}{\$14,000,000} \times \frac{\$14,000,000}{\$7,000,000} = 4\% \times 2 = 8\% \]

   Division C:
   \[ \text{ROI} = \frac{\$800,000}{\$25,000,000} \times \frac{\$25,000,000}{\$5,000,000} = 3.2\% \times 5 = 16\% \]

2.  

<table>
<thead>
<tr>
<th></th>
<th>Division A</th>
<th>Division B</th>
<th>Division C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average operating assets</td>
<td>$3,000,000</td>
<td>$7,000,000</td>
<td>$5,000,000</td>
</tr>
<tr>
<td>Required rate of return</td>
<td>\times \ 14%</td>
<td>\times \ 10%</td>
<td>\times \ 16%</td>
</tr>
<tr>
<td>Required operating income</td>
<td>$ 420,000</td>
<td>$ 700,000</td>
<td>$ 800,000</td>
</tr>
<tr>
<td>Actual operating income</td>
<td>$ 600,000</td>
<td>$ 560,000</td>
<td>$ 800,000</td>
</tr>
<tr>
<td>Required operating income (above)</td>
<td>$ 420,000</td>
<td>$ 700,000</td>
<td>$ 800,000</td>
</tr>
<tr>
<td>Residual income</td>
<td>$ 180,000</td>
<td>$(140,000)</td>
<td>$ 0</td>
</tr>
</tbody>
</table>
Exercise 11-12 (continued)

3. a. and b. 

<table>
<thead>
<tr>
<th></th>
<th>Division A</th>
<th>Division B</th>
<th>Division C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return on investment (ROI)</td>
<td>20%</td>
<td>8%</td>
<td>16%</td>
</tr>
<tr>
<td>Therefore, if the division is presented with an investment opportunity yielding 15%, it probably would</td>
<td>Reject</td>
<td>Accept</td>
<td>Reject</td>
</tr>
<tr>
<td>Minimum required return for computing residual income</td>
<td>14%</td>
<td>10%</td>
<td>16%</td>
</tr>
<tr>
<td>Therefore, if the division is presented with an investment opportunity yielding 15%, it probably would</td>
<td>Accept</td>
<td>Accept</td>
<td>Reject</td>
</tr>
</tbody>
</table>

If performance is being measured by ROI, both Division A and Division C probably would reject the 15% investment opportunity. These divisions’ ROIs currently exceed 15%; accepting a new investment with a 15% rate of return would reduce their overall ROIs. Division B probably would accept the 15% investment opportunity because accepting it would increase the division’s overall rate of return.

If performance is measured by residual income, both Division A and Division B probably would accept the 15% investment opportunity. The 15% rate of return promised by the new investment is greater than their required rates of return of 14% and 10%, respectively, and would therefore add to the total amount of their residual income. Division C would reject the opportunity because the 15% return on the new investment is less than its 16% required rate of return.
Exercise 11-13 (15 minutes)

1. Margin = \( \frac{\text{Net operating income}}{\text{Sales}} \)
   \[\frac{\$150,000}{\$3,000,000} = 5\%\]

   Turnover = \( \frac{\text{Sales}}{\text{Average operating assets}} \)
   \[\frac{\$3,000,000}{\$750,000} = 4\]

   ROI = Margin \times Turnover
   \[= 5\% \times 4 = 20\%\]

2. Margin = \( \frac{\text{Net operating income}}{\text{Sales}} \)
   \[\frac{\$150,000(1.00 + 2.00)}{\$3,000,000(1.00 + 0.50)}\]
   \[= \frac{\$450,000}{\$4,500,000} = 10\%\]

   Turnover = \( \frac{\text{Sales}}{\text{Average operating assets}} \)
   \[\frac{\$3,000,000(1.00 + 0.50)}{\$750,000} = \frac{\$4,500,000}{\$750,000} = 6\]

   ROI = Margin \times Turnover
   \[= 10\% \times 6 = 60\%\]
Exercise 11-13 (continued)

3. Margin = \frac{\text{Net operating income}}{\text{Sales}}

\begin{align*}
&= \frac{150,000 + 200,000}{3,000,000 + 1,000,000} \\
&= \frac{350,000}{4,000,000} = 8.75\
\end{align*}

Turnover = \frac{\text{Sales}}{\text{Average operating assets}}

\begin{align*}
&= \frac{3,000,000 + 1,000,000}{750,000 + 250,000} \\
&= \frac{4,000,000}{1,000,000} = 4
\end{align*}

ROI = \text{Margin} \times \text{Turnover}

\begin{align*}
&= 8.75\% \times 4 = 35\%
\end{align*}
Problem 11-14 (30 minutes)

1. a., b., and c.

<table>
<thead>
<tr>
<th>Month</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Throughput time—days:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process time (x)</td>
<td>2.1</td>
<td>2.0</td>
<td>1.9</td>
<td>1.8</td>
</tr>
<tr>
<td>Inspection time</td>
<td>0.6</td>
<td>0.7</td>
<td>0.7</td>
<td>0.6</td>
</tr>
<tr>
<td>Move time</td>
<td>0.4</td>
<td>0.3</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Queue time</td>
<td>4.3</td>
<td>5.0</td>
<td>5.8</td>
<td>6.7</td>
</tr>
<tr>
<td>Total throughput time (y)</td>
<td>7.4</td>
<td>8.0</td>
<td>8.8</td>
<td>9.5</td>
</tr>
</tbody>
</table>

Manufacturing cycle efficiency (MCE):

\[
\text{Process time (x)} \div \text{Throughput time (y)}
\]

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>28.4%</td>
<td>25.0%</td>
<td>21.6%</td>
<td>18.9%</td>
</tr>
</tbody>
</table>

Delivery cycle time—days:

<table>
<thead>
<tr>
<th>Wait time from order to start of production</th>
<th>16.0</th>
<th>17.5</th>
<th>19.0</th>
<th>20.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Throughput time</td>
<td>7.4</td>
<td>8.0</td>
<td>8.8</td>
<td>9.5</td>
</tr>
<tr>
<td>Total delivery cycle time</td>
<td>23.4</td>
<td>25.5</td>
<td>27.8</td>
<td>30.0</td>
</tr>
</tbody>
</table>

2. All of the performance measures display unfavorable trends. Throughput time per unit is increasing—largely because of an increase in queue time. Manufacturing cycle efficiency is declining and delivery cycle time is increasing. In addition, the percentage of on-time deliveries has dropped.
Problem 11-14 (continued)

3. a. and b.

<table>
<thead>
<tr>
<th>Month</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

Throughput time—days:

<table>
<thead>
<tr>
<th>Time Type</th>
<th>Month 5</th>
<th>Month 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process time (x)</td>
<td>1.8</td>
<td>1.8</td>
</tr>
<tr>
<td>Inspection time</td>
<td>0.6</td>
<td>0.0</td>
</tr>
<tr>
<td>Move time</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Queue time</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Total throughput time (y)</td>
<td>2.8</td>
<td>2.2</td>
</tr>
</tbody>
</table>

Manufacturing cycle efficiency (MCE):

<table>
<thead>
<tr>
<th>Efficiency Calculation</th>
<th>Month 5</th>
<th>Month 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process time (x) ÷ Throughput time (y)</td>
<td>64.3%</td>
<td>81.8%</td>
</tr>
</tbody>
</table>

As a company reduces non-value-added activities, the manufacturing cycle efficiency increases rapidly. The goal, of course, is to have an efficiency of 100%. This will be achieved when all non-value-added activities have been eliminated and process time is equal to throughput time.
Problem 11-15 (20 minutes)

1. Operating assets do not include investments in other companies or in undeveloped land.

<table>
<thead>
<tr>
<th></th>
<th>Beginning Balances</th>
<th>Ending Balances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash</td>
<td>$140,000</td>
<td>$120,000</td>
</tr>
<tr>
<td>Accounts receivable</td>
<td>450,000</td>
<td>530,000</td>
</tr>
<tr>
<td>Inventory</td>
<td>320,000</td>
<td>380,000</td>
</tr>
<tr>
<td>Plant and equipment (net)</td>
<td>680,000</td>
<td>620,000</td>
</tr>
<tr>
<td>Total operating assets</td>
<td>$1,590,000</td>
<td>$1,650,000</td>
</tr>
</tbody>
</table>

Average operating assets = \( \frac{1,590,000 + 1,590,000}{2} \) = $1,620,000

Margin = \( \frac{\text{Net operating income}}{\text{Sales}} \)

\[ \text{Sales} = \frac{\$405,000}{\$4,050,000} = 10\% \]

Turnover = \( \frac{\text{Sales}}{\text{Average operating assets}} \)

\[ \text{Sales} = \frac{\$4,050,000}{\$1,620,000} = 2.5 \]

ROI = Margin \times Turnover

\[ = 10\% \times 2.5 = 25\% \]

2. Net operating income ........................................... $405,000
Minimum required return (15% \times $1,620,000)...... 243,000
Residual income ................................................... $162,000
Problem 11-16 (45 minutes)

1. MPC’s previous manufacturing strategy was focused on high-volume production of a limited range of paper grades. The goal of this strategy was to keep the machines running constantly to maximize the number of tons produced. Changeovers were avoided because they lowered equipment utilization. Maximizing tons produced and minimizing changeovers helped spread the high fixed costs of paper manufacturing across more units of output. The new manufacturing strategy is focused on low-volume production of a wide range of products. The goals of this strategy are to increase the number of paper grades manufactured, decrease changeover times, and increase yields across non-standard grades. While MPC realizes that its new strategy will decrease its equipment utilization, it will still strive to optimize the utilization of its high fixed cost resources within the confines of flexible production. In an economist’s terms, the old strategy focused on economies of scale while the new strategy focuses on economies of scope.

2. Employees focus on improving those measures that are used to evaluate their performance. Therefore, strategically-aligned performance measures will channel employee effort towards improving those aspects of performance that are most important to obtaining strategic objectives. If a company changes its strategy but continues to evaluate employee performance using measures that do not support the new strategy, it will be motivating its employees to make decisions that promote the old strategy, not the new strategy. And if employees make decisions that promote the new strategy, their performance measures will suffer.

Some performance measures that would be appropriate for MPC’s old strategy include: equipment utilization percentage, number of tons of paper produced, and cost per ton produced. These performance measures would not support MPC’s new strategy because they would discourage increasing the range of paper grades produced, increasing the number of changeovers performed, and decreasing the batch size produced per run.
Problem 11-16 (continued)

3. Students’ answers may differ in some details from this solution.

Financial

- Sales
- Contribution margin per ton

Customer

- Number of new customers acquired
- Time to fill an order
- Customer satisfaction with breadth of product offerings

Internal Business Processes

- Number of different paper grades produced
- Average change-over time
- Average manufacturing

Learning and Growth

- Number of employees trained to support the flexibility strategy
Problem 11-16 (continued)

4. The hypotheses underlying the balanced scorecard are indicated by the arrows in the diagram. Reading from the bottom of the balanced scorecard, the hypotheses are:

- If the number of employees trained to support the flexibility strategy increases, then the average changeover time will decrease and the number of different paper grades produced and the average manufacturing yield will increase.

- If the average changeover time decreases, then the time to fill an order will decrease.

- If the number of different paper grades produced increases, then the customer satisfaction with breadth of product offerings will increase.

- If the average manufacturing yield increases, then the contribution margin per ton will increase.

- If the time to fill an order decreases, then the number of new customers acquired, sales, and the contribution margin per ton will increase.

- If the customer satisfaction with breadth of product offerings increases, then the number of new customers acquired, sales, and the contribution margin per ton will increase.

- If the number of new customers acquired increases, then sales will increase.

Each of these hypotheses can be questioned. For example, the time to fill an order is a function of additional factors above and beyond changeover times. Thus, MPC’s average changeover time could decrease while its time to fill an order increases if, for example, the shipping department proves to be incapable of efficiently handling greater product diversity, smaller batch sizes, and more frequent shipments. The fact that each of the hypotheses mentioned above can be questioned does not invalidate the balanced scorecard. If the scorecard is used correctly, management will be able to identify which, if any, of the hypotheses are invalid and modify the balanced scorecard accordingly.
Problem 11-17 (30 minutes)

1. Breaking the ROI computation into two separate elements reveals important relationships that otherwise might remain hidden. First, the importance of asset turnover as a key element to overall profitability is emphasized. Prior to use of the ROI formula, managers tended to allow operating assets to swell to excessive levels. Second, the importance of sales volume in profit computations is explicitly recognized. Third, breaking the ROI computation into margin and turnover elements stresses the possibility of trading one off for the other in attempts to improve the overall profit picture. That is, a company may shave its margins slightly hoping for a large enough increase in turnover to increase the overall rate of return. Fourth, ratios make it easier to make comparisons between segments of the organization.

2. The missing information is as follows:

<table>
<thead>
<tr>
<th>Companies in the Same Industry</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>$600,000*</td>
<td>$500,000*</td>
<td>$2,000,000</td>
</tr>
<tr>
<td>Net operating income</td>
<td>$84,000*</td>
<td>$70,000*</td>
<td>$70,000</td>
</tr>
<tr>
<td>Average operating assets</td>
<td>$300,000*</td>
<td>$1,000,000</td>
<td>$1,000,000*</td>
</tr>
<tr>
<td>Margin</td>
<td>14%</td>
<td>14%</td>
<td>3.5%*</td>
</tr>
<tr>
<td>Turnover</td>
<td>2.0</td>
<td>0.5</td>
<td>2.0*</td>
</tr>
<tr>
<td>Return on investment (ROI)</td>
<td>28%</td>
<td>7%*</td>
<td>7%</td>
</tr>
</tbody>
</table>

*Given.

NAA Report No. 35 states (p. 35):

“Introducing sales to measure level of operations helps to disclose specific areas for more intensive investigation. Company B does as well as Company A in terms of profit margin, for both companies earn 14% on sales. But Company B has a much lower turnover of capital than does Company A. Whereas a dollar of investment in Company A supports two dollars in sales each period, a dollar investment in Company B supports only fifty cents in sales each period. This suggests that the analyst should look carefully at Company B’s investment. Is the company keeping an inventory larger than necessary for its sales volume? Are receivables being collected promptly? Or did Company A acquire its fixed assets at a price level which was much lower than that at which Company B purchased its plant?”
Problem 11-17 (continued)

Thus, by including sales specifically in ROI computations the manager is able to discover possible problems, as well as reasons underlying a strong or a weak performance. Looking at Company A compared to Company C, notice that C’s turnover is the same as A’s, but C’s margin on sales is much lower. Why would C have such a low margin? Is it due to inefficiency, is it due to geographical location (requiring higher salaries or transportation charges), is it due to excessive materials costs, or is it due to other factors? ROI computations raise questions such as these, which form the basis for managerial action.

To summarize, in order to bring B’s ROI into line with A’s, it seems obvious that B’s management will have to concentrate its efforts on increasing turnover, either by increasing sales or by reducing assets. It seems unlikely that B can appreciably increase its ROI by improving its margin on sales. On the other hand, C’s management should concentrate its efforts on the margin element by trying to pare down its operating expenses.
## Problem 11-18 (30 minutes)

1. |   | Present | New Line | Total |
---|---|---|---|
(1) Sales | $10,000,000 | $2,000,000 | $12,000,000 |
(2) Net operating income | $800,000 | $160,000 | $960,000 |
(3) Operating assets | $4,000,000 | $1,000,000 | $5,000,000 |
(4) Margin (2) ÷ (1) | 8% | 8% | 8% |
(5) Turnover (1) ÷ (3) | 2.5 | 2.0 | 2.4 |
(6) ROI (4) × (5) | 20.0% | 16.0% | 19.2% |

* Sales................................................. $2,000,000
  Variable expenses (60% × $2,000,000) ....... 1,200,000
  Contribution margin................................. 800,000
  Fixed expenses........................................ 640,000
  Net operating income............................... $ 160,000

2. Dell Havasi will be inclined to reject the new product line because accepting it would reduce his division’s overall rate of return.

3. The new product line promises an ROI of 16%, whereas the company’s overall ROI last year was only 15%. Thus, adding the new line would increase the company’s overall ROI.

4. a. |   | Present | New Line | Total |
---|---|---|---|
Operating assets | $4,000,000 | $1,000,000 | $5,000,000 |
Minimum return required | × 12% | × 12% | × 12% |
Minimum net operating income | $ 480,000 | $ 120,000 | $ 600,000 |
Actual net operating income | $ 800,000 | $ 160,000 | $ 960,000 |
Minimum net operating income (above) | 480,000 | 120,000 | 600,000 |
Residual income | $ 320,000 | $ 40,000 | $ 360,000 |

b. Under the residual income approach, Dell Havasi would be inclined to accept the new product line because adding the product line would increase the total amount of his division’s residual income, as shown above.
Problem 11-19 (30 minutes)

1. a., b., and c.

<table>
<thead>
<tr>
<th>Month</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process time</td>
<td>2.1</td>
<td>2.0</td>
<td>1.9</td>
<td>1.8</td>
</tr>
<tr>
<td>Inspection time</td>
<td>0.8</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
</tr>
<tr>
<td>Move time</td>
<td>0.3</td>
<td>0.4</td>
<td>0.4</td>
<td>0.5</td>
</tr>
<tr>
<td>Queue time during production</td>
<td>2.8</td>
<td>4.4</td>
<td>6.0</td>
<td>7.0</td>
</tr>
<tr>
<td>Total throughput time</td>
<td>6.0</td>
<td>7.5</td>
<td>9.0</td>
<td>10.0</td>
</tr>
</tbody>
</table>

Manufacturing cycle efficiency (MCE): Process time ÷ Throughput time

- Month 1: 35.0%
- Month 2: 26.7%
- Month 3: 21.1%
- Month 4: 18.0%

Delivery cycle time in days:

<table>
<thead>
<tr>
<th>Month</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wait time to start of production</td>
<td>9.0</td>
<td>11.5</td>
<td>12.0</td>
<td>14.0</td>
</tr>
<tr>
<td>Throughput time</td>
<td>6.0</td>
<td>7.5</td>
<td>9.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Total delivery cycle time</td>
<td>15.0</td>
<td>19.0</td>
<td>21.0</td>
<td>24.0</td>
</tr>
</tbody>
</table>

2. a. Areas where the company is improving:

- **Quality control.** The number of defects has decreased by over 50% in the last four months. Moreover, both warranty claims and customer complaints are down sharply. In short, overall quality appears to have significantly improved.

- **Material control.** The purchase order lead time is only half of what it was four months ago, which indicates that purchases are arriving in less time. This trend may be a result of the company’s move toward JIT purchasing.

- **Delivery performance.** The process time has decreased from 2.1 days to 1.8 days over the last four months.
Problem 11-19 (continued)

b. Areas of deterioration:

*Material control.* Scrap as a percentage of total cost has tripled over the last four months.

*Machine performance.* Machine downtime has doubled over the last four months. This may be a result of the greater setup time, or it may just reflect efforts to get the new equipment operating properly. Also note that use of the machines as a percentage of availability is declining rapidly.

*Delivery performance.* All delivery performance measures are moving in the wrong direction. Throughput time and delivery cycle time are both increasing, and the manufacturing cycle efficiency is decreasing.

3. a. and b.

<table>
<thead>
<tr>
<th>Month</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Process time</td>
<td>1.8</td>
<td>1.8</td>
</tr>
<tr>
<td>Inspection time</td>
<td>0.7</td>
<td>0.0</td>
</tr>
<tr>
<td>Move time</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Queue time during production</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Total throughput time</td>
<td>3.0</td>
<td>2.3</td>
</tr>
</tbody>
</table>

Manufacturing cycle efficiency (MCE):

| Process time ÷ Throughput time | 60.0%  | 78.3% |

As non-value-added activities are eliminated, the manufacturing cycle efficiency improves. The goal, of course, is to have an efficiency of 100%. This is achieved when all non-value-added activities have been eliminated and process time equals throughput time.
Problem 11-20 (30 minutes)

1. ROI = \( \frac{\text{Net operating income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Average operating assets}} \)
   
   \[
   = \frac{360,000}{4,000,000} \times \frac{4,000,000}{2,000,000} \\
   = 9\% \times 2 = 18\%
   \]

2. ROI = \( \frac{360,000}{4,000,000} \times \frac{4,000,000}{1,600,000} \)
   
   \[
   = 9\% \times 2.5 = 22.5\%
   \] (Unchanged) (Increase) (Increase)

3. ROI = \( \frac{392,000}{4,000,000} \times \frac{4,000,000}{2,000,000} \)
   
   \[
   = 9.8\% \times 2 = 19.6\%
   \] (Increase) (Unchanged) (Increase)

4. Interest is a financing expense and thus it is not used to compute net operating income.

   ROI = \( \frac{380,000}{4,000,000} \times \frac{4,000,000}{2,500,000} \)
   
   \[
   = 9.5\% \times 1.6 = 15.2\%
   \] (Increase) (Decrease) (Decrease)
Problem 11-20 (continued)

5. The company has a contribution margin ratio of 30% ($24 CM per unit, divided by the $80 selling price per unit). Therefore, a 20% increase in sales would result in a new net operating income of:

\[
\begin{align*}
\text{Sales (1.20 \times $4,000,000) .....} & = $4,800,000 & \text{100 \%} \\
\text{Variable expenses} & = 3,360,000 & \text{70} \\
\text{Contribution margin} & = 1,440,000 & \text{30 \%} \\
\text{Fixed expenses} & = 840,000 \\
\text{Net operating income} & = $600,000
\end{align*}
\]

\[
\text{ROI} = \frac{\frac{600,000}{4,800,000}}{\frac{2,000,000}{4,800,000}} = \frac{12.5\%}{2.4} = \frac{30\%}{(Increase) (Increase) (Increase)}
\]

6. \[
\text{ROI} = \frac{\frac{320,000}{4,000,000}}{\frac{1,960,000}{4,000,000}} = \frac{8\%}{2.04} = \frac{16.3\%}{(Decrease) (Increase) (Decrease)}
\]

7. \[
\text{ROI} = \frac{\frac{360,000}{4,000,000}}{\frac{1,800,000}{4,000,000}} = \frac{9\%}{2.22} = \frac{20\%}{(Unchanged) (Increase) (Increase)}
\]
Problem 11-21 (90 minutes)

1. Both companies view training as important; both companies need to leverage technology to succeed in the marketplace; and both companies are concerned with minimizing defects. There are numerous differences between the two companies. For example, Applied Pharmaceuticals is a product-focused company and Destination Resorts International (DRI) is a service-focused company. Applied Pharmaceuticals’ training resources are focused on their engineers because they hold the key to the success of the organization. DRI’s training resources are focused on their front-line employees because they hold the key to the success of their organization. Applied Pharmaceuticals’ technology investments are focused on supporting the innovation that is inherent in the product development side of the business. DRI’s technology investments are focused on supporting the day-to-day execution that is inherent in the customer interface side of the business. Applied Pharmaceuticals defines a defect from an internal manufacturing standpoint, while DRI defines a defect from an external customer interaction standpoint.
**Problem 11-21 (continued)**

2. Students’ answers may differ in some details from this solution.

### Applied Pharmaceuticals

**Financial**
- Return on Stockholders’ Equity

**Customer**
- Customer perception of first-to-market capability
- Customer perception of product quality

**Internal Business Processes**
- R&D Yield
- Defect rates

**Learning and Growth**
- Percentage of job offers accepted
- Dollars invested in engineering technology
- Dollars invested in engineering training per engineer
Problem 11-21 (continued)

Destination Resorts International

Financial

Sales +

Number of repeat customers +

Internal Business Processes

Room cleanliness +

Percentage of error-free repeat customer check-ins +

Average time to resolve customer complaint -

Learning and Growth

Employee turnover -

Employee morale as shown in survey +

Number of employees receiving database training +
Problem 11-21 (continued)

3. The hypotheses underlying the balanced scorecards are indicated by the arrows in each diagram. Reading from the bottom of each balanced scorecard, the hypotheses are:

**Applied Pharmaceuticals**
- If the dollars invested in engineering technology increase, then the R&D yield will increase.
- If the percentage of job offers accepted increases, then the R&D yield will increase.
- If the dollars invested in engineering training per engineer increase, then the R&D yield will increase.
- If the R&D yield increases, then customer perception of first-to-market capability will increase.
- If the defects per million opportunities decrease, then the customer perception of product quality will increase.
- If the customer perception of first-to-market capability increases, then the return on stockholders’ equity will increase.
- If the customer perception of product quality increases, then the return on stockholders’ equity will increase.

**Destination Resort International**
- If the employee turnover decreases, then the percentage of error-free repeat customer check-ins and room cleanliness will increase and the average time to resolve customer complaints will decrease.
- If the number of employees receiving database training increases, then the percentage of error-free repeat customer check-ins will increase.
- If employee morale increases, then the percentage of error-free repeat customer check-ins and room cleanliness will increase and the average time to resolve customer complaints will decrease.
- If the percentage of error-free repeat customer check-ins increases, then the number of repeat customers will increase.
- If the room cleanliness increases, then the number of repeat customers will increase.
- If the average time to resolve customer complaints decreases, then the number of repeat customers will increase.
- If the number of repeat customers increases, then sales will increase.
Problem 11-21 (continued)

Each of these hypotheses is questionable to some degree. For example, in the case of Applied Pharmaceuticals, R&D yield is not the sole driver of the customers’ perception of first-to-market capability. More specifically, if Applied Pharmaceuticals experimented with nine possible drug compounds in year one and three of those compounds proved to be successful in the marketplace it would result in an R&D yield of 33%. If in year two, it experimented with four possible drug compounds and two of those compounds proved to be successful in the marketplace it would result in an R&D yield of 50%. While the R&D yield has increased from year one to year two, it is quite possible that the customer’s perception of first-to-market capability would decrease. The fact that each of the hypotheses mentioned above can be questioned does not invalidate the balanced scorecard. If the scorecard is used correctly, management will be able to identify which, if any, of the hypotheses are invalid and the balanced scorecard can then be appropriately modified.
Problem 11-22 (45 minutes)

The answers below are not the only possible answers. Ingenious people can figure out many different ways of making performance look better even though it really isn’t. This is one of the reasons for a balanced scorecard. By having a number of different measures that ultimately are linked to overall financial goals, “gaming” the system is more difficult.

1. Speed-to-market can be improved by taking on less ambitious projects. Instead of working on major product innovations that require a great deal of time and effort, R&D may choose to work on small, incremental improvements in existing products. There is also a danger that in the rush to push products out the door, the products will be inadequately tested and developed.

2. In this case, the ground crews raced from one arriving airplane to another in an effort to unload luggage from these airplanes as soon as possible. However, once the luggage was unloaded from the airplane it was being left on the tarmac rather than being delivered in a timely manner to carousels or appropriate connecting flights. Another flaw of the CEO’s bonus system is that ground crews would probably “smooth” their rate of improvement to earn as many monthly bonuses as possible. They would not perform at their highest level during the first month of the new bonus scheme because it would diminish their chances of earning bonuses in subsequent months.

3. In real life, the production manager simply added several weeks to the delivery cycle time. In other words, instead of promising to deliver an order in four weeks, the manager promised to deliver in six weeks. This increase in delivery cycle time did not, of course, please customers and drove some business away, but it dramatically improved the percentage of orders delivered on time.
Problem 11-22 (continued)

4. As stated above, ratios can be improved by changing either the numerator or the denominator. Managers who are under pressure to increase the revenue per employee may find it easier to eliminate employees than to increase revenues. Of course, eliminating employees may reduce total revenues and total profits, but the revenue per employee will increase as long as the percentage decline in revenues is less than the percentage cut in number of employees. Suppose, for example, that a manager is responsible for business units with a total of 1,000 employees, $120 million in revenues, and profits of $2 million. Further suppose that a manager can eliminate one of these business units that has 200 employees, revenues of $10 million, and profits of $1.2 million.

<table>
<thead>
<tr>
<th></th>
<th>Before eliminating the business unit</th>
<th>After eliminating the business unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total revenue........</td>
<td>$120,000,000</td>
<td>$110,000,000</td>
</tr>
<tr>
<td>Total employees.......</td>
<td>1,000</td>
<td>800</td>
</tr>
<tr>
<td>Revenue per employee</td>
<td>$120,000</td>
<td>$137,500</td>
</tr>
<tr>
<td>Total profits.........</td>
<td>$2,000,000</td>
<td>$800,000</td>
</tr>
</tbody>
</table>

As these examples illustrate, performance measures should be selected with a great deal of care and managers should avoid placing too much emphasis on any one performance measure.
Appendix 11A  
Transfer Pricing

Exercise 11A-1 (30 minutes)

1. a. The lowest acceptable transfer price from the perspective of the selling division is given by the following formula:

\[
\text{Transfer price} \geq \frac{\text{Variable cost per unit}}{} + \frac{\text{Total contribution margin on lost sales}}{\text{Number of units transferred}}
\]

Because there is enough idle capacity to fill the entire order from the Hi-Fi Division, no outside sales are lost. And because the variable cost per unit is $42, the lowest acceptable transfer price as far as the selling division is concerned is also $42.

\[
\text{Transfer price} \geq 42 + \frac{0}{5,000} = 42
\]

b. The Hi-Fi division can buy a similar speaker from an outside supplier for $57. Therefore, the Hi-Fi Division would be unwilling to pay more than $57 per speaker.

\[
\text{Transfer price} \leq \text{Cost of buying from outside supplier} = 57
\]

c. Combining the requirements of both the selling division and the buying division, the acceptable range of transfer prices in this situation is:

\[
42 \leq \text{Transfer price} \leq 57
\]

Assuming that the managers understand their own businesses and that they are cooperative, they should be able to agree on a transfer price within this range and the transfer should take place.

d. From the standpoint of the entire company, the transfer should take place. The cost of the speakers transferred is only $42 and the company saves the $57 cost of the speakers purchased from the outside supplier.
Exercise 11A-1 (continued)

2. a. Each of the 5,000 units transferred to the Hi-Fi Division must displace a sale to an outsider at a price of $60. Therefore, the selling division would demand a transfer price of at least $60. This can also be computed using the formula for the lowest acceptable transfer price as follows:

\[
\text{Transfer price} \geq 42 + \frac{60 - 42 \times 5,000}{5,000}
\]

\[
= 42 + \frac{60 - 42}{5,000} = 60
\]

b. As before, the Hi-Fi Division would be unwilling to pay more than $57 per speaker.

c. The requirements of the selling and buying divisions in this instance are incompatible. The selling division must have a price of at least $60 whereas the buying division will not pay more than $57. An agreement to transfer the speakers is extremely unlikely.

d. From the standpoint of the entire company, the transfer should not take place. By transferring a speaker internally, the company gives up revenue of $60 and saves $57, for a loss of $3.
### Exercise 11A-2 (20 minutes)

1. |
---|---|---|---|
Sales | Division A | Division B | Total Company |
---|---|---|---|
$2,500,000$ | $1,200,000$ | $3,200,000$ |

Expenses:
- Added by the division: $1,800,000$ | $400,000$ | $2,200,000$
- Transfer price paid: $500,000$

Total expenses: $1,800,000$ | $900,000$ | $2,200,000$

Net operating income: $700,000$ | $300,000$ | $1,000,000$

1. $20,000$ units $\times$ $125$ per unit $= 2,500,000$.  
2. $4,000$ units $\times$ $300$ per unit $= 1,200,000$.  
3. Division A outside sales: $16,000$ units $\times$ $125$ per unit $= 2,000,000$.  
   Division B outside sales: $4,000$ units $\times$ $300$ per unit $= 1,200,000$.  
   Total outside sales: $3,200,000$.

Note that the $500,000$ in intracompany sales have been eliminated.

2. Division A should transfer the 1,000 additional circuit boards to Division B. Note that Division B’s processing adds $175$ to each unit’s selling price (B’s $300$ selling price, less A’s $125$ selling price $= 175$ increase), but it adds only $100$ in cost. Therefore, each board transferred to Division B ultimately yields $75$ more in contribution margin ($175 - 100 = 75$) to the company than can be obtained from selling to outside customers. Thus, the company as a whole will be better off if Division A transfers the 1,000 additional boards to Division B.
Exercise 11A-3 (20 minutes)

1. The lowest acceptable transfer price from the perspective of the selling division is given by the following formula:

$$\text{Transfer price} \geq \frac{\text{Variable cost per unit}}{} + \frac{\text{Total contribution margin on lost sales}}{\text{Number of units transferred}}$$

There is no idle capacity, so each of the 40,000 units transferred from Division X to Division Y reduces sales to outsiders by one unit. The contribution margin per unit on outside sales is $20 (= $90 – $70).

$$\text{Transfer price} \geq ($70 - $3) + \frac{20 \times 40,000}{40,000}$$

$$= $67 + $20 = $87$$

The buying division, Division Y, can buy a similar unit from an outside supplier for $86. Therefore, Division Y would be unwilling to pay more than $86 per unit.

$$\text{Transfer price} \leq \text{Cost of buying from outside supplier} = $86$$

The requirements of the two divisions are incompatible and no transfer will take place.
Exercise 11A-3 (continued)

2. In this case, Division X has enough idle capacity to satisfy Division Y’s demand. Therefore, there are no lost sales and the lowest acceptable price as far as the selling division is concerned is the variable cost of $60 per unit.

\[
\text{Transfer price} \geq 60 + \frac{0}{40,000} = 60
\]

The buying division, Division Y, can buy a similar unit from an outside supplier for $74. Therefore, Division Y would be unwilling to pay more than $74 per unit.

\[
\text{Transfer price} \leq \text{Cost of buying from outside supplier} = 74
\]

In this case, the requirements of the two divisions are compatible and a transfer hopefully will take place at a transfer price within the range:

\[
60 \leq \text{Transfer price} \leq 74
\]
Problem 11A-4 (60 minutes)

1. The lowest acceptable transfer price from the perspective of the selling division is given by the following formula:

$$\text{Transfer price} \geq \frac{\text{Variable cost per unit}}{\text{Total contribution margin on lost sales}} \times \frac{\text{Number of units transferred}}{\text{Transfer price per unit}}$$

The Pulp Division has no idle capacity, so transfers from the Pulp Division to the Carton Division would cut directly into normal sales of pulp to outsiders. The costs are the same whether the pulp is transferred internally or sold to outsiders, so the only relevant cost is the lost revenue of $70 per ton from the pulp that could be sold to outsiders. This is confirmed below:

$$\text{Transfer price} \geq \frac{\text{Variable cost per unit}}{\text{Total contribution margin on lost sales}} \times \frac{\text{Number of units transferred}}{\text{Transfer price per unit}}$$

$$= \frac{2}{\frac{1}{5,000}} = \frac{2 \times 5,000}{1} = 10,000$$

Therefore, the Pulp Division will refuse to transfer at a price less than $70 a ton.

The Carton Division can buy pulp from an outside supplier for $70 a ton, less a 10% quantity discount of $7, or $63 a ton. Therefore, the Division would be unwilling to pay more than $63 per ton.

$$\text{Transfer price} \leq \text{Cost of buying from outside supplier} = $63$$

The requirements of the two divisions are incompatible. The Carton Division won’t pay more than $63 and the Pulp Division will not accept less than $70. Thus, there can be no mutually agreeable transfer price and no transfer will take place.

2. The price being paid to the outside supplier, net of the quantity discount, is only $63. If the Pulp Division meets this price, then profits in the Pulp Division and in the company as a whole will drop by $35,000 per year:

- Lost revenue per ton ......................... $70
- Outside supplier’s price ...................... $63
- Loss in contribution margin per ton ...... $7
- Number of tons per year ................... $63 $63 \times 5,000$
- Total loss in profits ....................... $35,000
**Problem 11A-4** (continued)

Profits in the Carton Division will remain unchanged because it will be paying the same price internally as it is now paying externally.

3. The Pulp Division has idle capacity, so transfers from the Pulp Division to the Carton Division do not cut into normal sales of pulp to outsiders. In this case, the minimum price as far as the Carton Division is concerned is the variable cost per ton of $42. This is confirmed in the following calculation:

\[
\text{Transfer price} \geq \$42 + \frac{\$0}{5,000} = \$42
\]

The Carton Division can buy pulp from an outside supplier for $63 a ton and would be unwilling to pay more than that for pulp in an internal transfer. If the managers understand their own businesses and are cooperative, they should agree to a transfer and should settle on a transfer price within the range:

\[
\$42 \leq \text{Transfer price} \leq \$63
\]

4. Yes, $59 is a bona fide outside price. Even though $59 is less than the Pulp Division’s $60 “full cost” per unit, it is within the range given in Part 3 and therefore will provide some contribution to the Pulp Division.

If the Pulp Division does not meet the $59 price, it will lose $85,000 in potential profits:

\[
\begin{align*}
\text{Price per ton} & : \$59 \\
\text{Variable costs} & : \$42 \\
\text{Contribution margin per ton} & : \$17
\end{align*}
\]

\[
5,000 \text{ tons} \times \$17 \text{ per ton} = \$85,000 \text{ potential increased profits}
\]

This $85,000 in potential profits applies to the Pulp Division and to the company as a whole.

5. No, the Carton Division should probably be free to go outside and get the best price it can. Even though this would result in lower profits for the company as a whole, the buying division should probably not be forced to buy inside if better prices are available outside.
Problem 11A-4 (continued)

6. The Pulp Division will have an increase in profits:

- Selling price ........................................ $70
- Variable costs ...................................... 42
- Contribution margin per ton .................... $28

\[ 5,000 \text{ tons} \times \$28 \text{ per ton} = \$140,000 \text{ increased profits} \]

The Carton Division will have a decrease in profits:

- Inside purchase price .......................... $70
- Outside purchase price ....................... 59
- Increased cost per ton ......................... $11

\[ 5,000 \text{ tons} \times \$11 \text{ per ton} = \$55,000 \text{ decreased profits} \]

The company as a whole will have an increase in profits:

- Increased contribution margin in the Pulp Division .... $28
- Decreased contribution margin in the Carton Division .... 11
- Increased contribution margin per ton .................. $17

\[ 5,000 \text{ tons} \times \$17 \text{ per ton} = \$85,000 \text{ increased profits} \]

So long as the selling division has idle capacity, profits in the company as a whole will increase if internal transfers are made. However, there is a question of fairness as to how these profits should be split between the selling and buying divisions. The inflexibility of management in this situation damages the profits of the Carton Division and greatly enhances the profits of the Pulp Division.
**Problem 11A-5 (45 minutes)**

1. The Quark Division will probably reject the $340 price because it is below the division’s variable cost of $350 per unit. This variable cost includes the $140 transfer price from the Screen Division, which in turn includes $30 per unit in fixed costs. Nevertheless, from the perspective of the Quark Division, the entire $140 transfer price from the Screen Division is a variable cost. Thus, it will reject the offered $340 price.

2. If both the Screen Division and the Quark Division have idle capacity, then from the perspective of the entire company the $340 offer should be accepted. By rejecting the $340 price, the company will lose $60 in potential contribution margin per unit:

<table>
<thead>
<tr>
<th>Price offered per unit</th>
<th>$340</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less variable costs per unit:</td>
<td></td>
</tr>
<tr>
<td>Screen Division</td>
<td>$70</td>
</tr>
<tr>
<td>Quark Division</td>
<td>210</td>
</tr>
<tr>
<td>Potential contribution margin per unit</td>
<td>$60</td>
</tr>
</tbody>
</table>

3. If the Screen Division is operating at capacity, any screens transferred to the Quark Division to fill the overseas order will have to be diverted from outside customers. Whether a screen is sold to outside customers or is transferred to the Quark Division, its production cost is the same. However, if a unit is diverted from outside sales, the Screen Division (and the entire company) loses the $140 in revenue. As a consequence, as shown below, there would be a net loss of $10 on each unit sold for $340.

<table>
<thead>
<tr>
<th>Price offered per unit</th>
<th>$340</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less:</td>
<td></td>
</tr>
<tr>
<td>Lost revenue from sales of screens to outsiders</td>
<td>$140</td>
</tr>
<tr>
<td>Variable cost of Quark Division</td>
<td>210</td>
</tr>
<tr>
<td>Net loss per unit</td>
<td>$ (10)</td>
</tr>
</tbody>
</table>
Problem 11A-5 (continued)

4. When the selling division has no idle capacity, as in part (3), market price works very well as a transfer price. The cost to the company of a transfer when there is no idle capacity is the lost revenue from sales to outsiders. If the market price is used as the transfer price, the buying division will view the market price of the transferred item as its cost—which is appropriate because that is the cost to the company. As a consequence, the manager of the buying division should be motivated to make decisions that are in the best interests of the company.

When the selling division has idle capacity, the cost to the company of the transfer is just the variable cost of producing the item. If the market price is used as the transfer price, the manager of the buying division will view that as his/her cost rather than the real cost to the company, which is just variable cost. Hence, the manager will have the wrong cost information for making decisions as we observed in parts (1) and (2) above.
Problem 11A-6 (60 minutes)

1. From the standpoint of the selling division, Alpha Division:

\[
\text{Transfer price} \geq \frac{\text{Variable cost per unit}}{+} \frac{\text{Total contribution margin on lost sales}}{\text{Number of units transferred}}
\]

\[
\text{Transfer price} \geq \$18 - \$2 + \frac{($30 - $18) \times 5,000}{5,000} = $16 + $12 = $28
\]

But, from the standpoint of the buying division, Beta Division:

\[
\text{Transfer price} \leq \text{Cost of buying from outside supplier} = $27
\]

Beta Division won’t pay more than $27 and Alpha Division will not accept less than $28, so no deal is possible. There will be no transfer.

2. a. From the standpoint of the selling division, Alpha Division:

\[
\text{Transfer price} \geq \frac{\text{Variable cost per unit}}{+} \frac{\text{Total contribution margin on lost sales}}{\text{Number of units transferred}}
\]

\[
\text{Transfer price} \geq \$65 - \$5 + \frac{($90 - $65) \times 30,000}{30,000} = $60 + $25 = $85
\]

From the standpoint of the buying division, Beta Division:

\[
\text{Transfer price} \leq \text{Cost of buying from outside supplier} = $89
\]

In this instance, an agreement is possible within the range:

\[
$85 \leq \text{Transfer price} \leq $89
\]

Even though both managers would be better off with any transfer price within this range, they may disagree about the exact amount of the transfer price. It would not be surprising to hear the buying division arguing strenuously for $85 while the selling division argues just as strongly for $89.
Problem 11A-6 (continued)

b. The loss in potential profits to the company as a whole will be:

- Beta Division’s outside purchase price: $89
- Alpha Division’s variable cost on the internal transfer: $85
- Potential added contribution margin lost to the company as a whole: $4
- Number of units: $4 \times 30,000

Potential added contribution margin and company profits forgone: $120,000

Another way to derive the same answer is to look at the loss in potential profits for each division and then total the losses for the impact on the company as a whole. The loss in potential profits in Alpha Division will be:

- Suggested selling price per unit: $88
- Alpha Division’s variable cost on the internal transfer: $85
- Potential added contribution margin per unit: $3
- Number of units: $3 \times 30,000

Potential added contribution margin and divisional profits forgone: $90,000

The loss in potential profits in Beta Division will be:

- Outside purchase price per unit: $89
- Suggested price per unit inside: $88
- Potential cost avoided per unit: $1
- Number of units: $1 \times 30,000

Potential added contribution margin and divisional profits forgone: $30,000

The total of these two amounts equals the $120,000 loss in potential profits for the company as a whole.

3. a. From the standpoint of the selling division, Alpha Division:

\[
\text{Transfer price} \geq \frac{\text{Variable cost per unit} + \frac{\text{Total contribution margin on lost sales}}{\text{Number of units transferred}}}{2} \leq \frac{40 + \frac{0}{20,000}}{} = 40
\]

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Problem 11A-6 (continued)

From the standpoint of the buying division, Beta Division:

Transfer price ≤ Cost of buying from outside supplier

\[
\text{Transfer price} \leq \$75 - (0.08 \times \$75) = \$69
\]

In this case, an agreement is possible within the range:

\[
\$40 \leq \text{Transfer price} \leq \$69
\]

If the managers understand what they are doing and are reasonably cooperative, they should be able to come to an agreement with a transfer price within this range.

b. Alpha Division’s ROI should increase. The division has idle capacity, so selling 20,000 units a year to Beta Division should cause no increase in the division’s operating assets. Therefore, Alpha Division’s turnover should increase. The division’s margin should also increase, because its contribution margin will increase by $400,000 as a result of the new sales, with no offsetting increase in fixed costs:

\[
\begin{align*}
\text{Selling price} & \quad \$60 \\
\text{Variable costs} & \quad 40 \\
\text{Contribution margin} & \quad 20 \\
\text{Number of units} & \quad \times 20,000 \\
\text{Added contribution margin} & \quad \$400,000
\end{align*}
\]

Thus, with both the margin and the turnover increasing, the division’s ROI would also increase.

4. From the standpoint of the selling division, Alpha Division:

\[
\text{Transfer price} \geq \frac{\text{Variable cost per unit} + \frac{\text{Total contribution margin on lost sales}}{\text{Number of units transferred}}}{\text{(Transfer price)}}
\]

\[
\text{Transfer price} \geq \$21 + \frac{\$50 - \$26 \times 45,000}{120,000} = \$21 + \$9 = \$30
\]
Appendix 11B
Service Department Charges

Exercise 11B-1 (15 minutes)

1. and 2.

<table>
<thead>
<tr>
<th></th>
<th>Northern Plant</th>
<th>Southern Plant</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable cost charges:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$0.25 per ton × 130,000 tons</td>
<td>$32,500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$0.25 per ton × 50,000 tons</td>
<td></td>
<td>$12,500</td>
<td>$45,000</td>
</tr>
<tr>
<td>Fixed cost charges:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70% × $300,000</td>
<td>210,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30% × $300,000</td>
<td></td>
<td>$90,000</td>
<td>300,000</td>
</tr>
<tr>
<td>Total charges</td>
<td>$242,500</td>
<td>$102,500</td>
<td>$345,000</td>
</tr>
</tbody>
</table>

3. Part of the $364,000 in total cost will not be charged to the plants, as follows:

<table>
<thead>
<tr>
<th></th>
<th>Variable Cost</th>
<th>Fixed Cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total actual cost incurred</td>
<td>$54,000</td>
<td>$310,000</td>
<td>$364,000</td>
</tr>
<tr>
<td>Total charges (above)</td>
<td>45,000</td>
<td>300,000</td>
<td>345,000</td>
</tr>
<tr>
<td>Spending variance</td>
<td>$9,000</td>
<td>$10,000</td>
<td>$19,000</td>
</tr>
</tbody>
</table>

The overall spending variance of $19,000 represents costs incurred in excess of the budgeted $0.25 per ton variable cost and budgeted $300,000 in fixed costs. This $19,000 in uncharged cost is the responsibility of the Transport Services Department.
**Exercise 11B-2 (20 minutes)**

1. **Restaurants**
   
<table>
<thead>
<tr>
<th>Restaurants</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rick's Harborside</strong></td>
<td>32%</td>
</tr>
<tr>
<td><strong>Imperial Garden</strong></td>
<td>50%</td>
</tr>
<tr>
<td><strong>Ginger Wok</strong></td>
<td>18%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100%</td>
</tr>
</tbody>
</table>

   Percentage of 2014 sales: 32%, 50%, 18%
   Allocation of 2014 fixed administrative expenses (based on the above percentages): $640,000, $1,000,000, $360,000, $2,000,000

2. 2014 allocation (above): $640,000, $1,000,000, $360,000, $2,000,000
   2013 allocation: $800,000, $750,000, $450,000, $2,000,000
   Increase (decrease) in allocation: $(160,000), $250,000, $(90,000), $0

   The manager of the Imperial Garden undoubtedly will be upset about the increased allocation of fixed administrative expense. Such an increased allocation may be viewed as a penalty for an outstanding performance.

3. Sales dollars is not ordinarily a good base for allocating fixed costs. The departments with the greatest sales will be allocated the greatest amount of cost and the costs allocated to a department will be affected by the sales in other departments. In our illustration above, the sales in two restaurants remained static and the sales in the third increased. As a result, less cost was allocated to the restaurants with static sales and more cost was allocated to the one restaurant that showed improvement during the period.
**Exercise 11B-3** (20 minutes)

1. **Long-Run Average**

<table>
<thead>
<tr>
<th>Department</th>
<th>Number of Employees</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutting Department</td>
<td>180</td>
<td>30%</td>
</tr>
<tr>
<td>Milling Department</td>
<td>120</td>
<td>20%</td>
</tr>
<tr>
<td>Assembly Department</td>
<td>300</td>
<td>50%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>600</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Department</th>
<th>Cutting</th>
<th>Milling</th>
<th>Assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable cost charges:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$80 per employee × 150 employees</td>
<td>$12,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$80 per employee × 80 employees</td>
<td></td>
<td>$6,400</td>
<td></td>
</tr>
<tr>
<td>$80 per employee × 270 employees</td>
<td></td>
<td></td>
<td>$21,600</td>
</tr>
<tr>
<td>Fixed cost charges:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30% × $400,000</td>
<td>120,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20% × $400,000</td>
<td></td>
<td>80,000</td>
<td></td>
</tr>
<tr>
<td>50% × $400,000</td>
<td></td>
<td></td>
<td>200,000</td>
</tr>
<tr>
<td><strong>Total charges</strong></td>
<td><strong>132,000</strong></td>
<td><strong>86,400</strong></td>
<td><strong>221,600</strong></td>
</tr>
</tbody>
</table>

2. Part of the total actual cost should not be charged to the operating departments as shown below:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Fixed</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>Cost</td>
<td></td>
</tr>
<tr>
<td>Total actual costs incurred</td>
<td>$41,000</td>
<td>$408,000</td>
</tr>
<tr>
<td>Total charges</td>
<td>40,000</td>
<td>400,000</td>
</tr>
<tr>
<td>Spending variance</td>
<td>$1,000</td>
<td>$8,000</td>
</tr>
</tbody>
</table>

The overall spending variance of $9,000 represents costs incurred in excess of the budgeted variable cost of $80 per employee and the budgeted fixed cost of $400,000. This $9,000 in uncharged costs is the responsibility of the Medical Services Department.
Problem 11B-4 (45 minutes)

1. 

<table>
<thead>
<tr>
<th></th>
<th>Auto Division</th>
<th>Truck Division</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable costs:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$3 per meal × 20,000 meals ....</td>
<td>$60,000</td>
<td>$60,000</td>
</tr>
<tr>
<td>Fixed costs:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>65% × $40,000</td>
<td>26,000</td>
<td>14,000</td>
</tr>
<tr>
<td>35% × $40,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total cost charged</td>
<td>$86,000</td>
<td>$74,000</td>
</tr>
</tbody>
</table>

The variable costs are charged using the budgeted rate per meal and the actual meals served. The fixed costs are charged in predetermined, lump-sum amounts, based on budgeted fixed costs and peak-load capacity. Any difference between budgeted and actual costs is not charged to the operating divisions, but rather is treated as a spending variance of the cafeteria:

<table>
<thead>
<tr>
<th></th>
<th>Variable</th>
<th>Fixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total actual cost for the month</td>
<td>$128,000</td>
<td>$42,000</td>
</tr>
<tr>
<td>Total cost charged above</td>
<td>120,000</td>
<td>40,000</td>
</tr>
<tr>
<td>Spending variance—not allocated</td>
<td>$  8,000</td>
<td>$ 2,000</td>
</tr>
</tbody>
</table>

2. Actual variable cost ............ $128,000
   Actual fixed cost................. 42,000
   Total actual cost................. $170,000

One-half of the total cost, or $85,000, would be allocated to each division, because the same number of meals was served in the two divisions during the month.
Problem 11B-4 (continued)

3. This method has two major problems. First, allocating the total actual cost of the service department to the operating departments essentially allocates the spending variances to the operating departments. This forces the inefficiencies of the service department onto the operating departments. Second, allocating the fixed costs of the service department according to the actual level of activity in each operating department results in the allocation to one operating department being affected by the actual activity in the other operating departments. For example, if the activity in one operating department falls, the fixed charges to the other operating departments will increase.

4. Managers may understate their peak-period needs to reduce their charges for fixed service department costs. Top management can control such ploys by careful follow-up, with rewards being given to those managers who estimate accurately, and severe penalties assessed against those managers who understate their departments’ needs. For example, departments that exceed their estimated peak-period maintenance requirements may be forced to hire outside maintenance contractors, at market rates, to do their maintenance work during peak periods.
Problem 11B-5 (20 minutes)

1.  

<table>
<thead>
<tr>
<th></th>
<th>Forming Department</th>
<th>Assembly Department</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Variable costs:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$0.40 per machine-hour ×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>190,000 machine-hours ....</td>
<td>$76,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$0.40 per machine-hour ×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70,000 machine-hours ....</td>
<td>$28,000</td>
<td></td>
<td>$104,000</td>
</tr>
<tr>
<td><strong>Fixed costs:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70% × $150,000</td>
<td>105,000</td>
<td></td>
<td>150,000</td>
</tr>
<tr>
<td>30% × $150,000</td>
<td></td>
<td>45,000</td>
<td></td>
</tr>
<tr>
<td><strong>Total cost charged</strong></td>
<td>$181,000</td>
<td>$73,000</td>
<td>$254,000</td>
</tr>
</tbody>
</table>

2. Any difference between the budgeted and actual variable cost per machine-hour or between the budgeted and actual total fixed cost would not be charged to the other departments. The amount not charged would be:

<table>
<thead>
<tr>
<th></th>
<th>Variable Cost</th>
<th>Fixed Cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual cost incurred during the year ...</td>
<td>$110,000</td>
<td>$153,000</td>
<td>$263,000</td>
</tr>
<tr>
<td>Cost charged (above) ......................</td>
<td>104,000</td>
<td>150,000</td>
<td>254,000</td>
</tr>
<tr>
<td>Cost not charged (spending variance)</td>
<td>$6,000</td>
<td>$3,000</td>
<td>$9,000</td>
</tr>
</tbody>
</table>

The costs not charged are spending variances of the Maintenance Department and are the responsibility of the Maintenance Department's manager.