

## CHAPTER 21

### CAPITAL BUDGETING AND COST ANALYSIS

**21-1** No. Capital budgeting focuses on an individual investment project throughout its life, recognizing the time value of money. The life of a project is often longer than a year. Accrual accounting focuses on a particular accounting period, often a year, with an emphasis on income determination.

**21-2** The six stages in capital budgeting are:

1. An *identification stage* to distinguish which types of capital expenditure projects are necessary to accomplish organization objectives.
2. A *search stage* that explores alternative capital investments that will achieve organization objectives.
3. An *information-acquisition stage* to consider the expected costs and expected benefits of alternative capital investments.
4. A *selection stage* to choose projects for implementation.
5. A *financing stage* to obtain project financing.
6. An *implementation and control stage* to get projects underway and monitor their performance.

**21-3** In essence, the discounted cash-flow method calculates the cash inflows and outflows of a project as if they occurred at a single point in time so that they can be aggregated (added, subtracted, etc.) in an appropriate way and then can be compared to cash flows from other projects.

**21-4** No. Only quantitative outcomes are formally analyzed in capital budgeting decisions. Many effects of capital budgeting decisions, however, are difficult to quantify in financial terms. These nonfinancial or qualitative factors (for example, the number of accidents in a manufacturing plant or employee morale) are important to consider in making capital budgeting decisions.

**21-5** Sensitivity analysis can be incorporated into DCF analysis by examining how the DCF of each project changes with changes in the inputs used. These could include changes in revenue assumptions, cost assumptions, tax rate assumptions, and discount rates.

**21-6** The payback method measures the time it will take to recoup, in the form of net cash inflows, the total dollars invested in a project. The payback method is simple and easy to understand. It is a handy method when precision in estimates of profitability is not crucial and when predicted cash flows in later years are highly uncertain. The main weakness of the payback method is its neglect of profitability and the time value of money.

**21-7** The accrual accounting rate-of-return (AARR) method divides an accounting measure of income by an accounting measure of investment. The strengths of the accrual accounting rate of return method are that it is simple, easy to understand, and considers profitability. Its weakness is that it ignores the time value of money.

**21-8** No. The discounted cash-flow techniques implicitly consider depreciation in rate of return computations; the compound interest tables automatically allow for recovery of investment. The net initial investment of an asset is usually regarded as a lump-sum outflow at time zero. Where taxes are included in the DCF analysis, depreciation costs are included in the computation of the taxable income number that is used to compute the tax payment cash flow.

**21-9** A point of agreement is that an exclusive attachment to the mechanisms of any single method examining only quantitative data is likely to result in overlooking important aspects of a decision.

Two points of disagreement are (1) DCF can incorporate those strategic considerations that can be expressed in financial terms, and (2) "Practical considerations of strategy" not expressed in financial terms can be incorporated into decisions *after* DCF analysis.

**21-10** All overhead costs are not relevant in NPV analysis. Overhead costs are relevant only if the capital investment results in a change in total overhead cash flows. Overhead costs are not relevant if total overhead cash flows remain the same but the overhead allocated to the particular capital investment changes.

**21-11** The Division Y manager should consider why the Division X project was accepted and the Division Y project rejected by the president. Possible explanations are:

- a. The president considers qualitative factors not incorporated into the IRR computation and this leads to the acceptance of the X project and rejection of the Y project.
- b. The president believes that Division Y has a history of overstating cash inflows and understating cash outflows.
- c. The president has a preference for the manager of Division X over the manager of Division Y—this is a corporate politics issue.

Factor a. means qualitative factors should be emphasized more in proposals. Factor b. means Division Y needs to document whether its past projections have been relatively accurate. Factor c. means the manager of Division Y has to play the corporate politics game better.

**21-12** The categories of cash flow that should be considered are:

- 1a. Initial machine investment,
- b. Initial working capital investment,
- c. After-tax cash flow from current disposal of old machine,
- 2a. Annual after-tax cash flow from operations (excluding depreciation effects),
  - b. Income tax cash savings from annual depreciation deductions,
- 3a. After-tax cash flow from terminal disposal of machine, and
  - b. After-tax cash flow from recovery of working capital.

**21-13** Income taxes can affect the cash inflows or outflows in a motor vehicle replacement decision as follows:

- a. Tax is payable on gain or loss on disposal of the existing motor vehicle,
- b. Tax is payable on any change in operating costs of the new vehicle vis-à-vis the existing vehicle, and
- c. Tax is payable on gain or loss on the sale of the new vehicle at the project termination date.

**21-14** A cellular telephone company manager responsible for retaining customers needs to consider the expected future revenues and the expected future costs of “different investments” to retain customers. One such investment could be a special price discount. An alternative investment is offering loyalty club benefits to long-time customers.

**21-15** These two rates of return differ in their elements:

**Real-rate of return**

1. Risk-free element
2. Business-risk element

**Nominal rate of return**

1. Risk-free element
2. Business-risk element
3. Inflation element

The inflation element is the premium above the real rate that is demanded for the anticipated decline in the general purchasing power of the monetary unit.

**21-16 Exercises in compound interest, no income taxes.**

The answers to these exercises are printed after the last problem, at the end of the chapter.

**21-17 (22–25 min.) Comparison of approaches to capital budgeting, no income taxes.**

1. The table for the present value of annuities (Appendix C, Table 4) shows:  
10 periods at 16% = 4.833

$$\begin{aligned} \text{Net present value} &= \$50,000 (4.833) - \$220,000 \\ &= \$241,650 - \$220,000 = \$21,650 \end{aligned}$$

2. Payback period =  $\$220,000 \div \$50,000 = 4.4$  years

3. Internal rate of return:

$\$220,000 =$  Present value of annuity of \$50,000 at R% for 10 years, or what factor (F) in the table of present values of an annuity (Appendix C, Table 4) will satisfy the following equation.

$$\begin{aligned} \$220,000 &= \$50,000F \\ F &= \frac{\$220,000}{\$50,000} = 4.400 \end{aligned}$$

**21-17** (Cont'd.)

On the 10-year line in the table for the present value of annuities (Appendix C, Table 4), find the column closest to 4.400; 4.400 is between a rate of return of 18% and 20%. Interpolation is necessary:

	<u>Present Value Factors</u>	
18%	4.494	4.494
IRR rate	—	4.400
20%	<u>4.192</u>	<u>—</u>
Difference	<u>0.302</u>	<u>0.094</u>

$$\begin{aligned}\text{Internal rate of return} &= 18\% + \left[ \frac{0.094}{0.302} \right] (2\%) \\ &= 18\% + (0.311) (2\%) = 18.62\%\end{aligned}$$

4. Accrual accounting rate of return based on net initial investment:

Net initial investment	= \$220,000
Estimated useful life	= 10 years
Annual straight-line depreciation	= \$220,000 ÷ 10 = \$22,000

$$\begin{aligned}\text{Accrual accounting rate of return} &= \frac{\text{Increase in expected average annual operating income}}{\text{Net initial investment}} \\ &= \frac{\$50,000 - \$22,000}{\$220,000} = \frac{\$28,000}{\$220,000} = 12.73\%\end{aligned}$$

Note how the accrual accounting rate of return, whichever way calculated, can produce results that differ markedly from the internal rate of return.

**22-18** (30 min.) **Capital budgeting methods, no income taxes.**

The table for the present value of annuities (Appendix C, Table 4) shows: 10 periods at 14% = 5.216

1a. Net present value = \$28,000(5.216) – \$110,000  
= \$146,048 – \$110,000 = \$36,048

b. Payback period =  $\frac{\$110,000}{\$28,000} = 3.93$  years

**21-18 (Cont'd.)**

c. Internal rate of return:

\$110,000 = Present value of annuity of \$28,000 at R% for 10 years, or what factor (F) in the table of present values of an annuity (Appendix C, Table 4) will satisfy the following equation.

$$\begin{aligned} \$110,000 &= \$28,000F \\ F &= \frac{\$110,000}{\$28,000} = 3.929 \end{aligned}$$

On the 10-year line in the table for the present value of annuities (Appendix C, Table 4), find the column closest to 3.929; 3.929 is between a rate of return of 20% and 22%.

Interpolation can be used to determine the exact rate:

	<u>Present Value Factors</u>	
20%	4.192	4.192
IRR rate	—	3.929
22%	<u>3.923</u>	<u>—</u>
Difference	<u>0.269</u>	<u>0.263</u>

$$\text{Internal rate of return} = 20\% + \left[ \frac{0.263}{0.269} \right] (2\%)$$

$$= 20\% + (0.978) (2\%) = 21.96\%$$

d. Accrual accounting rate of return based on net initial investment:

$$\begin{aligned} \text{Net initial investment} &= \$110,000 \\ \text{Estimated useful life} &= 10 \text{ years} \\ \text{Annual straight-line depreciation} &= \$110,000 \div 10 = \$11,000 \\ \text{Accrual accounting rate of return} &= \frac{\$28,000 - \$11,000}{\$110,000} \\ &= \frac{\$17,000}{\$110,000} = 15.46\% \end{aligned}$$

2. Factors City Hospital should consider include:

- a. Quantitative financial aspects.
- b. Qualitative factors, such as the benefits to its customers of a better eye-testing machine and the employee-morale advantages of having up-to-date equipment.
- c. Financing factors, such as the availability of cash to purchase the new equipment.

**21-19** (20 min.) **Capital budgeting, income taxes.**

1a. Net after-tax initial investment = \$110,000

Annual after-tax cash flow from operations (excluding depreciation effects):

Annual cash flow from operation with new machine	\$28,000
Deduct income tax payments (30% of \$28,000)	<u>8,400</u>
Annual after-tax cash flow from operations	<u>\$19,600</u>

Income tax cash savings from annual depreciation deductions 30% x \$11,000	<u>\$3,300</u>
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These three amounts can be combined to determine the NPV:

Net initial investment	
\$(110,000) x 1.00	\$(110,000)
10-year annuity of annual after-tax cash flows from operations:	
\$19,600 x 5.216	102,234
10-year annuity of income tax savings from annual depreciation deductions	
\$3,300 x 5.216	<u>17,213</u>
Net present value	<u>\$ 9,447</u>

b. Payback period

$$= \frac{\$110,000}{(\$19,600 + \$3,300)}$$

$$= \frac{\$110,000}{\$22,900}$$

$$= 4.803 \text{ years}$$

**21-19** (Cont'd.)

c. IRR:

$$F = \frac{\$110,000}{\$22,900} = 4.803$$

Interpolation can be used to determine the exact rate:

	<u>Present Value Factors</u>	
16%	4.833	4.833
IRR		4.803
18%	<u>4.494</u>	<u>          </u>
	<u>0.339</u>	<u>0.030</u>

$$\begin{aligned} \text{IRR} &= 16\% + \frac{.030}{.339} \times 2\% \\ &= 16.18\% \end{aligned}$$

$$\begin{aligned} \text{d. AARR} &= \frac{\$19,600 - \$11,000}{\$110,000} = \frac{\$8,600}{\$110,000} \\ &= 7.82\% \end{aligned}$$

2a. Increase in NPV. The \$10,000 terminal disposal price at the end of 10 years would have an after-tax NPV of:

$$\$10,000 (1 - 0.30) \times 0.270 = \$1,890$$

b. No change in payback as the payback period is 4.803 years. The cash inflow occurs at the end of year 10.

c. Increase in internal rate of return.

d. The AARR for years 1 to 9 would be unchanged. The AARR for year 10 would be increased by the increase in the numerator if the \$10,000 gain on disposal is treated as an "income" item.

**21-20 (30 min.) Capital budgeting with uneven cash flows, no income taxes.**

1. Present value of savings in cash operating costs:

	\$ 8,620
$10,000 \times 0.862$	
$8,000 \times 0.743$	5,944
$6,000 \times 0.641$	3,846
$5,000 \times 0.552$	2,760
$4,000 \times 0.476$	1,904
$3,000 \times 0.410$	1,230
$3,000 \times 0.354$	<u>1,062</u>
Present value of savings in cash operating costs	25,366
Net initial investment	<u>(28,000)</u>
Net present value	<u>\$ (2,634)</u>

2. Payback period:

<u>Year</u>	<u>Cash Savings</u>	<u>Cumulative Cash Savings</u>	<u>Initial Investment Yet to Be Recovered at End of Year</u>
0	—	—	\$28,000
1	\$10,000	\$10,000	18,000
2	8,000	18,000	10,000
3	6,000	24,000	4,000
4	5,000	29,000	—

$$\text{Payback period} = 3 \text{ years} + \frac{\$4,000}{\$5,000} = 3.8 \text{ years}$$

3. From requirement 1, the net present value is negative with a 16% required rate of return. Hence, the internal rate of return must be less than 16%.

Year (1)	Cash Savings (2)	P.V. Factor at 14% (3)	P.V. at 14% (4) = (2) × (3)	P.V. Factor at 12% (5)	P.V. at 12% (6) = (2) × (5)	P.V. Factor at 10% (7)	P.V. at 10% (8) = (2) × (7)
1	\$10,000	0.877	\$ 8,770	0.893	\$ 8,930	0.909	\$ 9,090
2	8,000	0.769	6,152	0.797	6,376	0.826	6,608
3	6,000	0.675	4,050	0.712	4,272	0.751	4,506
4	5,000	0.592	2,960	0.636	3,180	0.683	3,415
5	4,000	0.519	2,076	0.567	2,268	0.621	2,484
6	3,000	0.456	1,368	0.507	1,521	0.564	1,692
7	3,000	0.400	<u>1,200</u>	0.452	<u>1,356</u>	0.513	<u>1,539</u>
			<u>\$26,576</u>		<u>\$27,903</u>		<u>\$29,334</u>

**21-20 (Cont'd.)**

Net present value at 14% = \$26,576 – \$28,000 = \$(1,424)

Net present value at 12% = \$27,903 – \$28,000 = \$ (97)

Net present value at 10% = \$29,334 – \$28,000 = \$ 1,334

By interpolation:

$$\begin{aligned}\text{Internal rate of return} &= 10\% + \left( \frac{1,334}{1,334 + 97} \right) (2\%) \\ &= 10\% + (0.932) (2\%) = 11.86\%\end{aligned}$$

4. Accrual accounting rate of return based on net initial investment:

$$\text{Average annual savings in cash operating costs} = \frac{\$39,000}{7 \text{ years}} = \$5,571$$

$$\text{Annual straight-line depreciation} = \frac{\$28,000}{7 \text{ years}} = \$4,000$$

$$\text{Accrual accounting rate of return} = \frac{\$5,571 - \$4,000}{\$28,000}$$

$$= \frac{\$1,571}{\$28,000} = 5.61\%$$

**21-21 (30 min.) Comparison of projects, no income taxes.**

1.

Total Present Value	Present Value Discount Factors at 12%	Year			
		0	1	2	3
<i>Plan I</i>					
\$ (200,000)	1.000	\$(200,000)			
<u>(2,391,000)</u>	0.797			\$(3,000,000)	
<u>\$(2,591,000)</u>					
<i>Plan II</i>					
\$(1,000,000)	1.000	\$(1,000,000)			
(893,000)	0.893		\$(1,000,000)		
<u>(797,000)</u>	0.797			\$(1,000,000)	
<u>\$(2,690,000)</u>					
<i>Plan III</i>					
\$ (100,000)	1.000	\$(100,000)			
(893,000)	0.893		\$(1,000,000)		
(797,000)	0.797			\$(1,000,000)	
<u>(712,000)</u>	0.712				\$(1,000,000)
<u>\$(2,502,000)</u>					

2. Plan III has the lowest net present cost. Subject to financing being available, Plan III is the preferred one on financial criteria.
3. Factors to consider, in addition to NPV, are:
  - a. Financial factors including:
    - Competing demands for cash.
    - Availability of financing for project.
  - b. Nonfinancial factors including:
    - Risk of building contractor not remaining solvent. Plan II exposes Fox Valley most if Vukacek becomes bankrupt before completion.
    - Ability to have leverage over Vukacek if quality problems arise or delays in construction occur. Plans I and II give Fox more negotiation strength by being able to withhold sizable amounts if, say, quality problems arise in Year 1.
    - Investment alternatives available. If Fox Valley has capital constraints, the new building project will have to compete with other projects for the limited capital available.

**21-22** (30 min.)      **Payback and NPV methods, no income taxes.**

1. a. Payback measures the time taken to recoup, in the form of expected future cash flows, the net investment in a project. Payback emphasizes the early recovery of cash as a key aspect of project ranking. Some managers argue that this emphasis on early recovery of cash is appropriate if there is a high level of uncertainty about future cash flows. Projects with shorter paybacks give the organization more flexibility because funds for other projects become available sooner.

*Strengths*

- Easy to understand
- One way to capture uncertainty about expected cash flows in later years of a project (although sensitivity analysis is a more systematic way)

*Weaknesses*

- Fails to incorporate the time value of money
- Does not consider a project's cash flows after the payback period

b.

*Project A*

Outflow, \$200,000

Inflow,  $\$50,000^1 + \$50,000^2 + \$50,000^3 + \$50,000^4$

Payback = 4 years

*Project B*

Outflow, \$190,000

Inflow,  $\$40,000^1 + \$50,000^2 + \$70,000^3 + \frac{\$30,000^4}{\$75,000}$

Payback =  $3 + \frac{\$30,000}{\$75,000} = 3.4$  years

*Project C*

Outflow, \$250,000

Inflow,  $\$75,000^1 + \$75,000^2 + \$60,000^3 + \frac{\$40,000^4}{\$80,000}$

Payback =  $3 + \frac{\$40,000}{\$80,000} = 3.5$  years

**21-22 (Cont'd.)**

*Project D*

Outflow, \$210,000

Inflow, \$75,000(Year 1) + \$75,000(Year 2) + \$60,000(Year 3)

Payback = 3 years

2. Solution Exhibit 21-22 shows the following ranking:

	<u>NPV</u>
1. Project C	\$27,050
2. Project B	\$25,635
3. Project D	\$(3,750)
4. Project A	\$(19,750)

3. Using NPV, Project C is the preferred project despite its having the longest payback. Project C has sizable cash inflows after the payback period. Nonfinancial qualitative factors should also be considered. For example, are there differential worker safety issues across the projects? Are there differences in the extent of learning that can benefit other projects? Are there differences in the customer relationships established with different projects that can benefit Cording Manufacturing in future projects?

**SOLUTION EXHIBIT 21-22**

**Sketch of Relevant Cash Flows**

	<b>Total Present Value</b>	<b>Present Value Discount Factors at 12%</b>	<b>Sketch of Relevant Cash Flows</b>					
			0	1	2	3	4	5
<b>PROJECT A</b>								
Net initial invest.	\$ (200,000)	← 1.000	← \$(200,000)					
Cash inflows	44,650	← 0.893	← \$50,000					
	39,850	← 0.797	← \$50,000	← \$50,000				
	35,600	← 0.712	← \$50,000	← \$50,000	← \$50,000			
	31,800	← 0.636	← \$50,000	← \$50,000	← \$50,000	← \$50,000		
Net present value	<u>28,350</u>	← 0.567	← \$50,000	← \$50,000	← \$50,000	← \$50,000	← \$50,000	← \$50,000
	<u>\$ (19,750)</u>							
<b>PROJECT B</b>								
Net initial invest.	\$ (190,000)	← 1.000	← \$(190,000)					
Cash inflows	35,720	← 0.893	← \$40,000					
	39,850	← 0.797	← \$50,000	← \$50,000				
	49,840	← 0.712	← \$70,000	← \$70,000	← \$70,000			
	47,700	← 0.636	← \$75,000	← \$75,000	← \$75,000	← \$75,000		
Net present value	<u>\$ 25,635</u>	←	← \$75,000	← \$75,000	← \$75,000	← \$75,000	← \$75,000	← \$75,000
<b>PROJECT C</b>								
Net initial invest.	\$ (250,000)	← 1.000	← \$(250,000)					
Cash inflows	66,975	← 0.893	← \$75,000					
	59,775	← 0.797	← \$75,000	← \$75,000				
	42,720	← 0.712	← \$60,000	← \$60,000	← \$60,000			
	50,880	← 0.636	← \$80,000	← \$80,000	← \$80,000	← \$80,000		
Net present value	<u>\$ 27,050</u>	← 0.567	← \$100,000	← \$100,000	← \$100,000	← \$100,000	← \$100,000	← \$100,000
<b>PROJECT D</b>								
Net initial invest.	\$ (210,000)	← 1.000	← \$(210,000)					
Cash inflows	66,975	← 0.893	← \$75,000					
	59,775	← 0.797	← \$75,000	← \$75,000				
	42,720	← 0.712	← \$60,000	← \$60,000	← \$60,000			
	25,440	← 0.636	← \$40,000	← \$40,000	← \$40,000	← \$40,000		
Net present value	<u>\$ (3,750)</u>	← 0.567	← \$20,000	← \$20,000	← \$20,000	← \$20,000	← \$20,000	← \$20,000

**21-23 (30 min.) NPV, sharing rules and stadium projects, no income taxes.**

1. *Sharing Rule A*

Wafers receive all ticket and suite revenues, all advertising, naming rights, and concession revenues. Wafers pay all operating costs.

Annual cash inflows	
Tickets and suites	\$52.000
Advertising naming	
rights and concessions	<u>38.000</u>
Total	90.000
Annual cash outflows	
Operating costs	<u>35.000</u>
Net annual cash inflows	<u>\$55.000</u>

Net present value on January 1, 2001 of \$55.000 million each year at year end from 2001 to 2005 is:

$$\$55.000 \text{ million} \times 3.791 = \$208.505 \text{ million}$$

*Sharing Rule B*

Wafers pay 20% of construction costs and 80% of operating costs. Everything else as in Sharing Rule A.

Annual cash inflows	
Tickets and suites	\$52.000
Advertising naming	
rights and concessions	<u>38.000</u>
Total	90.000
Annual cash outflows	
Operating costs x 0.80	
\$35.000 x 0.80	<u>28.000</u>
Net annual cash inflows	<u>\$62.000</u>

The January 1, 2001 payment for 20% of construction costs is \$24.000 million (20% of \$120.000 million).

**21-23 (Cont'd.)**

Net present value as at January 1, 2001:

Construction cost sharing	
\$24.000 × 1.000	\$ (24.000)
Net annual cash inflows	
over years 2001 to 2005	
\$62.000 × 3.791	<u>235.042</u>
Net present value	<u>\$215.042</u>

2. San Jose Wafers could bear all the costs of the \$120 million construction and still have a positive NPV under either Sharing Rule A or B.

*Sharing Rule A*

NPV	\$208.505
Construction costs*	<u>120.000</u>
	<u>\$ 88.505</u>

*Sharing Rule B*

NPV	\$211.042
Construction costs*	<u>100.000</u>
	<u>\$111.042</u>

\* \$20,000 million already included in requirement 1.

3. Stadium construction projects are a contentious political issue. Santa Clara pays either all or 80% of the construction costs and receives a less than proportionate share of the revenues. On a NPV basis, the project is not an attractive one to the county. However, there can be other nonfinancial factors. These include a greater sense of community from having a GFL team and the ability to retain employment for many businesses that exist because there is a GFL team in Santa Clara (such as those operating concessions at the stadium). Santa Clara probably should negotiate harder the terms of the lease to capture more of the revenues or have the Wafers assume more of the construction costs.

**21-24** (22–30 min.) **DCF, accrual accounting rate of return, working capital, evaluation of performance, no income taxes.**

1. A summary of cash inflows and outflows (in thousands) are:



Present value of annuity of savings in cash operating costs (\$25,000 per year for 8 years at 14%): $\$25,000 \times 4.639$	\$115,975
Present value of \$30,000 terminal disposal price of machine at end of year 8: $\$30,000 \times 0.351$	10,530
Present value of \$8,000 recovery of working capital at end of year 8: $\$8,000 \times 0.351$	<u>2,808</u>
Gross present value	129,313
Deduct net initial investment:	
Special-purpose machine, initial investment	\$110,000
Additional working capital investment	<u>8,000</u>
Net present value	<u><u>\$ 11,313</u></u>

2. Use a trial-and-error approach. First, try a 16% discount rate:

$\$25,000 \times 4.344$	\$108,600
$(\$30,000 + \$8,000) \times .305$	<u>11,590</u>
Gross present value	120,190
Deduct net initial investment	<u>(118,000)</u>
Net present value	<u><u>\$ 2,190</u></u>

Second, try an 18% discount rate:

$\$25,000 \times 4.078$	\$101,950
$(\$30,000 + \$8,000) \times .266$	<u>10,108</u>
Gross present value	112,058
Deduct net initial investment	<u>(118,000)</u>
Net present value	<u><u>\$ (5,942)</u></u>

**21-24** (Cont'd.)

By interpolation:

$$\begin{aligned}\text{Internal rate of return} &= 16\% + \left( \frac{2,190}{2,190 + 5,942} \right) \times 2\% \\ &= 16\% + (.2693 \times 2\%) \\ &= 16.54\%\end{aligned}$$

3. Accrual accounting rate of return based on net initial investment:

$$\begin{aligned}\text{Net initial investment} &= \$110,000 + \$8,000 \\ &= \$118,000\end{aligned}$$

$$\begin{aligned}\text{Annual depreciation} \\ (\$110,000 - \$30,000) \div 8 \text{ years} &= \$10,000\end{aligned}$$

$$\text{Accrual accounting rate of return} = \frac{\$25,000 - \$10,000}{\$118,000} = 12.71\%$$

4. If your decision is based on the DCF model, the purchase would be made because the net present value is positive, and the 16.54% internal rate of return exceeds the 14% required rate of return. However, you may believe that your performance may actually be measured using accrual accounting. This approach would show a 12.71% return on the initial investment, which is below the required rate. Your reluctance to make a "buy" decision would be quite natural unless you are assured of reasonable consistency between the decision model and the performance evaluation method.

**21-25** (40 min.) **New equipment purchase, income taxes.**

1. The after-tax cash inflow per year is \$27,000 (\$21,000 + \$6,000)

Annual cash-operating cost savings	\$35,000
Deduct income taxes (0.40 × \$35,000)	<u>14,000</u>
Annual after-tax cash-operating cost savings	<u>\$21,000</u>

Annual depreciation on workstation (\$75,000 ÷ 5 years)	\$15,000
Income tax savings (0.40 × \$15,000)	\$6,000

**21-25 (Cont'd.)**

a. Solution Exhibit 21-25 reports the NPV computation. NPV= \$22,335

An alternative approach is:

Present value of 5-year annuity of \$27,000	
\$27,000 × 3.605	\$ 97,335
Present value of cash outlays	
\$75,000 × 1.000	<u>75,000</u>
Net present value	<u>\$ 22,335</u>

$$\begin{aligned} \text{b. Payback} &= \frac{\$75,000}{\$27,000} \\ &= 2.78 \text{ years} \end{aligned}$$

c. Let F = Present value factor for an annuity of \$1 for 5 years in Appendix C, Table 4

$$F = \frac{\$75,000}{\$27,000} = 2.778$$

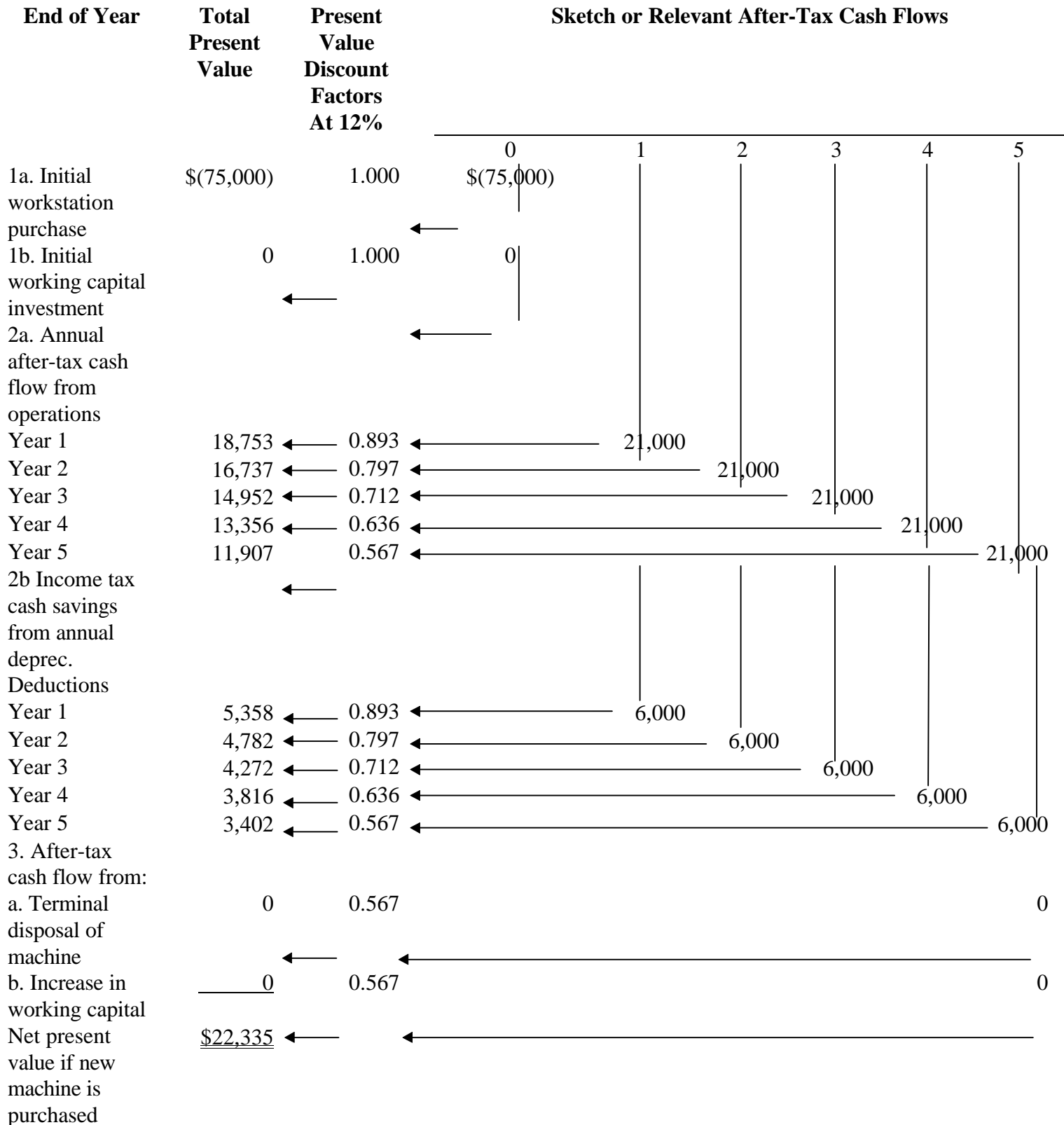
The internal rate of return can be calculated by interpolation:

<b>Present Value Factors for Annuity of \$1 for 5 year</b>		
22%	2.864	2.864
IRR	–	2.778
24%	<u>2.745</u>	–
Difference	<u>0.119</u>	<u>0.086</u>

$$\text{Internal rate of return} = 22\% + \left( \frac{0.086}{0.119} \right) (2\%) = 23.45\%$$

2. Both the net present value and internal rate of return methods use the discounted cash flow approach in which *all* expected future cash inflows and outflows of a project are measured as if they occurred at a single point in time. The payback method considers only cash flows up to the time when the expected future cash inflows recoup the net initial investment in a project. The payback method ignores profitability.

**SOLUTION EXHIBIT 21-25**



**21-26** (60 min.) **Selling a plant, income taxes.**

*1. Option 1*

Current disposal price	\$9,000,000
Deduct current book value	<u>0</u>
Gain on disposal	9,000,000
Deduct 40% taxes	<u>3,600,000</u>
Net present value	<u>\$5,400,000</u>

*Option 2*

Waterford receives three sources of cash inflows:

a. Rent. Four annual payments of \$2,400,000. The after-tax cash inflow is:  
 $\$2,400,000 \times (1 - 0.40) = \$1,440,000$  per year

b. Discount on material purchases, payable at year-end 2000:  
 $10\% \times \$2 \times 2,370,000 = \$474,000$

The after-tax cash inflow is:

$$\$474,000 \times (1 - 0.40) = \$284,400$$

c. Sale of plant at year-end 2003. The after-tax cash inflow is:  
 $\$2,000,000 \times (1 - 0.40) = \$1,200,000$

End of Year	Total Present Value	Present Value Discount Factors at 12%	Sketch of Relevant After-Tax Cash Flows					
			0	1	2	3	4	
1. Rent	\$1,285,920	← 0.893		← 1,440,000				
	1,147,680	← 0.797		← 1,440,000	← 1,440,000			
	1,025,280	← 0.712			← 1,440,000	← 1,440,000		
	915,840	← 0.636				← 1,440,000	← 1,440,000	
2. Discount on Purchases	253,969	← 0.893		← 284,400				
	226,667	← 0.797		← 284,400	← 284,400			
	202,493	← 0.712			← 284,400	← 284,400		
	180,878	← 0.636				← 284,400	← 284,400	
3. Sale of plant	763,200	← 0.636					← 1,200,000	
Net present value	<u>\$6,001,927</u>							

**21-26 (Cont'd.)**

*Option 3*

Contribution margin per jacket:

Selling price		\$42.00
Variable costs		
Direct materials	\$20.80	
Direct manuf., marketing and distribution labor	6.40	
Variable manuf., marketing and distribution overhead	<u>5.80</u>	<u>33.00</u>
Contribution margin		<u>\$ 9.00</u>

	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>
Contribution margin				
\$9.00 x 200,000; 300,000; 400,000; 100,000	\$1,800,000	\$2,700,000	\$3,600,000	\$900,000
Fixed overhead (cash) costs	200,000	200,000	200,000	200,000
Operating income before depreciation	<u>1,600,000</u>	<u>2,500,000</u>	<u>3,400,000</u>	<u>700,000</u>
Income taxes (40%)	<u>640,000</u>	<u>1,000,000</u>	<u>1,360,000</u>	<u>280,000</u>
Net cash inflow	<u>\$ 960,000</u>	<u>\$1,500,000</u>	<u>\$2,040,000</u>	<u>\$420,000</u>

Depreciation:

$$\$1,500,000 \div 4 = \$375,000 \text{ per year}$$

Income tax cash savings from depreciation deduction:

$$\$375,000 \times 0.40 = \$150,000$$

Sale of plant at end of 2003:

$$\$3,000,000 \times (1 - 0.40) = \$1,800,000$$

Solution Exhibit 21-26 presents the NPV calculations.

**21-26 (Cont'd.)**

2. Option 2 has the highest NPV:

	<u>NPV</u>
Option 1	\$5,400,000
Option 2	\$6,001,927
Option 3	\$3,872,880

Option 1 gives Waterford immediate liquidity which it can use for other projects.

Option 2 has the advantage of Waterford having a closer relationship with the supplier. However, it limits Waterford's flexibility if Auburn Mill's quality is not comparable to competitors.

Option 3 has Waterford entering a new line of business. If this line of business is successful, it could be expanded to cover souvenir jackets for other major events. The risks of selling the predicted number of jackets should also be considered. For example, bribery scandals at the Olympic movement could increase the uncertainty that the predicted sales will occur.

**SOLUTION EXHIBIT 21-26**

End of Year	Total Present Value	Present Value Discount Factors at 12%	Sketch of Relevant After-Tax Cash Flows				
			1999	2000	2001	2002	2003
1a. Initial plant upgrade	\$(1,500,000)	1.000	(1,500,000)				
1b. Initial working capital investment	0	1.000	0				
2a. Annual after-tax cash flow from operations (excluding depreciation effects)				960,000			
Year 1	857,280	0.893					
Year 2	1,195,500	0.797			1,500,000		
Year 3	1,452,480	0.712				2,040,000	
Year 4	167,120	0.636					420,000
2b. Income tax cash savings from annual depreciation deductions							
Year 1	133,950	0.893		150,000			
Year 2	119,550	0.797			150,000		
Year 3	106,800	0.712				150,000	
Year 4	95,400	0.636					150,000
3. After-tax cash flow from							
a. Terminal disposal of plant	1,144,800	0.636					1,800,000
b. Recovery of working capital	0	0.636					0
<b>Net present value</b>	<b><u>\$3,872,880</u></b>						

**21-27 (60 min.) Equipment replacement, no income taxes.**

1. Cash flows for modernizing alternative:

<b>Year (1)</b>	<b>Units Sold (2)</b>	<b>Net Cash Contributions (3) = (2) x \$18,000<sup>a</sup></b>	<b>Initial Investments (4)</b>	<b>Sale of Equip. at Termination (5)</b>
Jan. 1, 2001	-	-	\$(28,000,000)	-
Dec. 31, 2001	460	8,280,000		
Dec. 31, 2002	510	9,180,000		
Dec. 31, 2003		560	10,080,000	
Dec. 31, 2004		610	10,980,000	
Dec. 31, 2005		660	11,880,000	
Dec. 31, 2006		710	12,780,000	
Dec. 31, 2007		760	13,680,000	\$5,000,000

<sup>a.</sup> \$80,000 - \$62,000 = \$18,000 cash contribution per prototype.

Cash flow for replacement alternative:

<b>Year (1)</b>	<b>Units Sold (2)</b>	<b>Net Cash Contributions (3) = (2) x \$24,000<sup>b</sup></b>	<b>Initial Investments (4)</b>	<b>Sale of Equip. at Termination (5)</b>
Jan. 1, 2001	-	-	\$(49,000,000)	\$3,000,000
Dec. 31, 2001	460	11,040,000		
Dec. 31, 2002		510	12,240,000	
Dec. 31, 2003		560	13,440,000	
Dec. 31, 2004		610	14,640,000	
Dec. 31, 2005		660	15,840,000	
Dec. 31, 2006		710	17,040,000	
Dec. 31, 2007		760	18,240,000	\$12,000,000

<sup>b.</sup> \$80,000 - \$56,000 = \$24,000 cash contribution per prototype.

2. Payback period calculations for modernizing alternative:

<b>Year (1)</b>	<b>Cash Inflow (2)</b>	<b>Cumulative Cash Inflow (3)</b>	<b>Net Initial Investment Yet to be Recovered at Year End (4)</b>
Jan. 1, 2001	-	-	\$28,000,000
Dec. 31, 2001	\$ 8,280,000	\$ 8,280,000	19,720,000
Dec. 31, 2002		9,180,000	17,460,000
Dec. 31, 2003		10,080,000	10,540,000
Dec. 31, 2004		10,980,000	27,540,000
Payback	= 3 + $\frac{\$460,000}{\$10,980,000}$		

= 3.04 years

Payback period calculations for replace alternative:

<b>Year (1)</b>	<b>Cash Inflow (2)</b>	<b>Cumulative Cash Inflow (3)</b>	<b>Net Initial Investment Yet to be Recovered at Year End (4)</b>
Jan. 1, 2001	-	-	\$46,000,000
Dec. 31, 2001	\$11,040,000	\$11,040,000	34,960,000
Dec. 31, 2002		12,240,000	23,280,000
Dec. 31, 2003		13,440,000	22,720,000
Dec. 31, 2004		14,640,000	9,280,000
Payback	= 3 + $\frac{\$9,280,000}{\$14,640,000}$		

= 3.63 years

21-27 (Cont'd.)

3. Modernizing alternative:  
4.

<b>Year</b>	<b>Present Value Discount Factors At 12%</b>	<b>Net Cash Flow</b>	<b>Total Present Value</b>	
Jan. 1, 2001	1.000	\$(28,000,000)	\$(28,000,000)	
Dec. 31, 2001	0.893	8,280,000	7,394,040	
Dec. 31, 2002		0.797	9,180,000	7,316,460
Dec. 31, 2003		0.712	10,080,000	7,176,960
Dec. 31, 2004		0.636	10,980,000	6,983,280
Dec. 31, 2005		0.567	11,880,000	6,735,960
Dec. 31, 2006		0.507	12,780,000	6,479,460
Dec. 31, 2007		0.452	18,680,000	<u>8,443,360</u>
			<u>\$22,529,520</u>	

2. Replace Alternative:

<b>Year</b>	<b>Present Value Discount Factors At 12%</b>	<b>Net Cash Flow</b>	<b>Total Present Value</b>	
Jan. 1, 2001	1.000	\$(46,000,000)	\$(46,000,000)	
Dec. 31, 2001	0.893	11,040,000	9,858,720	
Dec. 31, 2002		0.797	12,240,000	9,755,280
Dec. 31, 2003		0.712	13,440,000	9,569,280
Dec. 31, 2004		0.636	14,640,000	9,311,040
Dec. 31, 2005		0.567	15,840,000	8,981,280
Dec. 31, 2006		0.507	17,040,000	8,639,280
Dec. 31, 2007		0.452	30,240,000	<u>13,668,480</u>
			<u>\$23,783,360</u>	

4. The NPV amounts are based on best estimates. Superfast chips could examine the sensitivity of the NPV amounts to variations in the estimates.

Nonfinancial qualitative factors could include the quality of the prototypes produced by the modernize and replace alternatives. These alternatives may differ in capacity and their ability to meet surges in demand beyond the estimated amounts. The alternatives may also differ in how workers increase their shop floor-capabilities. Such differences could provide labor force externalities that can be the source of future benefits to Superfast.

**21-28** (40 min.)      **Equipment replacement, income taxes**  
**(continuation of 21-27).**

1. Income tax rate = 30%

*Modernize Alternative*

Annual depreciation:

$$\$28,000,000 \div 7 \text{ years} = \$4,000,000 \text{ a year.}$$

Income tax cash savings from annual depreciation deductions:

$$\$4,000,000 \times 0.30 = \$1,200,000 \text{ a year.}$$

Terminal disposal of equipment = \$5,000,000.

After-tax cash flow from terminal disposal:

$$\$5,000,000 \times 0.70 = \$3,500,000.$$

The NPV components are:

1. Initial investment:		<u><b>NPV</b></u>
	$-(\$28,000,000) \times 1.000$	\$(28,000,000)
2a. Annual after-tax cash flow from operations (excluding depreciation):		
Dec. 31, 2001	$8,280,000 \times 0.70 \times 0.893$	5,175,828
2002	$9,180,000 \times 0.70 \times 0.797$	5,121,522
2003	$10,080,000 \times 0.70 \times 0.712$	5,023,872
2004	$10,980,000 \times 0.70 \times 0.636$	4,888,296
2005	$11,880,000 \times 0.70 \times 0.567$	4,715,172
2006	$12,780,000 \times 0.70 \times 0.507$	4,535,622
2007	$13,680,000 \times 0.70 \times 0.452$	4,328,352
2b. Income tax cash savings from annual depreciation deductions (annuity of \$1,200,000 for 7 years):		
	$\$1,200,000 \times 4.564$	5,476,800
3. After-tax cash flow from terminal sale of equipment:		
	$\$3,500,000 \times 0.452$	<u>1,582,000</u>
Net present value	<u>\$ 12,847,464</u>	

**21-28** (Cont'd.)

*Replace alternative*

Initial machine replacement = \$49,000,000

Sale in Jan. 1, 2001 of equipment = \$3,000,000

After-tax cash flow from sale:

$$\$3,000,000 \times 0.70 = \$2,100,000$$

Net after-tax initial investment

$$\$49,000,000 - \$2,100,000 = \$46,900,000$$

Annual depreciation

$$\$49,000,000 \div 7 \text{ years} = \$7,000,000 \text{ a year}$$

Income-tax cash savings from annual depreciation deductions

$$\$7,000,000 \times 0.30 = \$2,100,000$$

Terminal disposal of equipment = \$12,000,000

After-tax cash flow from terminal disposal

$$\$12,000,000 \times 0.70 = \$8,400,000$$

**21-28 (Cont'd.)**

The NPV components are:

1. Net after-tax initial investment			
	$\$(46,900,000) \times 1.000$		$\$(46,900,000)$
2a. Annual after-tax cash flow from operations (excluding depreciation)			
Dec. 31, 2001	$\$11,040,000 \times 0.70 \times 0.893$		6,901,104
2002	$12,240,000 \times 0.70 \times 0.797$		6,828,696
2003	$13,440,000 \times 0.70 \times 0.712$		6,698,496
2004	$14,640,000 \times 0.70 \times 0.636$		6,517,728
2005	$15,840,000 \times 0.70 \times 0.567$		6,286,896
2006	$17,040,000 \times 0.70 \times 0.507$		6,047,496
2007	$18,240,000 \times 0.70 \times 0.452$		5,771,136
2b. Income tax cash savings from annual depreciation deductions (annuity of \$2,100,000 for 7 years)			
	$\$2,100,000 \times 4.564$		9,584,400
3. After-tax cash flow from terminal sale of equipment			
	$\$8,400,000 \times 0.452$		<u>3,796,800</u>
Net present value			<u><u><math>\\$11,532,752</math></u></u>

2. Superfast would prefer to:

- a. have lower tax rates,
- b. have revenue exempt from taxation,
- c. recognize taxable revenues in later years rather than earlier years,
- d. recognize taxable cost deductions greater than actual outlay costs, and
- e. recognize cost deductions in earlier years rather than later years (including accelerated amounts in earlier years).

**21-29** (30 min.) **DCF, sensitivity analysis, no income taxes.**

1.

Revenues, $\$10 \times 1,000,000$	\$10,000,000
Variable cash costs, $\$4 \times 1,000,000$	<u>4,000,000</u>
Cash contribution margin	6,000,000
Fixed cash costs	<u>2,000,000</u>
Cash inflow from operations	<u>\$ 4,000,000</u>

Net present value:

Cash inflow from operations	
$\$4,000,000 \times 3.433$	\$13,732,000
Cash outflow for initial investment	<u>12,000,000</u>
Net present value	<u>\$ 1,732,000</u>

2a. 10% Reduction in selling prices:

Revenues, $\$9 \times 1,000,000$	\$9,000,000
Variable cash costs, $\$4 \times 1,000,000$	<u>4,000,000</u>
Cash contribution margin	5,000,000
Fixed cash costs	<u>2,000,000</u>
Cash inflow from operations	<u>\$3,000,000</u>

Net present value:

Cash inflow from operations	
$\$3,000,000 \times 3.433$	\$10,299,000
Cash outflow for initial investment	<u>12,000,000</u>
Net present value	<u>\$ (1,701,000)</u>

2b. 10% Reduction in unit sales:

Revenues, $\$10 \times 900,000$	\$9,000,000
Variable cash costs, $\$4 \times 900,000$	<u>3,600,000</u>
Cash contribution margin	5,400,000
Fixed cash costs	<u>2,000,000</u>
Cash inflow from operations	<u>\$3,400,000</u>

Net present value:

Cash inflow from operations	
$\$3,400,000 \times 3.433$	\$11,672,200
Cash outflow for initial investment	<u>12,000,000</u>
Net present value	<u>\$ (327,800)</u>

**21-29** (Cont'd.)

c. 10% increase in the variable cost per unit.

Revenues, $\$10 \times 1,000,000$	\$10,000,000
Variable cash costs, $\$4.40 \times 1,000,000$	<u>4,400,000</u>
Cash contribution margin	5,600,000
Fixed cash costs	<u>2,000,000</u>
Cash inflow from operations	<u>\$ 3,600,000</u>

Net present value:

Cash inflow from operations	
$\$3,600,000 \times 3.433$	\$12,358,800
Cash outflow for initial investment	<u>12,000,000</u>
Net present value	<u>\$ 358,000</u>

3. Sensitivity analysis enables management to see those assumptions for which input variations have sizable impact on NPV. Extra resources could be devoted to getting more informed estimates of those inputs with the greatest impact on NPV

Sensitivity analysis also enables management to have contingency plans in place if assumptions are not met. For example, if a 10% reduction in selling price is viewed as occurring with 0.40 probability, management may wish to line up bank loan facilities.

**21-30** (40 min.) **NPV and customer profitability, no income taxes.**

<b>Homebuilders</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>
Revenues (5%)*	<u>\$45,000</u>	<u>\$47,250</u>	<u>\$49,612</u>	<u>\$52,093</u>	<u>\$54,698</u>	<u>\$57,433</u>
COGS (4%)*	22,000	22,880	23,795	24,747	25,737	26,766
Op. Costs (4%)*	<u>10,000</u>	<u>10,400</u>	<u>10,816</u>	<u>11,249</u>	<u>11,699</u>	<u>12,167</u>
Total costs	32,000	33,280	34,611	35,996	37,436	38,933
Cash flow from operations	<u>\$13,000</u>	<u>\$13,970</u>	<u>\$15,001</u>	<u>\$16,097</u>	<u>\$17,262</u>	<u>\$18,500</u>
<b>Kitchen</b>						
Revenues (15%)*	<u>\$325,000</u>	<u>\$373,750</u>	<u>\$429,812</u>	<u>\$494,284</u>	<u>\$568,427</u>	<u>\$653,691</u>
COGS (4%)*	180,000	187,200	194,688	202,476	210,575	218,998
Op. Costs (4%)*	<u>75,000</u>	<u>78,000</u>	<u>81,120</u>	<u>84,365</u>	<u>87,740</u>	<u>91,250</u>
Total costs	255,000	265,200	275,808	286,841	298,315	310,248
Cash flow from operations	<u>\$ 70,000</u>	<u>\$108,550</u>	<u>\$154,004</u>	<u>\$207,443</u>	<u>\$270,112</u>	<u>\$343,443</u>
<b>Subdivision</b>						
Revenues (8%)*	<u>\$860,000</u>	<u>\$928,800</u>	<u>\$1,003,104</u>	<u>\$1,083,352</u>	<u>\$1,170,020</u>	<u>\$1,263,622</u>
COGS (4%)*	550,000	572,000	594,880	618,675	643,422	669,159
Op. Costs (4%)*	<u>235,000</u>	<u>244,400</u>	<u>254,176</u>	<u>264,343</u>	<u>274,917</u>	<u>285,914</u>
Total costs	785,000	816,400	849,056	883,018	918,339	955,073
Cash flow from operations	<u>\$75,000</u>	<u>\$112,400</u>	<u>\$154,048</u>	<u>\$200,334</u>	<u>\$251,681</u>	<u>\$308,549</u>

\* Annual increases given in question.

2.

<u>Year</u>	<u>P.V. Factor for 10%</u>	<u>Homebuilders</u>		<u>Kitchen</u>		<u>Subdivision</u>	
		<u>Cash Flow from Operations</u>	<u>Present Value</u>	<u>Cash Flow from Operations</u>	<u>Present Value</u>	<u>Cash Flow from Operations</u>	<u>Present Value</u>
2001	0.909	\$13,970	\$12,699	\$108,550	\$98,672	\$112,400	\$102,172
2002	0.826	15,001	12,391	154,004	127,207	154,048	127,244
2003	0.751	16,097	12,089	207,443	155,790	200,334	150,451
2004	0.683	17,262	11,790	270,112	184,486	251,681	171,898
2005	0.621	18,500	11,488	343,443	213,278	308,549	191,609
			<u>\$60,457</u>		<u>\$779,433</u>		<u>\$743,374</u>

Customer NPVs

Homebuilders	\$ 60,457
Kitchen Constructors	779,433
Subdivision Erectors	743,374

**21-30 (Cont'd.)**

3. Assume the 20% discount is given in 2001

	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>
Revenues (5%)	\$325,000	\$260,000 <sup>a</sup>	\$273,000 <sup>b</sup>	\$286,650 <sup>b</sup>	\$300,982 <sup>b</sup>	\$316,031 <sup>b</sup>
Total costs (4%)	255,000	265,200	275,808	286,841	298,315	310,248
Cash flow						
from operations	<u>\$ 70,000</u>	<u>\$ (5,200)</u>	<u>\$ (2,808)</u>	<u>\$ (191)</u>	<u>\$ 2,667</u>	<u>\$ 5,783</u>

<sup>a</sup> 20% price discount

<sup>b</sup> 5% annual increase

Net present value:

<b>Year</b>	<b>P.V. Factor at 10%</b>	<b>Cash Flow from Operations</b>	<b>Present Value</b>
2001	0.909	\$(5,200)	\$(4,727)
2002	0.826	(2,808)	(2,319)
2003	0.751	(191)	(143)
2004	0.683	2,667	1,822
2005	0.621	5,783	<u>3,591</u>
			<u>\$(1,776)</u>

The 20% discount and reduced subsequent annual revenue reduces the NPV from \$779,433 to (\$1,776). This is a drop of \$781,209 in NPV.

Christen should consider whether the price discount demanded by Kitchen need be met in full to keep the account. The implication of meeting the full demand is that the account is minimally profitable at best. An equally serious concern is whether Christen's other two customers will demand comparable price discounts if Kitchen's full demands are met. The consequence would be very large reductions in the NPVs of all its customers.

Christen should also consider the reliability of the growth estimates used in computing the NPVs. Are the predicted differences in revenue growth rates based on reliable information? Many revenue growth estimates by salespeople turn out to be overestimates or occur over a longer time period than initially predicted.

**21-31 (60 min.) NPV of JIT, income taxes.**

1. Initial investment (Year 0):

Computer system	\$1,250,000
Materials handling equipment.	<u>450,000</u>
Total initial investment	<u>\$1,700,000</u>

Working- capital investment:

Reduced working capital of	\$150,000 at end of Year 1.
Increased working capital of	\$150,000 at end of Year 5.

Depreciation on initial investment:

$$\$1,700,000 \div 5 \text{ years} = \$340,000 \text{ per year}$$

Income tax cash savings from annual depreciation deductions:

$$\$340,000 \times 0.40 = \$136,000$$

After-tax flow from disposal of materials-handling equipment at end of Year 5:

$$\$150,000 \times 0.60 = \$90,000$$

Annual after tax flow from operations:

	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>	<u>Year 4</u>	<u>Year 5</u>
Revenue	<u>\$800,000</u>	<u>\$880,000</u>	<u>\$968,000</u>	<u>\$1,064,800</u>	<u>\$1,171,280</u>
Contribution margin, 60%	480,000	528,000	580,800	638,880	702,768
Rent savings	60,000	60,000	60,000	60,000	60,000
Materials ordering cost	<u>(50,000)</u>	<u>(50,000)</u>	<u>(50,000)</u>	<u>(50,000)</u>	<u>(50,000)</u>
Annual cash inflow from operation	490,000	538,000	590,800	648,880	712,768
Income tax, 40%	<u>196,000</u>	<u>215,200</u>	<u>236,320</u>	<u>259,552</u>	<u>285,107</u>
After-tax annual cash inflow from operations	<u>\$294,000</u>	<u>\$322,800</u>	<u>\$354,480</u>	<u>\$389,328</u>	<u>\$427,661</u>

Solution Exhibit 21-31 reports the net present value to be \$246,111.

2. Rosen will have a NPV of \$246,111 with the new JIT system. Based on financial quantitative factors, this is an attractive investment. Qualitative factors could make the JIT system even more attractive. For example, if a competitor adopts JIT but Rosen does not, Rosen could be at a sizable competitive disadvantage. Not adopting JIT does not mean the status quo will remain. Rosen's workers can also gain additional shop-floor expertise when using the JIT system that can be beneficially employed on other Rosen projects.

**SOLUTION EXHIBIT 21-31**

	<b>Total Present Value</b>	<b>Present Value Discount Factors at 10%</b>	<b>Year 0</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
1a. Net initial investment	\$(1,700,000)	1.000	\$(1,700,000)					
1b. Working capital recovery	136,350	0.909		\$150,000				
2a. Annual after-tax cash flow from operations								
Year 1	267,246	0.909		294,000				
Year 2	266,633	0.826			322,800			
Year 3	266,214	0.751				354,480		
Year 4	265,911	0.683					389,328	
Year 5	265,577	0.621						427,661
2b. Income tax cash savings from annual deprec. deductions								
Year 1	123,624	0.909		136,000				
Year 2	112,336	0.826			136,000			
Year 3	102,136	0.751				136,000		
Year 4	92,888	0.683					136,000	
Year 5	84,456	0.621						136,000
3. After-tax cash flow from:								
a. Terminal disposal of machine	55,890	0.621						90,000
b. Increase in working capital	<u>(93,150)</u>	0.621						(150,000)
<b>Net present value</b>	<b><u>\$246,111</u></b>							

**21-32** (40 min.) **Replacement of a machine, income taxes, sensitivity.**

1. WRL Company should retain the old equipment because the net present value of the incremental cash flows is negative. The computations are presented below. In this format the present value factors appear at the bottom. All cash flows, year by year, are then converted into present values.

	<b>After-Tax Cash Flows</b>				
	<b>1999<sup>a</sup></b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>
Initial machine investment	\$(120,000)				
Current disposal price of old machine	40,000				
Tax savings from loss on disposal of old machine <sup>b</sup>	4,000				
Recurring after-tax cash-operating savings:					
Variable					
(\$0.06 × 300,000 × 0.6) <sup>c</sup>		\$10,800	\$10,800	\$10,800	\$10,800
Fixed (\$1,000 × 0.6) <sup>d</sup>		600	600	600	600
Difference in income tax cash savings from depreciation deductions <sup>e</sup>		6,000	6,000	6,000	6,000
Additional after-tax cash flow from terminal disposal of new machine over old machine (\$20,000 – \$8,200) <sup>f</sup>					11,800
Net after-tax cash flows	<u>\$ (76,000)</u>	<u>\$17,400</u>	<u>\$17,400</u>	<u>\$17,400</u>	<u>\$29,200</u>
Present value discount factors	<u>1.000</u>	<u>0.862</u>	<u>0.743</u>	<u>0.641</u>	<u>0.552</u>
Present value	<u>\$ (76,000)</u>	<u>\$14,999</u>	<u>\$12,928</u>	<u>\$11,153</u>	<u>\$16,118</u>
Net present value	<u>\$ (20,802)</u>				

a. Actually January 1, 2000

b. Original cost of old machine:	\$80,000
Depreciation taken during the first 3 years {[(80,000 – 10,000) ÷ 7] × 3}	<u>30,000</u>
Book value	50,000
Current disposal price:	<u>40,000</u>
Loss on disposal	\$10,000
Tax rate	<u>x 0.40</u>
Tax savings from loss on disposal of old machine	<u>\$ 4,000</u>

**21-32 (Cont'd.)**

c. Difference in recurring after-tax variable cash-operating savings, with 40% tax rate:

$$(\$0.20 - \$0.14) \times (300,000) \times (1 - 0.40) = \$10,800$$

d. Difference in after-tax fixed cost savings, with 40% tax rate:

$$(\$15,000 - \$14,000) \times (1 - 0.40) = \$600$$

e.		<b><u>Old Machine</u></b>	<b><u>New Machine</u></b>
	Initial machine investment	\$80,000	\$120,000
	Terminal disposal price at end of useful life	<u>10,000</u>	<u>20,000</u>
	Depreciable base	<u>\$70,000</u>	<u>\$100,000</u>
	Annual depreciation using straight-line (7-year life)	\$10,000	
	Annual depreciation using straight-line ( 4-year life):		\$ 25,000

Year (1)	Depreciation on Old Machine (2)	Depreciation on New Machine (3)	Additional Depreciation Deductions on New Machine (4) = (3) - (2)	Income Tax Cash Savings from Difference in Depreciation Deductions at 40% (4) × 40%
2000	\$10,000	\$25,000	\$15,000	\$6,000
2001	10,000	25,000	15,000	6,000
2002	10,000	25,000	15,000	6,000
2003	10,000	25,000	15,000	6,000

f.		<b><u>Old Machine</u></b>	<b><u>New Machine</u></b>
	Original cost	\$80,000	\$120,000
	Total depreciation	<u>70,000</u>	<u>100,000</u>
	Book value of machines on Dec. 31, 2003	10,000	20,000
	Terminal disposal price of machines on Dec. 31, 2003	<u>7,000</u>	<u>20,000</u>
	Loss on disposal of machines	3,000	0
	Add tax savings on loss (40% of \$3,000; 40% of \$0)	<u>1,200</u>	<u>0</u>
	After-tax cash flow from terminal disposal of machines (\$7,000 + \$1,200; \$20,000 - \$0)	<u>\$ 8,200</u>	<u>\$ 20,000</u>
	Additional after-tax cash flow from terminal disposal of machines: \$20,000 - \$8,200 = \$11,800.		

**21-32 (Cont'd.)**

2. Let the *additional* recurring after-tax variable cash operating savings required to make  $NPV = \$0$  be  $\$X$  each year.

The present value of an annuity of \$1 per year for 4 years discounted at 16% = 2.798 (Appendix C, Table 4)

To make  $NPV = 0$ , we need to generate cash savings with NPV of \$20,802.

That is  $\$X (2.798) = \$20,802$

$$X = 20,802 \div 2.798 = \$7,435$$

WRL must generate additional annual after-tax variable cash operating savings of \$7,435.

3. The nonquantitative factors that are important to WRL Company's decision include the following:

- a. The lower operating costs (variable and fixed) of the new machine would enable WRL to meet future competitive or inflationary pressures to a greater degree than it could using the old machine.
- b. If the increased efficiency of the new machine provides a labor or energy cost savings, then additional increases in these costs in the future would make the new machine more attractive.
- c. Maintenance and servicing of both machines should be reviewed in terms of reliability of the manufacturer and the costs.
- d. Potential technological advances in machinery over the next four years should be evaluated.
- e. Space requirements for the new machine should be reviewed and compared with the space requirements of the present equipment to determine if more or less space is required.

**21-33 (30–40 min.) Capital budgeting, inflation, income taxes, Appendix.**

1.	Relevant Cash Flows	Present Value Discount Factors at 10%	Total Present Value
Initial machine investment	<u>\$(10,000)</u>	1.000	\$(10,000)
Recurring cash operating savings for 5 years at 10%	<u>\$ 3,000</u>	3.791	<u>11,373</u>
Net present value			<u>\$ 1,373</u>

2.	Initial machine investment	<u>\$(10,000)</u>	1.000	\$(10,000)
	Recurring cash operating savings for 5 years at 10%	<u>\$ 3,000</u>		
	Additional income taxes at 40%	<u>(1,200)</u>		
	Recurring after-tax cash-operating savings each year for 5 years (excl. deprn. effects)	<u>\$ 1,800</u>	3.791	6,824
	Depreciation deductions: (\$10,000 ÷ 5): \$2,000 each year Income tax cash savings from depreciation deductions each year for 5 years at 40%: \$2,000 x 0.40	<u>\$ 800</u>	3.791	<u>3,033</u>
	Net present value			<u>\$ (143)</u>

3. The net present value of the machine will be the same as in requirement 1 (ignoring rounding differences). This result can be illustrated by estimating the cash flows in nominal dollars and using a nominal discount rate:

$$\begin{aligned}
 \text{Nominal rate} &= (1 + \text{Real rate}) (1 + \text{Inflation rate}) - 1 \\
 &= (1.10) (1.20) - 1 \\
 &= 1.32 - 1 = 0.32
 \end{aligned}$$

Alternatively:	Real rate of interest	0.10
	Inflation rate	0.20
	Combination (0.10 × 0.20)	<u>0.02</u>
	Nominal rate of interest	<u>0.32</u>

21-33 (Cont'd.)

Recurring cash-operating savings (nominal dollars and a nominal discount rate):

Year (1)	Cash-Operating Savings in Real Dollars (2)	Cumulative Inflation Rate (3)	Cash-Operating Savings In Nominal Dollars (4) = (2) × 3	Nominal Dollar Present Value Discount Factor (32%) (5)	Total Present Value (6) = (4) × (5)
2001	\$3,000	1.200	\$3,600	0.758	\$ 2,729
2002	3,000	1.440	4,320	0.574	2,480
2003	3,000	1.728	5,184	0.435	2,255
2004	3,000	2.074	6,222	0.329	2,047
2005	3,000	2.488	7,464	0.250	1,866
Initial machine investment					<u>(10,000)</u>
Net present value					<u>\$ 1,377</u>

4. Recurring after-tax cash-operating savings:

Year (1)	Before-Tax Cash-Operating Savings (Nominal Dollars) (2)	Tax Payments (40%) (3) = 0.4 × (2)	After-Tax Cash- Operating Savings (Nominal dollars) (4) = (2) - (3)	Nominal Dollar Present Value Discount Factor (32%) (5)	Total Present Value (6) = (4) × (5)
2001	\$3,600	\$1,440	\$2,160	0.758	\$ 1,637
2002	4,320	1,728	2,592	0.574	1,488
2003	5,184	2,074	3,110	0.435	1,353
2004	6,222	2,489	3,733	0.329	1,228
2005	7,464	2,986	4,478	0.250	<u>1,120</u>
					<u>6,826</u>

Depreciation Tax Savings

Year	Income Tax Depreciation Deductions (Straight Line)	Income Tax Cash Savings from Depreciation Deductions at 40%		
2001	\$ 2,000	\$ 800	0.758	606
2002	2,000	800	0.574	459
2003	2,000	800	0.435	348
2004	2,000	800	0.329	263
2005	2,000	800	0.250	<u>200</u>
				<u>1,876</u>
Net machine investment				<u>(10,000)</u>
Net present value				<u>\$ (1,298)</u>

**21-34** (40 min.)      **Ethics, capital budgeting.**

- 1a. Refer to the specific standards of competence, confidentiality, integrity, and objectivity in "Standards of Ethical Conduct for Management Accountants," (Chapter 1 p.15) George Watson's conduct in giving Helen Dodge specific instructions on preparing the second revision of the proposal is unethical because his conduct violates the following specific standards.

*Competence*

Watson has the responsibility to perform his professional duties in accordance with relevant technical standards, such as using conservatism and realistic estimates in the net present value analysis. Management accountants should prepare complete and clear reports and recommendations after appropriate analyses of relevant and reliable information.

*Confidentiality*

Watson should refrain from using or appearing to use confidential information acquired in the course of his work for unethical advantage or personal gain (saving on commuting time and costs).

*Integrity*

Watson has the responsibility to advise all parties of any potential conflict of interest. Watson should communicate unfavorable as well as favorable information and professional judgments and opinions.

*Objectivity*

Watson has the responsibility to disclose fully all relevant information that can influence an intended user's understanding of the analysis.

- 1b. Helen Dodge's revised proposal for the warehouse conversion is unethical because her actions violate the following standards.

*Competence*

Although the estimates used in the analysis are based on management's judgment, Dodge's action in changing reasonable estimates to remote assumptions is unethical. Management accountants have the responsibility to prepare complete and clear reports and recommendations after appropriate analysis of relevant and reliable information.

*Integrity*

Dodge has the responsibility to avoid conflicts of interest, refrain from subverting the attainment of the organization's legitimate and ethical objectives (profitability), and refrain from engaging in or supporting any activity that would discredit the profession.

*Objectivity*

Dodge has the responsibility to communicate information fairly and objectively and to disclose fully, all relevant information that can influence an intended user's understanding.

**21-34 (Cont'd.)**

2. Steps that Helen Dodge should follow in attempting to resolve this situation are as follows:

- Dodge should first investigate and see if Evans Company has an established policy for resolving conflict, and she should follow this policy if it does exist.
- Since it appears that George Watson, Dodge's superior, is involved, there is no need to confront Watson or discuss this issue with him any further. Dodge should present the situation to the next higher level, the vice president of finance, for resolution.
- If the issue is not resolved to Dodge's satisfaction, she should continue to successive higher levels, including the Audit Committee and the Board of Directors.
- Dodge should clarify the concepts of the issue at hand in a confidential discussion with an objective advisor, i.e., a peer.
- If the situation is still unresolved after exhausting all levels of internal review, Dodge will have no recourse but to resign and submit an informative memorandum to an appropriate representative of the organization.
- Unless legally bound (which does not appear to be the case in this situation), it is inappropriate to have communication about this situation with authorities and individuals not employed or engaged by the organization.

**21-35 (30 min.) Relevant costs, outsourcing, capital budgeting, income taxes.**

1. Relevant operating cash outflows and operating cash savings each year if Part No. 789 is outsourced:

	<u>2000</u>	<u>2001 to 2004</u>
Operating cash outflows for purchasing Part No. 789	<u>\$(50,000)</u>	<u>\$(50,000)</u>
Relevant operating cash savings from outsourcing Part No. 789:		
Direct materials	22,000	22,000
Direct manufacturing labor	11,000	11,000
Variable overhead	7,000	7,000
Product and process engineering	—	4,000
Rent	<u>1,000</u>	<u>1,000</u>
Total relevant operating cash savings	<u>41,000</u>	<u>45,000</u>
Net relevant operating cash outflows if Part No.789 purchased from Gabriella	<u>\$( 9,000)</u>	<u>\$( 5,000)</u>

NPV of cash inflows and outflows if Part No. 789 purchased from outside (in thousands):

End of Year	Total Present Value	Present Value of \$1 Discounted at 12%	Sketch of Relevant Cash Flows							
			1999	2000	2001	2002	2003	2004		
1. Disposal price of machine	\$15.000	◆— 1.000 ◆—								
2. Recurring operating cash flows	\$(8.037)	◆— 0.893 ◆—								
	(3.985)	◆— 0.797 ◆—								
	(3.560)	◆— 0.712 ◆—								
	(3.180)	◆— 0.636 ◆—								
	(2.835)	◆— 0.567 ◆—								
Net present value	<u>\$(6.597)</u>									

The decision to purchase Part No. 789 from Gabriella has a negative NPV of \$6,597. Strubel should continue to make Part No. 789 in-house based on quantitative, financial considerations.

Note the following:

- Equipment depreciation is a noncash cost and, hence, irrelevant for the NPV analysis.
- Product and process engineering is irrelevant for 19\_5, since \$4,000 in costs will be incurred in 2000 whether Part No. 789 is outsourced or manufactured in-house. But product and process engineering is relevant from 2001 to 2004. These cash costs will be saved if Strubel decides to outsource Part No. 789.
- The allocated rent costs of \$2,000 are irrelevant for NPV analysis, but the \$1,000 rent saved for outside storage if Strubel outsources Part No. 789 is a relevant cash savings, under the "outsourcing" alternative.

- d. Allocation of general plant overhead costs of \$5,000 is irrelevant since these costs will not change in total whether Part No. 789 is outsourced or manufactured in-house.

**21-35** (Cont'd)

2. Sensitivity analysis with respect to the quantity of Part No. 789 required seems desirable.
  - If demand for Part No. 789 decreases, Gabriella is willing to supply a lower quantity at the same price of \$50 per part. If Strubel continued to manufacture part No. 789, the costs it would incur may not decrease quite as fast with lower quantities of production because of fixed costs. Furthermore, the net cash outflows of outsourcing calculated in requirement 1 will be smaller if lower quantities of Part No. 789 are demanded. For example, if only 900 units per year are required, the net relevant cash outflows if Part No. 789 is purchased from Gabriella will be less by \$5,000 in years 2001 through 2004. Note that cash inflow from selling the machine is still \$15,000. This would make outsourcing Part No. 789 more attractive.
  - If, on the other hand, Strubel's demand for Part No. 789 increases, Strubel will continue to prefer manufacturing the part in-house.
3. Other nonfinancial and qualitative factors that Lin should consider before making a decision are:
  - a. Whether Gabriella will deliver Part No. 789 according to the agreed-upon delivery schedule.
  - b. Whether Gabriella will produce Part No. 789 according to the desired quality standards.
  - c. Whether Gabriella will be in a position to accommodate modifications in Part No. 789 if Strubel's requirements change.
  - d. Whether Gabriella will continue in business for the next five years and continue to make Part No. 789 based on Strubel's demands.

**21-35** (Cont'd.)

4. Compute the effects of relevant items on operating income under the alternatives of outsourcing versus making Part No. 789 in-house.

	<b>Increase (Decrease) in Strubel's Operating Income in 2000 (in thousands)</b>
<hr/>	
<i>Cost of Making Part No. 789 in-house</i>	
Direct materials	\$22,000
Direct manufacturing labor	11,000
Variable manufacturing overhead	7,000
Depreciation on machine	<u>10,000</u>
Relevant costs for operating income calculations if Part No. 789 is manufactured in-house	<u>\$50,000</u>
 <i>Cost of outsourcing part No. 789</i>	
Purchase costs of Part No. 789	\$50,000
Savings in rent	(1,000)
Loss on sale of machine <sup>a</sup>	<u>35,000</u>
Relevant costs to consider for operating income computations if Part No. 789 is outsourced	<u>\$84,000</u>
 <sup>a</sup> Proceeds from sale of machine	 \$15,000
Deduct book value of machine (\$60,000 – \$10,000)	<u>50,000</u>
Loss on sale of machine	<u>\$35,000</u>

Lin will maximize reported operating income in 2000 by manufacturing Part No. 789 in-house (relevant costs of \$50,000 by manufacturing in-house versus \$84,000 by outsourcing). In this case, there is no conflict between the conclusion Lin will reach based on NPV and operating income analysis. Note, however, that if the sale of the machine was postponed for another year, Lin will prefer to outsource Part No. 789 (relevant outsourcing costs of \$49,000 versus relevant manufacturing costs of \$50,000).

Note the following:

- a. Machine depreciation is relevant for operating income computations. This cost will only be incurred if Strubel continues to manufacture Part No. 789.
- b. Product and process engineering costs, allocated rent and allocated general plant overhead costs are irrelevant because these costs will continue to be incurred in total whether Part No. 789 is outsourced or manufactured in-house. The savings in rent of \$1,000 will only occur if Part No. 789 is outsourced. These savings are relevant and are, therefore, included in the calculation of operating income under the "outsource Part No. 789" alternative.