

EVALUATING PROPERTY INVESTMENT PROPOSALS

A STUDY OF THE EVALUATION PROCESS
WITHIN A CONSTRUCTION CONTRACTOR FIRM

BY TOMAS SVENSSON

Department of Real Estate Management
Lund Institute of Technology
Lund University, Sweden 2001



ISRN LUTVDG/TVLM 01/5061-SE

**EVALUATING PROPERTY
INVESTMENT PROPOSALS**

BY TOMAS SVENSSON

PREFACE

After five years of studies at Lund Institute of Technology and National University of Singapore, I have now finally reached the end of the road. This thesis is my final work in pursuing my Master of Science degree – specialising in Real Estate Economics. I hope that the reader has this in mind when reading the thesis, as some terms that are widely used in real estate and corporate finance literature are sometimes utilised without further explanation. However, in the *Appendix* a short glossary is presented in order to explain some of the more utilised terms. At a term's first appearance, a footnote directs the reader to *Glossary*.

Acknowledgements

The thesis is written in Oslo during spring 2001, at Selmer Skanska's Department of Commercial Property, where an office has been at the author's disposal. Thus, I would like to thank Selmer Skanska and the Department of Commercial Property in general, and Director Arild Rygg, Helge Instanæs, Karsten Hjertholm and Petter Vøien in particular. In addition, I would also like to express gratitude to Frode Kjeldsen, director of the finance department, for useful guidance and recommendations.

Furthermore, recognition to my supervisor, Cecilia Mildner at the Department of Real Estate Management, for support and guidelines.

Also, great credit to Richard Svärd for useful advises and for crucial coffee breaks, and to Mariko for supporting and encouraging me during the whole period, and for gradually proofreading the thesis.

Finally, I would like to express my appreciation to my opponent, Jacob Holmquist.

Thanks.

Oslo, June 2001

Tomas Svensson

SUMMARY

Introduction

Today, numerous real property investment projects, whose investment analyses all perhaps originally showed substantial prosperity, end up with a deficit. The author himself has, as employee in different construction firms, experienced several occasions where the project's site management has been unable to meet the original budget, why he feels entitled to ask the following questions – “What are the reasons for this? Is the individual project's profitability constantly overestimated or its' risk underestimated? Is company management not capable enough to develop the properties at the estimated cost?”

In order to answer these questions, the thesis investigates evaluation methods and techniques discussed in business literature, and subsequently compares them with the methods used by decision-makers in a construction contractor firm. The purpose is to reveal erroneous behaviour and to revise and improve the evaluation methods used, as the author believes that the answer to the previously asked questions lays in the performance of the evaluations, not at the construction site. Other authors (e.g. Jansson, 1992) argue that the persons performing the analyses and evaluations habitually 'decorate' the performed evaluations in order to get 'their' proposals accepted. The author is not ready to draw the same conclusion, but instead believes that the analysts and the evaluators simply lack the experience in using more sophisticated, reliable evaluation techniques.

The thesis' first two parts provide a literature review to reflect the academic opinions in capital budgeting in the field of economic evaluation of investment proposals. The third part deals with an evaluation of a property investment project, which is tested against the discussed theory. Finally, a discussion ending up in the conclusion of the thesis summarises the results.

Literature review

A firm is constantly confronted with the problem of deciding if a proposed use of resources is worthwhile in terms of forthcoming benefits. “The typical capital investment expenditure involves a commitment of current resources in order to secure a stream of benefits, i.e. a positive cash flow, in the future.” (Bierman Jr. & Smidt, 1988). According to Clark *et al* (1989) the firm's management must ensure to address the question of evaluating proposed expenditures in some systematic manner, since all organisations are more or less faced by a constraint on funds available for capital expenditure. The management must establish basic criteria for acceptance, rejection or postponement of investment proposals. Meredith and Mantel Jr. (2000) also stress that every investment proposal should be evaluated against standards and by methods established before the project's inception. As investment proposals generally are accepted/rejected by the top management of the firm, whom is more or less aware of the different factors influencing the investment, it has to rely upon the economic evaluations prepared by their subordinates. As a consequence, in order to make

reasonable choices in weighing alternative investments, it is necessary to have comparable, uniform basis for evaluation (Levy & Sarnat, 1994).

There are a wide variety of methods discussed in business literature and this thesis deals with a few of them, focusing on methods applicable to project investments. This thesis handles two discounted cash flow (DCF) methods and two rules of thumb methods. The two primary discounted cash flow investment evaluation methods used are net present value (NPV) and internal rate of return (IRR). The rules of thumb methods discussed are payback period and return on investment (ROI). These four measures are equally applied to different hypothetical investment alternatives, and consequently three of them are excluded as reliable measures of investment worth. Since, according to Levy and Sarnat (1994), the time factor is the prime aspect when evaluating a project's attractiveness; the two methods neglecting the time factor are excluded immediately. "The discounting for time is an essential part of any capital budgeting process, in order to evaluate a project" (Bierman Jr. & Smidt, 1988).

The net present value method and the internal rate of return method often lead to identical accept/reject decisions, but unless two investment criteria *habitually* lead to identical decisions, one cannot avoid having to choose between the two methods of measuring an investment proposal's desirability (Levy & Sarnat, 1994). Hence, it is impossible to be indifferent between the IRR- and the NPV-methods (Clark *et al.*, 1989). The net present value method is thus the optimal method and the conclusion is that the NPV-method should be used as *the sole method* when evaluating investment proposals, regardless of them being independent or mutually exclusive.

As a firm seldom operates in a state of perfect certainty, the undertaking of an investment represents a risk (Eeckhoudt & Gollier, 1995). In order to cope with that risk, the firm must perform a risk analysis. The principal contribution of a risk analysis is to focus the decision-maker's attention on understanding the nature and extent of the uncertainty associated with the variables used in a decision-making process (Meredith & Mantel Jr. 2000). Pricing the risk facing a project is complicated due to the vast amount of data often needed, and many organisations rather include a safety margin in the discount rate, than calculate the risk as a single measure. Consequently, this thesis will instead treat risk through a nonnumeric (qualitative) point of view. The two methods discussed in the thesis are the sensitivity analysis and the decision tree-method.

According to Bøhren and Gjørsum (1999), in practice the most adopted method when investigating financial effects connected with risk is the sensitivity analysis, which handles the risk in a pragmatic way. The objective of the sensitivity analysis-method is, as the name indicates, to survey how sensitive the project is to adjustments in the financial conditions the analysis builds upon. Thus, the result is not a single NPV figure based on a risk-adjusted cost of capital, but a basis of discussion (Ross, Westerfield & Jaffe, 1999). The result of the sensitivity analysis should be viewed as an alarm signal and a way to display where more information is needed (Bøhren & Gjørsum, 1999). However, the sensitivity analysis gives no information about the probability of a potential deviation in basic data nor considers possible management adjustments why an alternative method, the decision tree-method, is introduced.

Uncertain environments create a need for flexibility. In the context of project analysis, that flexibility expresses the possibility to push forward decisions concerning the

project. The decision tree visualises the investment's different alternative results, enabling the decision-maker to calculate an expected value of the investment, weighing in the different results' probability to occur. To have flexibility in a project is analogous to be in possession of an option, i.e. the right, not the constraint, to perform a predetermined thing. The situation with flexibility is fundamentally different from all other examples in this thesis, where decisions about whether to invest in the project or not, and the design of the project, are made at time zero. To evaluate flexibility is therefore an issue of pricing the project's options to perform a predetermined thing. An option offers flexibility and creates value when the cost of the option is lower than the benefits it provides (Copeland, 1996). The option pricing approach recognises entrepreneurial flexibility and risk explicitly, but Lucius (2001) argues in his paper that the use of option pricing within real estate development is limited. The author of this thesis also recognises difficulties when applying the decision tree-method to the property investment case investigated, why he leaves the method partly unexploited.

Application of NPV and sensitivity analysis to a property investment case

As the net present value method is concluded being the optimal method when evaluating investment proposals, the author thus advocates using the NPV-method as *the sole method* when performing evaluations, regardless of the investments being independent or mutually exclusive. The net present value method is therefore utilised when the author revises a performed evaluation of a property investment case. As a complement, and in order to communicate the uncertainty and to expose the risk facing the project, the sensitivity analysis method is utilised in combination with a calculation of the expected value of the investment.

The purpose is to illustrate the results of different approaches when evaluating the attractiveness of the proposed investment and my conclusion is that the evaluation performed by Selmer Skanska in the specific project that I have studied, not explicitly illustrates the uncertainty of the project. The time factor has also been neglected when calculating the result of the project, making the calculated result hard to compare to other investments' results. Thus, the investment's relative attractiveness to other investments cannot be defined.

If one habitually uses the same measures when evaluating investment proposals, and one makes sure that the used measures are reliable, it is my opinion that the risk for undertaking less prosperous investments is reduced. The net present value method is easily interpreted and provides the evaluator with a single, reliable measure that can be straightforwardly compared to other investment's net present values. Combined with a proper qualitative evaluation, e.g. a sensitivity analysis, the risk of the investment can be displayed and hence no longer be completely unknown to the person making the evaluation/investment.

TABLE OF CONTENTS

PREFACE	i
SUMMARY	ii
TABLE OF CONTENTS	v
INTRODUCTION	1
BACKGROUND	1
OBJECTIVES	2
METHODOLOGY AND DELIMITATIONS	2
PART I	3
1 INTRODUCTION TO CAPITAL BUDGETING	4
1.1 CAPITAL BUDGETING AND STRATEGIC MANAGEMENT	4
1.1.1 GOALS	5
1.1.2 STRATEGY	5
1.1.3 TACTICS	5
1.2 CERTAINTY, RISK AND UNCERTAINTY	6
1.2.1 CERTAINTY	6
1.2.2 RISK AND UNCERTAINTY	6
1.3 THE CAPITAL BUDGETING PROCESS	6
1.3.1 LONG-TERM GOALS	7
1.3.2 GENERATING INVESTMENT PROPOSALS	7
1.3.3 ESTIMATES	7
1.3.4 THE ADMINISTRATIVE FRAMEWORK	7
1.4 TIME VALUE OF MONEY	8
1.4.1 DISCOUNT RATE	9
1.4.2 PRESENT VALUE	9
2 CAPITAL BUDGETING UNDER CERTAINTY	10
2.1 ECONOMIC EVALUATION OF INVESTMENT PROPOSALS	10
2.2 MEASURES OF INVESTMENT WORTH	11
2.3 NET PRESENT VALUE	11
2.3.1 BASIS FOR NPV	12
2.3.2 RESTRICTIONS	12
2.3.3 NPV PROFILE	12
2.4 INTERNAL RATE OF RETURN	13
2.4.1 BASIS FOR IRR	13
2.5 RULES-OF-THUMB METHODS	14
2.5.1 PAYBACK PERIOD	14
2.5.2 RETURN ON INVESTMENT	14
2.6 RANKING FOUR INVESTMENTS	14
2.6.1 PAYBACK PERIOD	15
2.6.2 RETURN ON INVESTMENT	15
2.6.3 INTERNAL RATE OF RETURN	16
2.6.4 NET PRESENT VALUE	17
2.7 SUMMARY	17
3 COMPARISON BETWEEN NPV AND IRR	19
3.1 INDEPENDENT INVESTMENTS	19
3.2 MUTUALLY EXCLUSIVE INVESTMENTS	20
3.2.1 THE RANKING PROBLEM	21
3.2.2 THE SCALE PROBLEM	22
3.2.3 TIMING OF CASH FLOW	24

3.3	THE MULTIPLE-IRR PROBLEM	25
3.4	SUMMARY	26
PART II.....		27
4	CAPITAL BUDGETING UNDER UNCERTAINTY	28
4.1	RISK	28
4.1.1	RISK ALLOCATION.....	28
4.1.2	TRANSFERRING RISK.....	29
4.2	COST OF CAPITAL.....	29
4.3	FOUNDATIONS OF RISK ANALYSIS	29
5	RISK ANALYSIS.....	30
5.1	SENSITIVITY ANALYSIS	30
5.1.1	EXECUTE A SENSITIVITY ANALYSIS.....	30
5.1.2	RESTRICTIONS	32
5.1.3	SUMMARY – SENSITIVITY ANALYSIS.....	32
5.2	DECISION TREE.....	32
5.2.1	VALUE FLEXIBILITY.....	32
5.2.2	SUMMARY – DECISION TREE.....	34
5.3	SUMMARY	34
PART III.....		35
6	CORPORATE INFORMATION SELMER SKANSKA.....	36
6.1	HISTORY AND MARKET POSITION.....	36
6.1.1	ORGANISATIONAL STRUCTURE.....	36
6.2	DEPARTMENT OF COMMERCIAL PROPERTY	37
6.2.1	GOAL.....	37
6.2.2	INVESTMENT STRATEGY.....	37
6.2.3	RISK PROFILE.....	37
6.2.4	COST OF CAPITAL.....	38
6.2.5	CORPORATE TAXES.....	38
7	CASE DESCRIPTION –TOWNSTREET 2-4.....	39
7.1	BACKGROUND.....	39
7.2	THE AGREEMENT	39
8	ANALYSIS.....	41
8.1	QUANTITATIVE EVALUATION	41
8.2	QUALITATIVE EVALUATION.....	43
9	DISCUSSION.....	45
9.1	OPINIONS ABOUT INVESTMENT EVALUATION.....	45
9.2	THE DEPARTMENT’S EVALUATION PROCESS	46
9.3	REVISED EVALUATION	47
9.3.1	NET PRESENT VALUE.....	47
9.3.2	SENSITIVITY ANALYSIS	48
9.3.3	EXPECTED VALUE	48
9.3.4	SUMMARY	49
REFERENCES.....		50
BOOKS.....		50
ARTICLES AND PAPERS.....		50
INTERVIEWS.....		51
OTHER.....		51
APPENDIX.....		52

INTRODUCTION

A real property project represents a financial investment. Several different projects may offer substantial promise, but considering the usual situation where the availability of funds affects the selection process, the final authorisation of a project should be based on the most effective use of resources available (Roman, 1986). Hence, the subject matter of this thesis is the project evaluation procedure within a construction contractor organisation.

In investment literature, there are several depictions of investment processes in different respects, such as type of investment errand and type of investing organisation. What they all have in common is that they refer to the typical situation that persons handling the investment errand are supposed to motivate the investment suggested by means of an investment analysis (Jansson, 1992).

BACKGROUND

Organisations within the construction business often face constraints of different nature. One scarce resource is land, another is available personnel, and a third is funds available. Hence, project investment decisions must adapt to the strategy implemented by a firm, in order to utilise the firm's opportunities and to reach the set goals.

There are generally two basic types of project selection methods, numeric and nonnumeric (Meredith & Mantel Jr. 2000). Examples of some numeric (quantitative) methods widely used are the discounted cash flow methods; of which the most frequently applied is the internal rate of return¹ method, as it is easily communicated (Ross, Westerfield & Jaffe, 1999). The distinguishing feature of numeric methods is that they all leave a single measure, which make them understandable and hence popular.

On the other hand, nonnumeric (qualitative) methods provide the decision-maker with ample information numeric measures don't. It is therefore crucial to exploit both methods, as they complement, rather than exclude, each other. Hence, most corporations use a combination of the two, as they both have their benefits, and both measures will be handled in the thesis.

Before examining the different models, two crucial points must be made:

- Models do not make decisions – managers do.
- A model is only a partial illustration of the reality it is meant to reflect.

The reader must have this in mind when reading the thesis, as the thesis aims to illustrate, explain, and compare rather than come up with the universal solution.

¹ See Glossary – Internal Rate of Return (IRR).

OBJECTIVES

The objective of this thesis is to examine a project evaluation procedure at Selmer Skanska's Department of Commercial Property and *comparing the method used in practice with evaluation theories within business literature*. Hence, the two first parts of the thesis contains an extensive summary of some well-utilised evaluation techniques, of which some are in general questioned in virtually every literature. The methods discussed are practically viable and therefore widely used in organisations all over the world, even though, as will be presented, some erroneous conclusions are drawn by some of them.

Further, this thesis is dedicated to make visible the decision criterion used at the department, as implied by the assumed goal of wealth maximisation, and consequently, finding an *operationally useable* method for coping with both profitability and risk. The *evaluation process* applied by the firm is therefore emphasised.

METHODOLOGY AND DELIMITATIONS

In order to achieve a thorough understanding of different evaluation techniques and measures commonly used, I have performed extensive literature search. The area of project evaluation has been the subject matter of numerous books and dissertations, and the amount of literature available is hardly a delimiting trait. The two first parts, enclosing chapter 1-4, are thus solely an interpretation of the literature studied and, consequently, the scope and feature of the literature have therefore shaped the theory chapters this thesis builds upon. Due to this, the author's personal opinions are excluded in these two parts.

The final part contains the case upon which the theory is tested. Firstly, a short presentation of the company, Selmer Skanska AS, is made. Subsequently, the Department of Commercial Property is presented in a more detailed manner, explaining the constraints and conditions under which the department operates. These specifics are gathered through interviews and detailed discussions with diverse individuals within the organisation.

Thirdly, an analysis of the evaluation executed by the department's personnel is made, with the theory in chapter 1-4 taken as a starting point. The analysis aims to compare and reveal differences and biases eventually made. The author's own opinions are left out, in order to finally be exposed in the last section of this thesis, *Discussion*.

Investigation and comparison of one case delimits the thesis, as the studied case is of an explainable character and illustrates the project evaluation procedure within the department in an easily interpreted way. Further, to make the comparison between the written theory and the thesis' real case explicable and viable, I have been constrained to ignore corporate taxes and calculation of cost of capital.

The thesis is aimed at the Department of Commercial Property at Selmer Skanska AS and students with a thorough interest in property investments and a basic awareness of corporate finance.

The thesis is performed during spring 2001.

PART I

-CAPITAL BUDGETING

In the first chapter of Part I, an approach to decisions regarding cash flows occurring over time, that is, capital budgeting decisions is presented. The approach is theoretically correct and easily applied. The essential elements are the determination of a proper discount rate that represents the time value of money and applying this rate to the expected future cash flows, in order to compute the investments net present value. Thereafter, some measures of investment worth are introduced and consequently compared, in order to find the most reliable measure.

In this part of the thesis, it is assumed that the future cash flows related to an investment are known with certainty. Thus, the objective of this first part is to take the time value of money into consideration, with no adjustments for risk.

1 INTRODUCTION TO CAPITAL BUDGETING

Capital budgeting is the decision area of financial management that establishes criteria for investing resources in projects. Capital budgeting is simply a set of tools to assess the returns and risks associated with the commitment of funds to projects. There is no foolproof method for project selection, as a great deal of subjectivity and intuition are often involved in project evaluation. Total reliance on either quantitative or qualitative factors can influence unfavourably on project evaluation analysis (Roman, 1986).

From the project managers' point of view, one can make a distinction between two different applications of investment calculation – cognitive and communicative (Jansson, 1992). The *cognitive* approach aims to give information to the person conducting the analysis and provides a basis for decision-making, such as investigating alternatives' financial consequences, alternatives' financial restrictions, comparing different alternatives etc. The *communicative* application can be adopted to financially justify advocated actions or provide people with necessary information, enabling them to act. The thesis will mainly focus on the cognitive approach, just briefly touching the communicative application.

1.1 CAPITAL BUDGETING AND STRATEGIC MANAGEMENT

A firm manages innumerable decisions every day. This thesis is dedicated to a particular group of business decisions; those which determines a firm's capital expenditure. Those decisions derive from the *investment strategy* adopted by the firm, which more than any single factor determines its future growth and profitability. Hence, the decision rule applied must reflect the goal of the firm.

“Financial decision-making involves purposeful behaviour, which implies the existence of a goal, or what is more likely, some combination of goals” (Levy & Sarnat, 1994). In absence of any objectives, the firm would have no standard for selecting among alternative investments and projects. Only when one recognises the firm's objective or goal, one can evaluate the suitability of a decision rule.

Capital budgeting is part of the firm's overall plan, which outlines the expected development of the firm. When explaining the interaction between capital budgeting and strategic management, it is convenient to think of strategic management as having three elements (Clark *et al*, 1989); (1) defined goals of the firm, (2) strategy, and (3) a set of tactics.

1.1.1 GOALS

In a study, Robert F. Lanzillotti ('Pricing objectives in large companies', American Economic Review, 1958) examined the objectives upon which business firms base their investment decisions. A majority of the firms point out two key concerns of management (goals);

- Long-run profitability
- Stability

These goals are apparently inconsistent, as attempts to increase return (profit) often involve greater risks, i.e. less stability. The procedure of choosing a combination between expected profit and risk level that is appropriate for the firm, is complex. Finding an *operationally useable* method for including both risk and profitability into the firm's goal function is therefore a major challenge for any organisation. One way to handle this dilemma is to assume that the task of the management is maximisation of the firm's value (Levy & Sarnat, 1994).

Figure 1.1 summarises a general decision problem faced by a firm. In the rather unrealistic case where all the results of the decisions are known in advance, the goal of the firm ought to be maximisation of the firm's long-run profit. However, in the more realistic case where the firm makes the decisions under uncertainty, the firm must consider risk as well as profit. Thus, one must look for a combination of the two, in order to maximise the value of the firm. The figure shows that a firm that emphasises on low risk must not necessarily act inconsistent with the goal of maximising the value of the firm. It depends on what *strategy* the firm applies when evaluating new projects.

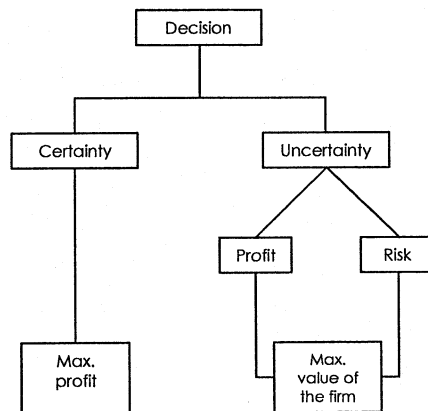


FIGURE 1.1: The general decision problem faced by a firm
 Source: Levy, Haim and Sarnat, Marshall.
Capital Investment & Financial Decisions, 1994.

1.1.2 STRATEGY

Strategy translates the firm's goals into specific policies in the search for tangible objectives. The strategy spells out the potential areas of business, sets priorities, and guides the planning process in order to steer in direction of the stated goals. Knowing the firm's strategy is therefore crucial when determining and evaluating the decision criteria applied by the firm.

1.1.3 TACTICS

Tactics relate to the fundamentals of implementing the firm's goals and strategy, that is, the analysis of specific projects for investment. Capital budgeting techniques can be applied to evaluate projects defined by the strategic plan. This thesis is dedicated to make visible those decision criteria, as implied by the assumed goal of wealth maximisation, and to describe the firm's capital budgeting process.

1.2 CERTAINTY, RISK AND UNCERTAINTY

Before going any further, I feel obligated to define the different states the firm operates in, as they are assumed in this thesis. In the opening chapters, it is assumed that the firm evaluates projects under certainty, without concern of risk. Then risk (or equivalently uncertainty) is introduced, and eventually methods coping with risk and uncertainty are discussed. The two states of expectation are defined as follows (Levy & Sarnat, 1994):

1.2.1 CERTAINTY

Absolute *certainty* refers to expectations that are single-valued, that is, forthcoming profits are characterised in terms of a single outcome. The term is used when describing situations in which the decision-maker knows in advance the exact future values of all the parameters that may effect the decision.

Seldom any investor knows the exact future outcome of a potential investment, but sometimes the outcome can be enough defined to call it a risk-free investment. Government Bonds are an example of securities that investors regard as 'secure'. If the probability of a revolution or a war that might jeopardise the return on the bills is neglected, one can view investing in bonds as risk free, or safe. Hence, the risk-free rate of return often equals the Government Bond's rate of return.

1.2.2 RISK AND UNCERTAINTY

The term *risk* (or, in this report, equivalent *uncertainty*) is used when describing an investment whose future outcome is not known in advance with absolute certainty, but for which a number of different outcomes and their probabilities are known.² Hence, a risky investment is one for which the distribution of outcomes is known (Levy & Sarnat, 1994).

1.3 THE CAPITAL BUDGETING PROCESS

A definition; "The typical capital investment expenditure involves a commitment of current resources in order to secure a stream of benefits, i.e. a positive cash flow, in the future." (Bierman Jr. & Smidt, 1988) The firm is constantly confronted by the problem of deciding if a projected use of resources is worthwhile in terms of forthcoming benefits. Many firms limit their efforts by just applying formal capital budgeting procedures to projects with a time span of more than one year between initial outlay and receipt of final payment. In addition, many firms also limit the use of capital budgeting to relatively large expenditures.

According to Clark *et al* (1988), capital budgeting involves several steps. It includes formulation of long-term goals, search for new and profitable use of investment funds, preparation of financial forecasts and estimates, preparation of control budgets and the integration of these budgets in the firm's information system, economic evaluation of alternative projects, and the post-audit of past project's performance.

² In Clark, John J., Hindelang, Thomas J. and Pritchard, Robert E. *Capital Budgeting, Planning and Control of Capital Expenditures, 3rd edition*, 1989, the authors distinguish between risk and uncertainty. When defining uncertainty, the authors suggest that the investor *may* or *may not* be able to place a probability on the different outcomes. However, in this thesis the assumption is that the investor *is* able to do it.

Below some of the steps are described and put into an administrative framework proposed by Levy and Sarnat (1994).

1.3.1 LONG-TERM GOALS

Long-term goals serve as guide for managerial decisions. Therefore, in order to have a systematic approach to capital investment decisions, a firm must clearly state these goals early on. As already mentioned, the assumption in this thesis is that the management aims to maximise the value of the firm. Speaking of capital budgeting, this means striving to receive the highest net return on its invested capital, corresponding with the risk involved.

1.3.2 GENERATING INVESTMENT PROPOSALS

A prosperous investment opportunity does not just appear; one must undertake creative search for it. Consequently, having sophisticated evaluation techniques is worthless if one does not search for new opportunities. In addition, a method must also be found to ensure that proposals can be transferred to the decision level. The optimal method for identification and generation of investment proposals differs, dependent on each individual firm.

1.3.3 ESTIMATES

When initiating a proposal, expected costs and revenues, in this thesis referred to as cash flows, must be estimated. The estimates performed in this early stage must often be revised and refined when the proposal is incorporated in the budget, but they are nevertheless essential when evaluating the suggested investment. Lastly, these estimates must be further refined and presented in the form of an application for fund for the project.

In the final stage of the planning process, most of the cost estimates will be replaced by definite offers from the suppliers, but several cash flows remain uncertain throughout the whole process.

1.3.4 THE ADMINISTRATIVE FRAMEWORK

“A systematic approach to capital budgeting requires an administrative framework which facilitates the gathering and transferring of relevant information on alternative courses of action both for purposes of decision-making as well as for the control of expenditures, once these decisions have been reached” (Levy & Sarnat, 1994). The approach the authors suggest requires a routine, of which an example is shown below, when evaluating new investment proposals. In this thesis, the *evaluation process* (circled in figure 1.2) applied by the firm is emphasised.

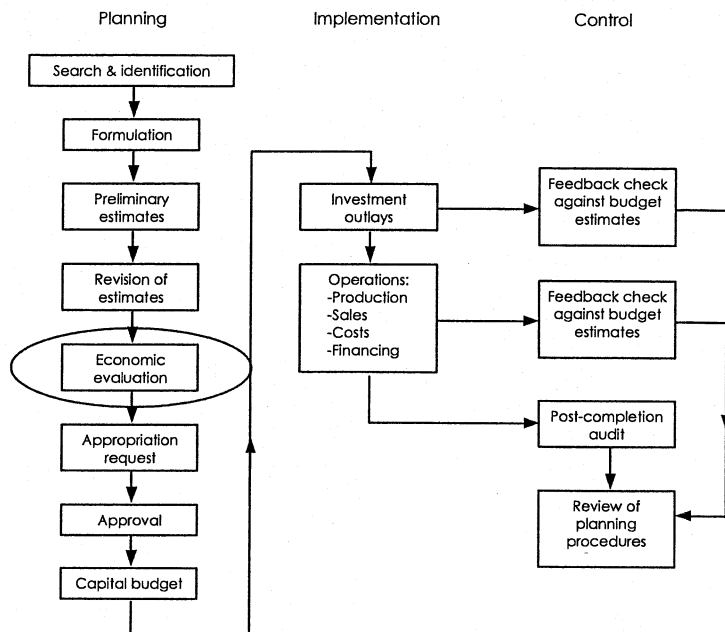


FIGURE 1.2: Framework for project planning

Source: Levy, Haim and Sarnat, Marshall.
Capital Investment & Financial Decisions, 1994.

Figure 1.2 sets out a simplified flow chart for a typical investment proposal. As illustrated, feedback is used both as control of the actual projects and for the future planning of new projects. The underlying assumption of the flow chart is that the firm performs rigorous financial planning. However, practice among firms is far from uniform.

The post-completion audit of capital investment projects is a stage often neglected. The stage is by definition not a part of the decision process, since it refers to already implemented projects, but a program of evaluating past decisions can profoundly contribute to improvements in the present decision-making.

1.4 TIME VALUE OF MONEY

The time factor is the prime aspect when evaluating a project's attractiveness. In times of inflation, which is the most common situation, the value of money declines over time. A dollar in hand 'today' is not equivalent to a dollar received 'tomorrow' (Levy & Sarnat, 1994). Generally, three factors are mentioned when explaining this preference.

- *Immediacy:* By nature, normally one attaches more weight to a present satisfaction than to a more distant one. Often one prefers to receive an amount of money today before later.
- *Alternative Investments:* An amount of money received now is more valuable than a dollar received in five years because of the opportunity to reinvest it. By doing so, one could have significantly more than a dollar in five years.
- *Risk:* Future cash flows and the value of them are never certain. Uncertainty reflects the world we live in, and affects every decision taken.

1.4.1 DISCOUNT RATE

The term 'discount rate' will be used to describe the time value of money.³ Through the discount rate, the project bears its capital costs, that is, the negative with tying up money in the project above investing them elsewhere. The size of the third component, risk, depends on the nature of the investment. The discount rate shall illustrate the return on best alternative usage (with the same risk) of the invested capital expressed as a percentage. Later in the report, techniques to adjust for the risk of the investment are introduced, however in the next two chapters risk considerations are neglected.

Every investment decision requires a comparison of alternatives. Even if there is only one project to consider, comparison must always be made. In that case, between investing in the project and putting the money in the bank, as it is a fact that money always can earn a positive return. The time factor thus becomes important as long as there exists alternatives of earning a positive return during the interim.

1.4.2 PRESENT VALUE

Assume that the alternative rate of return that can be earned in the market is r_m , independent of the decision under consideration, which is the discount rate in this case. How much is a dollar received a year from now worth at present? To explain this, the term *present value* (PV) is introduced. Given the alternative return r_m , the present value of that one dollar is calculated as

$$PV = \frac{1}{(1 + r_m)}$$

Generally put, if the amount of cash (C) is received in n years, the present value formula can be expressed as

$$PV = \frac{C_n}{(1 + r_m)^n}$$

This method is called discounting, and the formula is based on the theory of interest-on-interest⁴, on which most of the formulas in financial theory is based.

³ See Glossary – Discount Rate.

⁴ The theory of interest-on-interest assumes that money received is invested at the same rate every year, providing the investor with increasing investment worth.

2 CAPITAL BUDGETING UNDER CERTAINTY

Once the firm's management has established its goals and priorities for capital expenditures, it must address the question of evaluating proposed expenditures in some systematic manner (Clark *et al*, 1989). Since all organisations are faced by a constraint on funds available for capital expenditure, the management must establish some basic criteria for acceptance, rejection or postponement of investment proposals. Every investment proposal should be evaluated against standards and by methods established before the project's inception (Meredith & Mantel Jr. 2000).

There are a wide variety of methods used, and this thesis will cover a few of them, focusing on methods applicable to project investments. To provide a basis for further discussion of the project evaluation process, three factors are here cited⁵:

- The computed measures of project attractiveness should be consistently applied to all projects.
- The quantitative measures should be used as a guide rather than as the sole basis for acceptance or rejection of projects.
- Management should completely understand the assumptions made in the analysis, how the computations were carried out, and what the final results really mean.

With this in mind, I will start this chapter by explaining the importance of timing of cash flows before focusing on some quantitative measures used in the project evaluation process.

2.1 ECONOMIC EVALUATION OF INVESTMENT PROPOSALS

Investment decisions of business corporations involve very large sums of money and have a significant impact on the investing firm and the economy as a whole. Current investment decisions made by the firm are a major determining factor of tomorrow's output. These decisions are the most challenging task confronting the management, since in large measure future benefits is irrevocably determined by today's capital budgeting decisions. Hence, the time factor is the prime aspect when evaluating a project's attractiveness. Since the typical capital investment decision, as stated in the very definition of the term 'investment'⁶, normally involves the comparison of an initial outlay and future benefits, the *timing* of these cash flows are essential in the capital budgeting process.

A capital budgeting decision is characterised by costs and revenues that are spread out over several periods. It is therefore a prerequisite that the time value of money is

⁵ Pflomm, Norman E. *Managing Capital Expenditures* (New York: The Conference Board, 1963).

⁶ See Glossary – Investment

considered, in order to evaluate the alternatives with accuracy. Even though in practice one must consider risk (uncertainty) to be just as important as the time value preference, the discussion in this chapter is restricted to situations where cash flows and time value of money is known with certainty. That is, following the left wing in figure 1.1.

2.2 MEASURES OF INVESTMENT WORTH

Investment proposals are generally accepted/rejected by the top management of the firm, whom is more or less aware of the different factors influencing the investment. As it is impossible for the top management to be intimately familiar with those factors in each and every investment decision, they have to rely upon the economic evaluations prepared by their subordinates. In order to make reasonable choices in weighing alternative investments, it is necessary to have comparable, uniform basis for evaluation (Levy & Sarnat, 1994).

According to Bierman Jr and Smidt (1988), in search for that measure of economic worth of an investment, the assumption still is that the objective of the firm is to maximise the wealth of the firm. This thesis handles two discounted cash flow (DCF) methods and two rules of thumb methods. The two primary discounted cash flow investment evaluation methods used are net present value⁷ (NPV) and internal rate of return (IRR). The rules of thumb methods discussed are payback period and return on investment (ROI).⁸

These four measures will be discussed, and subsequently approached on four different hypothetical investments, in order to rank those four investments internally. The purpose is that the reader confidently will then be undoubtedly aware of the danger in just relying on one specific measure, except from the case with the net present value method.

2.3 NET PRESENT VALUE

The most intuitive definition of net present value describes it as the amount that one can afford to pay in excess of the initial cost. This definition is helpful in giving the decision-makers an explicit estimate of the room for error in the estimation of the costs of investment. An investment proposal's net present value (NPV) is the sum of all future expected cash flows, discounted at a rate that reflects the value of the best alternative use, deducting the initial outlay. Net present value display the return, capital gain or value creation achieved at time zero through choosing the project evaluated, above investing the money at discount rate (Bøhren & Gjørum, 1999).

⁷ See Glossary – Net Present Value (NPV).

⁸ Other rules of thumb methods that are widely used are accounting rate of return (ARR) on *total* investment and on *average* investment.

The net present value formula can be defined as follows:

$$NPV = -I_0 + \frac{CF_1}{(1+r_d)^1} + \frac{CF_2}{(1+r_d)^2} + \dots + \frac{CF_n}{(1+r_d)^n}$$

CF_t = net cash flow at the end of year t

in short

$$NPV = -I_0 + \sum_{t=1}^n \frac{CF_t}{(1+r_d)^t}$$

I_0 = initial investment at time zero
 r_d = discount rate, i.e. the required rate of return on new investments
 n = the project's duration in years

The general rule of acceptance/rejection is to accept all independent investments with a positive net present value, and reject investments whose value is less than zero.

2.3.1 BASIS FOR NPV

The basis for using NPV is not only because of the intuitive appeal, as there are other methods more easily communicated (Bierman Jr & Smidt, 1988). The net present value method is considered the valuation method with least unrealistic assumptions. One of the assumptions made is that owners of a firm want investments that offer greatest possible satisfaction, which is a rather realistic one. The satisfaction that the investor derives from the investments depends upon the amount and timing of the cash flows withdrawn from the business operations. Hence, each possible investment alternative may be described by a series of cash flows, representing the costs and the benefits each period. The size and the timing of the cash flows associated with the investment choices are assumed to be known in advance and with certainty. Further, it is assumed there is a well-known market interest rate at which the firm can lend or borrow as much as it wants.

2.3.2 RESTRICTIONS

Some problems with the NPV-method is that management often faces constraints on obtaining additional funds or that the future market interest rate of lending and borrowing may not be known. Additionally, the management might not experience that it is possible to predict future cash flows with certainty. Rather, there would likely exist a large number of cash flow patterns, any of which could be the outcome of the investment.

Under these circumstances, the NPV-method as described is not strictly applicable. In chapter 5, adaptations are made to make the method more useful of selecting investments under more realistic conditions (Meredith & Mantel Jr. 2000).

2.3.3 NPV PROFILE

The size of a project's NPV is dependent on the discount rate. To illustrate and to summarise an investment's profitability characteristics, the *NPV profile* is frequently used. It displays in an easily interpreted way the investment's net present value at different discount rates (Bøhren & Gjørnum, 1999). In example 2:1, a project's NPV profile is plotted.

EXAMPLE 2.1

Lets assume a project in which one has a kr100 investment that generates a kr200 receipt at the end of year one:

$$NPV = -I_o + \frac{CF_1}{(1+r_d)^1} = -100 + \frac{200}{(1+r_d)^1}$$

With a discount rate of zero, the net present value will be equal to kr100. On the contrary, if the discount rate is infinitely large, the NPV will be equal to the initial outlay, that is, kr-100. If one set the discount rate to 100%, the NPV is exactly 0, which determines the intercept with the horizontal axis.

$$NPV = -100 + \frac{200}{(1+1)^1} = 0$$

After determining three points, figure 2:1 graphs the NPV of this project as a function of the discount rate. The function slopes downwards as the discount rate increases. From the plot, it is obvious that the project's net present value is positive for all discount rates below 100%, and hence accepted if the required rate of return is less than 100%.

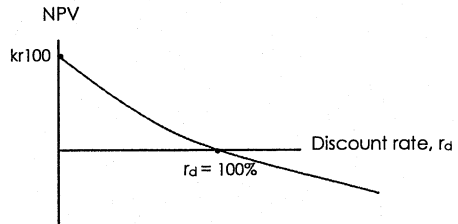


FIGURE 2.1: NPV profile
Source: Bøhren, Øyvind and Gjærum, Per Ivar.
Prosjekt Analyse, 1999.

2.4 INTERNAL RATE OF RETURN

There are several different terms used to define the internal rate of return. Some examples of these terms are *yield*, *rate of return*, *return on investment*, and *marginal efficiency* (Bierman Jr. & Smidt, 1988). However, in this report I have consequently used the terms internal rate of return and IRR.

Even though the NPV-method always works when evaluating mutually exclusive⁹ projects, many empirical studies show that in practice IRR is more frequently used as a measure of profitable investments. The problem with IRR-method is that it only registers the *relative* profitability, without consideration of the *absolute* level of profitability (Ross, Westerfield & Jaffe, 1999).

2.4.1 BASIS FOR IRR

The IRR-method utilises the present value concept. The aim is to find the discount rate where the present value of the expected cash flows equals to the initial outlay, that is, where net present value is zero, in order to compare it with the required rate of return. This discount rate is referred to as the internal rate of return of the investment, its IRR:

$$-I_o + \sum_{t=1}^n \frac{CF_t}{(1+IRR)^t} = 0$$

⁹ Projects are said to be mutually exclusive if the undertaking of one project eliminates the possibility to undertake the other. Mutually exclusiveness is further discussed in chapter 3.

Looking back at Figure 2.1, which plots a project's NPV profile, the IRR is to be found at the curve's intercept with the horizontal axis, at point r_d . In this point $IRR = r_d$, since it is the rate that reduces future cash flow to a worth equal to the initial outlay. From the graph, one can clearly see that for all $r_d < IRR$ the project's net present value is positive, and vice versa. Thus, the decision rule is that the internal rate of return must at least be equal to the required rate of return (Bierman Jr. & Smidt, 1988).

2.5 RULES-OF-THUMB METHODS

According to Levy and Sarnat (1994), in some cases it is possible to determine which investment is more attractive to another, with very simple methods. The methods though, have some serious limitations. Hence, two of them, payback period and return on investment, are just briefly discussed in this thesis.

2.5.1 PAYBACK PERIOD

The simplest, and therefore perhaps the most commonly used method to measure the economic value of an investment, is the payback period method.¹⁰ Used as a rule for decision, the management would probably set a maximum payback period and reject all investment proposals whose payback period overran the maximum period decided. When ranking different alternatives, the project with the shortest pay back time is usually accepted. The payback method is easy to use, which is its strength. On the other hand, it is so full of weaknesses that one cannot use it in investment situations as complex as property investments. The pay back-method does not take into account the fact that cash flows appear at different points in time, nor cash flows that appear after the original investment is paid back.

2.5.2 RETURN ON INVESTMENT

As mentioned above (section 2.4), the term return on investment is often used when one actually means the internal rate of return. However, in this report the term internal rate of return is used when referring to DCF calculation and the term return on investment is used when referring to an income divided by the investment calculation.

One ROI-measure is the *average income on cost*. The income is simply divided by the cost of the investment (depreciation not considered) and the method is used as a measure of efficiency. This method fails to rank the investments correctly because of its ignorance about timing of the cash receipt.

2.6 RANKING FOUR INVESTMENTS

In table 2.1 four hypothetical investments are described in terms of their cash flows. Assuming the four investments are *mutually exclusive*, the above-discussed methods of investment worth will here be used to rank¹¹ the four investment proposals. The

¹⁰ The *payback period* is defined as the length of time required for the cash receipts equalling the initial outlay (Bierman Jr. & Smidt, 1988).

¹¹ The ranking is supposed to state the relative desirability of two or more investments. If the investments are not restricted to mutually exclusive investments, the ability to rank investments is very limited.

example is constructed by Bierman Jr and Smidt (1988), and illustrates in an easily interpreted way the different measures' pros and cons.

TABLE 2.1 *Cash Flows of Hypothetical Investments*

Investment	Initial Cost	Net Cash Flows per Year	
		Year 1	Year 2
A	10,000	10,000	
B	10,000	10,000	1,100
C	10,000	3,762	7,762
D	10,000	5,762	5,762

Source: Bierman Jr. & Smidt, 1988

In purpose of avoiding complexities, zero taxes and no uncertainty are assumed. The concepts of risk are, as mentioned earlier, handled further on in this report.

2.6.1 PAYBACK PERIOD

Employing the payback period to rank the alternative investments in table 2.1, the investment having the shortest payback time is given the highest ranking, as shown in table 2.2. To check the rationality of the ranking given the investments by the payback method, one must study the cash flows' appearance. A and B are both ranked as number 1 because they have shorter payback periods than do the other investments. Comparing the two, B continues to receive cash after the payback period, making the investment superior to A. When considering the other two investments, D is superior to C, as one would have 2 000 available for reinvestment one year earlier.

TABLE 2.2 *Payback Period*

Investment	Payback Period (Years)	Ranking
A	1	1
B	1	1
C	1,8	4
D	1,7	3

The payback period measure therefore has two weaknesses – a) it fails to give any reflection to cash proceeds earned after the payback date, and b) it fails to adjust for the timing of the proceeds earned prior to the payback date. These weaknesses preclude the payback method as a general method of ranking investments.

2.6.2 RETURN ON INVESTMENT

The ROI-measure is useful when measuring performance, but it is less useful when ranking investments. Table 2.3 shows that both C and D are ranked as the best alternative, even though as discussed before, investment D is clearly preferable to C. The average income is calculated as the sum of the two years' incomes subtracted with the initial investment, and divided by two.

TABLE 2.3 Average Income on Cost

Investment	Cost	Average Income	Average Income on cost (%)	Ranking
A	10,000	0	0,0	4
B	10,000	550	5,5	3
C	10,000	762	7,6	1
D	10,000	762	7,6	1

The return on investment method fails to rank these investments correctly because of its ignorance to the timing of the cash flows, which leads to a wrong decision when used.

The two measures of investment worth hitherto discussed may give obviously incorrect results because of neglecting the investments' entire duration and not giving enough attention to the timing of future cash proceeds.

2.6.3 INTERNAL RATE OF RETURN

In table 2.4 the investments' internal rate of return are shown, and consequently the ranking that would result if this method were used. A comparison between the four investments in form of pairs, where A is compared to B and C is compared to D, is useful to determine the more advantageous investment of each pair. Previous measures were unable to rank the best alternative of each pair, even though there were significant differences in attraction. The conclusions were that B was preferable to A and D was preferable to C.

If one instead used the measure of internal rate of return as an investment method, the pairs would be given the accurate ranking, as shown in table 2.4. The internal rate of return for the investments is calculated as follows (calculation of IRR for investment C is shown as an example):

$$-10,000 + \frac{3,762}{(1+IRR)^1} + \frac{7,762}{(1+IRR)^2} = 0$$

The calculation leads to an internal rate of return of approximately 9%.

TABLE 2.4 Internal Rate of Return of the Investments

Investment	Internal Rate of Return (%)	Ranking
A	0	4
B	10	1
C	9	3
D	10	1

This far it is the only method used providing us with the intuitively correct ranking of the two pairs, as concluded when examining the different cash flows.

2.6.4 NET PRESENT VALUE

In the case with net present value as measure of investment worth, two sample discount rates are used. When discussing the two measures of investment worth that do not use a discounted cash flow method, conclusion was made that the relative ranking was obvious. Table 2.5 illustrates the ranking of the investment pairs in the correct relative order using a 6 percent discount rate, as one could conclude when examining the different cash flows.

TABLE 2.5 NPV of the Investments - Discount Rate is 6 Percent

Investment	PV of Cash Flow	PV of Outlay	Net Present Value	Ranking
A	9,430	10,000	-570	4
B	10,413	10,000	413	3
C	10,457	10,000	457	2
D	10,564	10,000	564	1

In table 2.6, a discount rate of 30 percent is used, instead of 6 percent as in the previous example. The relative ranking of the two investment pairs remains the same, B is still preferred to A, and D is still preferred to C.

TABLE 2.6 NPV of the Investments - Discount Rate is 30 Percent

Investment	PV of Cash Flow	PV of Outlay	Net Present Value	Ranking
A	7,692	10,000	-2,308	3
B	8,343	10,000	-1,657	1
C	7,487	10,000	-2,513	4
D	7,842	10,000	-2,158	2

The higher discount rate results in proceeds of the later years being worth less than the case with low discount rate. The net present value method always rank comparable investments in the correct order, independent of the size of the discount rate, as long as the same rate are used when determining the present value of both the investments.

2.7 SUMMARY

In table 2.7 the four hypothetical investments described in table 2.1 are ranked by each measure of investment worth discussed, in purpose to illustrate the tendency for each measure to give different ranking to identical investments. The aim is to emphasise the need for cautiousness when using different measures of investment worth to evaluate investment proposals.

TABLE 2.7 Summary of Rankings

Measure of Investment worth	Investment			
	A	B	C	D
Payback Period	1	1	4	3
Average Income on Cost	4	3	1	1
Internal Rate of Return	4	1	3	1
Net Present Value				
At 6%	4	3	2	1
At 30%	3	1	4	2

Given the different results, the conclusion must be that not all four measures can be equally applicable. By considering the investments in pairs, logic reasoning leads to the conclusion that the measures not using the discounted cash flow method, i.e. the payback period and the return on investment ROI measure, are evidently incorrect. As a result, these measures (payback period and ROI) will not be discussed any further.

The rankings given the investments by the measures of NPV and IRR are not equal. Hence, as neither of these rankings can be eliminated as obviously incorrect, further investigation must be carried out to prevent contradictory decisions. Hence, chapter 3 is dedicated to a comparison between the net present value and the internal rate of return methods.

3 COMPARISON BETWEEN NPV AND IRR

In the previous chapter the conclusion was reached that neither of the two discounted cash flow methods discussed is obviously incorrect. The IRR and the NPV methods of selecting capital investment proposals are closely related, as both are ‘time-adjusted’ measures of profitability and in addition, their mathematical formulas are identical. In many cases the methods lead to the same conclusions, but there are also times when they lead to different ones. Thus, unless the two investment criteria *habitually* lead to identical decisions, one cannot avoid having to choose between the two methods of measuring an investment proposal’s desirability (Levy & Sarnat, 1994).

Therefore, a comparison between the two methods will be made, in order to determine which of the two is the *optimal* method. Still the assumption is made that the timing and the size of the cash flows are known with certainty, in order to concentrate on the crucial characteristics of the two decision criteria. Due to this, the discussion of cost of capital is postponed and will occur in Part II. In this part, with the assumption of certainty, the cost of capital (discount rate) is simply the risk free rate of interest.

3.1 INDEPENDENT INVESTMENTS

In the case when evaluating conventional investments¹² economically independent of one another, the NPV method and the IRR method consequently lead to the same accept and reject decisions (Ross, Westerfield & Jaffe, 1999). Therefore, none of the methods can be excluded as the inferior of the two. Below an example illustrates this statement.

EXAMPLE 3.1

In figure 3.1, the NPV-profile of a conventional investment is plotted. As mentioned in section 2.4, the intercept between the plot and the horizontal axis, in this case R , represents the internal rate of return (IRR).

The graph shows that where the NPV is greater than zero, as the case when using r_1 as discount rate, R exceeds r_1 . Conversely, where NPV is negative, as the case when using r_2 as discount rate, R is smaller than r_2 . Hence, both methods result in identical accept/reject decisions.

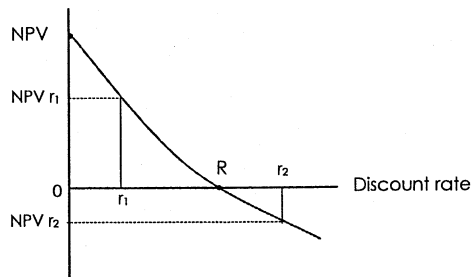


FIGURE 3.1: NPV profile of a conventional investment. Source: Ross, Westerfield & Jaffe. *Corporate Finance*, 1999

¹² Investments with an initial outlay followed by one or more cash proceeds over the following periods.

A firm that is faced with the problem of selecting acceptable investment proposals from unacceptable will thus be indifferent to which method employed, as for any conventional project, independent of the project's size or length, the NPV and IRR methods lead to the same decision (Levy & Sarnat, 1994).

3.2 MUTUALLY EXCLUSIVE INVESTMENTS

In the case with investments that are not independent, the conclusions drawn are different. Once one drops the assumption of independence, a disagreement between the two time-adjusted methods of selecting capital investments arise. Hence, just ranking the investments without considering their relative attractiveness, as in chapter 2, or evaluate them as acceptable or unacceptable as in section 3.1, is not sufficient (Clark *et al.*, 1989).

The situations where a corporation has two or more investment proposals available, but only one of them can be accepted occur frequently. If the undertaking of an investment decreases the expected benefits of another investment, the investments are considered as substitutes. In an extreme case where acceptance of one investment totally eliminates the expected benefits of the other investment, the investments are said to be mutually exclusive. The problems raised by such dependency can be illustrated by two one-year investments (Bierman Jr & Smidt, 1988):

TABLE 3.1 Cash Flows of Two Investments

Investment	Initial outlay	Net Cash Flows at end of the year
A	-10,000	12,000
B	-15,000	17,700

Source: Bierman Jr. & Smidt, 1988

The two investments' IRR can be calculated easily, as they both have a one-year duration:

$$-10,000 + \frac{12,000}{1 + IRR_A} = 0, \quad \text{hence } IRR_A = 20\%$$

$$-15,000 + \frac{17,700}{1 + IRR_B} = 0, \quad \text{hence } IRR_B = 18\%$$

Assuming a discount rate of 10%, the NPVs of the two projects are given by:

TABLE 3.2 Calculation of Net Present Value

Investment	Initial outlay	Net Cash Inflow -discounted at 10%	NPV
A	-10,000	10,909	909
B	-15,000	16,090	1,090

The two investments' measures of investment worth are summed up below:

TABLE 3.3 IRR and Net Present Value of the Two Investments

Investment	IRR	NPV
A	20%	909
B	18%	1,090

Despite the higher internal rate of return of investment A, investment B has the larger net present value. As long as we discuss investments that are independent, the result would be that both are accepted, as they both fulfil the criteria for acceptance set by the two methods of evaluating investment proposals. Their IRRs are higher than the discount rate and their NPVs are positive. However, if the decision-maker is forced to choose between the two, as in the case with mutually exclusive investments: Which of the two is the better one? A firm utilising the IRR-method would select investment A, while a firm using the NPV-method would select investment B.

3.2.1 THE RANKING PROBLEM

The conclusion above reflects the inconsistency between two discounted cash flow methods, as they do not necessarily rank investments similarly. When evaluating mutually exclusive investments, ranking becomes crucial to the firm, because undertaking one investment prevents the undertaking of another. Hence, it is impossible to be indifferent between the IRR- and the NPV-methods (Clark *et al*, 1989).

To illustrate the difference in ranking, the two investments' NPV-profiles are plotted below in figure 3.2. If the decision-maker utilises the IRR-method, the ranking would be constant, as investment A's 20% always exceeds investment B's 18%. On the other hand, the ranking of the investments using their net present values is not constant.

EXAMPLE 3.2

Figure 3.2 illustrates that the ranking by NPV depends on the discount rate applied. If the firm's cost of capital is greater than r_0 no problem occurs, as both methods rank investment A as the best one. However, as shown in the graph, if the firm is using a discount rate below that of r_0 , the two methods result in different rankings (Bierman Jr & Smidt, 1988).

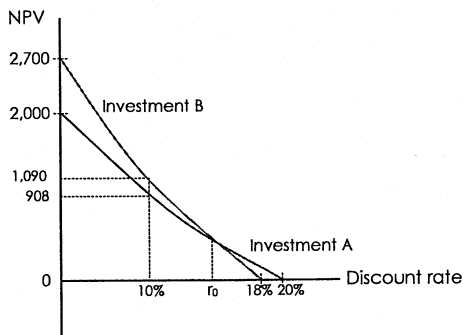


FIGURE 3.2: NPV-profiles of investment A and B.

There exists a wide range of values of the discount rate in which contradictory rankings can arise, and in the following sections of this report an argumentation for preferring the net present value-method will be made.

3.2.2 THE SCALE PROBLEM

Additional differences in the ranking of investments by the two methods discussed may occur for several reasons. This section illustrates the case when the cash flows of the investments are evidently different in size (Bierman Jr. & Smidt, 1988). Consider the cash flows of the following two investments:

TABLE 3.4 Cash Flows of Two Investments

Investment	Years:			
	0	1	2	3
A	-1,000	505	505	505
B	-11,000	5,000	5,000	5,000

Source: Bierman Jr. & Smidt, 1988

If the firm's cost of capital, that is, its discount rate is 10%, both investments are acceptable according to both methods, since their internal rate of return exceeds the discount rate and both investments have positive net present values.

TABLE 3.5 IRR and Net Present Value of the Two Investments

Investment	IRR	NPV
A	24%	256
B	17%	1,435

As stressed earlier in this report, the firm should choose the investment with the highest net present value, since the basic point made in this report is that the management's goal is to maximise the value of the firm. Thus, this example exhibits a defect with the internal rate of return criterion, as it would lead the manager to make a less favourable decision. Here the problem with the IRR-method is that it ignores issues of scale. To illustrate the reason for this disparity in ranking of the investments, figure 3.3 graphs the two investments' NPVs as functions of the discount rate.

EXAMPLE 3.3

As can be seen in figure 3.3, the net present value profiles of the two investments intersect at a discount rate of approximately 16.6%. The interpretation of the graph gives by hand that the larger of the two, investment B, should be favoured to investment A if the firm's cost of capital is below 16.6% (Bierman Jr & Smidt, 1988).

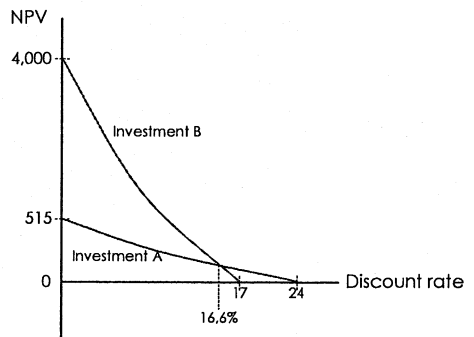


FIGURE 3.3: NPV-profiles of investment A and B.

The reason for the NPV-method to select investment B, in spite of its relatively lower rate of return, before investment A can be explained by considering the *incremental*¹³ cash flow investment B give rise to (Levy & Sarnat, 1994).

Initially, assume that the firm is using the IRR-method for evaluating investment proposals. The firm would then choose investment A as the most favourable one. We know that investment A, the smaller of the two, is acceptable as an independent investment, as its net present value is positive. Now the question is whether investing an additional 10,000 in order to accept the larger investment B instead of investment A is prosperous. Therefore, let's consider the hypothetical investment 'B minus A' in table 3.6, as the choice of investment B is the same as choosing investment A in addition to an investment of 10,000, which returns 4,495 each year for three years.

TABLE 3.6 Cash Flows of Two Investments and the Incremental CF of 'B minus A'

Investment	Years:			
	0	1	2	3
A	-1,000	505	505	505
B	-11,000	5,000	5,000	5,000
'B minus A'	-10,000	4,495	4,495	4,495

Source: Bierman Jr. & Smidt, 1988

The internal rate of return on this incremental cash flow is 16.6%, as shown in figure 3.4, and it is an acceptable investment given the cost of capital is still 10% and the IRR-method is used. Additionally, the NPV of the investment is positive, as shown in figure 3.4 where its NPV-profile is plotted. The net present value is 1,178 at a discount rate of 10%, which also indicates that the investment is acceptable.

EXAMPLE 3.4

The profile of the incremental investment's net present value shows that the investment is acceptable for discount rates below 16.6%, where its net present value is positive. Should the cost of capital be greater than 16.6%, the hypothetical investment 'B minus A' should be rejected according to the IRR-method, precisely as the NPV-method prescribed in figure 3.3 (Bierman Jr & Smidt, 1988).

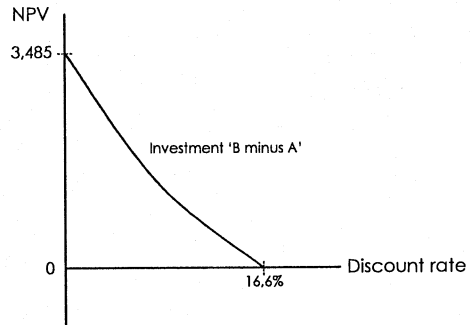


FIGURE 3.4: NPV-profile of investment 'B minus A'.

In figure 3.3 the graph also shows that the intersection of the two plots occur at the discount rate of 16.6%, which is similar to the internal rate of return of the incremental cash flow.

To sum up, if the cost of capital is greater than 16.6% the firm should choose to go with investment A and all other investments should be rejected. This conclusion is

¹³ Accepting investment B before investment A is synonymous to accepting a hypothetical investment 'B minus A' which characterise the *incremental* cash flow resulting from such a decision.

similar with the one made when using the NPV-method as the sole method when evaluating the two investments. By looking at and comparing the incremental cash flow against the firm's cost of capital, the NPV-method ensures that the firm reaches the optimal scale of investment when evaluating mutually exclusive investments.

3.2.3 TIMING OF CASH FLOW

The problem with the timing of an investment's cash flows is similar to the scale problem when evaluating mutually exclusive investments (Ross, Westerfield & Jaffe, 1999). The following example is illustrated in table 3.7 below, in order to show that even in the case of identical size of investments, the rankings by the IRR-method can differ from that the NPV-method offers.

TABLE 3.7 Cash Flows of Two Investments and the Incremental CF of 'B minus A'

Investment	Years:			
	0	1	2	3
A	-10,000	10,000	1,000	1,000
B	-10,000	1,000	1,000	12,000
'B minus A'	0	-9,000	0	11,000

Source: Ross, Westerfield & Jaffe, 1999

Assuming a cost of capital of 10%, the internal rate of return and net present value can be calculated (table 3.8). In the table also the IRR and the NPV of the hypothetical incremental investment is shown.

TABLE 3.8 IRR and Net Present Value of the Two Investments and 'B minus A'

Investment	IRR	NPV
A	16.0%	669
B	12.9%	751
'B minus A'	10.6%	83

Once again, the two methods' rankings contradict, even though the initial outlays are identical. Hence, the argument about the scale of investment cannot be used to justify the choice of investment B as the most prosperous. Still, the incremental technique used in the previous section can be applied to show that investment B is the one that should be accepted. The result is illustrated in figure 3.5.

EXAMPLE 3.5

For discount rates below 10.6% the incremental investment 'B minus A' is acceptable, which corresponds with the range over which investment B has the higher NPV. Thus, even when the sizes of the initial outlays are the same, the two methods can still yield different results and the NPV-profiles can intersect (Ross, Westerfield & Jaffe, 1999).

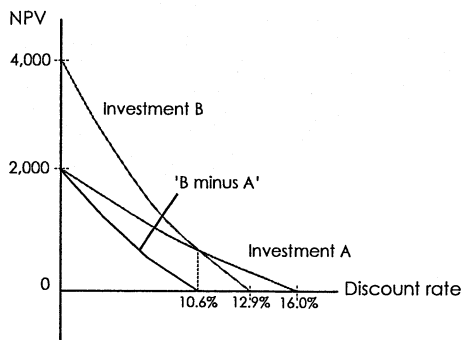


FIGURE 3.5: NPV-profiles of investment A, B and 'B-A'

To sum up, the failure of the IRR-method is often caused by its inability to properly evaluate the use of funds due to the fact that it ranks investments *independently* of the cost of capital. As long as there are differences in timing and size of the investments' cash flows, difference in the ranking of investments by the two methods can arise.

3.3 THE MULTIPLE-IRR PROBLEM

A problem that is facing both independent and mutually exclusive investments is the *multiple-IRR* problem (Ross, Westerfield & Jaffe, 1999). It occurs when the cash flow of the investment is non-conventional.¹⁴ The case with non-conventional investments is relatively common, as there many times are disposal costs connected with an investment. Nuclear-power plants and mining projects are examples often used.

Below an example is made to illustrate the problem facing the IRR-method when evaluating such investments.

TABLE 3.9 Cash Flows of a Non-Conventional Investment

Investment	Years:		
	0	1	2
A	-100	230	-132

Source: Ross, Westerfield & Jaffe, 1999

This investment has two internal rates of return. This fact is quite easily proven, since in the formula of internal rate of return, the IRR occurs in the denominator. The calculations of the IRRs are made below to leave the reader without a doubt about the conclusion drawn. In this case, the two rates are 10 and 20%, which makes the IRR-method hard, or even impossible, to apply. The investment's NPV-profile is plotted in figure 3.6, as it illustrates the problem in an easily interpreted way.

$$-I_0 + \frac{CF_1}{(1+IRR)^1} - \frac{CF_2}{(1+IRR)^2} = 0$$

$$-100 + \frac{230}{(1+0.10)^1} - \frac{132}{(1+0.10)^2} = 0$$

$$-100 + \frac{230}{(1+0.20)^1} - \frac{132}{(1+0.20)^2} = 0$$

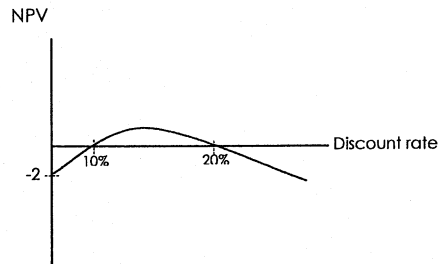


FIGURE 3.6: NPV-profile of Non-Conventional Investment.
Source: Ross, Westerfield & Jaffe.
Corporate Finance, 1999

There is no rule of which one to use, as there is no best answer, why the IRR-method simply cannot be used in the case with non-conventional investments. This is another reason for why the net present value is preferable to the internal rate of return.

¹⁴ A conventional investment consists of an initial outlay followed by one or more inflows. In the case with a non-conventional investment, the cash inflows are followed by an outflow, making the sign of the cash flow -, +, -.

3.4 SUMMARY

“The discounting for time is an essential part of any capital budgeting process, in order to evaluate a project.” (Bierman Jr. & Smidt, 1988) Comparing future cash flows with initial outlay explicitly gives an overall measure of investment worth. While some measures of value might be as effective as the net present value measure under some circumstances, no alternative method will be as flexible as the NPV-method. The net present value method provides the more attractive criterion for the following reasons:

- NPV reflects the absolute size of the investments while the IRR does not. The assumption in this thesis is that the firm is concerned with absolute profits, rather than the rate of profit.
- NPV implicitly assumes that received cash is invested at the cost of capital, and not at the investment’s internal rate of return as assumed by the IRR.
- Finally, in addition to its theoretical superiority, the NPV also has technical advantages. When non-conventional investments are evaluated, the IRR sometimes is prevented to present a real solution as several internal rates of return can exist.

Even though the NPV-method gives the most correct and secure measurement, both IRR and payback period are also frequently used since they provide managers with extra information about the project. Many people find it easier to communicate IRR than NPV and as long as the evaluated investments are independent and conventional, NPV and IRR always lead to the same accept/reject decision (Bøhren & Gjørnum, 1999).

However, when mutually exclusive investments are evaluated, the two methods do not *rank* the investments identically. Therefore, a method habitually giving the best basic data for decision-making must be utilised, why the NPV is the method chosen.

To sum up, the net present value method is the optimal method when all future cash flows and the appropriate cost of capital are known. Hence, the conclusion is that the NPV-method should be used as *the sole method* when evaluating investment proposals, regardless of them being independent or mutually exclusive.

PART II

-RISK AND UNCERTAINTY

As noted in Part I, the firm's capital investment decisions are strongly dependent on the degree of accuracy in cash flow estimations. In Part II, the subject of risk and uncertainty are introduced and thoroughly explored, as this part presents a discussion of techniques for dealing with capital budgeting under uncertainty.

First, some issues concerning risk are examined, as an understanding of the basis of risk is crucial to further reading. Then a brief discussion about the firm's cost of capital follows, before lastly, two different methods of coping with the risk involved in investments are introduced. The aim is to illustrate how these methods can serve as a complement to the net present value method previously concluded being the superior measure of investment worth.

4 CAPITAL BUDGETING UNDER UNCERTAINTY

This far it is assumed, implicitly or explicitly, that an investment could be described as a unique series of cash flows. The goal of the performed analysis has been to determine the net present value of the investment, as the cash flows have been well defined and received under certainty. However, the situation where future cash flows are known with certainty is rather unusual, why techniques coping with risk and uncertainty are introduced.

4.1 RISK

The total risk facing an investment or a project can be divided into two parts; the unsystematic risk and the systematic risk. An unsystematic risk is a risk that specifically affects a single project, that is, the different projects in a portfolio are under uncertainty connected to their specific nature (Ross, Westerfield & Jaffe, 1999). General risk theory suggests that the unsystematic risk is eliminated when the project is part of a larger portfolio of investments, with no perfect correlation in between. The method is called *diversification*, and it prevents individuals or organisations from relying on just one type of investments.¹⁵

A systematic risk is any risk that affects a large number of projects, each to a lesser or greater degree. Examples of systematic risks are uncertainty about inflation, interest rates and general politics. When it comes to the systematic risk one cannot eliminate the effects, no matter how widely one diversifies. The systematic risk is often referred to as the *market risk*.

4.1.1 RISK ALLOCATION

How is the allocation of risk transferred and who finally bears it? According to Eeckhoudt and Gollier (1995), transferring risk from one actor to another or sharing risk jointly does not make it evaporate, as many sometimes seem to believe. Thus, one can rightfully enquire about the benefits of the mechanisms of transfer or sharing. The aggregated wealth of the different actors is, as a rule, higher when the possibility of risk allocation exists.

The modern economies have developed numerous methods to reallocate individual (project specific) risks. The simplest example is a contract whereby one actor commits to paying a certain amount of money if a particular event occurs, which is called a 'bet' or an 'option'. In its most pure form, it consists of a bet on a particular state, which for example would be a promise to provide the opponent with money if the state

¹⁵ The subject of diversification is not discussed any further here. Instead, I recommend the interested reader to study this topic on his or her own. The perhaps most renowned book is Michael Porter's *Competitive Advantage*, 1980.

occurs. This is called a ‘contingent claim’, and is defined by its physical characteristics and by the state in which it is paid or received. When only discussing wealth, a contingent claim is the same as a monetary promise.

4.1.2 TRANSFERRING RISK

The possibility to transfer risks from one group of actors to another has been an important vehicle for the economic growth of the last two centuries. Henry Ford once said – “The true builders of the skyscrapers in New York were the insurers”. This can be applied for each time that the risk of undertaking a project would be excessive if the entrepreneur had to bear all of it (Eeckhoudt & Gollier, 1995). This exhibits the part played in the economy by the insurers, i.e. the financial sector, being the centre of the transferring of risk.

One thing is to examine who ends up bearing the risk; it is another to determine how risk ought to be shared. In an attempt to determine whether our market system is capable of efficiently distribute risk, Markowitz and Sharpe introduced the capital-asset-pricing model (CAPM) in the 1960s. For this contribution, they were 1990 awarded the Nobel Prize in Economics.

4.2 COST OF CAPITAL

The cost of capital reflects the cash-flow risk connected to the specific project. The greater uncertainty, the higher the rate of compensation is. The risk of the project is taken into consideration in the discount rate when pricing it and the investor is hereby compensated for not knowing exactly the future cash flows the project give rise to. Hence, expected cash flow itself does not reflect the risk (Ross, Westerfield & Jaffe, 1999).

It is only the risk component that varies between different projects. The risk-free rate of return and the inflation does not fluctuate, irrespective of what kind of project the organisation evaluates. However, the risk can differ significantly when comparing one project with another (Meredith & Mantel, 2000).

4.3 FOUNDATIONS OF RISK ANALYSIS

The principal contribution of risk analysis is to focus the decision-maker’s attention on understanding the nature and extent of the uncertainty associated with the variables used in a decision-making process (Meredith & Mantel Jr. 2000). Risk analysis can be performed with several different variables, even though the analysis regularly comprises financial measures in determining the attractiveness of an investment project. In many situations, it is not desirable, nor possible, to evaluate an uncertain project by means of the capital-asset-pricing model (Levy & Sarnat, 1994). In addition, many individuals display scepticism and disbelief to CAPM. The numerous assumptions underlying the model make it hard to employ in real projects. As a result, CAPM will not be applied in this thesis as main focus lays on other methods determining the risk involved in projects.¹⁶

¹⁶ There are numerous literatures handling CAPM, why I recommend the interested reader to study this topic on his or her own.

5 RISK ANALYSIS

Under times of certainty, the value of an investment can be described in terms of the present value of its future cash flows at a default-free discount rate. Consequently, this method is both theoretically correct and practically viable since there is only one possible cash flow and the predetermined discount rate is well defined. However, with a project facing uncertainty the situation is a little different. An approach that considered all possible future cash flows would be theoretically correct, but hardly practically viable as the amount of data assembled would be too extensive. Therefore, two methods – the sensitivity analysis and the decision tree-method – coping with the risk facing an investment are introduced in this chapter.

5.1 SENSITIVITY ANALYSIS

According to Bøhren and Gjørnum (1999) in practice the most adopted method when investigating financial effects connected with risk, is the sensitivity analysis. It is a pragmatic way of handling an investment's risk. The objective of the sensitivity analysis-method is, as the name indicates, to survey how sensitive the project is to adjustments in the financial conditions the analysis builds upon. Thus, the result is not a single NPV figure based on a risk-adjusted cost of capital, but a basis of discussion. The purpose is to provide decision-makers with information about the project's risk in a more intuitive and easily interpreted way than the CAPM. Additionally, while the capital-asset-pricing model only considers the systematic risk, the sensitivity analysis contemplates the *total risk*, i.e. the risk an investor must bear when only investing in one particular project.

The basic question in sensitivity analysis is “What if?” and the main purpose is to display *what* happens with a project's revenues *if* it turns out that the basic financial conditions have changed and actual cash flow differs from expected.

5.1.1 EXECUTE A SENSITIVITY ANALYSIS

The first step in a sensitivity analysis is to examine what happens to the calculated cash flow when project data diverge from the expected basic data used. The next step is to show what the divergence results in when looking at NPV. When calculating net present value one must bear in mind that, in contradiction to risk-adjusted discount rate method where the risk adjustment takes place in the denominator, the sensitivity analysis includes the risk in the numerator. This by calculating net present value for a number of different cash flow, as adjustments are done in the expected project data (Bøhren & Gjørnum, 1999).

As a result, one receives a wide spectrum of potentially achievable net present values and the spread itself is supposed to reflect the risk of the project. Due to this, one must simply discount the cash flows with the time cost, and not add the risk cost, as it would lead to calculating the risk twice. Hence, when calculating net present value in a

sensitivity analysis, a *risk-free discount rate* must be applied regardless the risk of the project's cash flow. Below an example of sensitivity analysis is made in order to visualise the theory (Levy & Sarnat, 1994).

EXAMPLE 5.1

Table 5.1 shows expected annual revenue and costs facing an ordinary project, in this case a property development project.

TABLE 5.1 Estimate of Future Annual Cash Flows

Revenue	100
Costs:	
Labour	40
Land	35
Material	10

Source: Levy & Sarnat, 1994

First, the project's net present value for the given estimates is calculated. In this example the assumed discount rate is 0%, why the net present value simply is the revenue subtracted with the costs. $NPV = 100 - 40 - 35 - 10 = 15$.

Thereafter are the different factors varied as a result of estimation errors, shown in table 5.2, leaving numerous outcomes of NPVs.

TABLE 5.2 Net Present Value at Different Cash Flows

Estimation Error	Revenue	Labour	Land	Material
-25%	-10,0	25,0	23,8	17,5
As Expected	15,0	15,0	15,0	15,0
+25%	40,0	5,0	6,3	12,5

Source: Levy & Sarnat, 1994

Lastly; the results are plotted in a graph, a so-called 'STAR-diagram', illustrating the sensitiveness of each factor. The lines are plotted through the three net present values calculated for each of the factors. They all intercept the Y-axis at the project's expected net present value, 15. The slope of each line illustrates the different factors' importance, depending on the size of the factor. As the size of the cash flow increases, so does the slope of its graph. Hence, revenue is the most important factor in the illustrated example, as interpreted in figure 5.1.

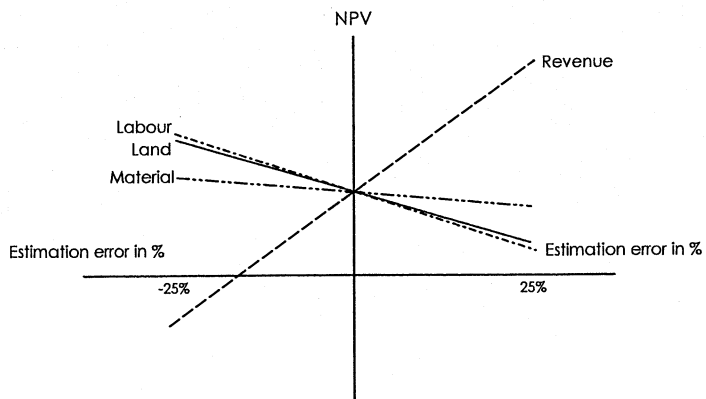


FIGURE 5.1: 'STAR-diagram' of different NPVs as function of revenues and costs.

5.1.2 RESTRICTIONS

There are at least two limitations with the sensitivity analysis-method, and it is important to have these in mind when performing an analysis. First, it is possible to change only one factor at the time, and implicitly presumed that the change does not affect other factors. While several factors are proven to directly infect each other, such as price and demand, inflation and nominal rate of return, the sensitivity analysis is unable to cope with a change in more than one factor at a time.

Second, suppose the corporation handling the project discovers a diminishing return caused by a decrease in sales. Presumably the management would act to prevent this decrease, e.g. through intense marketing, increase in price, cut in expenditure etc., all with the intention to boost revenues. Such actions can prevent the effect in return from being as big as the sensitivity analysis suggests. In the sensitivity analysis, all possibilities for such adjustments are neglected.

5.1.3 SUMMARY – SENSITIVITY ANALYSIS

As mentioned above, the sensitivity analysis only displays the result of the project when data deviates from basic conditions. The analysis does not take into account the probability of such divergence to occur. The result of the sensitivity analysis should instead be viewed as an alarm signal and a way to display where more information is needed. It can also serve as an indicator whether the performed NPV-analysis could be trusted or not.

5.2 DECISION TREE

The hitherto discussed method, sensitivity analysis, gives no information about the probability of a potential deviation in basic data, nor considers management adjustments. Thus an alternative method is introduced, the decision tree-method.

Uncertain environments create a need for flexibility. In the context of project analysis, that flexibility expresses the possibility to push forward decisions concerning the project. To have flexibility in a project is analogous to be in possession of an option, i.e. the right, not the constraint, to perform a predetermined thing.

5.2.1 VALUE FLEXIBILITY

Below two straightforward examples are shown (source: Bøhren & Gjørnum, *Prosjekt Analyse*, 1999), to illustrate how flexibility can be valued. The first example describes a situation without flexibility. The second example goes further by adding flexibility in the decision-making.

EXAMPLE 5.2

A production corporation is about to plan future production of a new product. The expected demand is uncertain, and the question is whether the corporation should invest in production at maximum or minimum capacity, which is comparable to two mutually exclusive alternatives. The challenge is that as long as production rate must be determined before the demand is known, the risk is to either lose sales or have a stock impossible to sell. Demand and production are shown in table 5.3 below, together with expected cash flow. Time value of money is neglected.

TABLE 5.3 Cash Flow and Data for a New Project

Production	Cost	Demand		Expected sale	Expected cash flow
		high	low		
max.	60	110	20	65	5
min.	30	70	20	45	15
probability		0.5	0.5		

Column 1 and 2 show production cost at the two different levels of production. Demand is displayed as sale in column 3 and 4, and as a result expected sale is calculated as the mean value, since the probability of both options are 0.5. With production costs subtracted, expected cash flow for the two alternatives are therefore 5 and 15 millions respectively.

The conclusion is that the corporation ought to select the alternative of minimum production rate, as expected cash flow is 10 million higher.

In example 5.2, there is no flexibility in the sense that once production rate is decided, one cannot reverse that decision. Thus, it is not possible to produce a different amount even if the corporation receives information about the uncertain factor, that is, the demand.

The opposite situation occurs in a flexible situation, in which the corporation knows the demand before making the production decision. In that case, it would be possible to push forward the decision to a moment when demand as a risk factor is eliminated. This situation is illustrated in example 5.3 by means of a decision tree.

EXAMPLE 5.3

The corporation has here an option to adjust the production rate after the demand has become known. Production costs are supposed to be the same as in example 5.2, and the corporation still wants to select the alternative with the highest expected cash flow. The new situation is described as a decision tree in figure 5.2, where explicitly the option to advance the decision is considered.

The decision tree is set up from the left, illustrating the decisions in chronological order. In this case the first action taking place is that the corporation finds out whether the demand is high or low. This is indicated by the circle, *receipt of information*, which is an event the corporation cannot affect. The probability for high or low demand is 50% respectively. In both cases the corporation will reach a *decision point*, indicated by a square, where they are able to affect the course of events. Probabilities, production costs and revenues are shown in the figure.

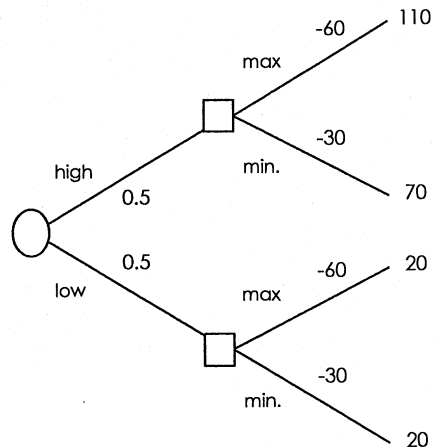


FIGURE 5.2: Decision tree for the two alternative investments.

A decision tree is solved in reverse, in this case starting with the two decision points. At the upper decision point the corporation already knows that the demand is high and the question simply is which alternative to select. Producing at maximum will result in a cash flow of 50 million, compared with 40 million if the other alternative is selected. At the lower decision point both alternatives end up with a negative cash flow. Assuming that the corporation is forced to deliver by a contract, selecting the alternative of minimum production results in least negative cash flow, -10 million. Therefore, by postponing the decision about production level, one obtains a situation of *decision strategy* (Bøhren & Gjørnum, 1999).

The value of the flexibility is therefore exactly the difference between the investments' cash flows in these two situations. On basis of example 5.3 and figure 5.2, one can therefore derive the subsequent optimal strategy for the corporation;

- If demand is high, produce at max. level, which result in a cash flow of 50 mill.
- If demand is low, produce at min. level, which result in a cash flow of -10 mill.

The probability of ending up with high or low demand is 50 % respectively. Expected cash flow, given that the corporation decide to produce at optimal level, is therefore $50 * 0.5 + (-10) * 0.5 = 20$ million. In example 1, where the decision about production level was taken before knowing the demand, we concluded that minimal production level was the best alternative. Expected cash flow was then 15 million. As a result, the *value* of the flexibility is 5 million (20m – 15m). Alternatively, one can view it as if the corporation not yet has investigated the possibility adjusting the production after demand; five million is the highest amount it can pay for such an option.

5.2.2 SUMMARY – DECISION TREE

The situation with flexibility is fundamentally different from all other examples in this thesis, where decisions about whether to invest in the project or not, and the design of the project, are made at time zero. To evaluate flexibility is therefore an issue of pricing the project's options to perform a predetermined thing. An option offers flexibility and creates value when the cost of the option is lower than the benefits it provides (Copeland, 1996).¹⁷

5.3 SUMMARY

The two methods of coping with risk involved in investment projects both have their benefits. However, neither of the two presents the decision-maker with a single measure or a figure comparable to other similar projects. Instead both of them should serve as an informative tool, communicating and displaying uncertainties and risks' effect on the evaluated investment proposal.

Pricing the risk of a project is complicated due to the vast amount of data often needed, and many organisations rather include a safety margin in the discount rate, than calculate the risk as a single measure (Bøhren & Gjørnum, 1999). Consequently, the analysis part of this thesis will instead treat risk through a nonnumeric (qualitative) point of view.

¹⁷ For further reading about the Option Pricing Model, I recommend Tom Copeland's *Valuation*.

PART III

-CASE

The last part of this thesis aims to compare the discussed theory with a performed evaluation within a construction contractor firm and subsequently revise the performed evaluation.

The first chapter in Part III contains an introduction to the firm, Selmer Skanska AS, in general and the department performing the analysis in particular. The department's strategy and market position are presented, to serve as a background when revising the analysis.

Second, a description of the case is made, presenting the property in question and the agreement signed with the investor. Lastly, the author conducts an analysis of the performed evaluation, and subsequently a discussion summarises the thesis.

6 CORPORATE INFORMATION

SELMER SKANSKA

The thesis has now reached the part where theory and practice are to interact. This chapter aims to present Selmer Skanska AS as a corporation in general and the Department of Commercial Property (DCP) in particular. The intention is to provide the reader with an overview of the department's goals and strategy.

6.1 HISTORY AND MARKET POSITION

Established in 2001, through Skanska AB's acquisition of Selmer ASA, Selmer Skanska AS is the prime construction company in Norway, employing approximately 4,700 and with an operating revenue exceeding NOK 8 billion. The company is headquartered in Oslo, and operates nation-wide both through wholly owned subsidiaries and joint ventures.

Selmer ASA has ever since the downturn in the construction business in early 1990s, when the company was close to bankruptcy, achieved a significant growth in financial strength, becoming the largest player in the Norwegian market. In addition, Skanska AB's well renowned reputation internationally, as being on of the top 10 construction companies world-wide, grants a strong competitive position for Selmer Skanska in the future. Selmer Skanska's business idea is cited below:

“We create added value for our customers in the building and construction market and contribute in making the society more efficient and the everyday better for all - in work and in leisure.” (Selmer Skanska, March 2001)

6.1.1 ORGANISATIONAL STRUCTURE

Figure 6.1 partially illustrates the group's organisational structure, and the intention is to outline the position of the Department of Commercial Property, marked with grey colour, as it is located within the Building Division:

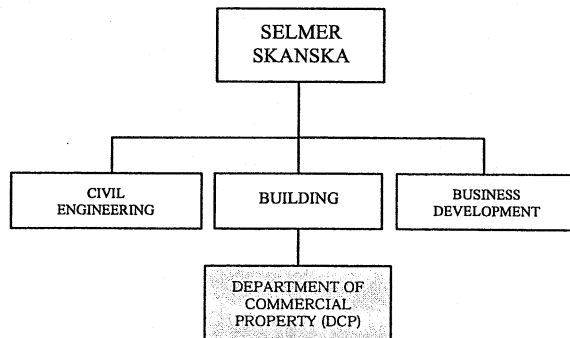


FIGURE 6.1: Organisational structure of Selmer Skanska AS
Source: Selmer Skanska, March 2001

6.2 DEPARTMENT OF COMMERCIAL PROPERTY

The intention in forming the Department of Commercial Property is to enable the company to operate throughout the entire value chain, from site acquisition and property development, to property management and brokering (Business Plan, Selmer Skanska, March 2001). This aligns the overall strategy, which assumes that value creation is based on active interaction within a process where knowledge and experience are the two prime success factors.

The department shall operate independently and irrespective of other areas of interest within the Selmer Skanska group. Then again, if possible the department ought to contribute to achievable synergies between departments within the group, under circumstances that market price is obtained.

6.2.1 GOAL

The Department of Commercial Property's goal is to deliver a minimum of 10.5% total return, before taxes and finances. The goal is set by the top management of Selmer Skanska, and hence, the issue of this thesis is not to discuss whether this goal is appropriate, with regard to the present investment climate in the Norwegian property market, or not. The goal is analogous to the discount rate employed by the department, as discussed in section 6.2.4 – Cost of Capital.

6.2.2 INVESTMENT STRATEGY

The DCP shall operate with a short-term perspective, and actively search for prosperous investment opportunities. Oslo serves as the primary market, with central, attractive properties in Bergen, Stavanger, and Trondheim as secondary markets.

The department has allowance to invest in wholly owned properties or, alternatively form partnership with other well-known, solemn actors in the market. However, the foremost strategy is to identify possible long-term investors and sell the developed project at an early stage, preferably before the construction works begin.

6.2.3 RISK PROFILE

The Department of Commercial Property is expected to operate under moderate risk exposure. The intention is to work in the span between the low risks significant for a contract construction firm and the high risks facing a conventional property developer who regularly invests in undeveloped properties (Kjeldsen, 2001). Figure 6.2 aims to illustrate the department's location, in terms of risk exposure, within the Selmer Skanska Group.

The expected return on investments increases when moving horizontally to the right, raising the risk exposure. The curve is similar to the curve often referred to as the security market line (SML), which serve as a base in the theory of CAPM.¹⁸

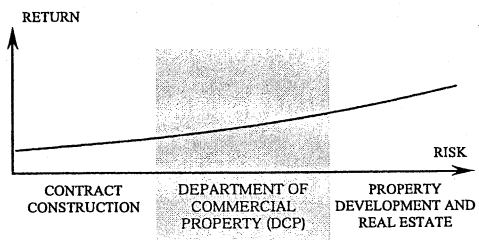


FIGURE 6.2: Risk exposure of different departments within Selmer Skanska AS. Source: Kjeldsen, 2001

¹⁸ The security market line, SML, illustrates the relationship between Expected Return on an Investment and Beta of the investment. (Ross, Westerfield & Jaffe, 1999)

6.2.4 COST OF CAPITAL

Normally, calculating the cost of capital is complicated and demands a lot of information about the firm and its finances. In this case, though, the cost of capital will not be calculated, as the Department of Commercial Property already is given a discount rate by Selmer Skanska's board of directors (Kjeldsen, 2001). The discount rate, which is applied to all investments made by the department, is presently at a level of 10.5% before taxes and finances, calculated as a weighted, average cost of capital.¹⁹ Hence, the discount rate will therefore not be a topic for further discussion.

6.2.5 CORPORATE TAXES

As the department's result is incorporated in the total result of Selmer Skanska AS, corporate taxes are neglected when evaluating the investment proposals. Hence, no comparison is made regarding pre- or after-tax calculations, as the department does not operate as an independent, taxable unit (Kjeldsen, 2001).

¹⁹ The weighted average cost of capital ($twacc$) is calculated as an average of the company's cost for equity and debt.

7 CASE DESCRIPTION – TOWNSTREET 2-4

As mentioned in section Method, the thesis will examine the performed evaluation process of an investment proposal the Department of Commercial Property recently was presented to. Since some parts of the information are confidential, the project chosen is given an assumed name, TownStreet 2-4, in the case description. The project is currently (June 2001) in a stage of planning, see figure 7.1. This chapter will provide the reader with a short background of the project, after which a short summary of the agreement reached between DCP and an investor, called OsloBank 1 (OB1), follows.

7.1 BACKGROUND

As DCP negotiated an agreement for buying the property TownStreet 2-4 for quite some time, analyses of different possible development models for the project were performed. The conclusion drawn was that the project had substantial economic potential, but despite this fact the board did not give their approval for DCP to buy it. Hence, an investor (OsloBank 1) was contacted in order to establish co-operation between the two.

7.2 THE AGREEMENT

The agreement below has been translated and summarised by the author, while some – according to the author – less important parts have been excluded. Still, the purpose of the agreement is reproduced in a correct manner, and it serves as a crucial component when assessing the evaluation made by DCP. Repetitive references to appendix 1 - Economic Evaluation, are therefore made.

Agreement between OsloBank 1 and Selmer Skanska AS/Dep of Commercial Property

OsloBank 1's Role

OsloBank 1 is obliged to purchase the property TownStreet 2-4, if they are able at an in advance specified purchase price. OB1 is responsible for financing the purchase of the existing property. They are also responsible for all costs associated with demolition of the existing building, and costs associated with the completion of the approved new building, see *appendix 1*. Further, OB1's obligation to buy the property is dependent on the Local Housing Committee's approval of the proposed building.

DCP's Role

If OB1 purchases the property, DCP's role is to act as a *project developer*; responsible for finding tenants for the premises in the existing building, follow up the approval process of the new building plan, and plan the construction works which are carried out by the Construction Department within Selmer Skanska. They are also responsible for finding tenants for the premises in the new building. DCP thus has the sole responsibility for the approval process, finding tenants, and all costs associated herewith.

DCP's Compensation

The compensation for the project development performed by DCP shall be based on the difference between accumulated costs and the estimated value (investment value) the developed property has at the time for completion, based on a yield of 8.25% on net rental income.²⁰ The net rental income is calculated as operational costs subtracted from gross rental income, see appendix 1. DCP's part of the development compensation is 87.5% of the total project development result and will be paid once the building is handed over by the contractor, all costs are known, and the first quarter's rental income is received by OB1. DCP's compensation for project management will be paid once the final public approval exists, and the construction works have begun, see figure 7.1 below.

Restrictions

The construction works can at its earliest start once 75% of the area in the new building has been let out. The tenants must be approved by OB1, and additionally the contract terms must be equivalent to normal market conditions. DCP's compensation will be calculated proportionally to the let area.

If the construction works are not commenced before December 31 2004, due to lack of public approval, or the total result of the project fall short of NOK 5 million; both parts are permitted to break the agreement. Further, if OB1 can verify that total net rental income of the existing building provides a return beneath 8% of invested capital, DCP shall compensate OB1 corresponding 50% of the compounded value of the deficit.²¹

In case of other than the above stated conditions, neither part can hold the other responsible for direct or indirect losses eventually occurring connected to the agreement.

Below the proposed project plan is illustrated, in order to provide a basis for the net present value calculations performed, as it was attached to the agreement.

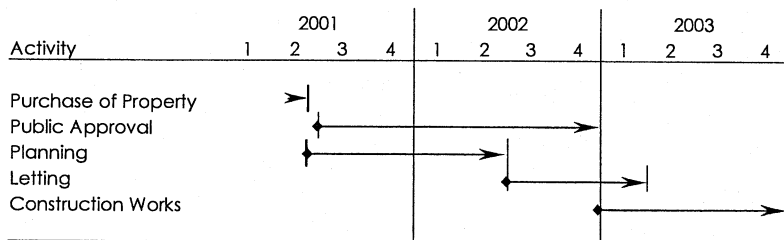


FIGURE 7.1 Project Plan for TownStreet 2-4. (DCP, 2001)

With this agreement in mind, the evaluation will now be analysed and revised; in order to assess the evaluation performed by DCP. Once again, the thesis aims to *illustrate*, *explain*, and *compare* rather than come up with the universal solution.

²⁰ In the Income Capitalization Approach, the investment value of a property is calculated as the net rental income divided by the investor's required rate of return (yield). The investment value is thus individual, depending on the investor's preferences (*The Appraisal of Real Estate*, Appraisal Institute).

²¹ The term 'compounding' refers to the process of leaving the money in the capital market and lending it for another year (Ross, Westerfield & Jaffe, 1999).

8 ANALYSIS

The aim of this chapter is to reproduce and analyse the evaluation of the proposed project, TownStreet 2-4, as the Department of Commercial Property performed it. The first section handles the *quantitative* (compare section Background) evaluation made. The purpose is to exemplify measures used, and then assess their reliability. The second part of this chapter touches the *qualitative* evaluation carried out, to see if the uncertainty and the risks connected to the project are considered in a theoretically appropriate way.

The analysis is outlined as follows: first DCP's measures, valuations, and results are presented in *century gothic* typeface, after which the author makes objective comments. The author's own opinions are set aside to chapter 9 – Discussion.

8.1 QUANTITATIVE EVALUATION

In appendix 1 a translation of the spreadsheet model used is presented. The aim is to gradually review the calculations made, and to comment the conclusions drawn from the analysis. Not every figure is reviewed, as expectantly the reader understands the main outline of the model.

In order to commence, a short explanation of the model is made. Under *Basic Conditions*, the evaluator punches in the expected rate of inflation, interest rates, discount rate and the investor's yield²². With the investor's yield and the expected total yearly net rental income as starting points, the *Investment Value* is calculated, by dividing the income with the required yield. Hence, as mentioned earlier, an investment value is individual and depends on the investor's required yield. The income capitalization approach is used when appraising income-producing properties (Appraisal Institute, Illinois). Costs associated with the project, such as construction, development, management, and marketing costs, are revealed under *Costs*, where also the purchase price of the property is shown. At the very bottom, under *Project Result*, the costs are subtracted from the presumed investment value, leaving the total result of the investment proposal, before and after financial costs.

Investment Value

The investment value *at sales point* is estimated to be approximately NOK 187.5 million, calculated in nominal value.²³ The gross rental income is reduced with the operational costs connected with the ownership. The net rent is regulated with price index (inflation), which means that the investment's real value is unchanged and its increase follows the estimated inflation rate, 2.5%.

²² See Glossary – Yield.

²³ The nominal value reflects the actual amount of money to be received in the future, in case of a sale of the property (Ross, Westerfield & Jaffe, 1999). See Glossary – Nominal Value.

The investment value is determined in nominal terms, and not compensated for a possible growth in capital return.²⁴ The index regulation of the rent ensures that the value calculated is topical, at sales point, and the method is therefore flexible. If the actual sales point diverges from the expected, the evaluator simply revises the date in the project plan, making the adjustments easily performed. However, the investment value is not discounted back to the time for the evaluation. That is a major flaw since the completion date of the construction works determines the value at that point, which implies that the investment value can be calculated several years from the moment of evaluation.

Costs

The costs are reproduced in real terms. The costs for the contract of construction and the property are the main parts. The costs for development and management are internal, based on DCP's work. There is also a part for unforeseen costs at approximately 7% of the total contract. The total costs are calculated exclusive and inclusive of financial costs respectively.

As the costs are determined in real terms, in opposition to the investment value, there are no possibilities to compare them to the investment value or to vary their appearance. The model hence is without concern whether the costs emerge early or late, that is, the timing of the cash flows is neglected. According to the discussion held earlier, in section 1.4 – Time Value of Money, the time value of money is considered being the prime aspect when evaluating investment proposals' attractiveness. Further, in chapter 2 – Capital Budgeting under Certainty, methods neglecting the time value of money were proven insufficient as evaluation methods, as they obviously can lead to a wrong decision. Due to this, it is of great importance that the period the costs occur is available as an extra variable.

Project Result

The project result is computed as the assumed investment value minus total costs. The investment value is calculated in nominal terms, that is, inflation is incorporated, while the costs are calculated without concern of inflation. Additionally, the result is then put in relation to the total costs, leaving a measure of return on investment (ROI).

Analogous with the above discussion, timing is crucial and therefore a factor unfeasible to neglect. In the case when determining the project result, the time factor is neglected in costs, but included in the calculation of investment value. Hence, the result derives from numbers indicated in two different time values. As stated earlier – “A dollar in hand ‘today’ is not equivalent to a dollar received ‘tomorrow’ (Levy & Sarnat, 1994)”.

Further, even if the return on investment in this case originates from numbers expressed in the same value, the ROI measure is unreliable as it, according to the discussion in section 2.5.2 – Return on Investment, too ignores the timing of the cash flows. Due to this, the project result and the ROI are erroneous as evaluation measures, not reliable when assessing the project's attractiveness.

²⁴ See Glossary - Capital Return.

8.2 QUALITATIVE EVALUATION

The qualitative evaluation made by the Department of Commercial Property is of a different, more explanative character, primarily based on the underlying agreement between the department and the investor, OB1. The evaluation handles the legal responsibility and the risk connected with the agreement, presented as the agreement in point form. A 'worst case'-scenario is mentioned under each category, explaining the consequences if the liabilities in the agreement are not fulfilled, whatever the reason might be.

As in the case with quantitative evaluation, the analysis is outlined as follows: first DCP's evaluation and conclusions are presented in century gothic typeface, after which the author's comments are made.

Public Approval

The Department of Commercial Property has the responsibility for implementing and managing the project, including contacts with public authorities. Consequences of the public approval, such as reduced area and increased costs derived from the denial of such an approval, are under DCP's liabilities. These factors affect the project result, leading to a diminished potential return for both OB1 and DCP.

'Worst Case' in this situation is a total rejection of the building plans, and hence no refurbishment at all. In that case, the project result is zero and DCP obtains no compensation for neither internal nor external development costs.

Taking the Local Housing Committee's approval as starting point, DCP accentuates the consequence on the department's compensation if the approval of the new building plans fails to happen. In the case of such a rejection, all costs up to that point falls on DCP, leaving the department with a loss. The size of that loss is rather easily calculated, but it is not displayed in the evaluation. Neither is there any estimate of the probability of an approval/rejection decision, and in the absence of a probability the potential profits/losses are impossible to estimate. The department thus faces a vast spectrum concerning the project result, stemming from the uncertainty connected with the public approval.

Costs

As the Department of Commercial Property has the responsibility for implementing and managing the project, this includes the costs estimated in the development plan. If the cost for development and construction works exceeds the budget, it inevitably charges the project result and hence DCP's compensation is reduced.

On the other hand, if reduced costs lead to a result better than expected, DCP's compensation increases proportionally with the reduction.

'Worst Case' in this situation is that the costs equal the investment value and the project result therefore turns out to be zero, and DCP obtains no compensation at all.

The risk for actual costs surpassing the estimated, leading to a zero profit effect for DCP, is discussed under Costs. An upside, that is if the real costs are lower than expected, is also mentioned as a possible scenario. The result of a possible increase or decrease in costs is hence unknown, and there are no educated guesses made over how large divergence in costs the project can manage, without leaving the department with a loss. A proper sensitivity analysis, as discussed in section 5.1 – Sensitivity Analysis, would enable the department to put a figure on the uncertainty of the different outcomes. It would facilitate the department with a percentage measure of the span of cost divergence the project can face.

Market Conditions

The Department of Commercial Property is responsible for the contact with the market, possibly through a broker, all marketing, and signing of lease agreements. The effect of increased or decreased rental incomes affects the project result, and consequently directly DCP's compensation.

'Worst Case' in this situation is that the department fails to reach the level of let space, mentioned in the agreement under Restrictions, within the set time and the construction works are deferred. In that case, the project result is zero and DCP obtains no compensation for neither internal nor external development costs.

The rent underlying the calculation equals the current top quotation experienced in the Oslo office space market. In case of a recess in the property market, the rent level serving as a basis for the investment value can be hard to achieve, leading to a poorer project result than expected. Further, a possible decrease in demand for high-end office space is also a risk, indicating difficulties in reaching the set minimum level of 75% let area before end of 2004. Both cases lead to a situation where the department's compensation will be lower, or even zero, than expected. On the other hand, with increasing demand for office space and square meter prices rising above current level, the upside in the project result is reasonably immense.

Responsibility

Under point *Restrictions* in the agreement it is stated that neither part can hold the other responsible for neither direct nor indirect losses eventually occurring connected to the agreement. However, OB1 can claim compensation from DCP if the public approval, or the let situation, turn out to be poorer than expected, leading to deferring the project.

'Worst Case' in this situation is difficult to state in numbers, but is nevertheless illustrated with the following example if the construction works not start as planned:

-Existing building is in late 2004 being let out for approximately NOK 3 million.

-During the period 2001 to 2004 OB1's net rental income on existing building is NOK 7.5 million, which seems realistic.

OsloBank 1's total invested capital at December 31, 2004 is then:

Property	NOK million	57.4
-Rental income		7.5
<u>Financial costs</u>		<u>11.5</u>
Total		61.4

A total 8% return on investment (OB1's required yield)	4.9
<u>Real return (estimated)</u>	<u>3.0</u>
Rental deficit	1.9

DCP shall compensate OB1 with 50% of the compounded deficit of NOK 1.9 million. The yield negotiated is 8%. Hence, compensation is $1.900.000/0,8 \cdot 50\% = 11.875.000$.

In addition DCP receive no compensation for neither internal nor external development costs.

The calculation performed is based on sound assumptions and displays, in an easily interpreted way, the consequence a denial from the Local Housing Committee would have on the project. However, once again, no estimation of the probabilities for the different outcomes to occur is made and it is therefore not possible to come up with an expected result, coping with the two scenarios. Although estimations are difficult and sometimes not feasible to perform, still they provide the decision-maker with a sense for the alternatives' affect on the result.

9 DISCUSSION

The author would like to start the last element of this thesis with a reflection on project evaluation as a subject matter and the techniques used when determining an investment's attractiveness. Certainly a poor property investment proposal does not become prosperous, or vice versa, because of the use of a certain evaluation method. Instead the evaluation method as a process is investigated, since the aim with this thesis is not to find superior investments, but to compare the method used in practice within Selmer Skanska with evaluation techniques in business literature, summarised in chapter 1-5. Due to this, the *evaluation procedure* applied by the department has therefore been analysed in chapter 6 to 8 and consequently commented by the author.

In this chapter the author's own opinions and suggestions are made, as the aim with the previous chapters has been to present the evaluation process in an objective, less biased way. The evaluation performed by the Department of Commercial Property is therefore here revised and improved, in order to find *an operational useable method* for evaluating property investment proposals.

9.1 OPINIONS ABOUT INVESTMENT EVALUATION

Evaluation of property investments is performed in numerous different ways, varying from effortless rules-of-thumb methods to advanced scenario and options analyses. Historically, the methods used within the property and construction business have lagged behind the more sophisticated methods used in other asset investment businesses, as in stocks and bonds evaluation. According to Mildner (2001), as late as in the mid-90s, in some companies several large, complex property investments were evaluated through the payback period rule. In my opinion, the misalignment between the low number of economists and the high number of engineers in construction contractor firms is a probable cause of numerous poor projects being approved, ending up with a deficit.

The aim of the activities in which project managers apply investment calculations is of crucial importance. Often, it is argued, the actual aim of the activities is to justify and realise a chosen investment rather than to choose an investment to realise (Jansson, 1992). As I mentioned in section Background – when speaking of evaluation methods it is crucial to point out the fact that it is the managers making the decisions, not the methods or models used. They only serve as tools and provide the manager with a basis for the decision he or she is about to make. A project analysis is a comparison of many complex, future and uncertain consequences, and the analysis will not have better quality than the data it builds upon (Bøhren & Gjørnum, 1999).

To assess an evaluation made, it is necessary to have a standardised, uniform model in order to compare the investment evaluations with each other (Meredith & Mantel Jr. 2000). Otherwise it is not possible to obtain an objective evaluation process, because

the manager can choose to present the investment in terms of measures being favourable to the investment proposed. According to Segelod (Jansson, 1992), the choice of measures and assumptions made in connection with the evaluated investment seldom are at a disadvantage, compared to other investments. Further, Jansson (1992) argues that project managers, in their effort to get the investment approved, both attempt to adapt the project and to adapt other actors' view of the project.

I believe that Jansson is perhaps right, though I disagree with this conclusion that managers in general deliberately present the investment in a favourable way. Instead, my attitude towards this problem is that the lack of standardised and reliable measures facilitates uncertainty when choosing methods. The fact that many evaluators simply are unacquainted with the erroneous conclusions possible to be drawn from the different methods used, often leads to a less favourable decision. A solution would be to tutor the managers making the evaluations, raising the level of awareness and broadening the understanding of business dynamics, in order to keep up with the more sophisticated evaluation techniques, such as DCF methods and scenario building, used elsewhere (Ratcliffe, 2000).

9.2 THE DEPARTMENT'S EVALUATION PROCESS

The performed evaluation made by the Department of Commercial Property is in accordance with the custom within the department, formed by previously gained personal experience by the department's personnel. As the department is recently established, guidelines and directions from the board of directors are sometimes thought of as unclear and vaguely defined (Rygg, 2001). There is no pronounced common practice established in accord between the department and its board of directors. Lack of standards makes it, according to Levy and Sarnat (1994), impossible to measure the relative attractiveness of each project and hence difficult to reach the set objectives.

As the author analysed the performed evaluation, numerous possible uncertainties and erroneous numbers were identified, insufficiently estimated. There is an inconsistency in using real and nominal money value and there has been limited concern about the timing of the different cash flows. The main parts of the numbers are depicted without discounting them through a proper discount rate, implying that the time value of money is neglected. As prior concluded, every method overlooking the timing of cash flows is incorrect. Hence, using a method that copes with the timing of the different cash flows would represent a significant improvement of the evaluation process. The utilisation of the net present value method is thus motivated.

According to Homer & Simmons (2001), risk management today is no longer about insurance; it is about making informed, deliberate decisions regarding all of the risks at hand. Hence, a proactive search for potential risks and estimating their probability to occur is crucial to protect the company against unexpected deficits. Otherwise, the analysis turns out to be less reliable and the decision situation haphazard.

Further, the department's evaluation lacks a proper risk analysis, as there are no estimations made of the different outcomes' probabilities to occur. As a result, it is not

possible to calculate the expected value of the project.²⁵ In the case of TownStreet 2-4, the costs connected to a potential denial from the Local Housing Committee are relatively high compared to the possible return, why an estimation of the possibility of such a denial to occur must be made. If one looks at the project result calculated by the department, without taking into account the time value of money, and compares it to DCP's compensation to OB1 in case of a denial, one sees that the project's expected value can be negative if the probability of a denial is high enough. As the department not explicitly displays the probability in its evaluation, an uncertainty about the expected value of the project remains. Unless the decision-maker is aware of the risks connected to the actual project, the decision is made under conditions more uncertain than reasonable.

9.3 REVISED EVALUATION

As the net present value method in this thesis is concluded being the optimal method when evaluating investment proposals, the NPV-method is utilised when revising the performed evaluation. As a complement, and in order to communicate the uncertainty and to expose the risk facing the project, the sensitivity analysis method is utilised in combination with a calculation of the expected value of the investment.

9.3.1 NET PRESENT VALUE

A basic condition for calculating the net present value is that the different numbers included in the value are declared in the same time value. Hence, there must be consistency in using either nominal or real value. In this case the nominal value is used, as both the investment value and costs are inclusive of inflation.

In order to calculate the net present value of the investment proposal of TownStreet 2-4, I have used a spreadsheet-based investment model I developed when working at the Department of Commercial Property. The discount rate used is corresponding with the department's discount rate, 10.5%.

In the model I have enabled flexibility as development costs, construction costs and the sales point can be varied, depending on the project plan illustrated in figure 7.1. In appendix 2 the project's cash flow over the whole project period is shown, and the costs for development and construction are spread out in order to count in the time factor. The graph below the cash flow analysis illustrates the investor's estimated cash flow profile – from the acquisition of the property to the investment value at the sales point.

The calculated net present value of the investment is NOK18.5 million, exclusive of financial costs, as can be seen down to the right in the spreadsheet. This can be compared to the calculated result of NOK48.4 million, determined without any concern of the dissimilar timing of the cash flows. The compensation to the Department of Commercial Property would hence be 87.5% of the calculated net present value, that is, NOK16.2 million.

²⁵ The expected value (EV) is calculated as the different outcomes' cash flow (CF_n) multiplied by their probability (p_n), as previously discussed in section 5.2 – Decision Tree;

$$EV = CF_1 * p_1 + CF_2 * p_2 + \dots + CF_n * p_n$$

9.3.2 SENSITIVITY ANALYSIS

The sensitivity analysis is conducted with the calculated net present value above as basis and the two factors varied are costs of construction and rental income, as these factors are without doubt the most essential ones. The net present values for the different scenarios are shown in below in table 9.1.

TABLE 9.1 Net Present Value at Different Cash Flows (NOK mill.)

Estimation Error	Costs of Construction	Net Rental Income
-10%	25,0	3,9
As Expected	18,5	18,5
+10%	12,0	33,1

The factors are varied with $\pm 10\%$, and the result is plotted in a 'star-diagram' below in figure 9.1.

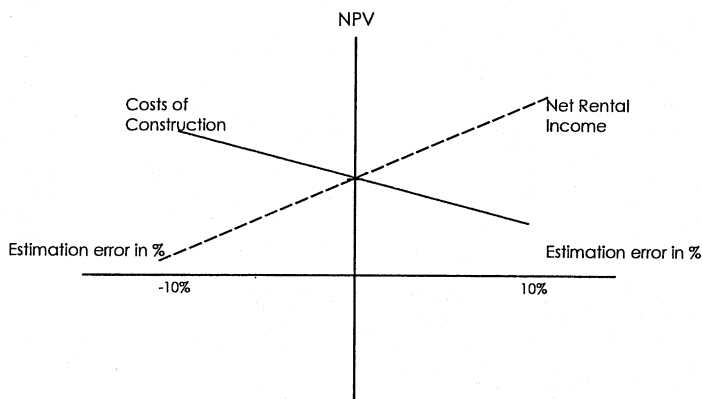


FIGURE 9.1: 'STAR-diagram' of different NPVs as function of net rental income and costs.

The conclusion possible to be drawn from the diagram is that the divergence in net rental income affects the investment's attractiveness the most. For example, if the net rental income becomes less than 88% of the estimated income, the net present value of the investment will be negative. This can be compared to the department's evaluation, where a similar decrease in rental income still gives a positive result of NOK28.9 million.

9.3.3 EXPECTED VALUE

In order to calculate an expected value, probabilities of the different states to occur must be estimated. The director of the department estimated, when interviewed, the probability of a potential denial from the Local Housing Committee being approximately 25% (Rygg, 2001).

The department shall, as a consequence of a potential denial from the Local Housing Committee, compensate OB1 with 50% of the compounded deficit in year 2004. The compensation is estimated to NOK11.9 million, see section 8.2 – Qualitative Evaluation. Using the discount rate of 10.5%, the net present value of such a denial

would be NOK8.4 million. In addition DCP receives no compensation for neither internal nor external development costs, which are estimated to be approximately NOK2.1 million. The total deficit for the department would in that case be NOK10.5 million.

The expected value (EV) for the result of DCP, calculated in net present value, would hence be:

$$EV = NPV_{\text{approval}} * P_{\text{approval}} - NPV_{\text{denial}} * P_{\text{denial}}$$

that is,

$$EV = 16.2 * 0.75 - 10.5 * 0.25 = \text{NOK}9.5 \text{ million.}$$

The proposed investment is still attractive, as its expected net present value is positive.

9.3.4 SUMMARY

To wrap up, the purpose have not been to decide whether the investment should be undertaken or not, but to illustrate the results of the different approaches when evaluating the attractiveness of the proposed investment.

If one habitually uses the same measures when evaluating investment proposals, and makes sure those measures are reliable, the risk for undertaking less good investments is reduced. The net present value method is easily interpreted and provides the evaluator with a single, reliable measure that can be straightforwardly compared to other investment's net present values. Combined with a proper qualitative evaluation, e.g. a sensitivity analysis, the risk of the investment can be displayed and hence no longer be completely unknown to the person making the evaluation/investment.

REFERENCES

BOOKS

- Bierman Jr, Harold and Seymour, Smidt. 1988 *The Capital Budgeting Decision – Economic Analysis of Investment Projects*, 7th edition. © Macmillan Publishing Company, USA.
- Bøhren, Øyvind and Gjørum, Per Ivar. 1999 *Prosjekt Analyse*. © Skarvet Førlag AS, Bergen.
- Clark, John J., Hindelang, Thomas J. and Pritchard, Robert E. 1989 *Capital Budgeting, Planning and Control of Capital Expenditures*, 3rd edition. © Prentice-Hall Inc, New Jersey.
- Copeland, Tom, Koller, Tim and Murrin, Jack. McKinsey & Company, Inc. 1996 *Valuation – Measuring and Managing the Value of Companies*, 2nd edition. © John Wiley & Sons, Inc. Canada.
- Eeckhoudt, Louis and Gollier, Christian. 1995 *Risk evaluation, management and sharing*, 2nd edition. © Harvester Wheatsheaf, Hertfordshire.
- Jansson, David. 1992 *Spelet kring investeringskalkyler*. © CE Fritzes AB, Stockholm.
- Levy, Haim and Sarnat, Marshall. 1994 *Capital Investment and Financial Decisions*, 5th edition. © Prentice Hall, Cambridge.
- Meredith, Jack R. and Mantel Jr., Samuel J. 2000 *Project Management – A Managerial Approach*, 4th edition. © John Wiley & Sons, Inc. New York.
- Roman, Daniel D. 1986 *Managing Projects; A Systems Approach*, 1st edition. © Elsevier Publishing Co., Inc, The Netherlands.
- Ross, Stephen A., Westerfield, Randolph W. and Jaffe, Jeffrey. 1999 *Corporate Finance*, 5th edition. © McGraw-Hill Book Co, Singapore.

ARTICLES AND PAPERS

- Commercial Investment Property: Valuation Methods – An Information Paper. The Royal Institution of Chartered Surveyors (RICS).
- European Valuation Practice – Theory and Techniques*. 1995 The European Group of Valuers of Fixed Assets. © E & FN Spon, London.

Lucius, Dominik I, European Business School, Schloß Reicharthausen, Germany. *Real Options in Real Estate Development*. Journal of Property Investment & Finance, Vol. 19 No 1, 2001. © MCB University Press.

Homer, Fletch and Simmons, Brian. *Managing Risk in the 21st Century*. 2001 Global Real Estate Now. © Pricewaterhouse Coopers LLP, New York, USA.

Ratcliff, John, Dublin Institute of Technology, Dublin, Ireland. *Scenario Building: A Suitable Method for Strategic Property Planning?* Property Management, Vol. 18 No 2, 2000. © MCB University Press.

The Appraisal of Real Estate, 10th edition. Appraisal Institute, Chicago, Illinois.

Yields and Rates of Interest. Estates Gazette, September 1994.

INTERVIEWS

Kjeldsen, Frode. Director, Department of Finance, Selmer Skanska AS. May 2001.

Mildner, Cecilia. June 2001.

Rygg, Arild. Director, Department of Commercial Property, Selmer Skanska AS. May 2001.

OTHER

Business Plan, Selmer Skanska, March 2001

APPENDIX

1. **ECONOMIC EVALUATION – DEP. OF COMMERCIAL PROPERTY**
2. **CASH FLOW ANALYSIS**
3. **GLOSSARY**

1. ECONOMIC EVALUATION – TOWNSTREET 2-4

SOURCE: DEP. OF COMMERCIAL PROPERTY, 2001

Name of Project **TownStreet 2-4**
 Start Date **May 2nd, 2001**

Basic Conditions	Rate
Inflation - p.a	2,50 %
Inflation - p.q	0,62 %
Financial Income - Rate	7,2 %
Financial Cost - Rate	8,0 %
Discount Rate - p.a	10,50 %
Discount Rate - p.q	2,53 %
Investors Yield	8,25 %

Investment Value (NOK kkr)	Area	Total	Kr/sqm
Office Space	5.129	12.823	2.500
Retail	752	1.880	2.500
Parking	1.503	1.503	1.000
Other		0	0
Total Area - Total Sum	7.384	16.206	
Yearly Index Regulation of Rent - %			100 %
Vacancies - in %		0	0 %
Operational Costs - per sqm		738	100
Yearly Net Rent		15.467	2.095
Yearly Net Rent - at Sales Point		16.656	2.256
Investment Value, at Sales Point		187.480	25.390

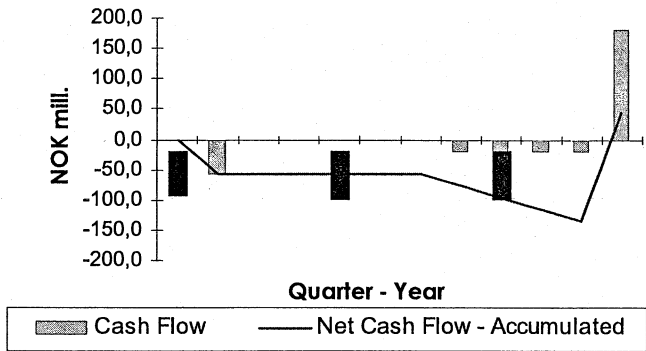
Costs (NOK kkr)	Total	Kr/sqm
Total Contract - Refurbished	0	0
Total Contract - New Building	73.708	9.982
Project Development	1.327	180
Project Management	848	115
Document Fee	823	111
Unforeseen Costs	5.000	677
Marketing	370	50
Sale - Brokerage	0	0
Letting - Brokerage	1.650	223
Costs Exclusive of Property	83.725	11.339
Property	57.400	7.774
Costs Inclusive of Property	141.125	
Rent During Development	-2.000	-271
Rent to Investor	0	0
Total Costs Exclusive of Finance	139.125	18.841
Financial Income (-) or Financial Cost (+)	14.952	2.025
Total Costs Inclusive of Finance	154.077	20.866

Project Result (Nok kkr)		
Project Result before Financial Costs	48.355	
Project Return - %		25,79 %
Project Result after Financial Costs	33.403	
Project Return - %		17,82 %
Return on Investment - %		21,68 %

2. CASH FLOW – TOWNSTREET 2-4

	Quarter	1	2	3	4	5	6	7	8	9	10	11	12
Townstreet 2-4													
Cash Flow of Project (Nok mill.)													
	1-2001	2-2001	3-2001	4-2001	1-2002	2-2002	3-2002	4-2002	1-2003	2-2003	3-2003	4-2003	
Development Costs	0,0	-0,4	-0,4	-0,4	-0,4	-0,4	-0,4	0,0	0,0	0,0	0,0	0,0	0,0
Property	0,0	-57,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Marketing	0,0	-0,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Broker Fee	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Construction													
Construction Costs	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-19,1	-19,2	-19,4	-19,5	-6,8	
Net Rent	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rent during development	0,0	2,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sales Price	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	187,5
Total quarterly ex. finance	0,0	-56,2	-0,4	-0,4	-0,4	-0,4	-0,4	-19,1	-19,2	-19,4	-19,5	180,7	
Required Rate of Return													
Accumulated	0,0	-56,2	-56,6	-57,1	-57,5	-57,9	-58,4	-77,5	-96,7	-116,1	-135,6	45,1	
Quarterly - Discounted at 10.5%	0,0	-56,2	-0,4	-0,4	-0,4	-0,4	-0,4	-16,5	-16,2	-15,9	-15,6	140,8	
Accumulated - Discounted at 10.5%	0,0	-56,2	-56,6	-57,0	-57,4	-57,8	-58,2	-74,7	-90,8	-106,7	-122,3	18,5	

Total Cash Flow - Nominal Value



3. GLOSSARY

The glossary aims to explain some of the more frequently utilised terms in the thesis, in order to avoid confusion. The glossary contains terms that occasionally are explained inside the text; why it serves as a reminder and summary of expressions used to facilitate making the thesis more easily interpreted.

Capital Return	The increase or decrease in value over a given period, after allowing for capital expenditure, expressed as a percentage of the capital employed over the period.
Discount Rate	The rate of interest selected when calculating the present value of some future cost or benefit.
Internal Rate of Return (IRR)	The rate of interest at which all future cash flows must be discounted in order to the net present value of those cash flows should be equal to zero.
Investment	Commitments of resources made in the hope of realising benefits in the future. The expected benefits are higher than those at the time investment was made are.
Net Present Value (NPV)	The discounted value of a series of future cash flows, where the initial outlay is included as an outflow. The NPV is thus the surplus or deficit present valued monetary sum above or below the initial outlay (purchase price).
Nominal Value	The nominal value reflects the actual amount of money to be received in the future, at the time of the receipt.
Real Value	The real value is the nominal value minus inflation, and it reflects the value in year 0's purchasing power.
Yield	Annual percentage amount expected to be produced by an investment. The yield is therefore often identified as a measure of market expectation.

