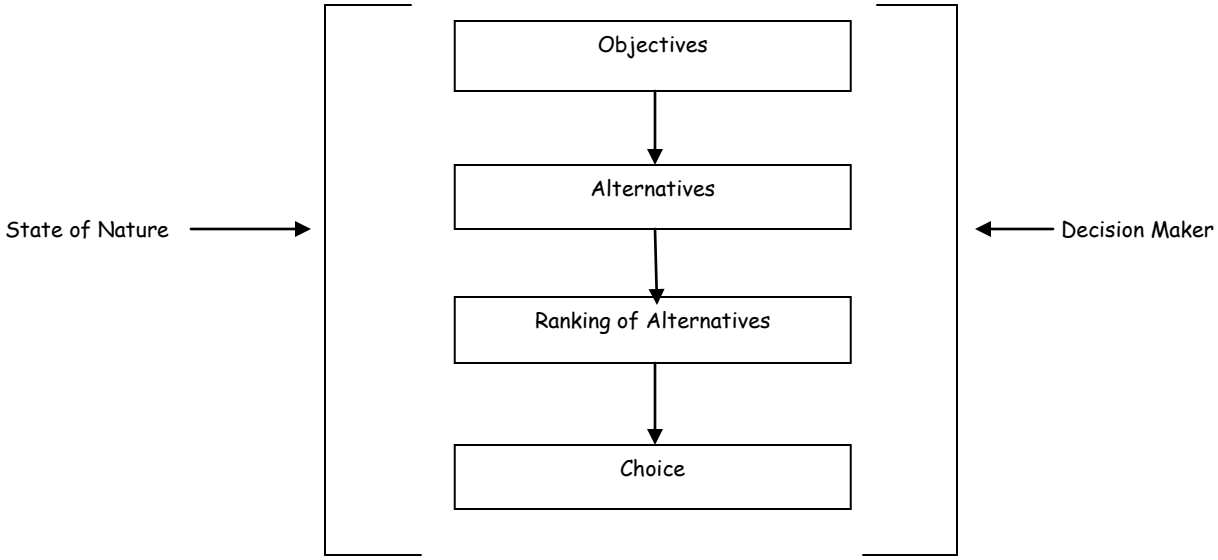
I. The Nature of Capital Budgeting

A. *Capital Budgeting* is
   1. the process of planning for the acquisition of long-lived assets (capital investments)
   2. a decision making tool based on the gathering of information specifically relevant to the long-term capital acquisition;
   3. The *process* which allows managers to evaluate alternative investment opportunities and select the investment offering the best financial advantage by analyzing and ranking competing opportunities.
   4. The state of nature describes the constraints under which the decision maker operates including the constraints of limited knowledge and resources (i.e. time and money).

II. The Importance of Capital Budgeting

A. Acquisitions resulting from capital budgets have a major financial and operational impact. They involve large expenditures for *durable* long-lived assets. Since the effect of a capital investment is long term and will determine plant scale and operating capabilities for years to come, careful planning is a critical factor if we are to achieve long-run profitability.

ELEMENTS IN THE CAPITAL BUDGETING DECISION PROCESS



III. The Capital Budgeting Process

A. Determination of Future Differential Costs
   1. The only relevant costs in the decision process are those that change the status quo (our present situation) in future periods. These costs are referred to as **future-differential costs**. In other words, if we make no capital expenditure—the status quo is maintained whereas if purchase new equipment, the status quo is altered. It is the effect of these changes that are relevant to the decision process
   2. Put another way, the costs already incurred (sunk costs) are irreversible—and therefore irrelevant to the decision process because
      a. there is nothing we can do about them and
      b. They are not affected by any new decision. Their only purpose is to serve as a guide for future estimates.

B. Determination of investment periods
   1. The focus in a capital budgeting decision in not on the capital asset to be acquired but on the change in the cash flow that the asset will create for the periods the capital asset is expected to be retained.
   2. This means that the investment in a capital asset is not made by comparing the cost of competing alternatives, but by examining the predicted cash flows over their expected lives.
   3. If the alternatives are mutually exclusive, the investment offering the largest positive differential should be selected

C. Simplifying Assumptions
   1. All competing alternatives must evaluated over the same time period. This assumption is necessary because we are comparing the future-differential conditions within a fixed operating period and that period must be the same in order to reasonably compare alternatives.
   2. However: Because investment lives in the real world are not often equivalent, we can invoke two rules to more closely approximate equal lives:
      a. Rule 1: All alternatives have a useful life one-half or less than the useful life of the longest-lived alternative should be *recycled*. That is, we assume in each case successive purchases of the same asset, not exceeding the period as determined by the longest-lived asset.
      b. Rule 2: After any possible recycling, all alternatives should be adjusted to life of the shortest-lived asset, *by estimating an early retirement*. The *truncation* (or shortening) effects of the early retirement are included in the new investment period of the asset affected.
      c. This process will be illustrated in the example that follows.

Recycling and Truncation

Note: In Capital budgeting we provide information bearing directly on future operating capacity. Consequently all alternative capital expenditures are evaluated in terms of their contribution to the financial condition of future operating periods. If different investment periods are used for each alternative, no basis of comparison exists. For instance, how can we compare an asset with a ten-Year life and one with a four-year life? The future-differential effects of a ten-year life surely will differ from those of four years. If we compare only the first four years of the ten-year asset, we ignore the latter six-year period which ma he a better or poorer investment than any available when the four-year asset expires. The solution is to recycle and/or truncate.

D. Alternative Approaches to Capital Budgeting: **Income Flows** or **Cash Flows**.
   1. The two most common approaches to Capital Budgeting decisions involve the examination of Income Flows or Cash Flows.
      a. Recall that net income (NI) is computed by deducting expenses from revenues while cash flows consider only the inflow and outflow of cash.
      b. Because income flows consider expenses (recall that under accrual accounting concepts expenses are deducted when incurred, not when paid) that may not have been paid for, the rate of return using income flows will typically be less than under cash flows.
      c. None-the-less, the ranking will be the same under either method and for the investment period as a whole, the flows should yield identical totals.
      d.

IV. Capital Budgeting Example 1: Capital Budgeting with Income Flows:
   1. Recall that our focus in on the future differential costs and cash flows for competing capital acquisitions. This means that we will prepare *pro forma* (estimated) financial estimates. The process is summarized as follows:
      a. Prepare a series of *pro forma* income statements for each year of the investment period and for each alternative capital expenditure.
      b. Using the status quo as a reference, differences in income are computed.
      c. These differences are expressed as a return on the respective *incremental investment.*
      d. The investment yielding the highest return is normally the preferred choice.
   2. To illustrate assume the following:
      a. Kelly Shoe Manufacturing Company operates from a plant in New York City. Replacement decisions for stitching machines are made on an annual basis by reviewing manufacturers' specifications and prices. *Pro forma* income statements are prepared for each alternative investment and resulting rates of return are compared to determine whether to invest, and in which asset or group of assets to invest. Preliminary analysis this Year indicates that *two* investments are possible. Financial information relating to each plan is as follows:

1. Plan A: Maintain Status Quo (do nothing). Kelly Company is presently operating with three three-year-old automatic stitching machines. The original life of the machines was eight years with a total cost of $92.000 and no salvage value. The disposal value now is $40,000.
2. Plan B: Replace three old machines with two machines having a ten-Year life. Cost of two machines is $120.000. Manufacturing cost can be reduced by $.022/unit and estimated salvage value is $30,000 at the end of seven years and $14,000 at the end of ten years.
3. Plan C: Replace three old machines with one large machine having a seven-year life. Cost of the machine is $140,000. Manufacturing cost per unit can be reduced by $.03/unit and there is no salvage value to the new machine at the end of its useful life.

Other Pro Forma Data:	Years 1-3	Years 4-5	Years 7-10
Projected Sales in Units:	1,000,000	1,200,000	1,500,000

Kelly uses Straight-Line depreciation
Assume a tax rate of 40%

Required:

1. Compute the rate of return for the competing alternatives using the formula

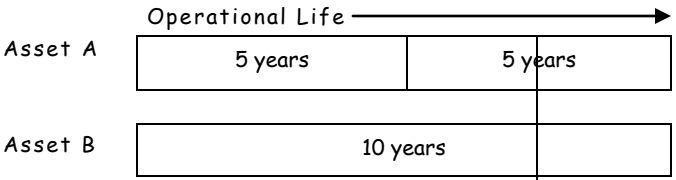
R = Na/I where

Na = average incremental change in net income after taxes
I = Incremental investment and
R = Rate of return

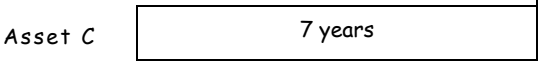
Note: ***The incremental investment*** is the difference between the cost of the new investment and the net after tax effect (*disposal value* of the old investment plus or minus the tax effect on any gain or loss on the old investment) of the premature sale of the status quo asset. When there is no old investment (status quo situation), the incremental investment is simply the cost of the new investment.

In this example one tax rate will be used despite the occurrence of any capital gains or losses. This follows an interpretation of the Internal Revenue Code for *personal property* under Section 1245. Under section 1231, however, a lower tax rate is applicable to any capital gain on real property.

Recycling



Truncation



Solution:
Step 1: Determine the investment period to be used for analysis.

Plan A: Life 5 years Can be recycled twice (10/5 = 2)
Plan B: Life 10 years Longest lived asset
Plan C: Life 7 years Not less than ½

- Plan A is the only alternative with a life ½ or less than the life of the longest lived asset.
- Plan A is recycled and then all plans are truncated at seven years (the shortest life of the alternatives after all recycling has taken place).
- **Therefore, the investment life for purposes of analysis it seven years**.

Review of Recycling/Truncation rule

Rule 1: All alternatives having a useful life one-half or less than the useful life of the longest-lived alternative should be *recycled*. That is, we assume in each case successive purchases of the same asset, not exceeding the period as determined by the longest-lived asset.

Rule 2: After any possible recycling, all alternatives should be adjusted to the life of the shortest-lived asset, by estimating an early retirement. The *truncation* (or shortening) effects of the early retirement are included in the new investment period of the asset affected.

Step 2: Compute the Rate of Return (R) for Plans B and C using Plan A as the status quo.

Note: By comparing Plans B and C to Plan A (Status Quo) any positive rate of return is an improvement over the status quo and the plan with the greatest rate of return is normally the best solution…

Compute the Rate of Return Plan B: This process requires us to examine the Future differential cash flows created by Plan B.

Differential Income Flows from Plan B

	End of Year							
	1	2	3	4	5	6	7	Total
A. Savings in mfg. costs	22.000	22,000	22.000	26.400	26,400	26.400	33.000	178,200
B. Change in deprec.	900	900	900	900	900	(10,800)	(10.600)	(16.700)
C. Loss on disposal of old Machines*	(17.500)							(17,500)
D. Loss on premature retirement of new machines							(18,800	(15,800)
Total before taxes	5,400	22.900	22.900	27.300	27,300	15,800	6,600	128,200
Tax (40%)	(2.160)	(9.160)	(9.180)	(10.920)	(10,920)	(6.320)	(2,640)	(51.280)
Total after taxes	3.240	13.740	13.740	18.380	16,380	9,480	3,980	76.920

Supporting Computations:
A. Savings in manufacturing costs:
Years 1-3: $.022 x 1,000,000 = $22,000
Years 4-6 $.022 x 1.200,000 = $26,400
Years 7-8 $.022 x 1,500,000 = $33,000

B. Δ Depreciation:

	End of Year 1	2	3	4	5	6	7
Plan A (92,000/8)	11,500	11,500	11,500	11,500	11,500		
Plan B (120K-14k/10)	(10,600)	(10,600)	(10,600)	(10,600)	(10,600)	(10,600)	(10,600)
Δ Depreciation.	900	900	900	900	900	(10,600)	(10,600)

C. (Gain)/Loss on Sale of old machine

The old machine will be sold if either Plan B or Plan C is adopted. (Gain) or loss is the difference between the carrying (book) value (Cost-Accumulated Depreciation) and the sales value of the old asset when the new asset is acquired.

Cost of old machine	=	$92,000	
Accumulated Depreciation	=	$34,500	(11,500 x 3 years)
Carrying (Book) Value	=	$57,500	
Salvage Value	=	$40,000	(assume old machine (Plan A) is sold for stated salvage value.
(Gain)/Loss on Disposal	=	$17,500*	

*Note: This (Gain/Loss) on disposal is for financial reporting purposes only. For tax reporting purposes, the loss on exchange deferred and added to the depreciable cost of the new machine and is reflected in greater depreciation charges over the life of the new machines.

D. (Gain)/Loss on Premature Retirement of New Machines

Note: Recall that for purposes of analysis we used the truncated life of seven years. Since the Plan B machines actually have a life of ten years, we must compute the pro forma premature retirement (gain)/loss at the end of the analysis life. Note further that this was also the case in part A above as the "Recycled" life of Plan A was used only to compute the analytical life.

Cost of new machine	=	$120,000	
Accumulated Depreciation	=	$74,200	(10,600 x 7 years)
Carrying (Book) Value	=	$45,800	
Salvage Value	=	$30,000	(assume new machine (Plan B) is sold for stated salvage value.
(Gain)/Loss on Disposal	=	$15,800*	

E. Rate of Return (R) on Plan B:

R = Na/I = $10,989/$73,000 = 15% (rounded) where

Na = average incremental change in net income after taxes = $76,920 / 7 years = $10,989

I = Incremental investment = Cost – (Disposal Value old +- tax effect) = 120k – (40k + 17,500 x .4) = $73,000

Note that in the computation of I above that the cost of the new machine is reduced by the $40,000 salvage value of the old and the tax effect of the loss of $17,500. This is because the loss of $17,500 resulted in a decrease in tax liability, thereby reducing the cost of the Plan B acquisition.

Compute Rate of Return on Plan C

The rate of return on Plan C is 13% computed as follows:

Differential Income Flows from Plan C

	End of Year 1	2	3	4	5	6	7	Total
A. Savings in mfg. costs	30,000	30.000	30,000	36.000	36,000	36,000	45,000	243,000
B. Change in deprec.	(8,500)	(8,500)	(8.500)	(8.500)	(3,500)	(20,000)	(20,000)	(82,500)
C. Loss on disposal of old machines	(17.500)							(17500)
Total before taxes	4,000	21,500	21.500	27,500	27,500	16,000	25,000	143,000
Tax (40%)	(1,600)	(8,600)	(8.600)	(11.000)	(11,000)	(6,400)	(10.000)	(57.200)
Total after taxes	2,400	12.900	12.900	16.500	16,500	9,600	15,000	85,800

Supporting Computations for Plan C

A. Savings in manufacturing costs:

Years 1-3:	$.03 x	1,000,000	=	$30,000
Years 4-6	$.03 x	1.200,000	=	$36,000
Years 7-8	$.03 x	1,500,000	=	$45,000

B. Δ Depreciation:

	End of Year 1	2	3	4	5	6	7
Plan A (92,000/8)	11,500	11,500	11,500	11,500	11,500		
Plan C (140K-0k/7)	(20,000)	(20,000)	(20,000)	(20,000)	(20,000)	(20,000)	(20,000)
Δ Depreciation.	(8,500)	(8,500)	(8,500)	(8,500)	(8,500)	(20,000)	(20,000)

C. (Gain)/Loss on Sale of old machine

The old machine will be sold if either Plan B or Plan C is adopted. (Gain) or loss is the difference between the carrying (book) value (Cost-Accumulated Depreciation) and the sales value of the old asset when the new asset is acquired.

Cost of old machine	=	$92,000	
Accumulated Depreciation	=	$34,500	(11,500 x 3 years)
Carrying (Book) Value	=	$57,500	
Salvage Value	=	$40,000	(assume old machine (Plan A) is sold for stated salvage value.
(Gain)/Loss on Disposal	=	$17,500*	

*Note: This (Gain/Loss) on disposal is for financial reporting purposes only. For tax reporting purposes, the loss on exchange deferred and added to the depreciable cost of the new machine and is reflected in greater depreciation charges over the life of the new machines.

D. Rate of Return (R) on Plan C:

R = Na/I = $12,757/$93,000 = 13% (rounded) where

Na	=	average incremental change in net income after taxes	=	$85,800 / 7 years	=	$12,757
I	=	Incremental investment = Cost – (Disposal Value old +- tax effect)	=	140k – (40k + 17,500 x .4)	=	$93,000

Note that in the computation of I above that the cost of the new machine is reduced by the $40,000 salvage value of the old and the tax effect of the loss of $17,500. This is because the loss of $17,500 resulted in a decrease in tax liability, thereby reducing the cost of the Plan B acquisition.

V. Alternative Capital Budgeting Models Example 2: Capital Budgeting with Cash Flows

1. Recall that for the *investment period as a whole,* income flows and cash flows should yield *identical totals*. However, the return on investment, and consequently the rate of return will always be higher when using cash flow. This occurs because the *investment* return represented by cash flow does not include the negative cash flow from the incremental investment. With income flow this is not the case since the incremental investment is represented by depreciation and treated as a reduction in investment return.
2. Depreciation and gains or losses on disposal cause income flow to be lower than cash flow. As we know, depreciation is essentially an attempt to distribute the investment burden to the periods in which income is earned. As such it actually serves as a distortion of true investment income
3. The cash flow calculation is similar to that for income flow. Again, using the status quo as a reference, the differences in cash flow are computed. Incremental cash flow is compared to incremental cash investment and a rate of return is computed as follows:
   R = Ca/I where
   Ca = Average incremental change in cash flow after tax
   I = Incremental cash investment and

R = Rate of Return

4. Taxation Rule: *In a cash flow analysis anything which affects income produces a related cash flow from the income tax effect.*
   a. If income increases more taxes are paid —hence, a *cash outflow*.
   b. If income decreases, less taxes are paid — hence a *cash inflow* (savings).
   c. Depreciation, while it is not a cash flow, produces cash benefits from the tax effect of the decreased income.
   d. Also, the sale of assets produces cash flow effects. For instance, suppose you sell for $20,000 a machine with a book value of $18,000. Assuming a tax rate of 40%, an analysis of cash flows shows an $18,000 cash inflow and an $800 ($2,000 x .4) cash outflow from the tax effect on the $2.000 gain.

B. Cash Flow example:
   1. Using our example of the Kelly Shoe Company an analysis of the Plan B cash flow is as follows:

$$R = \frac{\$21,417}{\$73,000} = \frac{\text{Average Incremental change in Cash Flow}}{\text{Incremental Cash investment}} = \frac{\$21,417}{\$120,000 - (40,000 + 7,000)}$$

$$= 29.34\%$$

Incremental Change in Cash Flows for Plan B

	End of Year								
	0	1	2	3	4	5	6	7	Total
A. Savings in mfg. costs		22.000	22.000	22.000	26,400	26,400	26.400	33.000	178.200
B. Tax effect on savings		03800)	(8.800)	(8.800)	(10.560)	(10.560)	(10.560)	(11,200)	71.280)
C. Purchase of new machines	(120,000)								(120.000)
D. Tax effect on degree. change		(360)	(360)	(360)	(360)	(360)	4.240	4.240	6.680
E. Disposal of old machines	40.000								40000
F. Tax effect on disposal loss of $17.500	7.000								7.000
G. Premature re-tirement of n e w machines								30,000	30.000
H. Tax effect an retirement loss of 515.800								6.320	6.320
Total cash flows	(73,000)	12.840	12.840	12.840	15.480	15.480	20.080	60.360	76.920

Supporting Computations Plan B:

A. Cash Savings:

Years 1-3:	$.022 x	1,000,000	=	$22,000
Years 4-6	$.022 x	1.200,000	=	$26,400
Years 7-8	$.022 x	1,500,000	=	$33,000

Notice that the tax effect are always the opposite of the transaction from which they result!!!

B. Cash Outflows related to tax effect on Cash Savings

Years 1-3:	$22,000	x .4	=	(8,800)
Years 4-6	$26,400	x .4	=	(10,560)
Years 7-8	$33,000	x .4	=	(13,200)

C. Purchase of New Machines: $120,000

D. Tax effect resulting from Δ Depreciation:

	End of Year						
	1	2	3	4	5	6	7
Plan A (92,000/8)	11,500	11,500	11,500	11,500	11,500		
Plan C (140K-0k/7)	(20,000)	(20,000)	(20,000)	(20,000)	(20,000)	(20,000)	(20,000)
Δ Depreciation.	(8,500)	(8,500)	(8,500)	(8,500)	(8,500)	(20,000)	(20,000)
Tax Rate:	.4	.4	.4	.4	.4	.4	.4
Tax Effect:	3,400	3,400	3,400	3,400	3,400	8,000	8,000

The old machine will be sold if either Plan B or Plan C is adopted. (Gain) or loss is the difference between the carrying (book) value (Cost-Accumulated Depreciation) and the sales value of the old asset when the new asset is acquired.

E. Disposal of old Machine: $40,000 inflow

F. Tax effect (Gain)/Loss on Sale of old machine

Cost of old machine	=	$92,000	
Accumulated Depreciation	=	$34,500	(11,500 x 3 years)
Carrying (Book) Value	=	$57,500	
Salvage Value	=	$40,000	(assume old machine (Plan A) is sold for stated salvage value.
(Gain)/Loss on Disposal	=	$17,500*	This is a loss and will result in tax savings
Tax rate:	=	.4	
Tax Effect:	=	$7,000	Tax savings from loss on disposal of old machine

*Note: This (Gain/Loss) on disposal is for financial reporting purposes only. For tax reporting purposes, the loss on exchange deferred and added to the depreciable cost of the new machine and is reflected in greater depreciation charges over the life of the new machines.

Note: Recall that for purposes of analysis we used the truncated life of seven years. Since the Plan B machines actually have a life of ten years, we must compute the pro forma premature retirement (gain)/loss at the end of the analysis life. Note further that this was also the case in part A above as the "Recycled" life of Plan A was used only to compute the analytical life.

G. Cash Inflow Premature Retirement of Old Machine: $30,000 (salvage value)

H. (Gain)/Loss on Premature Retirement of New Machines

Cost of new machine	=	$120,000	
Accumulated Depreciation	=	$74,200	(10,600 x 7 years)
Carrying (Book) Value	=	$45,800	
Salvage Value	=	$30,000	(assume new machine (Plan B) is sold for stated salvage value.
(Gain)/Loss on Disposal	=	$15,800*	
Tax Rate:	=	.4	
Tax effect from Loss	=	$ 6,320	

I. Rate of Return (R) on Plan B:

$$R = \frac{\$21,417}{\$73,000} = 29.34\%$$

$\$21,417$ = Average Incremental change in Cash Flow

$\$73,000$ = Incremental Cash investment = $120,000 - (40,000 + 7,000)$

Note that in the computation of I above that the cost of the new machine is reduced by the $40,000 salvage value of the old and the tax effect of the loss of $17,500. This is because the loss of $17,500 resulted in a decrease in tax liability, thereby reducing the cost of the Plan B acquisition.

Solution for Plan C:

Incremental Change in Cash Flow for Plan C

	End of Year								
	0	I	2	3	4	5	6	7	Total
A. Savings in mfg. costs		30,000	20.000	30000	36.000	36.000	36.000	45.000	243.000
A. Tax effect on savings		(12.000)	(12,0001	(12.000)	(14.400)	(14400)	(14.400)	(18000)	(97.200)
C. Purchase of new machine	(140.000)								(140.000)
D. Tax effect on deprec. change		3,400	3,400	3,400	3.400	3.400	5000	8.000	33,000
E. Oirriosal of old . mach	40,000								40.000
F. Tax effect on disposal loss of $17,500	7,000								7.000
Total cash flow	(93.000)	21,400	21.400	21,400	25,000	25.000	29.600	35.000	85.800

Supporting Computations Plan C:

A. Cash Savings:

Years 1-3: $.03 x 1,000,000 = $30,000
Years 4-6 $.03 x 1.200,000 = $36,000
Years 7-8 $.03 x 1,500,000 = $45,000

B. Cash Outflows related to tax effect on Cash Savings

Years 1-3: $30,000 x .4 = (12,000)
Years 4-6 $36,000 x .4 = (14,400)
Years 7-8 $45,000 x .4 = (18,000)

C. Purchase of New Machines: $140,000

D. Tax effect resulting from Δ Depreciation:

	End of Year						
	1	2	3	4	5	6	7
Plan A (92,000/8)	11,500	11,500	11,500	11,500	11,500		
Plan B (120K-14k/10)	(10,600)	(10,600)	(10,600)	(10,600)	(10,600)	(10,600)	(10,600)
Δ Depreciation.	900	900	900	900	900	(10,600)	(10,600)
Tax Rate:	.4	.4	.4	.4	.4	.4	.4
Tax Effect:	(360)	(360)	(360)	(360)	(360)	4,240	4,240

The old machine will be sold if either Plan B or Plan C is adopted. (Gain) or loss is the difference between the carrying (book) value (Cost-Accumulated Depreciation) and the sales value of the old asset when the new asset is acquired.

E. Disposal of old Machine: $40,000 inflow

F. Tax effect (Gain)/Loss on Sale of old machine

Cost of old machine = $92,000
Accumulated Depreciation = $34,500 (11,500 x 3 years)

Carrying (Book) Value	=	$57,500	
Salvage Value	=	$40,000	(assume old machine (Plan A) is sold for stated salvage value.
(Gain)/Loss on Disposal	=	$17,500*	This is a loss and will result in tax savings
Tax rate:	=	.4	
Tax Effect:	=	$7,000	Tax savings from loss on disposal of old machine

*Note: This (Gain/Loss) on disposal is for financial reporting purposes only. For tax reporting purposes, the loss on exchange deferred and added to the depreciable cost of the new machine and is reflected in greater depreciation charges over the life of the new machines.

Note: Recall that for purposes of analysis we used the truncated life of seven years. Since the Plan B machines actually have a life of ten years, we must compute the pro forma premature retirement (gain)/loss at the end of the analysis life. Note further that this was also the case in part A above as the "Recycled" life of Plan A was used only to compute the analytical life.

G. Cash Inflow Premature Retirement of Old Machine: $-0- (salvage value) Plan C was utilized for its full life and had no salvage value at the end of that life.

H. (Gain)/Loss on Premature Retirement of New Machines: This option has the same life as that used in the analysis, so there is no gain/loss or consequent tax effect.

VI. Improving Capital Budgeting Models: Adjusting for the Time Value of Money

A. The Time Value of Money
1. Examples 1 and 2 above fail to recognize the ***time value of money***…that is to say that possessing a dollar today is worth more than the right to possess a dollar in the future.
   a. One of the major advantages of the cash flow approach (example 2) is that it can be adjusted for the time value of money whereas the income flow approach (example 1) cannot.

B. Three capital budgeting models take into account the time value of money:
   a. **Time Adjusted Rate of Return:** The **time value of money** approach produces the *rate of return that causes the present value of the net cash inflow to exactly equal the present value of the incremental investment*.
      i. **Example 3:** Assume the following:
         Investment Cost: $50,000
         Expected incremental cash flow: $8,000/yr
         a. Time adjusted rate of return = 50,000 x 8,000 (f) where (f) is the present value factor that makes the $8,000 annuity exactly equal 50,000. In this case f = 50,000/8,000 = 6.250
         b. Because this is an annuity (an equal amount received at the end of the period for n periods) we examine the present value (PV) annuity tables and find that in the n=8 row, 6.250 occurs between 5% and 6%
         c. We interpolate as follows:

Consider the following relationship:

	A	B	C	
Interest rate	5%	rate	6%	← Difference of 1% between 5% and 6%
Annuity Table Factor	6.463	6.250	6.210	← Difference of 0.253
		0.253	0.040	

Let X = the incremental adjustment that discounts the annuity to equal the cost

Note: 1. To achieve the most accurate result always interpolate between the smallest difference (B and C)
2. We can now establish the following relationship:

$$\frac{X}{1} = \frac{0.040}{0.253} = 0.16$$ Therefore subtracting .16 from 6% we get 5.84%

Note: 1. The time adjusted rate of return (TARR) will always be less than Ca (the unadjusted cash flow rate)
2. In non-annuity situations, a cumbersome trial and error approach is necessary

b. **Minimum Desired Rate of Return:** Management sometimes establishes a minimum acceptable rate of return on capital. This model is sometimes referred to as the ***Cost of Capital model*** where cost of capital represents the cost to the firm to invest using either its own or borrowed capital. It is based on the concept that if a capital investment is financed with new equity (loans or sales of stock), or with already existing equity, the return should exceed the return on existing equity.

i. The Cost of Capital Model can be expressed as follows:

K = I/E where K = Cost of Capital
I = Estimated future annual income after tax
E = Market Value of Equity

ii. **Example 4:** Assume the following:

Expected annual net income	$	81,500
Expected annual interest on debt:		8,500
Income prior to payment of interest		90,000
Income Tax (at 40%)		36,000
Expected annual Income After Tax:	$	54,000 ← I
Market Value of Outstanding Debt:	$	170,000
Market Value of Owners Equity:		280,000
Total Market Value of Equity:	$	450,000 ← E

Remember: A = L + OE

K = 54,000/450,000 = 12%

Goodwill complications

I.

In many situations the market value of a company exceeds the market value of its assets. This results in unrecorded Goodwill. If unrecorded goodwill exists, it can produce an artificially low cost of capital by overstating the market value of the equity assets (E).

This can be accounted for by using the following formula: K = I/A where A = Market Value of Assets.

To illustrate assume that the market value of the assets in the above example is $420,000 and the market value of equity is $450,000. This means that there appears to be $30,000 of unrecorded Goodwill. In this case K is computed as follows:

K = 54,000/420,000 = 12.86%

c. **Net Present Value Method (NPV):** The NPV method discounts the expected cash flows of investment alternatives using the companies cost of capital. The sum of the NPV of all the cash flows, including the incremental investment, determines the ranking of the alternatives.

1. Positive NPV indicates that the PV of the inflows exceed the PV of the outflows at the company's cost of capital.
2. **Example 5:** NPV method
   Assume the following:
   - XYZ is considering a computer system costing $180,000
   - Salvage value will be $40,000 in five years
   - Maintenance Costs are estimated to be $3,600/year
   - XYZ has a tax rate of 40%
   - XYZ uses a cost of capital of 12%
   - Savings/year

	Years 1-3	Years 4-5
Invoice Preparation	$ 12,000	$ 12,000
Salaries Savings	32,000	28,000
Improved Billing	7.000	8,000
Improved Inventory Mgt.	16,000	20,000
Total Savings/year	$ 67,000	$ 68,000

Required: What is your recommendation to XYZ and why?

		PV @ 12%					
	Time Period	0	1	2	3	4	5
A	Purchase Cost of Computer	(180,000)					
B	Depreciation Tax Shield	40,373	11,200	11,200	11,200	11,200	11,200
C	Salvage Value of Computer	22,697					40,000
D	Annual Savings	242,723	67,000	67,000	67,000	68,000	68,000
E	Tax Effect of Savings	(97,089)	(26,800)	(26,800)	(26,800)	(27,200)	(27,200)
F	Maintenance	(12,977)	(3,600)	(3,600)	(3,600)	(3,600)	(3,600)
G	Tax Effect of Maintenance	5,191	1,440	1,440	1,440	1,440	1,440
	Net Present Value	20,918					

Supporting computations:

A. Outflow at time period 0 (the present) has a present value of 1
B. Depreciation Tax Shield: (Cost – Salvage)/Life = (180,000-40,000)/5 years = $28,000/yr
C. Salvage Value: PV of $40,000 in five years at 12%
D. The NPV of this string using MS EXCEL NPV function (can be computed several ways by hand)
E. The NPV of this string using MS EXCEL NPV function (can be computed several ways by hand)
F. The The NPV of this string using MS EXCEL NPV function (can be computed several ways by hand)
G. The NPV of this string using MS EXCEL NPV function (can be computed several ways by hand)

Recommendation: The positive NPV indicates the investment exceeds the cost of capital. Using this criteria, the investment should be made.

Example 6: Using the NPV model to evaluation competing, mutually exclusive alternatives

Assume that XYZ has another alternative that consists of a five year lease of a computer for $1,800/month plus the purchase of support equipment (also five year life) with the following cost/salvage profiles: e:

	Cost	Salvage
Purchase of Computer 1	$ 14,000	$ 5,000
Purchase of special printer	38,000	13,000
Purchase of Computer 2	85,000	19,000
Total	$ 137,000	$ 37,000

- Maintenance Costs are estimated to be $2,500/year
- XYZ has a tax rate of 40%
- XYZ uses a cost of capital of 12%
- Savings/year

	Years 1-3	Years 4-5
Invoice Preparation	$ 11,000	$ 14,000
Salaries Savings	40,000	40,000
Improved Billing	7.000	8,000
Improved Inventory Mgt.	15,000	18,000
Total Savings/year	$ 73,000	$ 80,000

Required:

1. Evaluate this alternative proposal and give your recommendations and reasons for accepting or rejecting it.

	PV @ 12% Time Period	0	1	2	3	4	5
A	Lease Cost of Computer	(77,863)	(21,600)	(21,600)	(21,600)	(21,600)	(21,600)
B	Tax Effect of Lease Payments	31,145	8,640	8,640	8,640	8,640	8,640
C	Purchase of Equipment	(137,000)					
D	Depreciation Tax Shield	28,838	8,000	8,000	8,000	8,000	8,000
E	Salvage of Equipment	20,995					37,000
F	Annual Savings	271,569	73,000	73,000	73,000	80,000	80,000
G	Tax Effect of Savings	(108,628)	(29,200)	(29,200)	(29,200)	(32,000)	(32,000)
H	Maintenance	(9,012)	(2,500)	(2,500)	(2,500)	(2,500)	(2,500)
I	Tax Effect of Maintenance	3,605	1,000	1,000	1,000	1,000	1,000
	Net Present Value	23,650					

Supporting computations:

A. Lease cost is $1,800/month x 12 months for five years
B. Lease expense reduces income and saves taxes by annual lease cost x tax rate (21,600 x .4
C. Outflow at time period 0 (the present) has a present value of 1
D. Depreciation Tax Shield: (Cost – Salvage)/Life = (180,000-40,000)/5 years = $28,000/yr
E. Salvage Value: PV of $37,000 in five years at 12%
F. The NPV of this string using MS EXCEL NPV function (can be computed several ways by hand)
G. The NPV of this string using MS EXCEL NPV function (can be computed several ways by hand)
H. The NPV of this string using MS EXCEL NPV function (can be computed several ways by hand)
I. The NPV of this string using MS EXCEL NPV function (can be computed several ways by hand)

Recommendation: The positive NPV indicates the investment exceeds the cost of capital; In addition the NPV of this investment (23,650) exceeds the NPV of the Example 5 investment (20,918). This appears to be the best investment choice.

VII. Final Considerations: Depreciation Methods and Asset Exchanges

A. Depreciation Methods: Accelerated depreciation methods do not materially affect total depreciation over the life of an asset but they produce greater cash flows earlier in the life of an investment and lower cash flows later in life (a larger depreciation expense amount decreases tax outflow early in the cycle and is reversed later in the cycle).

	PV @ 10% Time Period	0	1	2	3	4	Total Depreciation
	Straight Line:		(13,500)	(13,500)	(13,500)	(13,500)	
A	PV of SL Tax Shield	30,529	5,400	5,400	5,400	5,400	21,600
	Double Declining Balance		(30,000)	(15,000)	(7,500)	(1,500)	
B	PV of DDB Tax Shield	31,943	12,000	6,000	3,000	600	21,600
	Sum of Years Digits		(21,600)	(16,200)	(10,800)	(5,400)	
C	PV of SYD Tax Shield	31,343	8,640	6,480	4,320	2,160	21,600

Supporting Computations:

A. Straight-Line: (Cost - Salvage)/Life = (60,000-6,000)/4 = 13,500 x .4 = 5,400 x PV annuity n=4; i=0.10

B. **Double-declining balance calculations:**

Twice the straight-line rate is 50%

Year	Book Value	Deprec. Rate	Annual Deprec.	Tax Rate	Tax Shield	P.V. Factor	P.V.
1	60,000	.5	30,000	.4	12,000	.909	10,908
2	30,000	.5	15,000	.4	6,000	.826	4,956
3	15.000	.5	7,500	.4	3,000	.751	2,253
4	7,500	*	1,500*	.4	. 600	.683	410
			54,000				18,527**

Note 1: Notice that salvage value is not deducted from the depreciable base in declining balance depreciation.

Note 2: *Recall that total depreciation is limited to cost-salvage (60,000-6000) therefore only 1,500 remains to be depreciated

3. Sum-of-the-years'-digits calculations:

2

Year	Deprec. Cost		Fraction		Annual Deprec.		Tax Rate		Tax Shield		P.V. Factor		P.V.
1	54,000	x	4/10	=	21,600	X	.40	=	8,640	x	.909	=	7,854
2	54,000	x	3/10	=	16,200	x	.40	=	6,480	x	.826	=	5.352
3	54,000	x	2/10	=	10,800	x	.40	=	4,320	x	.751	=	3,244
4	54,000	x	1/10	=	5,400	X	.40	i=	2,160	x	.683	=	1,475

For a review of depreciation methods go to:

http://www.csulb.edu/~mdchase/StudyGuideChap09.pdf

B. Recognition of Gain/Loss on the Exchange: Another problem that can affect the capital budgeting cash flow is whether or not gain is recognized on the exchange.
   1. No gain or loss is recognized on the exchange of "like kind" assets under IRC section 1231. The gain/loss is deferred and used to adjust the depreciable base of the new asset.
   2. When gain or loss is not recognized, the depreciation charges on the new equipment are altered to reflect a spreading of the gain or loss over the life of the new asset. Consequently, when a gain is involved, the non-recognition of this gain produces a larger positive present value than would recognition. Not recognizing an increase in income now results in lower depreciation expense in future periods, and thus spreads the gain over the new investment period. The cash outflow resulting from the increased tax now occurs in later periods. Hence, the present value of these outflows will be less than if the gain were recognized at the time of the exchange. With a loss, the reverse is true.
   3. To illustrate, assume that
      - XYX Company is analyzing an investment opportunity that involves the trade-in of an old machine with a book value of $8,000.
      - The new machine costs $60,000, has a four-year life, and has an estimated salvage of $4,000.
      - The trade-in allowance on the old machine will be $15,000.
      - XYZ has a 40% tax rate
      - XYZ uses a cost of capital of 10% and uses straight-line depreciation

Asset Exchange with Recognition of Gain or Loss

	P V. at 10%	End of Year			
		1	2	3	4
A. Purchase of new machine	(60,000)				
B. Trade-in allowance on old machine	15,000				
C. *Tax effect* on gain	(2,800)				
D. *Tax shield* on deprec.	17,752	5,600	5,600	5,600	5,600
E. Salvage	2,732				4,000
Net present value	(27,316)				

Supporting Computations:

A. Given

B. Given

C. $15,000 - $8,000 =$7,000 *gain* on exchange.
   $7,000 X 40%=$2,800 *outflow* from tax effect on gain.

D. Step 1: $60,000 - $4,000 (salvage) =$56,000 depreciable base.
   Step 2: $56,000/4 years = $14,000 annual depreciation.
   Step 3: $14,000 x 40%=$5,600 *inflow* per year from tax effect on depreciation.
   Step 4: $5,600 x 3.170 =$17,752 *inflow.*

E. $5,000 x.683 =$2,732 *inflow* from salvage.

Asset Exchange with no recognition of Gain or Loss

	PV at 10%	End of Year			
		1	2	3	4
A. Purchase of new machine	(60,000)				
B. Trade-in allowance on old machine	5,000				
C. *Tax shield* on deprec.	5,533	4,900	4,900	4,900	4,900
D. Salvage	2,732				4,000
Net present value	(26,735)				

Supporting computations:

A. Given
B. Given
C. Step 1: $15,000 - $8,000 =$7,000 *gain* on exchange.
Step 2: Cost - Gain - Salvage = depreciable base = $60,000 - $7,000 - $4,000 = $49,000
Step 3: $49,000/4 years = $1.2,250 annual depreciation.
Step 4: $12,250 x 40% =$4,900 inflow per year from tax effect on depreciation.
Step 5: $4,900 X 3.17 = $15,533 *inflow.*
D. $4,000 x .683 =$2,732 *inflow* from salvage.

CAPITAL BUDGETING ANALYSIS—COMPREHENSIVE PROBLEM

Consider the following three mutually exclusive investment opportunities:

Plan A: A machine costing $700 will be purchased. This machine has a useful life of five years (for depreciation purposes) and a disposal value of $100 at the end of five years. This plan, however, requires the machine to be traded in for $250 on a similar machine at the end of four years. The cost of a new machine at this time is expected to be $900 and have an estimated useful life (for depreciation purposes) of only four years. The disposal value of this new machine after four years is expected to be $100. The annual cash operating expenses will amount to $400 in each year the first machine is used and $450 in each year the second machine is used. The sales revenue will be $1,000 per year for each of the eight years.

Plan B: A machine costing $1.600 will be bought. This machine has a useful fife of eight years (for depreciation purposes) and a disposal value of $160 at the end of eight years. The annual *cash* operating expenses will amount to $425 and the revenue $1,000. This machine will require an overhaul at the end of the third year costing $200, and at the end of the sixth year costing $100. (Overhauls are expensed in the year of occurrence and are not capitalized.)

Plan C: A machine costing $2,000 will be bought. This machine has a useful life of eight years (for depreciation purposes) and a zero disposal value at the end of eight years. The annual cash operating expenses amount to $350 and the revenue $1,000.

- Cost of capital is 8%
- Income tax rate of 40% on ordinary income and capital gains.
- Straight-line depredation is used. and *salvage value* is considered.
- Round amounts to whole dollars.
- Sales revenue *should not be excluded* from the analysis because of irrelevancy.

Required: Set up an Excel Spreadsheet to analyze the three alternatives and address the following issues:

(a) What is the net present value of Plan A assuming any gain or loss is recognized on the exchange?

(b) What is the net present value of Plan B?

(c) What is the net present value of Plan C?

(d) On the basis of the excess present value index, which is the better investment?

(e) What is the net present value of Plan A assuming any gain or loss is not recognized on the exchange?

(f) Compute the yield on Plan C.

(g) What minimum number of service years must the machine in Plan C provide in order to earn a 16% yield?

(h) Using Plan A. compute the present value of the tax shield or tax savings resulting from depreciation deductions using sum-of-the-years'-digits depreciation with the provision for residual value (Both machines use this method). Assume that any *gain* or loss on the asset *exchange* in the fourth year is ***not recognized***