

Capital Budgeting

Financial Appraisal of Investment Projects

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1 Capital budgeting: an overview

Financial management is largely concerned with *financing*, *dividend* and *investment* decisions of the firm with some overall goal in mind. Corporate finance theory has developed around a goal of maximizing the market value of the firm to its shareholders. This is also known as shareholder wealth maximization. Although various objectives or goals are possible in the field of finance, the most widely accepted objective for the firm is to maximize the value of the firm to its owners.

Financing decisions deal with the firm's optimal capital structure in terms of debt and equity. Dividend decisions relate to the form in which returns generated by the firm are passed on to equity-holders. Investment decisions deal with the way funds raised in financial markets are employed in productive activities to achieve the firm's overall goal; in other words, how much should be invested and what assets should be invested in. Throughout this book it is assumed that the objective of the investment or capital budgeting decision is to maximize the market value of the firm to its shareholders. The relationship between the firm's overall goal, financial management and capital budgeting is depicted in Figure 1.1. This self-explanatory chart helps the reader to easily visualize and retain a picture of the capital budgeting function within the broader perspective of corporate finance.

Funds are invested in both short-term and long-term assets. Capital budgeting is primarily concerned with *sizable* investments in *long-term* assets. These assets may be tangible items such as property, plant or equipment or intangible ones such as new technology, patents or trademarks. Investments in processes such as research, design, development and testing – through which new technology and new products are created – may also be viewed as investments in intangible assets.

Irrespective of whether the investments are in tangible or intangible assets, a capital investment project can be distinguished from recurrent expenditures by two features. One is that such projects are significantly *large*. The other is that they are generally *long-lived* projects with their benefits or cash flows spreading over many years.

Sizable, *long-term* investments in tangible or intangible assets have long-term consequences. An investment today will determine the firm's strategic position many years hence. These investments also have a considerable impact on the organization's future cash flows and the risk associated with those cash flows. Capital budgeting decisions thus have a long-range impact on the firm's performance and they are critical to the firm's success or failure.

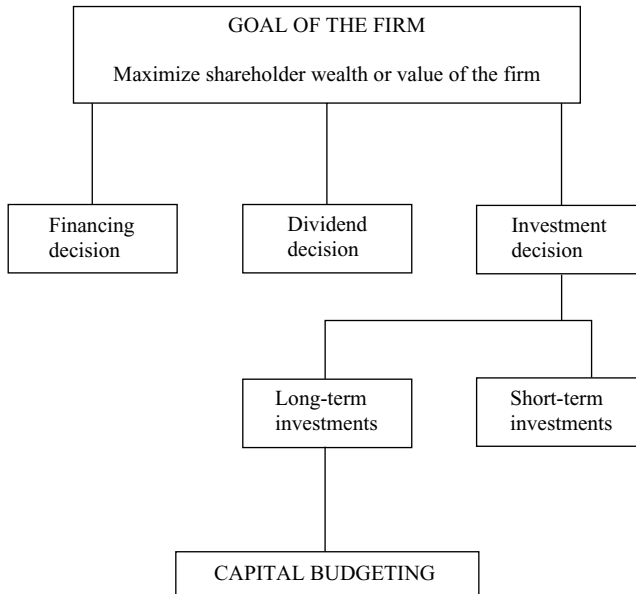


Figure 1.1. Corporate goal, financial management and capital budgeting.

As such, capital budgeting decisions have a major effect on the value of the firm and its shareholder wealth. This book deals with capital budgeting decisions.

This chapter defines the shareholder wealth maximization goal, defines and distinguishes three types of investment project on the basis of how they influence the investment decision process, discusses the capital budgeting process and identifies one of the most crucial and complex stages in the process, namely, the financial appraisal of proposed investment projects. This is also known as economic or financial analysis of the project or simply as ‘project analysis’. This financial analysis is the focus of this book.

Actual project analysis in the real world involves voluminous, tedious, complex and repetitive calculations and relies heavily on computer spreadsheet packages to handle these evaluations. Throughout this book, Excel spreadsheets are used to facilitate and supplement various calculation examples cited. These calculations are provided in workbooks on the Cambridge University Press website. Those workbooks are identified at the relevant places in the text.

Study objectives

After studying this chapter the reader should be able to:

- define the capital budgeting decision within the broader perspective of financial management
- describe how the net present value contributes to increasing shareholder wealth
- classify investment projects on the basis of how they influence the investment decision process

- sketch out a broad overview of the capital budgeting process
- identify the financial appraisal of projects as one of the critically important and complex stages in the capital budgeting process
- appreciate the importance of using computer spreadsheet packages such as Excel for capital budgeting computations
- gain a broad overview of how the material in this book is organized.

Shareholder wealth maximization and net present value

The efficiency of financial management is judged by the success in achieving the firm's goal. The shareholder wealth maximization goal states that management should endeavour to maximize the net present (or current) value of the expected future cash flows to the shareholders of the firm. *Net present value* refers to the discounted *sum* of the expected net cash flows. Some of the cash flows, such as capital outlays, are cash outflows, while some, such as cash proceeds from sales, are cash inflows. Net cash flows are obtained by subtracting a given period's cash outflows from that period's cash inflows. The *discount rate* takes into account the *timing* and *risk* of the future cash flows that are available from an investment. The longer it takes to receive a cash flow, the lower the value investors place on that cash flow now. The greater the risk associated with receiving a future cash flow, the lower the value investors place on that cash flow.

The shareholder wealth maximization goal, thus, reflects the *magnitude*, *timing* and *risk* associated with the cash flows expected to be received in the future by shareholders. In terms of the firm's objective, shareholder wealth maximization has been emphasized because this book has a corporate focus.

For a simplified case where there is only one capital outlay which occurs at the beginning of the first year of the project, the net present value (NPV) is calculated by subtracting this capital outlay from the present value of the annual net operating cash flows (and the net terminal cash flows). If the capital outlay occurs only at the beginning of the first year of the project then it is already a present value and it is not necessary to discount it any further. The formula for the NPV in such a simplified situation is:

$$NPV = \sum_{t=1}^n \frac{C_t}{(1+r)^t} - CO$$

where CO is the capital outlay at the beginning of year one (or where $t = 0$), r is the discount rate and C_t is the net cash flow at end of year t .

For example, suppose project Alpha requires an initial capital outlay of \$900 and will have net cash inflows of \$300, \$400 and \$600 at the end of years 1, 2 and 3, respectively. The discount rate is 8% per annum. The net present value is:

$$NPV = \frac{300}{(1.08)} + \frac{400}{(1.08)^2} + \frac{600}{(1.08)^3} - 900 = 197.01$$

Project Alpha will add \$197.01 to the firm's value.

Classification of investment projects

Investment projects can be classified into three categories on the basis of how they influence the investment decision process: independent projects, mutually exclusive projects and contingent projects.

An *independent project* is one the acceptance or rejection of which does not directly eliminate other projects from consideration or affect the likelihood of their selection. For example, management may want to introduce a new product line and at the same time may want to replace a machine which is currently producing a different product. These two projects can be considered independently of each other if there are sufficient resources to adopt both, provided they meet the firm's investment criteria. These projects can be evaluated independently and a decision made to accept or reject them depending upon whether they add value to the firm.

Two or more projects that cannot be pursued simultaneously are called *mutually exclusive projects* – the acceptance of one prevents the acceptance of the alternative proposal. Therefore, mutually exclusive projects involve 'either-or' decisions – alternative proposals cannot be pursued simultaneously. For example, a firm may own a block of land which is large enough to establish a shoe manufacturing business or a steel fabrication plant. If shoe manufacturing is chosen the alternative of steel fabrication is eliminated. A car manufacturing company can locate its manufacturing complex in Sydney, Brisbane or Adelaide. If it chooses Adelaide, the alternatives of Sydney and Brisbane are precluded.

Mutually exclusive projects can be evaluated separately to select the one which yields the highest net present value to the firm. The early identification of mutually exclusive alternatives is crucial for a logical screening of investments. Otherwise, a lot of hard work and resources can be wasted if two divisions independently investigate, develop and initiate projects which are later recognized to be mutually exclusive.

A *contingent project* is one the acceptance or rejection of which is dependent on the decision to accept or reject one or more other projects. Contingent projects may be complementary or substitutes. For example, the decision to start a pharmacy may be contingent upon a decision to establish a doctors' surgery in an adjacent building. In this case the projects are complementary to each other. The cash flows of the pharmacy will be enhanced by the existence of a nearby surgery and conversely the cash flows of the surgery will be enhanced by the existence of a nearby pharmacy.

In contrast, substitute projects are ones where the degree of success (or even the success or failure) of one project is increased by the decision to reject the other project. For example, market research indicates demand sufficient to justify two restaurants in a shopping complex and the firm is considering one Chinese and one Thai restaurant. Customers visiting this shopping complex seem to treat Chinese and Thai food as close substitutes and have a slight preference for Thai food over Chinese. Consequently, if the firm establishes both restaurants, the Chinese restaurant's cash flows are likely to be adversely affected. This may result in negative net present value for the Chinese restaurant. In this situation, the success of the Chinese restaurant project will depend on the decision to reject the Thai restaurant proposal. Since they are close substitutes, the rejection of one will definitely boost the cash flows of the other. Contingent

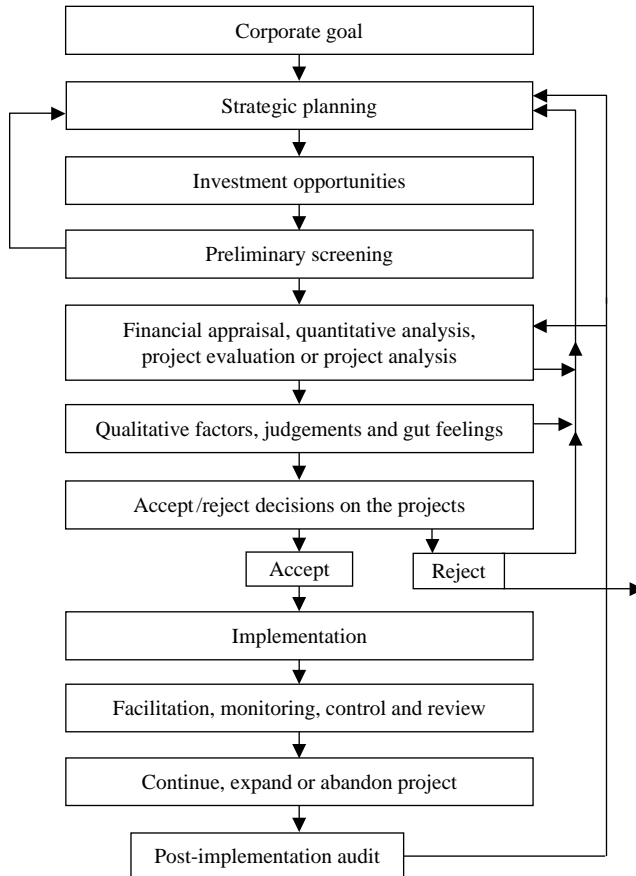


Figure 1.2. The capital budgeting process.

projects should be analysed by taking into account the cash flow interactions of all the projects.

The capital budgeting process

Capital budgeting is a multi-faceted activity. There are several sequential stages in the process. For typical investment proposals of a large corporation, the distinctive stages in the capital budgeting process are depicted, in the form of a highly simplified flow chart, in Figure 1.2.

Strategic planning

A strategic plan is the grand design of the firm and clearly identifies the business the firm is in and where it intends to position itself in the future. Strategic planning translates the firm's corporate goal into specific policies and directions, sets priorities, specifies the structural,

strategic and tactical areas of business development, and guides the planning process in the pursuit of solid objectives. A firm's vision and mission is encapsulated in its strategic planning framework.

There are feedback loops at different stages, and the feedback to 'strategic planning' at the project evaluation and decision stages – indicated by upward arrows in Figure 1.2 – is critically important. This feedback may suggest changes to the future direction of the firm which may cause changes to the firm's strategic plan.

Identification of investment opportunities

The identification of investment opportunities and generation of investment project proposals is an important step in the capital budgeting process. Project proposals cannot be generated in isolation. They have to fit in with a firm's corporate goals, its vision, mission and long-term strategic plan. Of course, if an excellent investment opportunity presents itself the corporate vision and strategy may be changed to accommodate it. Thus, there is a two-way traffic between strategic planning and investment opportunities.

Some investments are mandatory – for instance, those investments required to satisfy particular regulatory, health and safety requirements – and they are essential for the firm to remain in business. Other investments are discretionary and are generated by growth opportunities, competition, cost reduction opportunities and so on. These investments normally represent the strategic plan of the business firm and, in turn, these investments can set new directions for the firm's strategic plan. These discretionary investments form the basis of the business of the corporation and, therefore, the capital budgeting process is viewed in this book mainly with these discretionary investments in mind.

A profitable investment proposal is not just born; someone has to suggest it. The firm should ensure that it has searched and identified potentially lucrative investment opportunities and proposals, because the remainder of the capital budgeting process can only assure that the best of the proposed investments are evaluated, selected and implemented. There should be a mechanism such that investment suggestions coming from inside the firm, such as from its employees, or from outside the firm, such as from advisors to the firm, are 'listened to' by management.

Some firms have research and development (R&D) divisions constantly searching for and researching into new products, services and processes and identifying attractive investment opportunities. Sometimes, excellent investment suggestions come through informal processes such as employee chats in a staff room or corridor.

Preliminary screening of projects

Generally, in any organization, there will be many potential investment proposals generated. Obviously, they cannot all go through the rigorous project analysis process. Therefore, the identified investment opportunities have to be subjected to a preliminary screening process by management to isolate the marginal and unsound proposals, because it is not worth spending resources to thoroughly evaluate such proposals. The preliminary screening may

involve some preliminary quantitative analysis and judgements based on intuitive feelings and experience.

Financial appraisal of projects

Projects which pass through the preliminary screening phase become candidates for rigorous financial appraisal to ascertain if they would add value to the firm. This stage is also called quantitative analysis, economic and financial appraisal, project evaluation, or simply project analysis.

This project analysis may predict the expected future cash flows of the project, analyse the risk associated with those cash flows, develop alternative cash flow forecasts, examine the sensitivity of the results to possible changes in the predicted cash flows, subject the cash flows to simulation and prepare alternative estimates of the project's net present value.

Thus, the project analysis can involve the application of forecasting techniques, project evaluation techniques, risk analysis and mathematical programming techniques such as linear programming. While the basic concepts, principles and techniques of project evaluation are the same for different projects, their application to particular types of projects requires special knowledge and expertise. For example, asset expansion projects, asset replacement projects, forestry investments, property investments and international investments have their own special features and peculiarities.

Financial appraisal will provide the estimated addition to the firm's value in terms of the projects' net present values. If the projects identified within the current strategic framework of the firm repeatedly produce negative NPVs in the analysis stage, these results send a message to the management to review its strategic plan. Thus, the feedback from project analysis to strategic planning plays an important role in the overall capital budgeting process.

The results of the quantitative project analyses heavily influence the project selection or investment decisions. These decisions clearly affect the success or failure of the firm and its future direction. Therefore, project analysis is critically important for the firm. This book focuses on this complex analytical stage of the capital budgeting process, that is, financial appraisal of projects (or simply, project analysis).

Qualitative factors in project evaluation

When a project passes through the quantitative analysis test, it has to be further evaluated taking into consideration qualitative factors. Qualitative factors are those which will have an impact on the project, but which are virtually impossible to evaluate accurately in monetary terms. They are factors such as:

- the societal impact of an increase or decrease in employee numbers
- the environmental impact of the project
- possible positive or negative governmental political attitudes towards the project
- the strategic consequences of consumption of scarce raw materials
- positive or negative relationships with labour unions about the project

- possible legal difficulties with respect to the use of patents, copyrights and trade or brand names
- impact on the firm's image if the project is socially questionable.

Some of the items in the above list affect the value of the firm, and some not. The firm can address these issues during project analysis, by means of discussion and consultation with the various parties, but these processes will be lengthy, and their outcomes often unpredictable. It will require considerable management experience and judgemental skill to incorporate the outcomes of these processes into the project analysis.

Management may be able to obtain a feel for the impact of some of these issues, by estimating notional monetary costs or benefits to the project, and incorporating those values into the appropriate cash flows. Only some of the items will affect the project benefits; most are externalities. In some cases, however, those qualitative factors which affect the project benefits may have such a negative bearing on the project that an otherwise viable project will have to be abandoned.

The accept/reject decision

NPV results from the quantitative analysis combined with qualitative factors form the basis of the decision support information. The analyst relays this information to management with appropriate recommendations. Management considers this information and other relevant prior knowledge using their routine information sources, experience, expertise, 'gut feeling' and, of course, judgement to make a major decision – to accept or reject the proposed investment project.

Project implementation and monitoring

Once investment projects have passed through the decision stage they then must be implemented by management. During this implementation phase various divisions of the firm are likely to be involved. An integral part of project implementation is the constant monitoring of project progress with a view to identifying potential bottlenecks thus allowing early intervention. Deviations from the estimated cash flows need to be monitored on a regular basis with a view to taking corrective actions when needed.

Post-implementation audit

Post-implementation audit does not relate to the current decision support process of the project; it deals with a post-mortem of the performance of already implemented projects. An evaluation of the performance of past decisions, however, can contribute greatly to the improvement of current investment decision-making by analysing the past 'rights' and 'wrongs'.

The post-implementation audit can provide useful feedback to project appraisal or strategy formulation. For example, *ex post* assessment of the strengths (or accuracies) and weaknesses (or inaccuracies) of cash flow forecasting of past projects can indicate the level

of confidence (or otherwise) that can be attached to cash flow forecasting of current investment projects. If projects undertaken in the past within the framework of the firm's current strategic plan do not prove to be as lucrative as predicted, such information can prompt management to consider a thorough review of the firm's current strategic plan.

Organization of the book

This book follows a natural progression from the development of basic concepts, principles and techniques to the application of them in increasingly complex and real-world situations.

An important and initial step in project analysis is the estimation of cash flows. Chapter 2 commences with the basic concepts and principles for the identification of *relevant cash flows* followed by illustrative cash flow calculation examples for both asset expansion and asset replacement projects. All the cash flows for project evaluation are expected future cash flows. Estimation of cash flows, therefore, involves forecasting. Quantitative and qualitative (judgemental) methods useful for forecasting project cash flows are discussed, with examples, in Chapters 3 and 4.

Once the cash flows are estimated, projects are subjected to project evaluation techniques. The application of these techniques involves financial mathematics. Frequently encountered formulae in capital budgeting are illustrated with simple examples in Chapter 5. A thorough understanding of the application of these formulae provides a springboard for the project analysis material in the remainder of the book.

Chapter 6 uses the cash flow concepts and the formulae (from Chapters 2 and 5) to evaluate the projects using several criteria, such as net present value, internal rate of return and payback period, and demonstrates the versatility of the net present value criterion. Project appraisal is carried out in Chapter 6 under the following assumptions:

- a single goal of wealth maximization for the firm
- capital expenditures and cash flows known with certainty
- no resource constraints (all the profitable projects can be accepted).

This basic model is then expanded to deal with risk (or uncertainty of cash flows) in Chapters 7 to 10. Chapter 7 discusses, with illustrative examples, the risk-adjusted discount rate and certainty equivalent methods for incorporating risk. Chapter 8 illustrates the use of sensitivity and break-even analyses as tools for aiding the decision-makers to make investment decisions under uncertainty. Project risk analysis is further extended by introducing simulation concepts and methods in Chapter 9 and then applying those concepts and methods to a case study in evaluation of a forestry investment in Chapter 10.

Resource constraints on the capital budgeting decision are considered in Chapter 11 by introducing the basics of linear programming (LP) and applying the LP technique for selection of the optimal project portfolios. Chapter 12 presents extensions to the LP technique which make the approach more versatile.

A number of special topics in capital budgeting are covered towards the end of the book. They include property investment analysis (Chapters 14 and 15), and evaluation of international investments (Chapter 16). Capital budgeting decisions under resource constraints

analysed in the two linear programming chapters (11 and 12) also provide a number of special cases in project analysis. Simulation and financial modelling in forestry project evaluation as discussed in Chapters 10 and 13 may also be viewed as special topics in capital budgeting because they apply to specific type of investments, namely investments in forestry.

Using Excel for computations

As mentioned earlier, actual project analysis in the real world involves voluminous, tedious, complex and repetitive calculations and relies heavily on computer packages. Capital budgeting concepts, processes, principles and techniques can be made clear by words, graphs and numerical examples. Numerical examples – particularly those which involve repeated, complex, tedious or large calculations – are made simple, clear, useful, attractive and sometimes fun by the use of such computer packages.

In this book, the Excel spreadsheet package is used, wherever appropriate, for calculations in examples. Excel workbooks are held on the Cambridge University Press website (<http://publishing.cambridge.org/resources/052181782x/>). For convenience, the relevant Excel workbook is indicated with a marker at the appropriate places in the text.

This book is written in such a way that the materials can be studied independently of the Excel workbooks or computer access. However, Excel workbooks will help in understanding the computations and may facilitate the clarification of any computational queries for which answers cannot be found in the text. The many Excel workbooks may be viewed as supplementary or complementary to the discussion in the text. These workbooks will aid in working through problems and will provide templates that may be applied in this work.

Concluding comments

This introductory chapter has set the capital budgeting decision within the broader perspective of the finance discipline and its financial management context. A broad overview of the capital budgeting process was presented in Figure 1.2. The financial appraisal of projects, which is the focus of this book, was identified as one of the critically important and complex stages in the capital budgeting process. The financial appraisal is often known in simple and general terms as ‘project analysis’.

Emphasis has been placed on shareholder wealth maximization as the firm’s goal (i.e. the book has a corporate focus).

The use of Excel as a teaching and learning aid in this book and then as a practical tool for real-world project analysis has been emphasized.

The flow of materials in this book follows a natural progression from the development of basic concepts, principles and techniques to the application of them in increasingly complex and real-world situations. With this background, the main areas covered in the various chapters have been outlined, together with their relationships to one another.

Review questions

- 1.1 In finance theory, what is the most widely accepted goal of the firm? How does the net present value of a project relate to this goal?
- 1.2 Discuss the relationships between the firm's goal, financial management and capital budgeting.
- 1.3 Present two examples for each of the following types of investment projects:
 - (a) independent projects
 - (b) mutually exclusive projects
 - (c) contingent projects.
- 1.4 Should relatively small capital expenditures be subjected to thorough financial appraisal and the other key stages of a typical capital budgeting process?
- 1.5 Briefly discuss the main stages of a typical, well-organized capital budgeting process in a large corporation.