Capital Budgeting
Investments in New Technology

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Unit 1  Relevance Issues

1.1 Relevance Issues Overview

Key Concepts

• The importance of using cash flows in analysis
• General rules in considering items to be relevant or not
• The importance of considering context, time frame, and the cost benefit trade-off
• Behavioral issues
1.2 Cash Flows versus Accounting Income

- One of the major differences between cash flows and accrual-based income in capital budgeting involves depreciation expense.
- Example:
  - Manager is considering the purchase of an $80,000 fixed asset
  - Four-year useful life
  - Expected $30,000 annual cash inflow
1.3 Depreciation Example

- Double-declining-balance depreciation
- Discount rate of 12 percent

Result: Before tax ARR figures:
- Year 1 \( \frac{(30,000 - 40,000)}{80,000} = (12.5\%) \)
- Year 2 \( \frac{(30,000 - 20,000)}{80,000} = 12.5\% \)
- Year 3 \( \frac{(30,000 - 10,000)}{80,000} = 25.0\% \)
- Year 4 \( \frac{(30,000 - 10,000)}{80,000} = 25.0\% \)

- With the current year negative ARR results, the manager has no short-term incentive to make the investment, even though the NPV of the investment of $11,120 is positive.
1.4 Depreciation and Delayed Benefits

- Increasing benefits over an asset’s life is often the case, even in the absence of depreciation effects.
- Thus, a short term performance evaluation system can produce similar results with cash-based models.
- This short-term emphasis in performance evaluation must be avoided.
1.5 Important Notes

- Effects are greater where accrual-based metrics are employed.
- The problem is compounded by the fact that accelerated depreciation produces increased cash inflows in the initial years of the investment.
- Cash-based metrics are recommended exclusively for capital budgeting.
1.6 Relevant Cash Flows Defined

- Relevant cash flows (by definition) are expected *future* cash flows that *differ* among alternatives.
- Both of these criteria must be met for a cash flow to be considered relevant.
1.7 Relevant Cash Flows per Most Models

- Initial investments
- Cash from the disposal of old assets
- Recurring operating cash flows
- Terminal disposal price of fixed assets and recovery of working capital
1.8 Relevant Cash Flows per Most Models (cont.)

- Initial investment cost is usually established without much ambiguity.
- Working capital amounts are more difficult to estimate in some cases and are often omitted from the analysis.
- Cash from the disposal of old assets can also be difficult to estimate.
  - usually not a significant amount in the analysis
1.9 Recurring Operating Cash Flows

- Most difficult of all cash flows to estimate
- Most important amounts to the analysis
- Two unrelated reasons for this:
  - The more obvious operating savings are difficult to extrapolate.
  - There are differences that are qualitative in nature.
1.10 Terminal Disposal Value

The terminal disposal price of fixed assets and working capital recovery is often difficult to estimate, but is much less important than operating cash flows.

- Amount is usually not significant
- Impact becomes even smaller as the time period and discount rate used increase
1.11 Common Errors in Determining Relevance

- Assuming all variable costs are relevant
- Assuming all fixed costs are not relevant
- Incorrectly using “unitized” data (i.e., amounts per unit)
- Communication or interpretation problems
1.12 Context, Time Frame, and Cost Benefit Trade-offs

Context can involve many variables, but often includes:

- Type of capital asset
- Type of transaction
- Firm strategy
- Nature of the operating environment
- Behavioral issues
1.13 Cash Flows and Time Frame

- Time frame is specific not only to the type of decision to be made, but also to the perspective of the decision maker.
- If you tell someone that capital budgeting involves “long-term” analysis, this may have a somewhat ambiguous meaning.
1.14 Cash Flows and Cost Benefit Analysis

- Cost benefit trade-offs are pervasive considerations in virtually every analysis.
- Cost benefit tradeoffs impact the degree of effort and precision desirable in the analysis itself.
1.15 Qualitative Factors

- Financial effects attributed to qualitative factors can also be imputed if desired.
- Benefits due to qualitative improvements are often difficult to value quantitatively.
- Benefits are often important strategic and competitive factors that should not be ignored.
- Technological change creates operating efficiencies that translate into cost savings.
- Many benefits are found, not from reduction in operating cost, but rather increases in revenue.
1.16 Examples of Revenue Enhancing Benefits

- Increases in product quality, manufacturability, reliability, and maintainability
- Faster response time
- Increases in flexibility
- Greater availability of options and features
1.17 Quality and Technology

- Increasing quality includes, in some sense, every item listed in the examples.
- All of these items, in some context, might be expected to increase sales.
- All of these benefits are typically brought about by advances in technology.
1.18 Behavioral Issues

- Most behavioral conflicts in the capital budgeting result from a lack of congruence between individual and organizational goals.
1.19 Goal Congruence Problems

- Short-term emphasis
- Accelerated depreciation and delayed benefits
- Accrual-based accounting metrics
- Diluted hurdle rate: manager has little or no incentive to adopt a fixed asset investment that lowers or dilutes the total performance evaluation metric
- Discounted cash flow considerations

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>>Unit Review
2.1 Investment Management Issues Overview

- Investments in “New” technology are classified as such due to their inclusion of advanced technology such as computer integrated manufacturing (CIM) or flexible manufacturing systems (FMS).
- They invariably involve computerization and/or automation.
2.2 Investment Management Issues Overview (cont.)

- The investment *justification* issue is characterized by the difficulty in producing a decision rule result that would favor the adoption of such investments using conventional analysis methods.

- reasons for the *existence* of problems are related to the nature of the investment, while how to *deal with* the problems is related to the nature of the analysis.
2.3 Nature of the Investment

- New technology investments
  - Are more expensive
  - Are more complex
  - Have longer, useful lives
- These factors create problems with the timing of returns and increased risk for the organization.
2.4 Nature of the Analysis

- Five alternative approaches have been used to deal with investments in new technology.
  - Discard all formal financial analysis as unworkable
  - Refine the way in which conventional models are used
  - Create new analysis models
  - Emphasize the way that the investment impacts strategy
  - Employ some combination of the above

- Behavioral considerations should be incorporated into the analysis as well.
2.5 Integrating Financial, Strategic, and Behavioral Analysis

- Integrating financial, strategic, and behavioral analysis into capital budgeting is not easy and requires the consideration of many factors.
- Financial analysis will be considered first by examining the key analysis elements.
2.6 Integrating Financial, Strategic, and Behavioral Analysis (cont.)

- Strategic analysis will consider how to incorporate the consideration of distinctive competencies.
- Behavioral analysis will consider areas where the organization must be careful to employ analysis methods that result in outcomes that promote goal congruence.

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2.7 Financial Analysis

- Since the most popular conventional model is net present value, we will focus discussion on the elements of the DCF model that require adjustment. These include the
  - Initial cost
  - Discount rate used
  - Useful life of the asset
  - Relevant cash inflows
2.8 Initial Cost

• The analyst must be sure to include all relevant costs
  – Working capital investments for supplies and software
  – Consulting fees coincident with implementation
  – Startup adjustments and customization
  – Testing of the equipment
2.9 Discount Rate

- Some would say the *discount rate* associated with investments in new technology is often unreasonably high.
- Many analysts seem to adjust the discount rate as a method of impounding risk into the analysis.
- If this is the case, the analyst should be able to support their rate choice.
- Certainly, rate elevations should not be made arbitrarily.
2.10 Asset Life

- Investments in new technology have longer, useful lives than conventional assets.
- They require longer periods of time to pay back the investment.
- The general impact of longer life and return periods is that of increased risk.
2.11 The Factor with the Largest Impact: Future Cash Inflows

In some sense, the analysis becomes one of analyzing the consequences of *not* investing in the new technology.
2.12 Strategic Analysis

- All analysis should be strategic.
- Emphasis should be in one of three areas:
  - Cost leadership (i.e., competing on the basis of price)
  - Product differentiation (i.e., competing on the basis of product characteristics)
  - Quick response (i.e., competing on the basis of service)
2.13 Strategy and New Technology

- Generally, all three of Porter’s strategic approaches can be enhanced by investments in new technology.
- The organization should consider their distinctive competencies.
- The organization must then consider how to exploit those distinctive competencies to obtain competitive advantage.
- The organization should focus analysis on how a prospective new technology investment will enable a particular strategy.
2.14 Special Issues

- The moving baseline concept concerns the delayed returns associated with investments in new technology and the assumptions of not investing.
- Comparing projected net cash flows over time with current operating cash flows is not necessarily valid.
- Consequences of *not* investing may not be properly considered.
2.15 Special Issues (cont.)

- They argue that if the investment is not made, cash flows should be expected to decrease rather than stay the same.
- The fallacy surrounding the moving baseline concept is that one cannot say with any degree of certainty what the future cash flows will be like.
2.16 Bias Toward Incremental Investments

- Produced by stratified approval processes
- Purchases exceeding a certain value may require approval from higher management levels.
- The manager may give up considerable control by pursuing investments with higher complexity and dollar values.
2.17 Post-investment Audits

- The organization formally examines the progress of the investment over and at the end of its life.
- The problem with this is that the organization often has no history to rely on.
- Post-investment audits of 100% of investments in new manufacturing technology is likely unnecessary.
- Often the benefits of the investment so overwhelm the analysis, that the investment is clearly justifiable. At other times, the investment may clearly turn out to be a mistake.
Unit 3  New and Conventional Approaches

3.1 New Approaches Overview

- New methods and modifications to old ones are discussed in this unit.
- We will review the features of ROI smoothing and discounted cash flow ROI (DCFROI), bailout payback and DCF payback, and one NPV variation—PV Index.
3.2 New Approaches Overview (cont.)

- The break-even model will be applied to capital budgeting.
- New broad-based performance metrics—Economic Value Added (EVA), cash flow return on investment (CFROI), and residual cash flow (RCF).
3.3 ROI Variations

- ROI is a comparatively poor method for purposes of both performance evaluation and capital budgeting. However, two variations of ROI are sometimes used.
  - ROI smoothing
  - Discounted cash flow return on investment (DCFROI)
- Although these variations improve somewhat on traditional forms of ROI, they do so at the expense of introducing considerable uncertainty into the model.
3.4 Returns Smoothing

- Suggested to correct the problems of accelerated depreciation and delayed benefits
- Smoothing is accomplished by giving managers credit in early years for additional profits sufficient to raise the ROI to the hurdle rate established by the company.
- The additional profits are added to the investment base.
3.5 DCFROI Model

- Uses cash flows (not accrual-based profits)
- Allows a long-term approach
- Considers the time value of money
- Computed by dividing the present value of net cash inflows by the initial investment
- One of the most important disadvantages—the diluted hurdle rate problem—remains
3.6 ROI Variations

- Both ROI Smoothing and DCFROI introduce uncertainty into the performance evaluation process by insisting that reliance be placed on projected cash flows or accrual-based returns that are unknown.
- Managers are generally unwilling to reward performance based on estimates.
- While these modifications provide improvements on the basic ROI model, each is subject to the diluted hurdle rate problem.
- Because results are stated as a rate, portfolio evaluation remains difficult.

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3.7 Break-Even Analysis and Special Methods

• **Break even** analysis can be used as a substitute for NPV when considering non-competing investments in new technology.

• Here’s how it works:
  – Step one: Determine the expected cash outflows over the expected useful life of the asset.
  – Step two: Use break even analysis to determine the minimum level of monthly utilization necessary to generate cash inflows adequate to cover the expected cash outflows.
  – Step three: Judmentally consider whether the calculated utilization rate is attainable.
3.8 Break-Even Model Features

- The break-even method is similar to the NPV method in that NPV equates discounted cash inflows and outflows to determine net benefits.
- In this regard, break-even analysis presents a minimum level for a positive NPV to be attained.
- The break-even model does not use DCF techniques but can be modified to do so in a manner equivalent to NPV.
3.9 Use of Break-Even Analysis

- It can help determine the feasibility of an investment in new technology where future cash flow benefits are difficult to estimate.
- The method cannot be used for competing investments.
3.10 Bailout Payback

- A variation on the conventional payback method
- The computation uses a cumulative approach by adding the disposal value of the new equipment and the recovery of working capital at the end of each year to the annual cash flows.
- It allows an analysis of the downsize risk involved with early abandonment.
3.11 DCF Payback

- Another variation of the conventional payback model
- Known as *break even net present value*
- It is the number of years it will take to yield a NPV equal to zero
- Takes an incremental approach and determines the year (and fraction of a year) at which negative discounted net cash flows become positive
3.12 Present Value Index (PVI)

- Also known as the *profitability index* and *cost/benefit ratio*
- A variation on the NPV model where the present value of cash inflows is divided by the present value of cash outflows to provide a NPV *index*
- Employed to enable a simple ranking of competing investments
- Useful when investments of differing sizes are being compared
- Decision rule: accept a project with a PVI greater than 1 or accept the highest PVI

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3.13 Broad-Based Performance Metrics

- Two most widely-adopted macro performance metrics (as of this writing) are economic value added (EVA) and cash flow return on investment (CFROI).
- EVA is defined as the cost of capital subtracted from some form of income—a specific form of residual income (RI).
- CFROI is defined as operating cash flow divided by investment.
3.14 Metric Features

- Progression from earnings to cash flows is recognized by the CFROI metric while retaining the popular form of the return-based metric ROI.
- Residual-based metrics have increased in popularity while retaining the focus on earnings.
- Both RI/EVA and CFROI can be considered improvements from ROI by progressing to residual and cash-based forms, respectively.
3.15 RI/EVA Advantages

- Provides a unique or consistent answer
- Avoids the diluted hurdle rate problem
- Results can be added together meaningfully for multiple assets
3.16 CFROI Advantages

- Uses relevant cash flows rather than accrual income
- DCF techniques can be applied meaningfully
- Properly considers depreciation and tax effects
3.17 Residual Cash Flow (RCF)

- RCF replaces the income figure in RI/EVA with operating cash flows as used by CFROI.
- RCF enjoys the relative advantages of both of the previous metrics in that it is both cash-based and residual-based.
3.18 RCF Features

- When using RCF with capital budgeting, the analyst can incorporate DCF in the net cash inflows from the individual investment being analyzed.
- A decision rule consistent with NPV can then be employed to determine the viability of the investment.