# 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, ongoing changes in net working capital, and the taxation consequences of terminal cash flows.
3. Ration limited investment capital among competing capital projects to maximize returns.
4. Illustrate how capital projects of varying lives can be compared.
5. Incorporate risk in the capital budgeting process using the minimum payback period, risk-adjusted discount rates, sensitivity analysis, scenario analysis, simulation, and decision trees with management options.
6. Solve capital budgeting projects using advanced techniques such as spreadsheets.

**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A factory manager believes some of their plant’s equipment is outdated so they schedule an appointment with a major supplier.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 decreases and they 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 not any 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.

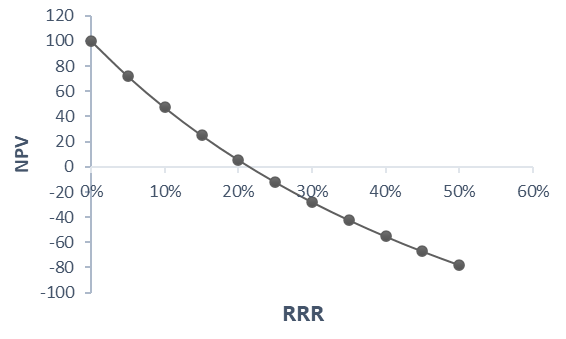
**Accounting rate of return (ARR).** It is a project’s average net income divided by the average assets used to earn that income over its life. This is the only method that uses accounting instead of cash flow estimates to determine a project’s rate of return. Even though this approach does not use cash 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 costs 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.

* 1. **| Capital Rationing**

The general rule in capital budgeting is a company should accept all projects with a positive NPV, but this is not always possible. At the divisional level, managers normally receive a limited budget to spend on capital items. If this budget is insufficient to finance all profitable projects, then the division will have to decide how to best allocate or ration these limited funds to maximize the total NPV. When capital rationing is done at the divisional level, it is referred to as soft rationing.

If divisions are underfunded, it would be logical for a company to simply raise more capital for them. As a company’s assets grow, they are financed with a combination of debt and equity subject to the company’s optimal capital structure as not to overleverage the firm. Raising new capital, especially equity is not always easy. Stock markets can be undervalued for an extended period making it ill-advised to issue new shares. Even if stock markets are fairly valued, companies have an aversion to issuing new equity due to high issuance costs and potential control problems. Retained earnings may be insufficient to fund maximum growth given a desired level of dividends, so a company may have no choice but to reduce its growth and ration its limited capital to maximize NPV. A company could also have difficulty raising new funds if it is experiencing financial distress or its loan conditions prevent any additional borrowing. Sometimes, the limitation on the size of the capital is not due to a lack of financing, but a shortage of other non-financial resources such as human capital including qualified executives, engineers, or marketing specialists. When capital rationing is done at the corporate level, it is referred to as hard rationing.

**Capital Rationing Using Solver**

If a company has a large number of positive NPV projects to choose from, it would be very difficult to determine which combination maximizes NPV manually. For this, the Solver feature in Excel is an excellent tool. To demonstrate capital rationing using Solver, enter the spreadsheet in Exhibit 7 containing the initial investment and NPV for five different projects along with the formulas. The total amount available to spend on all capital projects is CAD 2,500,000 and Projects A and B are mutually exclusive meaning they cannot both be done. All other projects are independent of each other.

**Exhibit 7: Capital Rationing Using Solver**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **A** | **B** | **C** | **D** | **E** | **F** |
| **1** | **Project** | **Initial**  **Investment** | **NPV** | **Selection** | **Investment** | **NPV** |
| **2** | A | 1,000,000 | 700,000 |  | =D2\*B2 | =D2\*C2 |
| **3** | B | 2,000,000 | 1,000,000 |  | =D3\*B3 | =D3\*C3 |
| **4** | C | 500,000 | 100,000 |  | =D4\*B4 | =D4\*C4 |
| **5** | D | 500,000 | 85,000 |  | =D5\*B5 | =D5\*C5 |
| **6** | E | 500,000 | 75,000 |  | =D6\*B6 | =D6\*C6 |
| **7** |  |  |  | **Total** | = Sum (E2...E6) | = Sum (F2…F6) |

Open Solver under the Data tab in Excel. In the drop box, complete the following:

**Maximize F7.** Done by setting F7 as the objective function and instructing Excel to maximize that value. F7 is the total NPV of all the projects selected.

**By changing variable cells D2:D6.** Excel will select all possible combinations of D2:D6 subject to any constraints.

**Constraints.**

* **D2:D6 = Binary.** Excel will only select combinations where D2:D6 are either “1” or “0”. A “1” means the project is selected, while “0” means it is not.
* **A7 ≤ 1.**  Cell A7 equals the addition of D2 and D3 which can only be “0” or “1” if Project A and B are mutually exclusive.
* **E7 ≤ CAD 2,500,000.** Excel will not consider a combination of projects if E7 exceeds the total capital budget of CAD 2,500,000. E7 is the total investment in all projects selected.

**Solve.** Excel maximizes F7 subject to the constraints and selects Projects B and C with a maximum NPV of CAD 1,100,000.

Instead of using Solver, some companies rank projects based on either their PI or IRR and simply go down the list accepting projects until the capital budget is completely spent. This approach should not be used as it can generate a group of projects that do not maximize NPV. Exhibit 8 contains the same example using a PI ranking.

**Exhibit 8: Capital Rationing by Ranking PIs**

|  |  |  |  |
| --- | --- | --- | --- |
| **Project** | **Initial Investment**  **(CAD)** | **Present Value**  **(CAD)** | **PI** |
| A | 1,000,000 | 1,700,000 | 1.70 |
| B | 2,000,000 | 3,000,000 | 1.50 |
| C | 500,000 | 600,000 | 1.20 |
| D | 500,000 | 585,000 | 1.17 |
| E | 500,000 | 575,000 | 1.15 |

Based on the PI ranking, Projects A, C, D, and E should be chosen. The entire capital budget of CAD 2,500,000 is spent and projects A and B, which are mutually exclusive, are not both selected. As can be seen in Alternative 1 and 2 below, the selection of A, C, D, and E does not maximize NPV though. Alterative 2 maximizes NPV because even though Project B has a slightly lower PI than Project A, the lower PI is earned on a larger investment of CAD 2,000,000 versus CAD 1,000,000 leading to a higher overall NPV.

**Exhibit 9: Incorrect Ranking Using PIs**

|  |  |  |  |
| --- | --- | --- | --- |
| **Alternative 1** | | | |
| **Project** | **Initial Investment (CAD)** | **Present Value (CAD)** | **NPV**  **(CAD)** |
| A | 1,000,000 | 1,700,000 | 700,000 |
| C | 500,000 | 600,000 | 100,000 |
| D | 500,000 | 585,000 | 85,000 |
| E | 500,000 | 575,000 | 75,000 |
| **Total** | **2,500,000** | **3,460,000** | **960,000** |
| **Alternative 2** | | | |
| **Project** | **Initial Investment**  **(CAD)** | **Present Value**  **(CAD)** | **NPV**  **(CAD)** |
| B | 2,000,000 | 3,000,000 | 1,000,000 |
| C | 500,000 | 600,000 | 100,000 |
| **Total** | **2,500,000** | **3,600,000** | **1,100,000** |

* 1. **| Comparing Projects of Varying Lives**

Much of the equipment a company buys such as water pumps or metal lathes are needed on an ongoing basis and must be replaced several times in succession as assets wear out. A problem in analyzing these types of capital projects is that the equipment options being considered likely have different economic lives thus making a comparison of their NPVs difficult. Two similar methods for dealing with this problem are chaining and equal annual annuity (EAA). To demonstrate these methods, consider the example in Exhibit 10 of two mutually exclusive equipment options with an RRR of 10.0% and varying lives of three and six years.

**Exhibit 10: Chaining and EAA**

|  |  |  |
| --- | --- | --- |
| **Year** | **Equipment A**  **(CAD)** | **Equipment B**  **(CAD)** |
| 0 | -25,000 | -21,000 |
| 1 | 11,640 | 7,325 |
| 2 | 11,640 | 7,325 |
| 3 | 11,640 | 7,325 |
| 4 |  | 7,325 |
| 5 |  | 7,325 |
| 6 |  | 7,325 |

**Chaining**

The lowest common multiple for the lives of the two equipment options is six years. To meet its needs for six years, the company has to purchase Equipment A twice or Equipment B once. For Equipment A, NPV for the first three-year period is added to NPV for the second three-year period. NPV for the second three-year period is discounted for three years since its implementation is deferred. For Equipment B, NPV is calculated for six years. The option with the highest total NPV is selected.

**Equipment A**

First 3-year period: 11,640 () – 25,000 = 3,946.96

Second 3-year period: = 2,965.41

Total NPV: 3,946.96 + 2,965.41 = 6,912.37

**Equipment B**

Total NPV: 7,325 () – 21,000 = 10,902.28

Equipment Option B is preferred.

**EAA**

Calculate an annual annuity that is equivalent to the NPV of Equipment A and B. The equipment option with the highest annual annuity is preferred as this annuity will be earned each year regardless of how many times the project is undertaken.

**Equipment A**

NPV: 11,640 () – 25,000 = 3,946.96

EAA: 3,946.96 = P () P = CAD 1,587.13

**Equipment B**

NPV: 7,325 () – 21,000 = 10,902.28

EAA: 10,902.28 = P () P = CAD 2,503.24

Equipment Option B is preferred.

The chaining and EAA methods can be used to choose between mutually exclusive projects that repeat themselves in the future. The method should not be used to compare one-time projects with different lives. Also, for the project that will be repeated, analysts may want to include in the analysis any expected changes in asset’s replacement cost caused by inflation or changes in technology that will make the newer asset more efficient or profitable. In practice, the materially principle and the ability to make accurate estimates should be considered before going into this level of detail.

* 1. **| Changes in NWC**

Previously, any additional NWC relating to a proposed capital project was classified as an initial cash outflow. When the NWC was liquidated at the end of the project, it was classified as a terminal cash inflow. This treatment is an over-simplification as NWC changes continuously as sales change over a project’s life and not just at the beginning and end of the project. Sales typically rise quickly but then level out and eventually fall based on a product’s or business’s life cycle. Changes in NWC each period can be estimated using the financial ratio:

This ratio is equivalent to:

Sales estimates for the proposed project are available. The relationship between sales and NWC as measured by NWC turnover is assumed to remain constant or may be adjusted to reflect the project’s varying NWC requirements. Knowing sales and NWC turnover, a project’s NWC needs each period can be calculated and the change included as either a cash inflow or outflow.

* 1. **| Taxation Effects of Terminal Cash Flows**

With large capital projects involving land, building, equipment, and government assistance, determining the relevant cash flows including the tax effects can be complex.

**Land.** A negative cash flow is included when land is purchased at the beginning of a project and a positive cash flow is recognized when it is sold at the end. The land is a non-depreciating asset so there are no CCA tax savings, but there is a tax effect relating to any capital gain or loss recognized on the sale of land that must be included in NPV. Under the ITA, only 50% of capital gains are taxable and only 50% of capital losses can be applied to reduce other capital gains to zero that year. If taxable capital gains are insufficient to absorb all taxable capital losses in that tax year, the losses can be applied to taxable capital gains going back three years and forward indefinitely until they are fully realized. By only taxing half of the capital gains, the government is encouraging risk-taking and recognizing that a significant portion of the capital gain is due to inflation.

**Building.** A negative cash flow is included when a building is purchased at the beginning of a project and a positive cash flow is recognized when it is sold at the end. A building is a depreciating asset so the present value of the CCA tax savings is recognized. When the building is sold, the sale price is deducted from the class’s UCC, and either a recapture or terminal loss is realized. If the building is sold above its original cost, the original cost is instead deducted from the CCA pool, and a capital gain is recognized on the additional amount received. Capital losses cannot occur on depreciable assets. The tax effects of any recaptures, terminal losses, or capital gains are included in NPV.

**Equipment.** A negative cash flow is included when equipment is purchased at the beginning of a project and a positive cash flow is recognized when it is sold at the end. Equipment is a depreciating asset so the present value of the CCA tax savings is recognized. When equipment is sold, the sale price is deducted from the appropriate class’s UCC. A terminal loss or recapture can occur. If the equipment is sold above its original cost, the original cost is instead deducted from the class’s UCC and a capital gain is calculated on the difference. Capital losses cannot occur on depreciable assets. Capital gains on equipment are rare because they generally depreciate unlike land and many buildings.

**Government assistance.**  Both federal and provincial governments provide investment tax credits (ITCs) to encourage economic growth. ITCs are for investments such as new buildings and equipment, research and development, resource exploration, or employee training. They are expressed as a percentage of the eligible expenditures and are paid by reducing taxes payable. When ITCs are given for the purchase of buildings or equipment, the capital cost added to the CCA class is reduced by the amount of the assistance, so the company does not benefit twice. Government assistance is also given in the form of cash grants or wages, rent, interest, and property tax subsidies. The related cash flows should be reduced by the amounts of these payments.

**More on Terminal Losses and Recaptures**

A terminal loss occurs when an asset class’s UCC is positive and no assets are remaining in the class. The positive UCC indicates that a company has not taken enough depreciation in the past and can now recognize a tax benefit equal to the class’s UCC times the company’s marginal tax rate. Terminal losses can occur with buildings because each building is held in a separate class which must be close out when that building is sold. They are far less likely with equipment as the classes generally contain several different pieces of equipment meaning the class is rarely empty.

Recaptures occur whenever an asset class’s UCC is negative regardless of whether the class is empty or not. The negative UCC indicates that a company has taken too much depreciation in the past and now must pay taxes equal to the class’s UCC times the company’s marginal tax rate. Recaptures occur can with buildings because, even though they are depreciable assets, they frequently appreciate leading to a negative UCC when the asset is sold. Recaptures are far less likely to occur with equipment because of the positive UCC in the class relating to other assets in the pool and equipment generally does not appreciate. If the company is growing at a reasonable rate, this UCC should be sufficient to absorb any asset sales. Even if it is not, good tax planners will arrange to buy needed assets that year so the UCC remains positive thus preventing any recaptures.

As discussed, the tax effects of any capital gains, terminal losses, or recaptures relating to equipment must be included in NPV but they are rare. What must be included is the present value of future CCA tax savings relating to the difference between the UCC of the piece of equipment being sold and the amount received from its sale. If this difference is positive, the company will continue to benefit from future CCA tax savings, but if negative, they will lose future CCA tax savings.

* 1. **| Managing Risk**

Capital budgeting is an uncertain process. Companies may be able to estimate a project’s initial cash flows with a high degree of certainty, but recurring and terminal cash flows that are five, ten, or fifteen years away are much more difficult to forecast. Because of this uncertainty, projects that were initially thought to be profitable may lose money for the company. This risk cannot be avoided, but it can be reduced. Common methods for managing risk include:

**Establish a minimum payback period.** Although NPV should be the primary method used to evaluate projects, companies can adopt a low discounted payback period cut-off point to reduce the risk of losing money. Only projects that meet this more conservative target are considered.

**Subjectively adjust the RRR.**  Introducing a new product in an unfamiliar market is riskier than replacing existing equipment. If a company uses its weighted average cost of capital as the RRR, the average level of risk for all its current projects is captured. The RRR can be subjectively adjusted upwards or downwards by management to reflect the risk of a specific project as in Exhibit 11.

**Exhibit 11: Adjusting RRR for Project Risk**

|  |  |  |  |
| --- | --- | --- | --- |
| **Project Risk Category** | **Project Types** | **Adjustment** | **WACC** |
| High | New product expansions | +3.0% | 12.0% |
| Medium | Cost savings projects  Existing product expansions | -0.0% | 9.0% |
| Low | Equipment replacement | -2.0% | 7.0% |
| Note: Company’s weighted average cost of capital is 9.0%. | | | | |

**Use sensitivity or scenario analysis.** Understanding the effect that changes in key variables like price or sales growth have on NPV, IRR, or discounted payback period can help companies better manage project risk. Sensitivity analysis can be conducted using the Data Tables feature in Excel to see the effect of changing one variable at a time on NPV. Excel’s Scenario Manager provides companies the option to define several scenarios consisting of numerous variables and also provides a scenario summary report. The best-case, worst-case, most-likely case scenarios are commonly used in business forecasting.

**Use simulation.** This technique is an advanced form of scenario analysis where a large number of variables are selected. A probability distribution is determined for each variable including its mean and standard deviation. By conducting a large number of “runs” where all variables change concurrently based on their probability distributions, a more reliable estimate of the project’s NPV distribution can be made. The mathematical complexity of this method limits its use, but it is becoming more common in practice. A simulation add-in in Excel called @Risk is available.

**Incorporate management options using decision trees.** Selecting a project is not a one-time decision requiring a company to make the entire investment upfront. Large projects are usually divided into multiple stages with specific spending commitments at each stage. Management only proceeds from one stage to the next if further investment is warranted based on new information such as proof of technical or market feasibility or customer demand. Managers also make other decisions after the commencement of the project based on additional information that increases the project’s NPV and reduces the risk of losing money. These decisions are called management or real options and typically include:

**Abandonment**. Scale back or abandon a project before the end of its life if sufficient demand does not materialize or costs are higher than expected.

**Timing**. Slow or accelerate the implementation of a project in reaction to new information.

**Growth**. Expand a project by increasing existing capacity, entering additional markets, or adding complementary products if demand is higher than expected.

**Flexibility**. Vary prices, inputs, outputs, and production methods over a project’s life to maximize profits.

* 1. **| Complex Capital Budgeting with Spreadsheets**

**Advantages of Using Spreadsheets**

Spreadsheets are invaluable in capital budgeting as they help to organize and automate a very complex process. By using an input page that defines all of a project’s variables in one place, estimates can be easily changed and sensitivity and scenario analysis employed to test various alternatives.

**Need for More Frequent Cash Flow Estimates**

For simplicity, when first learning about capital budgeting, students assume that cash inflows and outflows all occur at yearend. As shown in Exhibit 12, this yearend assumption can lead to erroneous results when using NPV.

**Exhibit 12: Erroneous Resulting Using the Yearend Cash Flow Assumption**

|  |  |
| --- | --- |
| **Project A**  Capital cost: CAD 10,000  Annual cash inflows: CAD 5,000  Annual cash outflows: CAD 2,000  Life of project: 10 years  RRR: 8.0%, compounded Yearly  **NPV Under Different Cash Flow Assumptions**  Year-end: CAD 10,130  Revenue at yearend, costs monthly: CAD 9,645 | **Project B**  Capital cost: CAD 10,000  Annual cash inflows: CAD 50,000  Annual cash outflows: CAD 47,000  Life of project: 10 years  RRR: 8.0%, compounded yearly  **NPV Under Different Cash Flow Assumptions**  Year-end: CAD 10,130  Revenue at yearend, costs monthly: -CAD 1,273 |

Projects A and B are very similar except for their annual cash inflows and outflows. For both projects, the net cash flows are CAD 3,000 per year over each project’s 10-year life, but the individual cash inflows and outflows are much larger in Project B. If the year-end assumption is used, Project A and B will have the same NPV. But what if the company receives its revenue at yearend and incurs its costs uniformly thorough the year? For Project A, the NPV falls slightly because the costs are being paid sooner, so they are higher on a present value basis thus lowering the NPV. For Project B, the NPV falls by much more and becomes negative. This is explained by the size of the individual cash outflows. Because the cash outflows are so large, paying them monthly instead of annually will lead to a much bigger increase in costs thus lowering the NPV.

This example demonstrates that adopting the yearend assumption without reference to the actual timing of cash flows can greatly distort the NPV. In this case, the company would have accepted a project that should have been refused. The yearend assumption will lead to erroneous results when 1) cash inflows and outflows are large in relative to their net values, and 2) cash inflows and outflows have different frequencies (i.e. monthly or yearly). Both these are true in the case of Project B and are very common in practice. To avoid this problem, cash flows should be measured on a monthly or quarterly basis so they are more accurately timed.

**Capital Budgeting Using Spreadsheet**

When using spreadsheets to analyze capital budgeting projects as in Exhibit 13, relevant cash flows are still classified as initial, recurring, and terminal, but some changes are made. Instead of classifying the present value of the tax savings relating to CCA on the building and equipment as initial cash flows, they are classified as recurring cash flows each month resulting in lower income tax and higher net operating cash flows. The changes to NWC occur over the life of the project and are classified as initial, recurring, and terminal cash flows. The tax effects of any capital gains, terminal losses, and recaptures on the disposal of land, building, and equipment are included in terminal cash flows.

Once the net cash flows are determined for each period, the initial and monthly NPVs are calculated by applying the RRR and these amounts are summed to yield the total NPV for the project. The IRR is calculated using Excel’s IRR function with the net cash flows as the data range. This is the monthly IRR since the net cash flows are monthly, so the result must be multiplied by 12 months to yield the annual IRR. Cumulative initial and monthly NPV is an aggregate total of all initial and monthly NPVs. The discounted payback period occurs when this amount becomes positive and remains positive.

**Exhibit 13: Format of a Capital Budgeting Spreadsheet**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Initial** | **Year 1** | **Year 10** |
| **Month 1** | **Month 12** |
| **Initial cash flows** |  |  |  |
| Land | $$$ |  |  |
| Building | $$$ |  |  |
| Equipment | $$$ |  |  |
| Initial change in NWC | $$$ |  |  |
|  | | | | |
| **Recurring cash flows** |  |  |  |
| Sales |  | $$$ | $$$ |
| Cost of sales |  | $$$ | $$$ |
| Non-traceable factory costs |  | $$$ | $$$ |
| Selling costs |  | $$$ | $$$ |
| Administration costs |  | $$$ | $$$ |
| CCA |  | $$$ | $$$ |
| Income tax |  | $$$ | $$$ |
| Net operating cash flows |  | $$$ | $$$ |
| Recurring change in NWC |  | $$$ |  |
|  | | | | |
| **Terminal cash flows** |  |  |  |
| Sale of land |  |  | $$$ |
| Capital gains tax |  |  | $$$ |
| Sale of building |  |  | $$$ |
| Recapture or terminal loss |  |  | $$$ |
| Sale of equipment |  |  | $$$ |
| Present value of future CCA deductions |  |  | $$$ |
| Terminal change in NWC |  |  | $$$ |
|  | | | | |
| **Net cash flows** | $$$ | $$$ | $$$ |
| **RRR** | %%% | %%% | %%% |
| **Initial and monthly NPV** | $$$ | $$$ | $$$ |
| **Cumulative initial and monthly NPV** | $$$ | $$$ | $$$ |
|  | | | | |
| **Total NPV** | $$$ |  |  |
| **Annual IRR** | %%% |  |  |
| **Discounted payback** | Date |  |  |

* 1. **| Capital Budgeting at Canadian Companies**

**Capital Budgeting in Practice**

The capital budgeting techniques described in this module are all used in industry to varying degrees. The practices that are preferred by companies is an area of considerable research. Academics are trying to determine how closely practice follows current corporate finance theory which is what was studied in this module. More closely adhering to current theory increases corporate profitability and overall economic efficiency and, therefore, is of significant interest. A recent study1 of Canadian businesses found:

**Use of discounted cash flows.** Project evaluation methods that use discounted cash flows are “often or always” used by 84% of companies, with 58% using them as their primary method, and 26% using them as their secondary method. Usage is higher among large firms due to their greater sophistication and resources.

**Preferred project evaluation methods.** The NPV, IRR, and payback period are the most popular methods. As Exhibit 14 shows, NPV is the preferred method followed closely by IRR and payback period although large firms favour the IRR approach. As discussed, companies typically used more than one method when evaluating a capital project. NPV provides the most reliable measure of profitability, but IRR conveniently expresses the return in percentage form, and the payback period is a valuable measure of project risk.

**Exhibit 14: Preferred Project Evaluation Methods in Canada**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Evaluation Method** | **% Often or Always** | **Full Sample** | **Firm Size** | |
| **Large** | **Small** |
| NPV | 74.6 | 2.93 | 2.92 | 2.95 |
| IRR | 68.4 | 2.81 | 3.40 | 2.52 |
| Payback period | 67.2 | 2.78 | 3.04 | 2.73 |
| ARR | 39.7 | 1.76 | 2.04 | 1.67 |
| Discounted payback | 24.8 | 1.18 | 0.61 | 1.34 |
| Adjusted present value | 17.2 | 0.90 | 1.04 | 0.88 |
| Profitability index | 11.2 | 0.53 | 0.32 | 0.60 |
| MIRR | 12.0 | 0.52 | 0.40 | 0.53 |
| Management options | 10.4 | 0.47 | 0.68 | 0.35 |
| Respondents indicate frequency level based on a five-point scale where 0=never, 1=rarely, 2=sometimes, 3=often, and 4=always. | | | | |

**Adoption of management options.** Researchers generally feel that management options are the most efficient way to allocate capital between projects because of their ability to incorporate flexible decision-making into NPV analysis. Regardless, management options are only “often or always” used by 10.4% of firms. It is used primarily by large companies that make major capital investments, are subject to considerable project uncertainty, and have greater flexibility in their investment decision-making. This includes mainly natural resource, pharmaceutical, and biotechnology enterprises. Companies who do not use management options said it was because of a lack of expertise, the method’s complexity, or being inapplicable to their business.

**Incorporating risk.** Companies do adjust for project risk when evaluating capital projects, but most firms do so subjectively based on their judgement. Sensitivity analysis is also used extensively but more complex methods such as scenario analysis, decision trees, or simulation are not. Large firms are more likely than small firms to incorporate risk into project analysis.

**Exhibit 15: Use of Risk-adjustment Methods in Canada**

|  |  |
| --- | --- |
| **Risk-adjustment Method** | **% Often or Always** |
| Judgement | 76.9% |
| Sensitivity analysis | 73.5% |
| Scenario analysis and decision trees | 31.9% |
| Simulation | 12.9% |
| Adjusting the payback | 8.6% |

Judgement is also employed to estimate a project’s future cash flows with 94.0% of firms “moderately or highly” dependent on this approach. Quantitative forecasting methods are “moderately or highly” used by 70.1% of companies, and expert consensus opinion is “moderately or highly” used by 42.7% of companies. Usage of these methods does not vary by firm size.

**Capital rationing.** Capital rationing is employed to allocate capital to competing projects when sufficient funds are not available. Small firms utilize capital rationing approximately 43% of the time, while large firms utilize it only 34%.

**Differences between countries.** U.S. companies are more likely to adopt capital budgeting methods that are consistent with corporate finance theory because that country has a more rigorous corporate governance system and larger firms.

**Agency Costs in Capital Budgeting**

Another important area of research relates to how agency costs affect the capital budgeting process. According to corporate finance theory, firms should work in the best interest of their shareholders and attempt to maximize the value of the firm by selecting projects with the highest NPV. In practice, managers pursuing their self-interests prevent companies from achieving this goal. Some typical management behaviours include:

**Empire building.** Managers prefer running larger firms especially if their pay is more closely linked to the size of the company and not its financial success. This causes firms to overinvest in capital projects especially if they have considerable financial flexibility in the form of high cash balances or low financial leverage.

**Quiet life.** Managers avoid difficult decisions. This results in underinvestment if profitable projects are not pursued, or overinvestment if underperforming products, plants, or divisions are not discontinued.

**Short-term behaviour.** Managers select projects that increase short-term instead of long-term share performance. They also underinvest in less noticeable assets like maintenance, employee training, or R&D to improve current results. This short-term focus maximizes a manager’s pay which is closely linked to near-term share performance under most executive compensation plans. It also enhances a manager’s reputation and their current value in the labour market.

**Herding.** Managers follow industry investment trends with little regard for the profit potential of the different projects. They feel comfort in following others and can more easily rationalize their actions and defend their failures.

**Competence.** Managers play it safe and avoid investments, especially risker and more costly projects, to hide their lack of competence and avoid being evaluated.

**Overconfidence.**  Managers are overly optimistic about the assets they control. This causes them to overinvest by exaggerating the profitability of new projects, not cancelling poorly performing products or business units, and overpaying for acquisitions.

**Willingness to issue equity.** Managers think their company’s shares are undervalued and are reluctant to issue new equity. This results in underinvestment as companies are forced to ration their capital and turn down positive NPV projects.

Senior management and capital expenditures planning committees need to be cognizant of these problems and take steps to mitigate their impact. A company’s strategic plans and performance evaluation and compensation systems must be adjusted so they do not encourage these behaviours.

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1Baker, H., Dutta, S., Saadi, S. (2011). Corporate Finance Practices in Canada: Where Do We Stand? *Multinational Finance Journal*, vol. 15, no. 3/4, 157-192.