# Capital Budgeting

**Learning Outcomes**

After completing this module, students will be able to:

1. Discuss the capital budgeting process and the importance of a formal system for project identification, selection, monitoring, and post-completion audit.
2. Determine the net present value of complex projects incorporating inflation, changes in net working capital, and taxation of terminal cash flows.

**Introduction**

A factory manager believes some of their plant’s equipment is outdated so they schedule an appointment with a major supplier. The salesperson confirms the equipment should be replaced and proceeds to describe what their company has to offer. Does the factory manager make the purchase immediately? Of course not—in addition to getting several competing bids, the manager must carefully compute whether the expected future benefits from the new equipment exceed its initial and ongoing costs on a present value basis. If they do not, then the company is failing to earn its required rate of return (RRR) and the project should not proceed.

Capital budgeting is a critical activity in any business. It helps senior management establish a long-term strategic direction for the company by evaluating different growth opportunities such as introducing new products, expanding into new markets, or acquiring competing firms. At the lower levels of the firm, it is invaluable in assessing product improvement ideas, cost-saving plans, or proposed capacity additions. Maintaining a constant flow of new investments is essential to a company’s long-term profitability and survival.

Although accountants typically take the lead in calculating a project’s net present value (NPV), specialists from the other business areas play a critical role in estimating a project’s future benefits and costs; determining an RRR that accurately reflects a project’s risk level; and ensuring a company’s strategic goals are met. This team approach results in a very thorough project evaluation that helps companies cope with the risk of high initial costs and uncertain future benefits.

* 1. **| Capital Budgeting Process**

The capital budgeting process allocates a company’s investment funds to major projects. The process becomes more elaborate as organizations become larger and the value and complexity of projects increase. Many large companies have formal capital expenditure planning committees with detailed operating procedures that approve all major capital costs. These committees generally consist of a team of experts from across the company and its different disciplines including accounting, finance, marketing, operations, and human resources. They critically review all projects from their varying perspectives to ensure that they are financially and operationally sound and consistent with the company’s strategic plans. As the size of capital expenditures decrease and become more routine, investment decision making is pushed down into a company’s divisions and departments, and the processes used to assess projects become simpler. Most organizations establish cost limits that determine which level of management has the authority to approve a project.

The five steps in the capital budgeting process include:

**Step 1–Project idea generation.**  Ideas can be found internally or by scanning the external business environment, benchmarking the company against its competitors, or acquiring innovative companies or products. Smaller investment proposals may originate at the department level among junior managers and line workers that are formed into autonomous work teams. As projects grow in value, divisional and corporate management becomes more involved. Pay and human resource systems at all levels should be designed to encourage employees to contribute.

**Step 2–Screening of proposals.** Before committing to an expensive evaluation of a project, the capital expenditure planning committee or senior management will review the project to ensure it has a reasonable chance of success and is consistent with the company’s strategic plans.

**Step 3–Project evaluation.** A project’s profitability is determined using different evaluation methods including payback period, discounted payback period, accounting rate of return (ARR), net present value (NPV), internal rate of return (IRR), or profitability indexes (PI). In addition to a thorough quantitative analysis, business units must also prepare a written description and justification which describes how the project supports the organization’s strategic goals. All forecasts should be consistent with a common economic outlook provided by the company.

**Step 4–Preparation of the capital budget.** All unprofitable or strategically undesirable projects are eliminated, and the remaining projects are ranked based on their profitability along with any resource constraints such as a lack of funding or manpower availability. Some projects are mandatory and must be done to comply with health and safety or environmental regulations in which case the goal to complete the project efficiently. Others may lose money but are accepted anyway for strategic reasons to give the company exposure to a new industry, or to develop new competencies in hopes of earning positive returns in the future. Pet projects championed by influential managers that usually do not go through the normal approval process or are approved based on overly optimistic projections should be avoided.

**Step 5–Monitoring and post-completion audits.** During implementation, a project must be monitored on an ongoing basis to ensure that construction targets are met, there are no cost overruns, and key inputs such as the price of the product do not need to be adjusted. If problems arise, the company has to decide whether to stay the course, alter its plans, or abandon the project. Post-completion audits also occur at the end of a project to help improve a company’s capital budgeting system. Benefits include:

* Ascertains why variations between planned and actual performance occurred so any lessons learned can be applied to current and future projects.
* Strengthens a manager’s estimating abilities by holding them accountable for their forecasts and project selections.
* Detects biases by managers who consistently overestimate benefits or underestimate costs.
* Discourages pet projects by influential managers.
* Provides an excellent training opportunity for new managers that can be part of their performance review.
* Provides an excellent source of new project ideas.
* Ensures the projects selected are consistent with the firm’s strategic plans.

Monitoring and post-completion audits should be conducted by individuals who are not involved in the project selection process to ensure their objectivity and help eliminate the psychological and internal political barriers to cancelling a project. Once a manager or business unit receives approval for a project, they are very hesitant to admit that they might have made a mistake and relinquish resources. Losses will continue longer than necessary especially if these managers can use their connections within the organization to gather support.

**Project Evaluation Methods**

There are six methods companies use to evaluate capital projects. Most use cash flow instead of accounting estimates which are heavily influenced by the accounting policies a firm has adopted.

**Payback period.** This is the time it takes to recover a project’s initial investment from its future cash flows. Companies may decide to only accept projects with a payback period below some specified cut-off point such as five years or use it to supplement other evaluation methods like NPV or IRR. The advantages of this approach are that it is 1) simple to use, 2) easy to understand and 3) conservative meaning it controls risk by measuring how quickly a company gets back its initial investment. Its disadvantages are 1) it does not use present value leading to faulty decisions, 2) the riskiness of the project is not reflected in the discount rate, 3) the cut-off point is arbitrarily selected, 4) it only measures a project’s breakeven point resulting in a bias against long-term projects with extended payback periods but higher overall profitability, and 5) it focuses too much on breaking even and not earning a profit which is the reason for going into business.

**Exhibit 1: Failure to Consider the Time Value of Money**

|  |  |  |
| --- | --- | --- |
| **Period** | **Project 1** | **Project 2** |
| 0 | CAD (40,000) | CAD (40,000) |
| 1 | 20,000 | 10,000 |
| 2 | 10,000 | 10,000 |
| 3 | 10,000 | 20,000 |
| 4 | 50,000 | 50,000 |
| **Payback** | **3 Years** | **3 Years** |
| **NPV** | **CAD 31,782** | **CAD 30,461** |
| Projects have the same payback period but Project 1 is more profitable due to the time value of money so it is the preferred project. The total cash flows of the two projects are the same, but Project 1 is more profitable because its cash inflows are received quicker. | | |

**Exhibit 2: Bias Against Long-term Projects**

|  |  |  |
| --- | --- | --- |
| **Period** | **Project 1** | **Project 2** |
| 0 | CAD (30,000) | CAD (30,000) |
| 1 | 20,000 | 10,000 |
| 2 | 10,000 | 10,000 |
| 3 | - | 10,000 |
| 4 | - | 20,000 |
| **Payback** | **2 Years** | **3 Years** |
| **NPV** | **CAD (2,908)** | **CAD 10,472** |
| Project 1 has a shorter payback period but loses money on a present value basis. Project 2 has a longer payback period but earns a much higher profit so it is the preferred project. | | |

**Discounted payback period.** This is the time it takes to recover a project’s initial investment from its discounted future cash flows. The advantages and disadvantages of this method are similar to the payback period method except present value is used and the discount rate can be adjusted to reflect varying levels of risk. If a project pays back its investment on a discounted basis it will make a profit, but it still may be rejected if the arbitrary cut-off point is not reached.

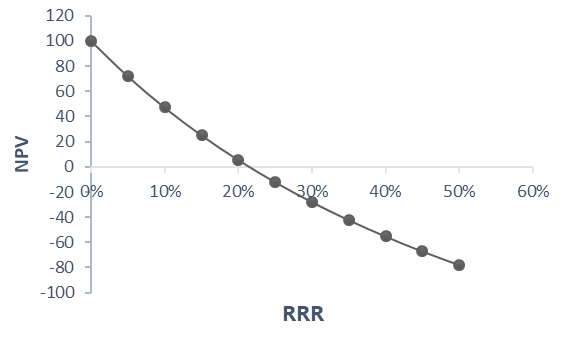
**Accounting rate of return (ARR).** It is a project’s average net income divided by the average assets used to earn that income over its life. This is the only method that uses accounting instead of cash flow estimates to determine a project’s rate of return. Even though this approach does not use cash flows or present value, it is popular among managers because it shows how a proposed project will affect a company’s rate of return assets over the life of the project.

**Net present value (NPV).** This is the present value of a project’s future cash flows minus the initial investment or its profitability in dollar terms. The discount rate used to determine the present value of future cash flows is the RRR that investors require to be fairly compensated for a project’s risk. A project with a positive NPV is generating a higher return than the RRR or what economists call excess profits. In competitive markets, there should be minimal excess profits due to the entry of new competitors. The advantages of this method are NPV is in dollars so it can be added directly to the company’s market value to determine the effect on the share price. Also, the RRR can be adjusted to reflect the varying risk levels of different projects or specific cash flows within a project. To maximize a company’s share price, all positive NPV projects should be accepted. Excel provides a function to calculate a project’s NPV.

**Internal rate of return (IRR).** This a project’s rate of return that equates its initial investment with its future cash flows. If the IRR was used as the RRR, a project’s NPV would be zero. The difference between the IRR and RRR is the project’s excess profits expressed as a percentage. Some companies prefer IRR because it is easier to communicate than NPV which is in dollars. IRR can also be used if a company cannot accurately estimate its RRR. Its disadvantages are IRR cannot be adjusted for the risk of a specific project or its cash flows like the RRR. Also, IRR has several mathematical problems that may result in the wrong project being selected. Excel provides a function to calculate a project’s IRR.

The NPV and IRR approaches are very similar. To relate these two methods, analysts sometimes create an NPV profile that graphical shows a project’s NPV at different RRRs and its IRR. Exhibit 3 shows a project with an initial investment of CAD 300 that generates yearly cash flows of CAD 200 over two years.

**Exhibit 3: NPV Profile**



IRR – 22%

**Profitability index (PI).** This is the ratio of the present value of a project’s future cash flows to the initial investment. A project with a profitability index higher than 1.0 has a positive NPV.

NPV is the preferred method for evaluating capital projects especially by large companies who better understand the limitations of the other approaches. Payback and IRR are used to supplement NPV but are typically not the primary methods because of the mathematical problems with the IRR. The remainder of this module will focus on the NPV method after carefully considering these problems.

**Mathematical Problems with IRR**

The IRR method’s mathematical problems are the re-investment rate used for the cash flows generated by the project, the potential for multiple IRRs, and faulty decisions when choosing between mutually exclusive projects.

**Re-investment rate.** IRR is the rate of return that equates a project’s initial investment with its future cash flows. This method assumes that when cash flows are received over a project’s life that they are reinvested at the IRR. In practice, this assumption may not be accurate as funds will likely be re-invested in other capital budgeting projects or investments with varying rates of return. If the rate of return on the project and the re-investment rate are expected to be materially different, then a modified IRR (MIRR) should be calculated. Using this method, the future values (i.e. not present value) of all recurring cash flows are calculated at the end of the project’s life using the re-investment rate. The interest rate that equates the total of these future values with the initial investment is the project’s modified IRR. The re-investment rate is usually assumed to be the RRR as this is what a firm will earn on average on all its projects if markets are competitive. Excel provides a function to calculate a project’s MIRR.

**Multiple IRRs.** As the RRR rises, a project’s NPV should logically fall. As the example in Exhibit 4 shows, this is not true if the cash flows are non-conventional which means they switch signs over a project’s life. The sign may change if a company expects to lose money at different points possibly during a major product retrofit or if it must incur significant costs to restore a mine or factory site at completion.

**Exhibit 4: Understanding Multiple IRRs**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **RRR**  **(%)** | **Cash Flows (CAD)** | | | | | **Difference**  **(CAD)** | **NPV**  **(CAD)** |
| **Year 0** | **Year 1** | | **Year 2** | |
| 0.0 | -58.00 | +149.00 | % Change | -94.00 | % Change | +55.00 | -3.00 |
| 11.4 | -58.00 | +133.75 | -10.23% | -75.75 | +19.41% | +58.00 | +0.00 |
| 26.2 | -58.00 | +118.07 | -11.72% | -59.02 | +22.09% | +59.05 | +1.05 |
| 45.5 | -58.00 | +102.41 | -13.26% | -44.40 | +24.77% | +58.00 | +0.00 |
| 50.0 | -58.00 | +99.33 | -3.01% | -41.78 | +5.90% | +57.56 | -0.44 |

In this example, the project has a negative NPV at an RRR of 0.0%, but then the NPV rises as the RRR rises. This is because the present value of the positive cash inflow in Year 1 falls as the RRR rises, but the negative cash outflow in Year 2 rises at a faster percentage rate as it is further in the future. If the negative cash flow in Year 2 rises at a faster rate, then the difference between the Year 1 and Year 2 cash flows will become more positive causing the NPV to rise. If the RRR rises to 11.4%, the project will breakeven after which the NPV will become positive. The NPV will remain positive until the RRR reaches 45.5% when the NPV will become negative again. This is because the benefit from the different rates of change in the positive and negative cash flows decreases as the RRR rises and is eventually surpassed by the decline in present value due to the increase in the RRR.

Again, the IRR is the RRR that results in an NPV of zero. Since the NPV was zero at both an RRR of 11.4% and 45.5%, this means there are two IRRs. The maximum number of IRRs is equal to the number of times the sign of the cash flows changes. The actual number depends on the magnitude of the individual cash flows which will vary with each project. There is usually only one IRR, but users should be aware of potentially confusing results. Using the MIRR instead of the IRR will eliminate the multiple IRR problem.

**Mutually exclusive projects.** IRR and NPV methods give conflicting results when deciding between two mutually exclusive projects. Consider the projects in Exhibit 5:

**Exhibit 5: Deciding Between Two Mutually Exclusive Projects**

|  |  |  |
| --- | --- | --- |
| **Year** | **Project 1** | **Project 2** |
| 0 | -CAD 220 | -CAD 220 |
| 1 | 100 | 30 |
| 2 | 80 | 70 |
| 3 | 80 | 110 |
| 4 | 60 | 130 |
| **Total Cash Inflows** | **CAD 320** | **CAD 340** |
| **IRR** | **18%** | **16%** |

|  |  |  |
| --- | --- | --- |
| **RRR** | **Project 1**  **NPV (CAD)** | **Project 2**  **NPV (CAD)** |
| 0% | 100.00 | 120.00 |
| 5% | 66.27 | 74.04 |
| 6% | 60.23 | 65.93 |
| 7% | 54.41 | 58.15 |
| 8% | 48.79 | 50.67 |
| 9% | 43.36 | 43.48 |
| 10% | 38.11 | 36.56 |
| 15% | 14.35 | 5.67 |
| 20% | -5.88 | -20.04 |

Project 1 has a higher IRR than Project 2, but Project 2 has a higher NPV up to an RRR of 9%. After 9%, Project 1 has the higher NPV of the two projects. The NPV results change because even though Project 2 has higher total cash inflows, they are further in the future so are more greatly affected by an increase in the RRR. As the RRR rises, Project 2’s NPV will fall faster than Project 1’s NPV until Project 1 eventually has the highest NPV. Because of this problem, the NPV method should always be used to choose between mutually exclusive projects.

* 1. **| Applying NPV Analysis**

**Types of Capital Budgeting Decisions**

There are two general types of capital budgeting decisions.

**Replacement.** NPV measures the difference in cash flows between two alternatives which are continuing to operate an existing asset or replacing it with another more efficient asset.

**Standalone.** NPV measures the difference in cash flows between two alternatives which are to do nothing or to expand/change a company’s operations in some way.

Data must be collected for both alternatives in a replacement decision. No information is needed for the do-nothing alternative in a standalone decision. NPV in each case will measure how much better or worse a company will be if they undertake the project.

Projects can also be classified as independent, mutually exclusive, or contingent. Independent means they can be accepted along with any other project. Mutually exclusive means two or more projects cannot be done together as they are likely options to accomplish the same task. Contingent means one project has to be completed before another product can begin.

**NPV Checklist**

When using the NPV method, the following checklist helps ensure that all relevant cash outflows and inflows are considered:

**Initial cash flows**

* 1. Cost of assets (cash outflow)
  2. CCA tax shield on assets (cash inflow)
  3. Increase or decrease in NWC (cash outflow or inflow)

**Recurring cash flows**

* 1. Incremental after-tax net cash flows (cash inflow)

**Terminal cash flows**

* 1. Disposal value of assets (cash inflow)
  2. Lost tax shield on disposal of assets (cash outflow)
  3. Return of NWC to previous levels (cash inflow or outflow)
  4. Decommissioning costs (cash outflow)

Initial cash flows occur at the start of a project and include the cost of any fixed assets and the tax savings that are realized from claiming depreciation on these assets. Most new projects also require additional net working capital (NWC) although sometimes NWC will fall if more efficient equipment is purchased that operates faster or is less prone to break down. Recurring cash flows include the after-tax net cash flows expected on an ongoing basis over a project’s life. These can come from selling new products, selling additional units of existing products, price increases, or cost reductions. Terminal cash flows occur at the end of a project. They include the proceeds from any asset disposals and the lost tax savings from no longer being able to claim depreciation on these amounts. NWC will also return to previous levels. In some industries, companies have to incur considerable decommissioning costs closing down a factory or mine and potentially rehabilitating the site to prevent future environmental problems.

**Estimating Cash Flows**

When estimating and discounting cash flows using the NPV method, there are several important principles to remember.

1. **Include relevant incremental after-tax cash flows.** Only incremental cash flows that specifically relate to a project are relevant in NPV analysis. These cash flows measure the actual costs incurred and benefits received at specific points in time over a project’s life and are not affected by the accounting policies adopted. Determining the effect of taxation on cash flows can be difficult but these amounts are usually significant so they cannot be ignored. Be careful not to miss any relevant cash flows or double count them.
2. **Use opportunity cost.** Projects sometimes use assets that a company already owns. The cost of these assets is not their current net book value but their opportunity cost. Opportunity cost is the price that outsiders are willing to pay for an asset, so it is what the company is giving up when the asset is used in a project. It is determined by an asset’s best alternative use. For example, if a patent was purchased for CAD 50,000, but an outsider is willing to pay CAD 100,000, then CAD 100,000 is what should be included as the initial cost in NPV analysis. If CAD 10,000 is all the company can negotiate, then that amount should be included.
3. **Ignore sunk costs.** Sunk costs are expenditures that cannot be recovered through a sale. Because they cannot be recovered, they are not relevant to a decision. Management accountants say “a sunk cost is no cost.” For example, if a company has already spent CAD 50,000 on a feasibility study for a new project, no cost should be included in NPV analysis unless it can be recovered by selling it to an outside group that is interested in taking over the project. NPV should only include a project’s future costs and benefits and not any sunk costs.
4. **Incorporate side effects.** Consider whether a proposed project will cannibalize or stimulate sales of existing company products. If so, their lost or additional contribution margins should be included in the NPV analysis. Also, consider how competitors will respond such as by lowering prices or entering the new market. With competition, most excess profits will usually disappear.
5. **Consider qualitative factors.** A project may have negative side effects like lowering employee morale due to layoffs, environmental problems, or community or political opposition that are difficult to quantify. These factors should be considered and may cause a profitable project to be rejected.
6. **Be cautious of overhead allocation.** Allocations of existing factory or corporate overhead should be ignored. Only include increased overhead caused by the project and be careful not to underestimate the additional expenditures that will be required.
7. **Ignore financing costs.** Financing costs such as interest paid to debt holders and dividends payments to equity investors should not be included as cash outflows since they are already reflected in the RRR used to determine a project’s NPV. The only exception is issuance costs relating to any new debt or equity raised to finance the project as these costs are usually not be included in the RRR.
8. **Apply the correct discount rate**. RRRs are typically nominal interest rates that include inflation, so future cash flow estimates must incorporate inflation as well otherwise the project’s NPV will be understated. RRR should reflect the riskiness of the proposed project and not the company’s overall cost of capital which is the average of all its existing business units. RRR should also not be the cost of any financing specifically used to fund the project such as a new loan.

**Capital Cost Allowance**

Under the Income Tax Act (ITC), businesses must use capital cost allowance (CCA) as their depreciation method for tax purposes. CCA is a declining-balance depreciation method that categorizes assets into one of 18 different classes. The cost of the individual assets in each class are pooled together to calculate CCA. Each class has a depreciation or CCA rate that is applied to the declining balance or undepreciated capital cost (UCC). This rate generally reflects the expected life of the class’s assets (i.e. longer-lasting assets have lower rates) but other considerations such as stimulating investment may result in higher rates (sometimes 100%) and a faster tax write-off.

Most asset classes are subject to the half-year rule which only allows half of the net acquisitions to be included in the class each fiscal year with the remainder added in the subsequent year. Net acquisitions are the net of all asset purchases and sales. The half-year rule was introduced because companies regularly bought assets at yearend but still claimed a full year’s CCA. For convenience, instead of requiring companies to prorate CCA based on the date of purchase, the half-year rule assumes all assets are bought halfway through the year. A typical asset class might look like in Exhibit 6:

**Exhibit 6: Mechanics of a CCA Pool**

|  |  |
| --- | --- |
| **Acquisitions and Disposals** | |
| Sales of assets | CAD 7,000 |
| Acquisitions | CAD 31,000 |
| Net acquisitions | CAD 24,000 |
| CCA rate | 20% |
| **CCA Class** | |
| UCC beginning | CAD 28,000 |
| Half of net acquisitions | 12,000 |
| Balance | 40,000 |
| CCA – Year 1 | (8,000) |
| UCC ending | CAD 32,000 |
| Half of net acquisitions | 12,000 |
| Balance | 44,000 |
| CCA – Year 2 | (8,800) |
| UCC ending | CAD 35,200 |

Although CCA is a non-cash expense and should not be deducted in calculating NPV, being able to deduct CCA for tax purposes does reduce taxes payable which is a cash inflow. This benefit is referred to as the CCA tax shield and its present value over an asset’s life can be calculated using the formula:

Present value of CCA tax shield = (Investment) (Marginal tax rate) () ()

There are a few asset classes that do not use the declining balance method and the half-year rule to calculate CCA. For example, Class 14 assets (franchises, concessions, patents, and licences) are amortized on a straight-line basis over the life of the property with a full year’s CCA in the year of acquisition. The present value of the CCA tax shield has to be calculated separately for these classes.

* 1. **Incorporating Inflation**

In developed economies, central banks typically have a general inflation target of 2.0% per year but in developing markets inflation can be much higher. It is unreasonable to assume that inflation is negligible.

Inflation is incorporated into NPV analysis using either the nominal or real approaches. With the nominal approach, recurring and terminal cash flows are expressed in future dollars which includes an allowance for inflation. To be consistent, the RRR must be expressed in nominal terms meaning it has an inflation component. With the real approach, future cash flows are expressed in today’s dollars so no adjustment is made for inflation. Since inflation is not included in future cash flows, it must be taken out of the discount rate resulting in a real RRR. Companies must be careful not to mix up the two methods by expressing all cash flows in today’s dollars while using a nominal RRR.

Rates of return are normally expressed nominally in the financial markets, so the inflation component must be removed from the RRR if the real approach is adopted. If the nominal RRR was 8.0% and inflation was 2.0%, then the real RRR would be 6.0%. This real RRR is only an approximation. An exact rate can be calculated using a formula referred to as the Fischer Effect:

Nominal rate = (1 + Real rate) x (1+ Inflation rate) – 1

0.08 = (1.0 + Real rate) x (1.0 + 0.02) – 1.0 Real rate = 0.0588 or 5.88%

This formula recognizes that investors must be compensated for inflation on both the original investment (as represented by 1.0 in the formula) as well as the real rate earned during the year. The difference between the Fischer Effect formula and just subtracting the real rate and the inflation rate is small, so the Fischer Effect is often ignored.

When incorporating inflation, do not assume the same inflation rate applies to all cash inflows and outflows. Even though the general inflation rate of the economy might be 2.0%, the inflation rate for individual cash flows can vary. For example, commodity prices can change dramatically due to shifts in supply and demand and geopolitical forces. Accurate inflation or price forecasts relating to all key inputs and outputs are essential.

Inflation is also problematic for businesses because once any capital costs are added to a CCA pool, they are not subsequently indexed for inflation. This reduces the value of the tax benefits companies receive from deducting CCA. The federal government has considered indexing the value of CCA pools to counter this effect but has decided against it due to the magnitude of lost tax revenues.