14 CAPITAL INVESTMENT DECISIONS

DISCUSSION QUESTIONS

1. Independent projects are such that the acceptance of one does not preclude the acceptance of another. With mutually exclusive projects, acceptance of one precludes the acceptance of others.

2. The timing and quantity of cash flows determine the present value of a project. The present value is critical for assessing whether a project is acceptable or not.

3. By ignoring the time value of money, good projects can be rejected and bad projects accepted.

4. The payback period is the time required to recover the initial investment.
Payback = $80,000/$30,000 = 2.67 years.

5. (a) A measure of risk. Roughly, projects with shorter paybacks are less risky.
(b) Obsolescence. If the risk of obsolescence is high, firms will want to recover funds quickly.
(c) Self-interest. Managers want quick paybacks so that short-run performance measures are affected positively, enhancing chances for bonuses and promotion.

6. The accounting rate of return is the average income divided by original or average investment.
ARR = $100,000/$300,000 = 33.33%

7. Agree. Essentially, NPV is a measure of the return in excess of the investment and its cost of capital.

8. NPV measures the increase in firm value from a project.

9. The cost of capital is the cost of investment funds and is usually viewed as the weighted average of the costs of funds from all sources. It should serve as the discount rate for calculating NPV or the benchmark for IRR analysis.

10. For NPV, the required rate of return is the discount rate. For IRR, the required rate of return is the benchmark against which the IRR is compared to determine whether an investment is acceptable or not.

11. If NPV > 0, then the investment is acceptable. If NPV < 0, then the investment should be rejected.

12. Disagree. Only if the funds received each period from the investment are reinvested to earn the IRR will the IRR be the actual rate of return.

13. Postaudits help managers determine if resources are being used wisely. Additional resources or corrective action may be needed. Postaudits serve to encourage managers to make good capital investment decisions. They also provide feedback that may help improve future decisions. The claims and benefits of advanced technology should especially be examined by a postaudit because of the uncertainty surrounding new technology.

14. NPV signals which investment maximizes firm value. IRR may provide misleading signals. IRR may be popular because it provides the correct signal most of the time and managers are accustomed to working with rates of return.

15. Often, investments must be made in assets that do not directly produce revenues. In this case, choosing the asset with the least cost (as measured by NPV) makes sense.

MULTIPLE-CHOICE EXERCISES

14-1. **c**

14-2. **e**

14-3. **d**

14-4. **b**

14-5. **a**

14-6. **d**

14-7. **e**

14-8. **d**

14-9. **e**

14-10. **e**

14-11. **a**

14-12. **b**

14-13. **d**

14-14. **c**

14-15. **e**

14-16. **b**

14-17. **e**

14-18. **d**

14-19. **c**

14-20. **a**

CORNERSTONE EXERCISES

CE 14-21

a. Payback period = $\frac{\$3,000,000}{\$750,000}$ = 4.00 years

b. Payback period:

$ 375,000	1.0 year
375,000	1.0 year
1,000,000	1.0 year
1,000,000	1.0 year
250,000	1.0 year
$3,000,000	5.0 years

CE 14-22

Average net income =

$$\frac{(\$300,000 + \$900,000 + \$1,000,000 + \$1,800,000 + \$2,400,000 + \$3,800,000 + \$2,400,000)}{7}$$

= $1,800,000

Accounting rate of return = $\frac{\text{Average net income}}{\text{Investment}}$

= $\frac{\$1,800,000}{\$15,000,000}$

= 0.12

CE 14-23

1.

Year	Item	Cash Flow
0	Equipment	$(1,440,000)
	Working capital	(180,000)
	Total	$(1,620,000)
1–4	Revenues	$ 1,350,000
	Operating expenses	(810,000)
	Total	$ 540,000
5	Revenues	$ 1,350,000
	Operating expenses	(810,000)
	Salvage	180,000
	Recovery of working capital	180,000
	Total	$ 900,000

CE 14-23 (Continued)

2. **Calculation of NPV:**

Year	Cash Flow*	Discount Factor**	Present Value
0	$(1,620,000)	1.00000	$(1,620,000)
1	540,000	0.92593	500,002
2	540,000	0.85734	462,964
3	540,000	0.79383	428,668
4	540,000	0.73503	396,916
5	900,000	0.68058	612,522
Net present value			$ 781,072

*From Requirement 1.

**From Exhibit 14B-1.

3. **Calculation of NPV:**

Year	Cash Flow*	Discount Factor**	Present Value
0	$(1,620,000)	1.00000	$(1,620,000)
1–4	540,000	3.31213	1,788,550
5	900,000	0.68058	612,522
Net present value			$ 781,072

*From Requirement 1.

**From Exhibit 14B-2.

CE 14-24

***df* = *I/CF* = $2,303,600/$400,000 = 5.75900**

From Exhibit 14B-2, 9 years and a discount factor of 5.75900 yields an IRR ≈ 10%.

CE 14-25

1. **CAM X Model:**

Year	Cash Flow	Discount Factor	Present Value
0	$(3,000,000)	1.00000	$(3,000,000)
1–10	750,000	6.14457	4,608,428
NPV			$ 1,608,428

CAM Y Model:

Year	Cash Flow	Discount Factor	Present Value
0	$(3,500,000)	1.00000	$(3,500,000)
1–10	875,000	6.14457	5,376,499
NPV			$ 1,876,499

CAM Y is the better choice (it has the higher NPV).

2. **df (CAM X) =** $\frac{I}{CF} = \frac{\$3{,}000{,}000}{\$750{,}000} = 4.00000$

df (CAM Y) = $\frac{I}{CF} = \frac{\$3{,}500{,}000}{\$875{,}000} = 4.00000$

A discount factor of 4 for 10 years implies that IRR is between 20% and 25%.

The IRR is equal for both models and so one is not preferred over the other.

EXERCISES

E 14-26

1. **Payback period =** $\frac{\$400,000}{\$120,000}$ **= 3.33 years**

2. **Payback period:**

$350,000	1.0 year
490,000	1.0 year
560,000	0.8 year
$1,400,000	2.8 years

3. **Investment = Annual cash flow × Payback period**
   = $960,000 × 4
   = $3,840,000

4. **Annual cash flow** $= \frac{\text{Investment}}{\text{Payback period}}$
   $= \frac{\$1,300,000}{2.5}$
   = $520,000 per year

E 14-27

1. **Initial investment (Average depreciation = $720,000):**

   Accounting rate of return $= \frac{\text{Average net income}}{\text{Investment}}$
   $= \frac{(\$6,000,000 - \$4,800,000 - \$720,000)}{\$3,600,000}$
   = 13.3%

2. **Accounting rate of return (ARR):**

   Project A: ARR = $\frac{\$49,500 - \$15,000}{\$75,000}$ **= 46%**

   Project B: ARR = $\frac{\$28,500 - \$15,000}{\$75,000}$ **= 18%**

   Project A should be chosen.
   Both projects have the same cash flows for the first three years (during which the initial investment is recovered), but Project A has significantly higher cash flows the last two years. ARR considers the total dollar returns beyond the payback period and thus correctly picks Project A.

E 14-27 (Continued)

3. $$\text{ARR} = \frac{\text{Average net income}}{\text{Initial investment}}$$

$$0.30 = \frac{\$120{,}000}{\text{Initial investment}}$$

$$\text{Initial investment} = \frac{\$120{,}000}{0.30} = \$400{,}000$$

4. $$\text{ARR} = \frac{\text{Average net income}}{\text{Initial investment}}$$

$$0.50 = \frac{\text{Average net income}}{\$150{,}000}$$

$$\text{Average net income} = 0.50 \times \$150{,}000 = \$75{,}000$$

E 14-28

1. NPV = $P - I$
   = (5.65022 × $400,000) – $2,250,000
   = $10,088

   Yes, the company should make the investment.

2. NPV = $P - I$
   = (4.62288 × $35,000) – $180,000 = ($18,199)

   The shop should not be purchased.

   NPV = (4.62288 × $45,000) – $180,000 = $28,030

   The shop should now be purchased. This reveals that the decision to accept or reject in this case is affected by small differences in estimated cash flows. Estimating future cash flows involves uncertainty and creating different estimates based on likelihood (e.g., most likely, pessimistic, and optimistic) may help in making the decision.

3. NPV = $P - I$
   I = $P - NPV$
   I = (5.33493 × $45,000) – $21,300
   = $218,772

E 14-29

1. $P = CF(df) = I$ for the IRR, thus,

$$df = \frac{\text{Investment}}{\text{Annual cash flow}} = \frac{\$7{,}200{,}000}{\$2{,}000{,}000} = 3.6$$

For five years and a discount factor of 3.60000, the IRR is very close to 12%. The equipment should not be purchased.

2. $P = CF(df) = I$ for the IRR, thus,

$$df = \frac{\$1{,}248{,}000}{\$240{,}000} = 5.2$$

For ten years and a discount factor of 5.20000, the IRR is very close to 14%. Yes, she should acquire the new system.

3. $CF(df) = I$ for the IRR, thus,

$$CF = \frac{I}{df} = \frac{\$2{,}880{,}000}{3.85926} = \$746{,}257$$

E 14-30

1. **Puro equipment:**

Year	Cash Flow	Discount Factor	Present Value
0	$(700,000)	1.00000	$(700,000)
1	400,000	0.89286	357,144
2	350,000	0.79719	279,017
3	300,000	0.71178	213,534
4	200,000	0.63552	127,104
5	150,000	0.56743	85,115
NPV			$ 361,914

Briggs equipment:

Year	Cash Flow	Discount Factor	Present Value
0	$(700,000)	1.00000	$(700,000)
1	150,000	0.89286	133,929
2	150,000	0.79719	119,579
3	400,000	0.71178	284,712
4	500,000	0.63552	317,760
5	550,000	0.56743	312,087
NPV			$ 468,067

E 14-30 (Continued)

2.
$$CF(df) - I = \text{NPV}$$
$$CF(3.60478) - \$700{,}000 = \$468{,}067$$
$$(3.60478)CF = \$1{,}168{,}067$$
$$CF = \frac{\$1{,}168{,}067}{3.60478}$$
$$CF = \$324{,}033 \text{ per year}$$

Thus, the annual cash flow must exceed $324,033 to be selected.

E 14-31

1. Payback period
$$= \frac{\text{Original investment}}{\text{Annual cash inflow}}$$
$$= \frac{\$640{,}000}{\$850{,}000 - \$600{,}000}$$
$$= \frac{\$640{,}000}{\$250{,}000}$$
$$= 2.56 \text{ years}$$

2. Initial investment (Average depreciation = $128,000):

Accounting rate of return
$$= \frac{\text{Average accounting income}}{\text{Investment}}$$
$$= \frac{\$250{,}000 - \$128{,}000}{\$640{,}000}$$
$$= 19.1\%$$

3.

Year	Cash Flow	Discount Factor	Present Value
0	$(640,000)	1.00000	$(640,000)
1	250,000	0.90909	227,273
2	250,000	0.82645	206,613
3	250,000	0.75131	187,828
4	250,000	0.68301	170,753
5	250,000	0.62092	155,230
NPV			$ 307,697

Or NPV = (3.79079 × $250,000) – $640,000 = $307,698*

*Difference is due to rounding.

E 14-31(Continued)

4. $P = CF(df) = I$ for the IRR, thus,

$$df = \frac{\text{Investment}}{\text{Annual cash flow}} = \frac{\$640{,}000}{\$250{,}000} = 2.56000$$

For 5 years and a discount factor of 2.56000, the IRR is between 25% and 30%.

E 14-32

1. **Payback period:**

Project A:

$ 6,000	1.00 year
8,000	1.00 year
6,000	0.60 year
$20,000	2.60 years

Project B:

$ 6,000	1.00 year
8,000	1.00 year
6,000	0.60 year
$20,000	2.60 years

Both projects have the same payback so the most profitable should be chosen (Project A).

2. **Accounting rate of return (ARR):**

Project A: $ARR = \frac{\$8{,}800 - \$4{,}000}{\$20{,}000} = 24\%$

Project B: $ARR = \frac{\$6{,}000 - \$4{,}000}{\$20{,}000} = 10\%$

Project A should be chosen.
The payback period ignores the returns provided beyond the payback point. In this case, Project A has 2.5 times as much cash flow for the remaining two years as Project B. ARR considers the total profitability of a project and thus correctly selects Project A.

3. **P = 11.46992 × $30,000 = $344,098**

Wilma should take the lump sum.

4. NPV $= P - I$
$= (4.62288 \times \$9{,}000) - \$30{,}000 = \$11{,}606$

Yes, he should make the investment.

E 14-32 (Continued)

5. $df = \frac{\$400,000}{\$75,000} = 5.33333$

IRR is very close to 13%.

Yes, Patsy should acquire the equipment.

E 14-33

1. a.	Return of the original investment	$240,000
b.	Cost of capital ($240,000 × 10%)	24,000
c.	Profit earned on the investment ($277,200 – $264,000)	13,200

Present value of profit:

$P = F \times \text{Discount factor}$
$= \$13,200 \times 0.90909$
$= \$12,000$

2.

Year	Cash Flow	Discount Factor	Present Value
0	$(240,000)	1.00000	$(240,000)
1	277,200	0.90909	252,000
Net present value			$ 12,000

Net present value gives the present value of future profit.

E 14-34

1. $P = I = df \times CF$
$2.91371^* \times CF = \$120,000$
$CF = \$41,185$

*From Exhibit 14B-2, 14% for 4 years.

2. For IRR (discount factors from Exhibit 14B-2):
$I = df \times CF$
$= 2.40183^* \times CF$ (1)

For NPV:
$NPV = df \times CF - I$
$= 2.57710 \times CF - I$ (2)

E 14-34 (Continued)

Substituting Equation 1 into Equation 2:

$$\text{NPV} = (2.57710 \times \text{CF}) - (2.40183 \times \text{CF})$$
$$\$1{,}750 = 0.17527 \times \text{CF}$$
$$CF = \frac{\$1{,}750}{0.17527}$$
$$= \$9{,}985 \text{ in savings each year}$$

Substituting CF = $9,985 into equation (1):

$$\text{I} = 2.40183 \times \$9{,}985$$
$$= \$23{,}982 \text{ original investment}$$

3. For IRR:

$$I = df \times CF$$
$$\$60{,}096 = \text{df} \times \$12{,}000$$
$$\text{df} = \frac{\$60{,}096}{\$12{,}000}$$
$$= 5.00800$$

From Exhibit 14B-2, 18% column, the year corresponding to df = 5.00800 is 14. Thus, the lathe must last approximately 14 years.

4. X = Cash flow in Year 4

Investment = 2X

Year	Cash Flow	Discount Factor	Present Value
0	(2X)	1.00000	(2X)
1	$10,000	0.90909	$9,091
2	12,000	0.82645	9,917
3	15,000	0.75131	11,270
4	X	0.68301	0.68301X
NPV			$3,927

$$-2X + \$9{,}091 + \$9{,}917 + \$11{,}270 + 0.68301X = \$3{,}927$$
$$-1.31699X + \$30{,}278 = \$3{,}927$$
$$-1.31699X = (\$26{,}351)$$
$$X = \$20{,}009$$

Cash flow in Year 4 = X = $20,009

Cost of project = 2X = $42,018

E 14-35

1. **NPV:**

Project I

Year	Cash Flow	Discount Factor	Present Value
0	$(100,000)	1.00000	$(100,000)
1	-	0.90909	-
2	134,560	0.82645	111,207
NPV			$ 11,207

Project II

Year	Cash Flow	Discount Factor	Present Value
0	$(100,000)	1.00000	$(100,000)
1	63,857	0.90909	58,052
2	63,857	0.82645	52,775
NPV			$ 10,827

Project I should be chosen using NPV.

IRR:

Project I

$$I = df \times CF$$

$$\$100{,}000 = \frac{\$134{,}560}{(1 + i)^2}$$

$$(1 + i)^2 = \frac{\$134{,}560}{\$100{,}000} = 1.34560$$

$$(1 + i) = 1.16$$

$$\text{IRR} = 16\%$$

Project II

$$df = \frac{I}{CP} = \frac{\$100{,}000}{\$63{,}857} = 1.56600$$

From Exhibit 14B-2, IRR is very close to 18%.

Project II should be chosen using IRR.

2. **NPV is an absolute profitability measure and reveals how much the value of the firm will change for each project. IRR gives a measure of relative profitability. Thus, since NPV reveals the total wealth change attributable to each project, it is preferred to the IRR measure.**

PROBLEMS

P 14-36

1. **Schedule of cash flows:**

Year	Item	Cash Flow	Cash Flow
0	Equipment		$(400,000)
	Working capital		(40,000)
1–7	Cost savings	$180,000	
	Equipment operating costs	(90,000)	90,000
5	Overhaul		(40,000)
7	Salvage value		32,000
	Recovery of working capital		40,000

2. **NPV:**

Year	Cash Flow	Discount Factor	Present Value
0	$(440,000)	1.00000	$(440,000)
1–7	90,000	4.86842	438,158
5	(40,000)	0.62092	(24,837)
7	72,000	0.51316	36,948
NPV			$ 10,269

Yes, the new process design should be accepted.

P 14-37

1. **Schedule of cash flows:**

Year	Item	Cash Flow
0	Equipment	$(1,500,000)
	Working capital	(75,000)
	Total	$(1,575,000)
1–5	Revenues	$ 1,600,000
	Operating expenses	(1,300,000)
	Total	$ 300,000
6	Revenues	$ 1,600,000
	Operating expenses	(1,300,000)
	Major maintenance	(125,000)
	Total	$ 175,000
7–9	Revenues	$ 1,600,000
	Operating expenses	(1,300,000)
	Total	$ 300,000

P 14-37 (Continued)

10	Revenues	$ 1,600,000
	Operating expenses	(1,300,000)
	Salvage	80,000
	Recovery of working capital	75,000
	Total	$ 455,000

2.

Year	Cash Flow	Discount Factor	Present Value
0	$(1,575,000)	1.00000	$(1,575,000)
1–5	300,000	3.60478	1,081,434
6	175,000	0.50663	88,660
7	300,000	0.45235	135,705
8	300,000	0.40388	121,164
9	300,000	0.36061	108,183
10	455,000	0.32197	146,496
NPV			$ 106,642

The new process should be accepted.

P 14-38

1. $df = \dfrac{\text{Investment}}{\text{Annual cash flow}}$

$= \dfrac{\$226{,}000}{\$40{,}000}$

$= 5.65000$

The IRR is essentially 12%. The company should acquire the new system.

2. Since *I* = *P* for the IRR:

$$I = df \times CF$$
$$\$226{,}000 = 6.71008^{*} \times CF$$
$$6.71008 \times CF = \$226{,}000$$
$$CF = \$33{,}681$$

*Discount factor at 8% (cost of capital) for 10 years.

3. For a life of 8 years:

$df = \dfrac{I}{CF}$

$= \dfrac{\$226{,}000}{\$40{,}000}$

$= 5.65000$

P 14-38 (Continued)

The IRR is between 8% and 9%—greater than the 8% cost of capital. The company should still acquire the new system.

Minimum cash flow at 8% for 8 years:

I	**=**	***df* × *CF***
$226,000	**=**	**5.74664 × CF**
5.74664 × CF	**=**	**$226,000**
CF	**=**	**$39,327**

4. **Requirement 2 reveals that the estimates for cash savings can be off by as much as $6,319 (over 15%) without affecting the viability of the new system. Requirement 3 reveals that the life of the new system can be 2 years less than expected and the project is still viable. In the latter case, the cash flows can also decrease by almost 2% as well without changing the outcome. Thus, the sensitivity analysis should strengthen the case for buying the new system.**

P 14-39

1. **First, calculate the expected cash flows:**
   Days of operation each year: 365 – 15 = 350
   Revenue per day: $235 × 2 × 150 = $70,500
   Annual revenue: $70,500 × 350 = $24,675,000

Annual cash flow	**=**	**Revenues – Operating costs**
	=	**$24,675,000 – $3,250,000**
	=	**$21,425,000**

NPV	**=**	***P* – *I***
	=	**(7.46944 × $21,425,000) – $120,000,000**
	=	**$160,032,752 – $120,000,000**
	=	**$40,032,752**

Yes, the aircraft should be purchased.

2. **Revised cash flow = (0.80 × $24,675,000) – $3,250,000**
   = $16,490,000

NPV	**=**	***P* – *I***
	=	**(7.46944 × $16,490,000) – $120,000,000**
	=	**$3,171,066**

Yes, the aircraft should be purchased.

P 14-39 (Continued)

3. NPV = (7.46944)CF – \$120,000,000 = 0

$$CF = \frac{\$120{,}000{,}000}{7.46944} = \$16{,}065{,}461$$

Annual revenue = \$16,065,461 + \$3,250,000
= \$19,315,461

$$\text{Daily revenue} = \frac{\$19{,}315{,}461}{350} = \$55{,}187$$

$$\text{Seats to be sold} = \frac{\$55{,}187}{\$470} = 117 \text{ seats (each way)}$$

$$\text{Seating rate needed} = \frac{117}{150} = 78\%$$

4. Round-trip average price = (2 × \$235) × 1.1 = \$517

$$\text{Seats to be sold} = \frac{\$55{,}187}{\$517} = 107 \quad \text{(rounded up)}$$

$$\text{Seating rate} = \frac{107}{150} = 71\%$$

This seating rate is less than the most likely and above the least likely rate of 70%. There is some risk, since it is possible that the actual rate could be below 71%. However, the interval is 20% (70% to 90%) and the 71% rate is only 6.7% of the way into the interval, suggesting a high probability of a positive NPV.

P 14-40

1.

1.00 year	\$16,800
1.00 year	24,000
1.00 year	29,400
0.13 year*	3,800
3.13 years	\$74,000

*\$3,800 / \$29,400

Note: Cash flow = Increased revenue less cash expenses of \$3,000.

2. Accounting rate of return:

$$\text{Average cash revenue} = \frac{(\$19{,}800 + \$27{,}000 + \$32{,}400 + \$32{,}400)}{4} = \$27{,}900$$

P 14-40 (Continued)

Average cash expenses = $3,000 per year

$$\text{Average depreciation} = \frac{\$74{,}000 - \$6{,}000}{4} = \$17{,}000$$

$$\text{Accounting rate of return} = \frac{(\$27{,}900 - \$3{,}000 - \$17{,}000)}{\$74{,}000}$$

$$= \frac{\$7{,}900}{\$74{,}000}$$

$$= 10.68\%$$

3.

Year	Cash Flow	Discount Factor	Present Value
0	$(74,000)	1.00000	$(74,000)
1	16,800	0.89286	15,000
2	24,000	0.79719	19,133
3	29,400	0.71178	20,926
4	35,400 *	0.63552	22,497
NPV			$ 3,556

*Includes $6,000 salvage.

IRR (by trial and error):

Using 14% as the first guess:

Year	Cash Flow	Discount Factor	Present Value
0	$(74,000)	1.00000	$(74,000)
1	16,800	0.87719	14,737
2	24,000	0.76947	18,467
3	29,400	0.67497	19,844
4	35,400	0.59208	20,960
NPV			$ 8

The IRR is about 14%.

The equipment should be purchased (the NPV is positive and the IRR is larger than the cost of capital). Dr. Avard should not be concerned about the accounting rate of return in making this decision. The payback, however, may be of some interest, particularly if cash flow is of concern to Dr. Avard.

P 14-40 (Continued)

4.

Year	Cash Flow	Discount Factor	Present Value
0	$(74,000)	1.00000	$(74,000)
1	11,200	0.89286	10,000
2	16,000	0.79719	12,755
3	19,600	0.71178	13,951
4	25,600	0.63552	16,269
NPV			$(21,025)

For Years 1–4, the cash flows are 2/3 of the original cash flow increases. Year 4 also includes $6,000 salvage.

Given the new information, Dr. Avard should not buy the equipment.

P 14-41

1. **Annual CF (rebuild alternative) = ($295.00 – $274.65)10,000 = $203,500**
   NPV = (CF × df) – I = ($203,500 × 3.79079) – $600,000 = $171,426

   Annual CF (scrap alternative) = $4 × 10,000 = $40,000
   NPV = (CF × df) – I = ($40,000 × 3.79079) – $0 = $151,632

   The NPV of the rebuild alternative is greater and so the new demag machine should be purchased.

2. **For the rebuild alternative,** $df = \frac{\$600{,}000}{\$203{,}500} = 2.94840$. **The IRR ≈ 20%.**

   For the scrap alternative, df × CF = 0 implies that the IRR is infinite (CF is $40,000 and so df = 0 is required, which can occur only if the discount rate approaches infinity). This means that the scrap alternative is better under the IRR criterion. However, this doesn't make sense because an infinite IRR is required even if the annual cash flow is $1 per year! Clearly, the NPV approach is better as it measures the absolute improvement in dollars.

P 14-42

1.

Project	Investment	Allocation
(1) Substance abuse wing	$1,500,000	$1,500,000
(2) Laboratory	500,000	0
(3) Outpatient surgery wing	1,000,000	0

Total net present value realized = $150,000

2. With unlimited capital, the substance abuse wing and the laboratory would be chosen. With limited capital the laboratory and outpatient surgery wing would be chosen.

3. Three qualitative considerations that should generally be considered in capital budgeting evaluations include:

   Quicker response to market changes and flexibility in production capacity.

   Strategic fit and long-term competitive improvement from the project, or the negative impact to the company's competitiveness or image if it does not make the investment.

   Risks inherent in the project, business, or country for the investment.

P 14-43

1. Payback period $= \frac{\text{Original investment}}{\text{Annual cash flow}}$

$= \frac{\$3,500,000}{\$3,900,000 - \$3,000,000}$

$= \frac{\$3,500,000}{\$900,000}$

= 3.89 years

2.

Year	Cash Flow	Discount Factor	Present Value
0	$(3,500,000)	1.00000	$(3,500,000)
1	900,000	0.90909	818,181
2	900,000	0.82645	743,805
3	900,000	0.75131	676,179
4	900,000	0.68301	614,709
5	900,000	0.62092	558,828
NPV			$ (88,298)

P 14-43 (Continued)

$P = CF(df)$ = I for the IRR, thus,

$$df = \frac{\text{Investment}}{\text{Annual cash flow}} = \frac{\$3,500,000}{\$900,000} = 3.88889$$

For 5 years and a discount factor of 3.88889, the IRR is about 9%.

3.

Year	Cash Flow*	Discount Factor	Present Value
0	$(3,500,000)	1.00000	$(3,500,000)
1	945,000	0.90909	859,090
2	992,250	0.82645	820,045
3	1,041,863	0.75131	782,762
4	1,093,956	0.68301	747,183
5	1,148,653	0.62092	713,222
NPV			$ 422,301

*$(1.05)^n$ × $900,000, n = 1, 2, …, 5. The asterisk is for years one through five.

It is very important to adjust cash flows for inflationary effects. Since the required rate of return for capital budgeting analysis reflects an inflationary component at the time NPV analysis is performed, a correct analysis also requires that the predicted operating cash flows be adjusted to reflect inflationary effects. If the operating cash flows are not adjusted, then an erroneous decision may be the outcome. Notice, for example, that after adjusting for inflation, the new system is now favored—a totally different decision.

P 14-44

1. Bond cost = $3,000/$60,000 = 0.05

   Cost of capital = 0.05(0.60) + 0.175(0.40)
   = 0.03 + 0.07
   = 0.10

2.

Year	Cash Flow*	Discount Factor	Present Value
0	$(100,000)	1.00000	$(100,000)
1	50,000	0.90909	45,455
2	50,000	0.82645	41,323
3	50,000	0.75131	37,566
NPV			$ 24,344

It is not necessary to subtract the interest payments and the dividend payments because these are associated with the cost of capital and are included in the firm’s cost of capital of 10%.

P 14-45

1. **Original savings and investment:**

(14% rate):

Year	CF	df	Present Value
0	$(45,000,000)	1.00000	$(45,000,000)
1–20	4,000,000	6.62313	26,492,520
20	5,000,000	0.07276	363,800
NPV			$(18,143,680)

(20% rate):

Year	CF	df	Present Value
0	$(45,000,000)	1.00000	$(45,000,000)
1–20	4,000,000	4.86958	19,478,320
20	5,000,000	0.02608	130,400
NPV			$(25,391,280)

2. **Total benefits: ($4,000,000 + $1,000,000 + $2,400,000)**

(14% rate):

Year	CF	df	Present Value
0	$(45,000,000)	1.00000	$(45,000,000)
1–20	7,400,000	6.62313	49,011,162
20	5,000,000	0.07276	363,800
NPV			$ 4,374,962

(20% rate):

Year	CF	df	Present Value
0	$(45,000,000)	1.00000	$(45,000,000)
1–20	7,400,000	4.86958	36,034,892
20	5,000,000	0.02608	130,400
NPV			$ (8,834,708)

3. **Analysis with increased investment:**

(14% rate):

Year	CF	df	Present Value
0	$(48,000,000)	1.00000	$(48,000,000)
1–20	7,400,000	6.62313	49,011,162
20	5,000,000	0.07276	363,800
NPV			$ 1,374,962

(20% rate):

Year	CF	df	Present Value
0	$(48,000,000)	1.00000	$(48,000,000)
1–20	7,400,000	4.86958	36,034,892
20	5,000,000	0.02608	130,400
NPV			$(11,834,708)

P 14-45 (Continued)

4. **The automated plant is an attractive investment when the additional benefits are considered—it promises to return at least the cost of capital (even for the high-cost scenario). Using the hurdle rate of 20% is probably too conservative—especially given the robustness of the outcome using the cost of capital. The company should invest in the new system.**

P 14-46

1.

Year	CF	df	Present Value
0	$(860,000)	1.00000	$(860,000)
1–8	225,000	4.34359	977,308
NPV			$ 117,308

2.

Year	CF	df	Present Value
0	$(920,000)	1.00000	$(920,000)
1–8	205,000	4.34359	890,436
NPV			$ (29,564)

After the fact, the decision was not a good one.

3. **The $60,000 per year is an annuity that produces a present value of $260,615 (4.34359 × $60,000).This restores the project to a positive NPV position ($260,615 – $29,564 = $231,051).**

4. **A postaudit can help ensure that a firm's resources are being used wisely. It may reveal that additional resources ought to be invested or that corrective action be taken so that the performance of the investment is improved. A postaudit may even signal the need to abandon a project or replace it with a more viable alternative. Postaudits also provide information to managers so that their future capital decision making can be improved. Finally, postaudits can be used as a means to hold managers accountable for their capital investment decisions.**

P 14-47

1. **Standard Equipment (Rate = 18%):**

Year	CF	df	Present Value
0	$(500,000)	1.00000	$(500,000)
1	300,000	0.84746	254,238
2	200,000	0.71818	143,636
3–10	100,000	2.92845 *	292,845
NPV			$ 190,719

*df for Years 1–10 less df for Years 1–2 (from Exhibit 14B-2)

CAM Equipment (Rate = 18%):

Year	CF	df	Present Value
0	$(2,000,000)	1.00000	$(2,000,000)
1	$100,000	0.84746	84,746
2	$200,000	0.71818	143,636
3	$300,000	0.60863	182,589
4–6	$400,000	1.32333	529,332
7	$500,000	0.31393	156,965
8–10	1,000,000	0.68256	682,560
NPV			$ (220,172)

2. **Standard Equipment (Rate = 10%):**

Year	CF	df	Present Value
0	$(500,000)	1.00000	$(500,000)
1	300,000	0.90909	272,727
2	200,000	0.82645	165,290
3–10	100,000	4.40903	440,902
NPV			$ 378,919

CAM Equipment (Rate = 10%):

Year	CF	df	Present Value
0	$(2,000,000)	1.00000	$(2,000,000)
1	$100,000	0.90909	90,909
2	$200,000	0.82645	165,290
3	$300,000	0.75131	225,393
4–6	$400,000	1.86841 *	747,364
7	$500,000	0.51316	256,580
8–10	1,000,000	1.27615	1,276,150
NPV			$ 761,686

*df for Years 1–6 less df for Years 1–3 (from Exhibit 14B-2)

3. Notice how the cash flows using a 10% rate in years 8–10 are weighted compared to the 18% rate. The difference in present value is significant. Using an excessive discount rate works against those projects that promise large cash flows later in their lives. The best course of action for a firm is to use its cost of capital as the discount rate. Otherwise, some very attractive and essential investments could be overlooked.

P 14-48

1. **Standard Equipment (Rate = 14%):**

Year	CF	df	Present Value
0	$(500,000)	1.00000	$(500,000)
1	300,000	0.87719	263,157
2	200,000	0.76947	153,894
3–10	100,000	3.56946	356,946
NPV			$ 273,997

CAM Equipment (Rate = 14%):

Year	CF	df	Present Value
0	$(2,000,000)	1.00000	$(2,000,000)
1	$100,000	0.87719	87,719
2	$200,000	0.76947	153,894
3	$300,000	0.67497	202,491
4–6	$400,000	1.56704	626,816
7	$500,000	0.39964	199,820
8–10	1,000,000	0.92781	927,810
NPV			$ 198,550

2. **Standard Equipment (Rate = 14%):**

Year	CF	df	Present Value
0	$(500,000)	1.00000	$(500,000)
1	300,000	0.87719	263,157
2	200,000	0.76947	153,894
3–10	50,000	3.56946	178,473
NPV			$ 95,524

The decision reverses—the CAM system is now preferable.This reversal is attributable to the intangible benefit of maintaining market share. To remain competitive, managers must make good decisions, and this exercise emphasizes how intangible benefits can affect decisions.

CASES

Case 14-49

The statement that Manny would normally have taken the first bid without hesitation implies that the bid met all of the formal requirements outlined by the company. If Manny's friend had met the bid as requested, then presumably Manny would have offered the business to his friend. The motive for this was friendship and possibly carried with it past experience in dealing with Todd's company. Perhaps there was some uncertainty in Manny's mind about the low bidder's ability to execute the requirements of the bid, especially since the winning bid was from out of state. If there was some legitimate concern about the winning bid and Manny was hopeful of eliminating this concern by dealing with a known quantity, then it could be argued that the call to Todd was justifiable. If, on the other hand, the only motive was friendship and Manny was confident that the winning bid could execute (as he appears to have been), then the call was improper. Confidentiality and integrity in carrying out the firm's bidding policies are essential.

The fact that Manny was tempted by Todd's enticements and appeared to be leaning toward accepting Todd's original offer compounds the difficulty of the issue. If Manny actually accepts Todd's offer and grants the business at the original price and accepts the gifts, then his behavior is unquestionably unethical. Some of the standards of ethical conduct that would be violated are listed below.

II. Confidentiality

1. **Keep information confidential except when disclosure is authorized or legally required.**
3. **Refrain from using confidential information for unethical or illegal advantage.**

III. Integrity

2. **Refrain from engaging in any conduct that would prejudice carrying out duties ethically.**

Case 14-50

1.

Shaftel Ready Mix Income Statement For the Proposed Plant		
Sales (35,000 × $45)……………………………		$1,575,000
Less: Variable expenses ($35.08 × 35,000)...		1,227,800
Contribution margin……………………………		$ 347,200
Less fixed expenses:		
Salaries………………………………………..	$135,000	
Insurance……………………………………..	75,000	
Telephone…………………………………….	5,000	
Depreciation………………………………….	56,200 *	
Utilities…………………………………………	25,000	296,200
Net income……………………………………….		$ 51,000

*Reported depreciation erroneously included $2,000 for the land.

Ratio of net income to sales = $\frac{\$51,000}{\$1,575,000}$ = 3.24%

Karl is correct that the return on sales is significantly lower than the company average.

2. Payback period = $\frac{\text{Original Investment}}{\text{Annual cash flow}}$

= $\frac{\$352,000}{\$107,200}$

= 3.28 years

*Net income of $51,000 + depreciation of $56,200

Karl is not right.The book value of the equipment and the furniture should not be included in the amount of the original investment because there is no opportunity cost associated with them. Excluding the book value reduces the investment from $582,000 to $352,000. Karl's payback would be correct if the equipment and furniture could be sold for their book value because there would now be an opportunity cost associated with them and that cost should be included in the original investment.

3. NPV:

Year	Cash Flow	Discount Factor	Present Value
0	$(352,000)	1.00000	$(352,000)
1–10	107,200	6.14457	658,698
NPV			$ 306,698

Case 14-50 (Continued)

IRR:

$$df = \frac{I}{CF}$$

$$= \frac{\$352,000}{\$107,200}$$

$$= 3.28358$$

Thus, the IRR is between 25% and 30%.

If the furniture and equipment can be sold for book value:

NPV:

Year	Cash Flow	Discount Factor	Present Value
0	$(582,000)	1.00000	$(582,000)
1–10	107,200	6.14457	658,698
NPV			$ 76,698

IRR:

$$= \frac{\$582,000}{\$107,200}$$

$$= 5.42910$$

Thus, the IRR is between 12% and 14%.

4. **Breakeven:**

$$\$45X = \$35.08X + \$296,200$$

$$\$9.92X = \$296,200$$

$$X = 29,859 \text{ cubic yards}$$

NPV (using break-even amount):

Year	Cash Flow	Discount Factor	Present Value
0	$(352,000)	1.00000	$(352,000)
1–10	56,200	6.14457	345,325
NPV			$ (6,675)

IRR:

$$= \frac{\$352,000}{\$56,200}$$

$$= 6.26335$$

Thus, the IRR is between 9% and 10%.

The investment is not acceptable, although it came close. It is possible to have a positive NPV at the break-even point. Breakeven is defined for accounting income, not for cash flow. Since there are noncash expenses deducted from revenues, accounting income understates cash income. Zero income does not mean zero cash inflows.

Case 14-50 (Continued)

5. **Cost of capital = 10% for 10 years, so df = 6.14457**

$$df = \frac{I}{CF}$$

$$6.14457 = \frac{\$352{,}000}{CF}$$

$$6.14457 \times CF = \$352{,}000$$

$$CF = \$57{,}286$$

Cash flow	**$57,286**
Less: Depreciation	**56,200**
Net income	**$ 1,086**

Net income = Sales – Variable expenses – Fixed expenses

$1,086 = $45X – $35.08X – $296,200

$1,086 = $9.92X – $296,200

$297,286 = $9.92X

X = 29,968 cubic yards

Sales	**$1,348,560**
Less: Variable expenses	**1,051,277**
Contribution margin	**$ 297,283**
Less: Fixed expenses	**296,200**
Net income	**$ 1,083 ***

***Difference, if any, is due to rounding.**