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How to cite this thesis

Dissertation to be submitted for the degree of
MAGISTER PHILOSOPHIAE

School of Postgraduate Engineering Management

Faculty of Engineering & Built Environment

University of Johannesburg

A comparison of financial evaluation methods used in
projects

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5 November 2016

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Prof. J.H.C. Pretorius
DECLARATION:

I declare that this mini dissertation is purely my own work. It is being submitted in partial fulfilment of the Masters Degree in Engineering Management at University of Johannesburg. This work has never been submitted for any examination at any university.

Stephen Makgegane Mamogobo

Date: 23/01/2017
ACKNOWLEDGEMENTS

The author would like to acknowledge inputs by the teaching staff of the University of Johannesburg. Appreciation for the support provided by both my leaders is expressed.

I especially wish to acknowledge my family members: My mother Mmanailego Debrakah Mamogobo and my late father Morakanyane Elias Mamogobo who gave me the foundation in life. My sister Mamagabane Rachel Oyiya and family, my late brother Robert Matshipu Mamagobo and brother Mamagobane Johannes Mamagobo.
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ABSTRACT

This mini dissertation is aimed at addressing evaluation of financial aspects of projects through the investigation into various methods of evaluating project financials. The aim is to determine the advantages and disadvantages of various methods and determine the influence of the sizes and time frames of projects. An integrated approach is very important in all functions that are performed today, as this research will endeavour to demonstrate. Projects experts are often required to participate in evaluation of projects with the identification of feasible projects as goal.

For the purposes of this paper, tax and inflation will be omitted. The following will however, be specifically addressed. The methods are sourced from [13]:
1. Payback period.
2. DCF - Discounted cash flow methods.
3. Discounted payback period.
4. IRR - Internal rate of return.
5. NPV - Net present value.
6. MARR - Minimum attractive rate of return.
7. MIRR - Modified internal rate of return.

Examples will be utilized in this research to highlight the difference between different models and the importance of choosing the best financing model for a project. The decision has a big bearing on the outcome and ultimately between failure and prosperity of any project. Management has to be convinced that such a technique or analysis will ensure the bearing of fruits, “remember they are investing other people’s money in these ventures”. This is a critical component of the engineering economics studies. Engineering economics is the application of economics laws and principles to solve intricate engineering problems and develop solutions to assess project’s viability [22].

Project and investment appraisal [7]:
- “Certain implements and techniques can be applied to evaluate future projects and make investment decisions. The purpose is to make apprised decisions when the business is faced with investing significant amounts of money in a project. These techniques enable managers to weigh up the possible future benefits (which have an element of uncertainty) against immediate costs (which are far more certain). Here are some situations for which the techniques of project appraisal are appropriate” [7]:
- “It is better to purchase an incipient piece of equipment, or vehicle, rather than continue to utilize subsisting, older items?”
- “Should the business surmount or merge with another company? Would the benefits outweigh the cost of acquisition?”
- “Should the business engender certain components itself, or continue to buy them in from external suppliers?”
- “Should the business pursue the research, development and marketing of a new product or service?”
- “The business is faced with two or more alternative projects with roughly equivalent costs, only one of which can be undertaken. Which one should go ahead? In this case, the decision may not only involve the financial outcome, but other critical resource limitations” [7].
The above quotation from [7] is a representative precis of the topic matter that will be addressed in this dissertation.
# GLOSSARY

## Table 1: Glossary

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPV</td>
<td>Net present value.</td>
</tr>
<tr>
<td>IRR</td>
<td>Internal rate of return.</td>
</tr>
<tr>
<td>MARR</td>
<td>Minimum attractive rate of return.</td>
</tr>
<tr>
<td>MIRR</td>
<td>Modified internal rate of return.</td>
</tr>
<tr>
<td>DCF</td>
<td>Discounted cash flows.</td>
</tr>
<tr>
<td>PV</td>
<td>Present value.</td>
</tr>
<tr>
<td>PW</td>
<td>Present worth.</td>
</tr>
<tr>
<td>FW</td>
<td>Future worth.</td>
</tr>
<tr>
<td>FV</td>
<td>Future value.</td>
</tr>
<tr>
<td>n</td>
<td>Number of interest periods. (years, quarters, etc.)</td>
</tr>
<tr>
<td>t</td>
<td>Time stated in time units.</td>
</tr>
<tr>
<td>P</td>
<td>Value at present or time 0.</td>
</tr>
<tr>
<td>CC</td>
<td>Capitalised cost.</td>
</tr>
<tr>
<td>AW</td>
<td>Annual worth.</td>
</tr>
<tr>
<td>F</td>
<td>Value at some future time (monetary).</td>
</tr>
<tr>
<td>A</td>
<td>Series of consecutive equal, end-of-period amounts</td>
</tr>
<tr>
<td>EUAW</td>
<td>Equivalent uniform annual worth.</td>
</tr>
<tr>
<td>WACC</td>
<td>Weighted average cost of capital.</td>
</tr>
<tr>
<td>C0</td>
<td>Cumulative net value series.</td>
</tr>
</tbody>
</table>

**Note:**

All references to monetary elements will be shown without units in this document.
CHAPTER 1: INTRODUCTION

1.1. Background

Project financing is one of the most crucial aspects in any organisation, it requires intensive analysis to ensure optimum decision making. With project financing being one of the most crucial aspects in any organisation it requires intensive analysis, incorporating the expertise of all relevant resources.

In most organisations, many projects compete for funds and usually project managers have to face the difficult task to determine what would persuade decision makers in their favour when deciding which project to finance. It is a competitive environment where the whole management team must consider all the relevant facts. They need to understand financial methods such as the Net Present Value (NPV), Internal Rate of Return (IRR), Minimum Attractive Rate of Return (MARR), Modified Internal Rate of Return (MIRR) and Discounted payback and Simple payback. Present day engineers need to understand and be well-versed in project financing and appraisals. A mastering of engineering economics is essential, for them to be able to design and plan projects with financing in mind. It will be a waste of time to design and be rejected at the final stage, thus engineers need to keep in mind how much is or will be available to execute that project. This makes it imperative to be able to do the calculations in advance, allowing for the comparison of all projects with the same yardstick and thus determine equitable merit. Engineers need to know how to meet the organization’s budget constraints.

Time value of money plays a crucial role in this type of analysis, although that means sometimes ignoring the simple payback method. Also of importance is other financial methods such as the Net Present Value (NPV), Internal Rate of Return (IRR), Minimum Attractive Rate of Return (MARR), Modified Internal Rate of Return (MIRR) and discounted payback.

1.2. Problem Statement

The challenge in any organisation to choose the best project in terms of long term investment is massive. Management must to decide which project to choose and what type or method of financing must be followed. Of necessity detailed analysis has to be followed, selection needs to be based on clear system analysis of expected revenues and costs over the entire project life-cycle.

All available resources must be exhausted before the accept-reject decision is taken.

It is imperative to bear in mind that every project has different characteristics, thus a clear feasibility study needs to be presented to management and investors, to back-up the decision.

1.3. Limitations

The research will exclude:

1. Tax and its effects on the overall investment and the duration of the project:
2. Risk that will be anticipated in the project;
3. Different scheduling methods; and lastly
4. Inflation (which means only interest rates will be used to evaluate projects, where applicable).

1.4. **Significance**

The significance of this research will be to contribute to the knowledge base of engineering management, specifically in terms of helping with future evaluations of projects. It will have both theoretical and practical significance in the engineering economics discipline. This study will attempt to develop easy ways and means to help leaders and managers understand project financing from an engineering management perspective. Case studies will be analysed which will contribute to the development of a simple and understandable method.

1.5. **Systematic Economic Analysis Technique (SEAT) [29]**

In performing engineering economic analyses, we recommend a process to determine answers to the following seven questions: the following seven questions be answered:

1. “What investment alternatives are available”?
2. “What is the length of time over which the decision is to be made”?
3. “What Time Value of Money (TVOM) will be used to move monies forward or backward in time”?
4. “What are the best estimates of the cash flows for each of the alternatives”?
5. “Which investment seems best, based on the economic criterion chosen”?
6. “How sensitive is the economic preference to changes in or errors in the estimates used in the analysis”?
7. “Which investment is recommended”?

1.6. **Research Questions**

The aim of this mini dissertation is to try and address the following questions:

1. Is simple payback still relevant today?
2. Are other methods superior to it in terms of applications and understanding?
3. Do companies get expected and satisfactory results from this technique?

A survey will be conducted across the different industries on the application of the relevant theoretical principles, with students being participants.
Figure 1-1: Capital Investment Appraisal [2]
CHAPTER 2: LITERATURE REVIEW

This chapter comprises the following presented as different sections: Discussion and Application of Theory for the following techniques; Simple Payback, Discounted Payback, Internal Rate of Return, Net Present Value, Minimum Attractive Rate of Return and Modified Internal Rate of Return.

This study aims to gain insight into the use of project financing methods in different industries and also the understanding thereof. In this chapter, applications of the financing methods used, and their advantages and disadvantages will be discussed. Further examples will be used to prove the study.

Project financing is the foundation of growth and should be done correctly, because it can grow or destroy an organisation. If inaccurate estimates are made that can serious consequences. Decisions of reject and approve must be made with full information at hand. It therefore not right to invest too little and also too much. Spending on critical equipment should be prioritised in order to stay competitive in business and is the return for investors, these two points must be combined well in order to succeed [22].

2.1. Discussion and application of theory

The most common factors for capital investment decisions as described by the resource used [14] are:

1. The credence investors have in the organisation’s future.
   - The mission and vision of management and investors in setting up a leading manufacturing or retail company. This reflects the plans they have in order that the business will prosper.
2. Of crucial importance, the selection of the best investment alternative.
   - What type of equipment will be chosen? This also affects investments in years to come. Performance of the equipment will influence the output of the business.

2.2. Simple Payback Method

2.2.1 Explanation/Description of the method

Payback time is explained as the exact length of time taken for an organisation or company to recuperate the original investment as calculated from cash inflows [13]. “Payback period is the least accurate of all investment budgeting techniques, as calculations are in dollars and not adjusted for the time value of money” [13]. “If a company undertakes investments decision based on the substructure of the payback period, it considers only those projects with a payback period shorter than the maximum acceptable payback period” [22]. “Investors like a short payback period” [22].

“The payback period for a project runs from the time when first cash out-flow takes place for investment in the project to the time when the project’s cash inflows sums up to the first cash outflow in other words, the duration of time it takes to accumulate your money back”. “If you
invest 10 000 today and are promised 5 000 one year from today and 5 000 two years from today, the payback period is two years, it takes two years to get your 10 000 investment back” [24].

2.2.2 Application of the theory

Example 1:

<table>
<thead>
<tr>
<th>Initial Investment</th>
<th>Expected Cash Inflows per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>Year 2</td>
</tr>
<tr>
<td>10 000</td>
<td>1 000</td>
</tr>
</tbody>
</table>

“From the table, Project A will last for exactly five years with the cash inflows shown”. “The payback period will be exactly four years”. “If the cash inflow in Year 4 were 6 000 instead of 5 000, then the payback period would be three years and 10 months”. “The problem with the payback method is that 5 000 received in Year 4 is not worth 5 000 today”. “This unsophisticated approach mandates that the payback method be used as a supplemental tool to accompany other methods” [13].

“Its calculations mostly compare the revenues with costs to determine length or period required to recuperate the first investment” [13]. “It is however a simple method which is utilized to achieve a quick analysis of the investment performance” [13]. “Other costs which may occur after time zero are not considered in the analysis calculations” [13]. “It additionally utilizes the procedures for a simple calculation to calculate revenues per period of time until enough revenues or total cash has been received to balance the investment” [13]. “In situations where the net cash inflows are equal, it can be computed as follows” [13]:

\[
\text{Cash Payback Period} = \frac{\text{Initial Cost}}{\text{Annual Net Cash Inflow}}
\]

Example [2]:

“A capital investment uses cash and must return cash in the future to be successful” [13]. “The expected period between the date of an investment and the recovery in cash of the amount invested is the cash payback period” [13].

“To illustrate, assume that management is evaluating the purchase of the following new machine” [13]:

| Cost of new machine | 200 000 |
|--------------------------------|
| Cash revenues from machine per year | 50 000 |
| Expenses of machine per year | 30 000 |
| Depreciation per year | 20 000 |

13
“To simplify; the revenues and expenditures other than depreciation are assumed to be in cash” [13]. “Hence, the net cash inflow per year from use of the machine is as follows” [13]:

<table>
<thead>
<tr>
<th>Net cash inflow per year:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash revenues from machine</td>
<td>50 000</td>
</tr>
<tr>
<td>Less cash expenses of machine</td>
<td>30 000</td>
</tr>
<tr>
<td>Less depreciation</td>
<td>20 000-10 000</td>
</tr>
<tr>
<td></td>
<td>40 000</td>
</tr>
</tbody>
</table>

“The time taken for the net cash flow to equal the cost of the new machine is the payback period [13]”. “Thus, the estimated cash payback period for the investment is five years, as computed below” [13].

\[
\text{Cash Payback Period} = \frac{\text{Initial Cost}}{\text{Annual Net Cash Inflow}} = \frac{200 000}{40 000} = 5 \text{ years}
\]

“In the preceding illustration, the annual net cash inflows are equal (40 000 per year)” [13]. “When the yearly net cash inflows are not equal, the cash payback period is determined by adding the annual net cash inflows until the cumulative total equals the initial cost of the proposed investment” [13].

“To illustrate, assume that a proposed investment has an initial cost of 400 000” [13]. “The annual and cumulative net cash inflows over the proposal’s six-year life are as follows” [13]:

<table>
<thead>
<tr>
<th>Year</th>
<th>Net Cash Flow</th>
<th>Cumulative Net Cash Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>60 000</td>
<td>60 000</td>
</tr>
<tr>
<td>2</td>
<td>80 000</td>
<td>140 000</td>
</tr>
<tr>
<td>3</td>
<td>105 000</td>
<td>245 000</td>
</tr>
<tr>
<td>4</td>
<td>155 000</td>
<td>400 000</td>
</tr>
<tr>
<td>5</td>
<td>100 000</td>
<td>500 000</td>
</tr>
<tr>
<td>6</td>
<td>90 000</td>
<td>590 000</td>
</tr>
</tbody>
</table>
Figure 2-2: Cash Payback Period [2]

According to reference [2] “the cumulative net cash flow at the end of year 4 equals the initial cost of the investment, 400 000” [2]. “Thus, the payback period is four year” [2]. “If the initial cost of the proposed investment had been 450 000 the cash payback period would occur during year 5” [2]. “Since 100 000 of net cash flow is expected during year 5 the additional 50 000 to increase the cumulative total to 450 000 occurs halfway through the year (50 000/100 000)” [2]. “Thus, the cash payback period would be 4 ½ years” [2].

“A short cash payback period is desirable” [2]. “This is because the sooner cash is recovered the sooner it can be reinvested in other projects” [2]. “In addition, there is less chance of losses from changing economic or business conditions” [2]. “A short cash payback period is also desirable for quickly repaying any debt used to purchase the investment” [2].

It can also have interest and no-interest. Payback without interest can be computed as:

$$\sum_{t=0}^{n} F_t \leq 0$$

Example 3:

Lumby et al. [17] provides the following examples of Payback Period calculations.

“Below are examples of the payback method operating in both decision-making situations” [17]. “With project A, assuming that the criterion for project is acceptance is a four-year(maximum) payback, then we can see that it should be accepted because it pays back the initial outlay of 4 000 within this time period” [17]:
Project A

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-4,000</td>
</tr>
<tr>
<td>1</td>
<td>+1,000</td>
</tr>
<tr>
<td>2</td>
<td>+1,000</td>
</tr>
<tr>
<td>3</td>
<td>+2,000</td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>+1,000</td>
</tr>
</tbody>
</table>

Payback period

“If Projects B and C are mutually exclusive, Project C has the faster ‘speed of payback’ and so is preferred investment” [17]. “B pays back within three years (i.e. \( \frac{5}{3} \) years: year 1 and 2 cash flow plus three-fifths of year 3 cash flow), whereas C pays back in two years exactly” [17]:

Project B

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-10,000</td>
</tr>
<tr>
<td>1</td>
<td>+3,000</td>
</tr>
<tr>
<td>2</td>
<td>+4,000</td>
</tr>
<tr>
<td>3</td>
<td>+5,000</td>
</tr>
<tr>
<td>4</td>
<td>+6,000</td>
</tr>
</tbody>
</table>

Project C

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-12,500</td>
</tr>
<tr>
<td>1</td>
<td>+5,000</td>
</tr>
<tr>
<td>2</td>
<td>+7,500</td>
</tr>
<tr>
<td>3</td>
<td>+1,000</td>
</tr>
<tr>
<td>4</td>
<td>+1,000</td>
</tr>
<tr>
<td>5</td>
<td>+1,000</td>
</tr>
</tbody>
</table>

2.2.3 Advantages and disadvantages of the method.

Lumby et al. [17] gives the following advantages of Payback:

1. It is relatively easy to understand and apply;
2. Organizations facing problems and uncertainty will benefit in using this method as it mostly concentrated on early recovery of investment;
3. Enterprises sitting with obsolete technology and enterprise prefer payback period method;
4. In situations of liquidity, cash flow is instantly needed. This method helps in minimal waiting time cash recovery;
5. Gives more overall picture on the risk involved in the investment; &
6. Offers a clear picture of liquidity.
Peterson [24] states the following disadvantages of the Payback Method:
1. “The simple payback period does not take into consideration cash flows occurring after the payback period”.
2. “Therefore, the simple payback method cannot pick out projects that maximise owner’s wealth”.

Lumby et al. [17] provides the following disadvantages of payback method:
1. No tangible information indicating how an investment improves the organization’s value.
2. Does not use the technique of time value of money.
3. Future cash flows risk not considered.

2.3. Discounted cash flow methods (DCF)

2.3.1 Discounted cash flow analysis

Probably one of the most important things today is for a company to select the best investment solution for each project, because that will have lasting impressions on a company. Investors want to be able to see growth in their investments and the organisation also needs to grow. These methods are normally used in mergers and accusations. The DCF methods had acquired a lot of recognition in the last 50 years, with many companies using them. These methods growths have also been attributed to the use of computers and the level of education of project managers [29].

The NPV and IRR methods lead to the same result with independent calculations and conditions. In cases where the two methods arrive at a different conclusion, the NPV will be entertained [14].

White et al. [29] give the four DCF rules:
1. Money has a time value;
2. Money can never be added nor subtracted unless this process occurs at the same time;
3. When doing a calculation of moving money forward one time unit, it must be multiplied by one plus the discount or interest rate;
4. Doing a backward movement one time unit, it is needed to divide by one plus the discount rate.

2.3.2 Discounted Payback Methods

Explanation/Description of the method
Park [22] states that to solve one of the shortcomings of the normal payback method, it might be needed that a modification of the procedure be introduced, that it caters for time value of money. This modified payback period is often explained as the discounted payback method. It is being defined as the number of years expected to recuperate an investment from discounted cash flows.
This principle concentrates on investing the revenues per period at a specific interest rate. Its period will be determined when adequate returns have been accrued at the set rate. It also uses the method of single payment compound amount for one period iteratively [3].

**Application of theory**

Formula for calculating it:

\[ \sum_{n_{t=1}} Rr(1 + t)^{n_{min} - 1} \geq \sum_{t=0} C_l \]

And with interest:

\[ \sum_{n_{t=1}} Fr(1 + t)^{-t} \geq 0 \]

Example 4:
Badiru [3] provides the following example:

1. “A new solar cell unit is to be installed in an office complex at an initial cost of 150 000” [3]. “It is expected that the system will generate annual cost savings of 22 500 on the electricity bill” [3].
2. “The solar cell unit will need to be overhauled every 5 years at a cost of 5 000 per overhaul” [3]. “If the annual interest rate is 10%, find the discounted payback period for the solar cell unit considering the time value of money” [3].
3. “The costs of the overhaul are to be considered in calculating the discounted payback period” [3].

“Solution: Using the single payment compound amount factor for one period iteratively, the following solution is obtained, as follows” [3]:

<table>
<thead>
<tr>
<th>Time</th>
<th>Cumulative savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>22 500</td>
</tr>
<tr>
<td>2</td>
<td>22 500 + 22 500(1,10)1=47 250</td>
</tr>
<tr>
<td>3</td>
<td>22 500 + 47 250(1,10)1=74 475</td>
</tr>
<tr>
<td>4</td>
<td>22 500 + 74 475(1,10)1=104 422,50</td>
</tr>
<tr>
<td>5</td>
<td>22 500 + 104 422,50(1,10)1-500=132 364,75</td>
</tr>
<tr>
<td>6</td>
<td>22 500 + 132 364,75(1,10)1=168 101,23</td>
</tr>
</tbody>
</table>

“The initial investment is 150 000” [3]. “By the end of period 6, we will have accumulated 168 101,23, more than the initial cost. Interpolating between period 5 and period 6 results in \( n_{\text{min}} \) of 5,49 years” [3]. “That is, it will take 5,5 years to recover the initial investment. The calculation is shown as follows” [3]:
Advantages and disadvantages of the method

Shtub et al. [26] states that the advantages of Discounted Payback Method are:
1. The time value of money is incorporated in the technique.
2. It takes into consideration the risks involved in projects’ cash flows due to the cost of capital.

Shtub et al. [26] states that the disadvantages of Discounted Payback Method are:
1. There are no concrete measures that show whether investment grow the organisation’s value;
2. Require evaluation of capital cost to determine payback; and lastly
3. It does not cater for cash flows beyond discounted payback period.

2.3.3 Internal Rate of Return (IRR) Technique

This technique is often used by managers and project managers for investment decisions [18].

Newnan et al. [21] states that “Internal Rate of Return is defined as the interest rate paid on the unpaid balance of a loan such that the payment schedule makes the unpaid loan balance equal to zero when the final payment is made” [21]. It is the approach most often used in industry thus the resultant rate of return is easily understood. In addition, the challenges in choosing the right interest rate to use in cash flow and present worth value are eliminated. In projects environment, as in most corporations and governments, bonds are traded using a combination of net present value and internal rate of return evaluation techniques.

According to Bender [5] “It is another type of project analysis tool. It expresses the project’s benefits in a percentage return format, comparable to other tools”. “This method helps to compare the project’s IRR to a stock repurchase plan, potential acquisition, or other standard investment” [5]. The following example as presented by [5] provides an example of the calculation of the IRR, the principle involved are thus practically demonstrated.

“For example, a financial group might look to invest 1 million”. “Its options include buying tax-free municipal bonds, initiating a stock buyback, or authorising a project” [5]. “Let’s assume that the municipal bonds offer a 12% return (tax adjusted), the stock is anticipated to grow at a rate of 18 percent per year, and the project exhibits an IRR of 25 percent” [5]. “Based on the information provided, the financial department would invest in the sample project” [5].

“The IRR is the discount rate that causes the NPV of a series of cash flows to result in a nett value of zero” [5].
“IRR can thus be interpreted as a financial break-even rate of return; at the IRR discount rate, the net value of the project is zero” [5]. The acceptance and rejection criteria are [5]:
[C0- cumulative net value series].
“If \( C_0 < 0 \) and all future cash flows are positive, accept the project if the internal rate of return is greater than or equal to the discount rate” [5].

“If \( C_0 < 0 \) and all future cash flows are positive, reject the project if the internal rate of return is less than the discount rate” [5].

“If \( C_0 > 0 \) and all future cash flows are negative, accept the project if the internal rate of return is less than or equal to the discount rate” [5].

“If \( C_0 > 0 \) and all future cash flows are negative, reject the project if the internal rate of return is greater than the discount rate” [5].

The original conception of the use of the internal rate of return, traces back to Keynes and Boulding. This approach is extensively applied as a means for decision making by scholars, managers, practitioners and is taught to every student of any business and management school [18].

“The IRR decision principle suggests accepting a project if and only if the IRR is greater than the cost of capital (usually, the market rate of capital) and grading competing projects through their IRR’s: the higher a project IRR, the higher its grade” [18]. “Unfortunately, the IRR gives rise to serious theoretical and technical problems” [18]:

1. An IRR that is real (based on realistic evaluation) may not exist, the assessment with the cost of capital is not likely [18].
2. Multiple IRR’s may arise, in which case the above stated assessment could be challenging [18].
3. It cannot be compared with the net present value, even if the IRR is unique [18].
4. The IRR might not be applied if the cost of capital varies over time. Extensive investigation and research has been conducted over the last 75 years in an attempt to address the perceived flaws and limitations of the IRR approach [18].

Example 5:
Calculate the internal rate of return.

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash outflow</th>
<th>Cash inflow</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1 000</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>400</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>250</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>250</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>150</td>
</tr>
</tbody>
</table>

In order to illustrate the calculation, the standard formula for the calculation of the IRR based on the example variable contained in the table above are provided below:

\[
Cash\ outflow = \sum_{t=1}^{n} \frac{Cash\ inflow_t}{(1 + r)^t}
\]

\[
1000 = \frac{400}{(1 + r)^1} + \frac{250}{(1 + r)^2} + \frac{250}{(1 + r)^3} + \frac{200}{(1 + r)^4} + \frac{200}{(1 + r)^5} + \frac{150}{(1 + r)^6}
\]

Let us first assume \( r = 12 \% \) p.a.
Thus, the Present Value of the Cash inflows becomes:

\[
\text{Cash inflow} = \frac{400}{(1,12)^1} + \frac{250}{(1,12)^2} + \frac{250}{(1,12)^3} + \frac{200}{(1,12)^4} + \frac{200}{(1,12)^5} + \frac{150}{(1 + r)^6}
\]

\[
= 357.14 + 199.30 + 177.95 + 127.10 + 113.49 + 75.99
\]

\[
= 1,050.97
\]

One then continues in a similar fashion with different discount rates to determine the optimal situation.

<table>
<thead>
<tr>
<th>Year</th>
<th>CF (_i)</th>
<th>Discount Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>12.00%</td>
</tr>
<tr>
<td>1</td>
<td>400</td>
<td>357.14</td>
</tr>
<tr>
<td>2</td>
<td>250</td>
<td>199.30</td>
</tr>
<tr>
<td>3</td>
<td>250</td>
<td>177.95</td>
</tr>
<tr>
<td>4</td>
<td>200</td>
<td>127.10</td>
</tr>
<tr>
<td>5</td>
<td>200</td>
<td>113.49</td>
</tr>
<tr>
<td>6</td>
<td>150</td>
<td>75.99</td>
</tr>
<tr>
<td>Sum=</td>
<td></td>
<td>1,050.97</td>
</tr>
</tbody>
</table>

The correct value of \(r\) lies between 14% and 15%. This value at which the present value of cash outflows is equal to the present value of cash inflows can be arrived at by interpolating between 14% and 15%.

\[
r_{IRR} = \frac{14 + (15 - 14) \times (1,002,62 - 979,89)}{(1,002,62 - 979,89)}
\]

\[
= 14 + 0,1139
\]

\[
= 14,114\%
\]

Advantages
Shtub et al. [26] sites the advantage that IRR, unlike NPV, enables the comparison of even an infinite number of different sized projects to be compared through utilisation of its percentage results.

Disadvantages
According to Shtub et al. [26] the following are the major disadvantages:
1. In an IRR evaluation various real-valued IRR’s may arise.
2. It might have multiple valued IRR’s.
3. It is therefore in totality not compatible with the NPV when it comes to the accept/reject decision.
4. Its application is not compatible with the adjustable costs of capital.

2.3.4 Multiple IRR’s [17]

Another challenge for the IRR decision rule, originates from the mathematics of its calculations when an investment time limit is extended. “The IRR of a project’s cash flow is the root of a polynomial equation, the problem is that, as the fifteenth-century French mathematician Descartes proved with his ‘rule of signs’, there are possible solutions to polynomial equations
for each change of sign” [17]. Thus, any certain investment project may have more than one IRR. “This important (and not special) phenomenon can be examined in terms of the NPV profiles of projects on the basis that the IRR is given by the point at which the profile line cuts the graph’s horizontal axis (along which the discount rate is measured)” [17].

2.3.5 Comparing NPV and IRR methods

Although [20] states that these two methods appear to be structurally the same, it can be demonstrated that there are other factors which causes differences between them. The following example sets out to demonstrate the differences. He provides the following example:

Compare the projects A and B using the net present value method, at discount rate of 11% p.a.

<table>
<thead>
<tr>
<th>Year</th>
<th>Project A</th>
<th>Project B</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-1000.0</td>
<td>-1000.0</td>
</tr>
<tr>
<td>1</td>
<td>800.0</td>
<td>400.0</td>
</tr>
<tr>
<td>2</td>
<td>600.0</td>
<td>400.0</td>
</tr>
<tr>
<td>3</td>
<td>300.0</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>300.0</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>200.0</td>
</tr>
</tbody>
</table>

A negative value indicates cash outflow.

Application of the tables results in the following:

<table>
<thead>
<tr>
<th>Year</th>
<th>PV (1, n ,11%)</th>
<th>Project A</th>
<th>Project B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CF</td>
<td>PV</td>
<td>CF</td>
</tr>
<tr>
<td>0</td>
<td>1,000</td>
<td>-1 000.0</td>
<td>-1 000.00</td>
</tr>
<tr>
<td>1</td>
<td>0,9009</td>
<td>800.0</td>
<td>720,72</td>
</tr>
<tr>
<td>2</td>
<td>0,8116</td>
<td>600.0</td>
<td>486,96</td>
</tr>
<tr>
<td>3</td>
<td>0,7312</td>
<td>0.00</td>
<td>300.0</td>
</tr>
<tr>
<td>4</td>
<td>0,6587</td>
<td>0.00</td>
<td>300.0</td>
</tr>
<tr>
<td>5</td>
<td>0,5935</td>
<td>200.0</td>
<td>118,70</td>
</tr>
<tr>
<td>Sum(PV)</td>
<td></td>
<td>207,68</td>
<td>220,67</td>
</tr>
</tbody>
</table>

From the table above it can be seen that project B has a higher NPV, it can thus be the preferred option between the two projects.

On calculating the IRR value one can determine and see if the results will match the NPV results: Project A: for analysis purposes assume an IRR of 25%, 26% and 28%.

Present value of cash inflows:
It can be determined that the value of IRR can be found between 26% and 28%.

\[
r_{IRR} = 26 + \frac{(28 - 26) \times (1,012,85 - 1,000,00)}{1,012,85 - 991,21}
= 26 + 2 \times \frac{12.85}{21.74}
= 26 + 1.187
= 27.187\%
\]

For Project B, the first choice is to use 27%, this renders a very low value (885.28), thus the next choice is to try 21% which is still low (990.19) and then try 19% which renders a value above (1,030.03).

The correct value can be determined to be between 19% and 21%:

\[
r_{IRR} = 19 + \frac{(21 - 19) \times (1,030.03 - 1,000,00)}{1,030.03 - 990.19}
= 19 + 2 \times \frac{30.03}{40.11}
= 19 + 1.497
= 20.50\%
\]

Analysis:

<table>
<thead>
<tr>
<th>Project A</th>
<th>Project B</th>
<th>Result:</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPV 207.68</td>
<td>220.67</td>
<td>Project B &gt; Project A</td>
</tr>
<tr>
<td>IRR 27.19 %</td>
<td>20.50 %</td>
<td>Project A &gt; Project B</td>
</tr>
</tbody>
</table>
On analysis of the above results one can argue that the results can be explained in terms of the different sizes of the projects and different times of cash inflows requiring different capital outlays. The validity of the statement by [20] is thus clear.

“When changes in the signs of cash flows happen more than once the problem may occur” (depending on the relative sizes of the individual cash flows). “Example: ++; --; +++--; +—+;” [7].

Brigham et al. [7] indicates that the disadvantages of using IRR in project proposals are:

1. The problem is that in IRR relative percentage is used instead of dollars. As compared to the NPV.
2. It can only be used when the cost of capital is constant.
3. Not easy to understand. It is one of the more difficult methods to understand especially when calculating its rate.
4. Assumptions may not be realistic. In calculating IRR, an assumption is created. In that it is the best method to reinvest the profits.
5. It is not a satisfying tool when the comparison requires consideration of two mutually exclusive investments.
Park [22] states that the advantages of using IRR are:

1. It uses the time value of money theory. That means all interest rates are taken into consideration, when an analysis is performed.
2. In this method, all cash flows are equally significant. It is the best technique for budgeting, because it takes care of all cash flows all the time.
3. It has a uniform ranking. It does not depend on a particular rate.
4. Shareholders get maximum profitability. When profitability is checked, IRR is higher than its cut off rate. The choice becomes easier.
5. It is not necessary to calculate cost of capital. Profitability can be checked for the specific project.

**Summary of IRR criterion**

Park [22] states that the flowchart in figure 2.3 explains how the net cash-flow sign rule can be applied. The acquired cash-flow sign test, and net-investment analysis to calculate an IRR and make an accept-reject decision for a single project becomes viable.
2.3.6 Net Present Value (NPV) Technique

Although the NPV technique has been extensively discussed in establishing the comparison with the IRR a more detailed discussion of its underlying principles is still warranted.

Rudolf [25] states that Net Present Value is a financial method used by finance and project managers to appraise the complete value of a project. It represents a value of money in today’s terms of the monetary worth of future cash flows. It is a representation of the active investment technique and discounted cash flow technique. The most important principle in this method is that a rand today’s, worth increases to more than that worth, tomorrow if invested, because it will generate interest. Clarity is provided by [25], with the following rules applying:

All investments whose:
“NPV = 0, achieve the same return as the alternate investment”,
“NPV >= 0, in comparison to another investment, achieve a capital increase”; and lastly
“NPV < 0, achieve a worse return than the alternative investment and the capital expenditure may not be recovered”.

Rudolf [25] stated that this technique depends on the theory of opportunity cost to place a value on cash inflows rising from a capital investment. Opportunity cost is the calculation of what is compromised or inevitable after a conclusion was reached. Present value is referred to as the value equivalent now of a sum receivable at a later stage. In the instance where the money was not banked or was banked, earning interest instead, the opportunity cost includes both the initial sum and the interest earned. It is a technique where cash inflows expected in future are discounted back to the present. Basically, this is calculated by using a discount rate equivalent to interest that might have been received on the sums, had the cash inflows been saved.

Mathematically it can be expressed as: [13]

\[ NPV = \sum_{t=1}^{n} \frac{FV}{(1+k)^t} + II \]

“Where FV is the future value of the cash inflows, II represents the initial investment, and k is the discount rate equal to the firm’s cost of capital” [13].

Kerzner [13] states that the following are pertinent points on NPV:
1. The present value is explained as the value of the rand/dollar today;
2. It determines the difference between today’s value of the added returns, to today’s value of added cost;
3. Its break-even point depends on the acceptable rate between the parties involved;
4. If it is equal to or greater than zero, then the IRR will be equal or greater than the acceptable rate of return agreed upon.

The advantages of NPV as stated by [13] are:
1. It considers the cash flows of the invested amount;
2. It is compatible with time value of money; & and lastly
3. It is capable of ranking equal duration projects using the present value index.

The disadvantages of NPV, on the other hand, according to [13] are:
1. Its methods computations are complex as when compared to other methods that don’t use present value; and
2. It assumes that cash flows might be reinvested at the minimum anticipated rate of return, which may not be valid in some instances.

### 2.3.7 Comparing IRR, NPV, & PAYBACK

Again, citing the view of [13] who stated that for many projects, the two techniques IRR and NPV will generate the same accept-reject decision. However, there are variances that can ex-
exist in the original expectations that can cause the projects to be graded differently. The major challenge is the differences in the size and timing of the cash inflows. NPV method assumes that the cash inflows are reinvested at the cost of capital, whereas IRR assumes reinvestment at the project’s IRR. NPV seems to be a more principled approach. Early year cash inflows tend to be at a lower cost of capital and are more expectable than later year cash inflows. Because of the downstream indecision, companies prefer larger cash inflows in the early years rather than the later years.

2.3.8 Minimum Attractive Rate of Return (MARR) Technique

Minimum Attractive Rate of Return is one of the important pillars in the net present worth analysis of a typical project. It is used to regulate the interest the company wishes to obtain in a project. This interest rate characterizes the rate at which the company can invest the money in its pool. The basis for selecting a MARR is to recover the cost of capital. The cost of capital consists of both the cost of debt and the cost of equity (the return stockholders requires from an organisation). It is very important for MARR to be greater than the cost. In engineering and business, it is often referred to as the hurdle rate on a project that management is willing to accept. It is a well-known fact that there often is a need to raise money for investments and that money is not free, it has a cost. MARR represents the trade-off between monetary amounts at different intervals and does not include inflation [9].

The MARR value is often referred to in public projects as a political decision. Its value is normally set for an entire organization depending on the opportunity cost of investing funds internally rather than externally in stock markets [9].

Collier et al. [9] states that for most public works projects, the MARR may usually be taken to be somewhere between the taxpayer’s cost of funds and the interest rate paid on bonds. For private projects, MARR is usually determined by evaluating competitive opportunities to invest (taking into account risk, liquidity, timing of cash flow, size of investment, etc.), since the interest rate on borrowed funds is typically lower than the interest rate of return on available alternative opportunities. Therefore, the MARR for private enterprise is usually assumed to be the opportunity cost.

In general, MARR must exceed the higher of these values [9]:
1. The cost of borrowing cash; and
2. The cost of opportunity.

Souder [27] states that in some situations management may have specified an acceptable rate of return to be used. This could be the either the firm’s opportunity cost of capital or an artificial rate which effectively serves as a cut-off rate. Where a MARR exists, the NPV can be calculated using \( i = \text{MARR} \). If the value of the NPV is negative, the project is unacceptable. Of course, the IRR can also be computed and compared to the MARR. Then if the IRR< MARR the project is unacceptable. But, the NPV is easier to compute and it always results in a single value.

It is a rate that is normally applied to determine whether a project will be profitable or not [9]. It characterizes the trade-off between projected amounts in various periods and excludes inflation. MARR percentage or figure is decided upon by the company based on its financial situ-
ation, and differs from with public financing projects [29]. Its disadvantage is that it uses different rates for different types of projects [29].

### 2.3.9 Comparison of Return on Investment Models

The table below (2.4), sourced from [27] presents some comparative results. For illustration purposes consider that there are four investment proposals: A, B, C, and D. Each proposal requires the same level of investment: 100 000. Proposals A, B, and C each have the same total net cash flow: 100 000. However, the time shape of the flows of the returns at the ends of years 1 through 5 differ. Thus, as presented in Table 2.5, the net present values differ.

How other companies determines the MARR: [29]

1. By adding a fixed percentage to the cost of capital.
2. By using the rate of return achieved over the last 5 years.
3. Using various figures(values) for various planning horizon’s durations.
4. By using different values for various sizes of investments.
5. Using varying values for new ventures and cost reduction projects.

Example 6:

<table>
<thead>
<tr>
<th>Table 2.3: Investment Proposals</th>
</tr>
</thead>
<tbody>
<tr>
<td>End of year</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>Net Cash flows:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2.4: Present Values of the Data in Table 2.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>End of year</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>NPVs:</td>
</tr>
</tbody>
</table>
Table 2.5: Evaluation of the 4 common models in table format

<table>
<thead>
<tr>
<th>Model</th>
<th>Proposals</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payback</td>
<td></td>
<td>2yrs</td>
<td>2yrs</td>
<td>4yrs</td>
<td>2yrs</td>
</tr>
<tr>
<td>%ROI</td>
<td></td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>NPV @ i=10%</td>
<td></td>
<td>59.83</td>
<td>56.06</td>
<td>32.09</td>
<td>-17.35</td>
</tr>
<tr>
<td>IRR</td>
<td></td>
<td>37%</td>
<td>32%</td>
<td>17%</td>
<td>negative</td>
</tr>
</tbody>
</table>

Conclusion: A>B>C; D is unacceptable; C will not be acceptable if MARR (cut-off point) is above 17%.

Akladios [1] provides the following example:

“A company is investing 10 000 into a 5-year project”. “The project will produce a uniform annual revenue of 5 310”. “The salvage value of the project is 2 000. Annual expenses will be 3 000/year”. “The company has decided that they will accept all projects returning a MARR of 10% or more/year” [1].

“Using the PW method, show if your company should adopt this project”.

Solution:

\[
P W @ 10\% = -10 000 + (5 310 - 3 000)(P/A, 10\%, 5) + 2 000(P/F, 10\%, 5) \\
= -10 000 + 2 310(3.7908) + 2 000(0.6209) \\
= -10 000 + 8 756.75 + 1 241.80 \\
= -1,45
\]

Project is border line acceptable.

2.3.8 Advantages of MARR [9]
1. It is the lowest return that would be accepted given other opportunities for investment.
2. It uses internally generated funds.
3. It is normally influenced by the markets, but not determined by the markets.
4. It exceeds the cost of capital in most cases

2.3.9 Disadvantages of MARR [9]
1. Not an exact evaluation method.
2. It may vary over time.
3. There might be different rates within one organisation: For example.
   - 12% for new investments.
   - 20% for expansion and modifications on new projects.
2.3.10 Modified Internal Rate of Return (MIRR) technique

Brigham et al. [7] states that the Modified IRR technique is similar to the IRR except that it assumes that the cash is invested in a portfolio that is more realistic for assumptions.

Lumby et al. [17] states that whilst there can be little argument about the theoretical superiority of NPV as a decision rule, managers who responded to surveys suggest that many of them feel that they understand the idea of IRR better than NPV simply because it is expressed in percentage terms rather than as an absolute figure. Managers are used to dealing with percentages, e.g. return on capital, dividend yields, gross profit margins, etc. It may also be that they (mistakenly) believe that it is not necessary to be able to determine the company’s cost of capital in order to use IRR. This has led to the development of MIRR.

This technique is really founded on an NPV analysis which is then converted into a return rate. However, instead of ignoring the project cash flows- at the appropriate prospect cost of capital- to present value, cash flows (except for the project’s outlay) are compounded forward to a total terminal value. Based on these two cash flows, the project’s outlay and the terminal value of its net cash inflows, the IRR is calculated [17].

Brigham et al. [7] describes the advantages of the MIRR approach as:

1. This technique assumes that cash flows are being reinvested at cost of capital. Because reinvestment at the internal rate of return is generally not correct, the MIRR is usually a better indicator of the rate of return on the project and reinvested in cash flows.
2. It helps in solving multiple IRR problem, there can never be more than one MIRR, which can be compared with the cost of capital when deciding on the projects. To be undertaken or when choosing between different project options.
The MIRR has all the attributes of the IRR, but it avoids the challenges of multiple rates of return that can occur with the IRR. The MIRR also measures the expected return of the project and its reinvested cash flows, which provides additional insight into the project. If decision makers want to know projects’ rates of return, the MIRR is one of the best indicators as when compared to the regular IRR.

In summary, the different measures provide different types of useful information [7].

<table>
<thead>
<tr>
<th>Table 2.6: Capital Budgeting in Practice [7]</th>
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<tbody>
<tr>
<td>Quantitative Measures Used by Companies</td>
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<tr>
<td>Npv</td>
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<tr>
<td>IRR</td>
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<td>Payback</td>
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<td>Discounted payback</td>
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2.3.11 Conclusions

The analysis of four different types of investments shows how accurate and precise the data should be for the project to be accepted. When applying the payback method, only the cash paid in a certain period is observed. People taking final decisions need to be clear and also have an in-depth understanding of the different methods [25].

The other steps which can be considered for analysis are [14]:
1. “Define the alternatives”.
2. “Determine the study period”.
3. “Specify the interest rate (MARR)”.
4. “Compare the alternatives”.
5. “Perform sensitivity analyses”.
6. “Select the preferred alternative(s)”.

Lumby et al. [17] states that despite the criticisms on payback, it is still one of the relatively easier to understand and apply methods. It’s popularity also comes from its ability to being able to cater for less risky projects. An additional benefit is the ease of use for minor projects as it does not take too much time to compute, requiring less time and skills and effort.

It is still one of the trusted financial method, that can be used for small or less risky projects.

“At best, for large investments, it can act successfully only as an initial screening device before more powerful methods of appraisal are applied” [17].
Research thus clearly indicates that it can be safely said that the higher the aggregate NPV of a firm’s investment, the higher will be the return of wealth to its shareholders. Therefore, as far as deciding between mutually exclusive investment alternatives is concerned, the decision rule would appear to be quite straightforward in terms of using the NPV; accepting whichever alternative projects that result in the greatest positive NPV, because this will produce the greatest addition to the shareholder’s wealth [17].

Lumby et al. [17] stated that the use of the IRR: “In the case of mutually exclusive investments, use of the IRR decision rule causes problems”. “Unlike the NPV calculation which automatically compares the project with the alternative capital market investment forgone, the IRR method makes the comparison on a somewhat different basis by using the decision rule”: “does the project yield a greater or lesser return than the capital market”? “In doing so, however, it does not give a consistently reliable indication of how much better or worse the project is, relative to the capital market investment alternative”.

“Thus, the IRR decision rule is safe to apply to single, independent decision situations (when all that is required is an answer to the question: does the project produce a return better or worse than that of the capital market?) but it cannot reliably be used to judge between alternative projects”. “This is a rather understated, but important point, and it requires some further explanation” [17].

In situations where we have mutually exclusive projects, it becomes a challenge to use the IRR decision rule. Unlike the NPV calculation which automatically equates the project with the alternate capital market investment forgone, the IRR method makes the comparison on a somewhat different basis by using the decision rule: does the project exceed a greater or lesser return than the capital market [17].

2.3.12 Modified IRR [17]
“Managers are used to dealing with percentages, e.g. return on capital, dividend yields, gross profit margins, etc”. “This has led to the development of modified IRR”. “It is thus an attempt to overcome the theoretical difficulties of the normal IRR technique, whilst retaining an evaluation of the project based on a percentage rate of return and so avoiding the perceived ‘user unfriendliness’ of NPV” [17].

2.4 Summary
This chapter has looked at the application of the two DCF investment appraisal methods in the context of decisions between mutually exclusive projects. Arising from this is the realisation that there are several difficulties with the IRR rule. The main points made are:

1. The NPV decision rule for mutually exclusive decisions is: accept whichever project has the largest positive NPV. The logic behind this was obvious, given the objective of shareholder wealth maximization and the meaning of NPV.
2. The decision rule holds even when the alternative investments are of unequal magnitude, duration or risk, assuming a perfect capital market given that the discount rate used properly reflects the return available elsewhere on the capital market from a similar-risk investment.
3. Standard IRR decision rule for mutually exclusive investments is:
   • The ‘best’ project has the highest IRR;
4. The reinvestment assumption is, strictly speaking, an assumption about the opportunity cost of the project-generated cash flows. Given a perfect capital market, the assumption made by the IRR is incorrect— their opportunity cost equates with the capital market rate of return for the risk level involved. The NPV method however allows for making the correct assumption.

5. The problem of the IRR can be resolved, in an artificial way, by a modified decision rule which, in its simplest form, states:
   - “If IRR of the differential cash flow is > hurdle rate, accept the project with the smallest IRR”;
   - “If IRR of the differential cash flow is > hurdle rate, accept the project with the largest IRR” [17].

6. The problem of multiple IRR’s can be resolved in a purely artificial way, through the use of the MIRR technique, but in reality, it is more akin to a cosmetic restatement of NPV.
CHAPTER 3: PRACTICAL USE OF DIFFERENT APPROACHES

3.1. Introduction

Extensive research has indicated that companies fail to use proper project evaluation methods because of lack of understanding and to some extent proper skills-sets. In this study a survey is indicated in order to gather more information from different sources. Practical insight into which methods are mostly applied in different industries and the understanding thereof, would thus be obtained.

In this survey the requirement was to assess and determine the application and understanding of different financing methods in various industries.

Research according to [6] describes a process that involves obtaining scientific knowledge by means of several objective procedures.

Kumar [16] has stated this form of research involves different methods, calculations, procedures for samples and figures. A researcher has the option to decide on using both types of methods, namely qualitative and quantitative methods. Data will be collected through a questionnaire and different methods of analysis will be used to interpret it.

Mixed methods will be also used, by mixed methods it is implied that a decision was made to consider using both qualitative and quantitative methods in order to find good results. The key of the mixed/multiple methods approach is the use of various methods belonging to both paradigms, or simply of more than one method from one pattern [16].

The approach entailed the development of a questionnaire which was sent to students in the Masters of Engineering Management class, the rationale being that the sample entailed individual who would be familiar with the subject matter as all the students were studying for the subject Advanced Engineering Economics. Their knowledge of the subject varied as they were mostly employed in different sectors, it gave a wide and better scope of applications. As it was deployed in the middle of the semester their knowledge of the subject matter could have been better. The respondents were not profiled as the entire class took part in the survey.

The research was quantitative and qualitative as well, the majority of the questions were based on the literature in chapter 2 and the practical day to day examples and problems that would typically be encountered by practising engineers and project managers. This was also to get a broader knowledge of which methods are still preferred in different industries. Most respondents understood the different methodologies and concepts, but lacked application knowledge. This survey helped them to realise the importance of the whole module / course and not just the theory part of it.

That was the main reason of running the survey in that group. The primary aim was to develop a solution which is easy to use for many industries, or at least a common method.

The questionnaire was developed and a Likert type scale was used with a typical 4-point scale:
3.2. **Survey Results**

The survey results are presented below. The approach taken is intended for ease of use and specific insight into any chosen specific area of interest. Each question posed is indicated and the most prevalent response in each instance indicated.

1. Does your organization use Simple Payback to evaluate projects?
   
<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
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   Answer: 1. Strongly agree. 75%

2. Does your organization use Discounted Payback to evaluate projects?
   
<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
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</table>

   Answer: 2. Agree. 70%

3. Does your organization use Internal Rate of Return to evaluate projects?

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
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</table>

   Answer: 1. Strongly agree. 85%

4. Does your organization use Net Present Value to evaluate projects?

<table>
<thead>
<tr>
<th>Strongly agree</th>
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<th>Disagree</th>
<th>Strongly disagree</th>
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</table>

   Answer: 1. Strongly agree. 90%

5. Does your organization use Minimal Accepted Rate of Return in the evaluation of projects?

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
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   Answer: 2. Agree. 95%

6. Does your organization use Modified Internal Rate of Return to evaluate projects?
Answer: 2. Agree. 92%

7. Does the size of a project determine the type of financing in your organisation?

<table>
<thead>
<tr>
<th>Strongly agree</th>
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Answer: 2. Agree. 80%

8. Is the financing approval in your organisation based on its growth strategy?

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
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Answer: 1. Strongly agree. 76%

9. Is thorough research being done before the approval of all possible financing methods?

<table>
<thead>
<tr>
<th>Strongly agree</th>
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<th>Disagree</th>
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Answer: 1. Strongly agree. 82%

10. Are existing projects and examples taken into consideration, to see what has transpired in similar projects before?

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
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Answer: 2. Agree. 74%

11. Are there techniques available to enable managers in weighing up the possible future benefits (which have an element of uncertainty) against immediate costs?

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
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Answer: 2. Agree. 70%

12. Is each project characteristics considered when making a final decision?
13. Is the duration of paying back the loan considered when financing is approved/applied for?

Answer: 1. Strongly agree. 86%

14. Are all abovementioned financing methods compared equally in terms of time and value (forecasting)?

Answer: 2. Agree. 72%

15. Is the economic situation being taken into consideration when making that decision?

Answer: 2. Agree. 62%

16. Are other options of investing being investigated?

Answer: 3. Disagree. 60%

17. Is the share-value being taken into consideration when deciding on payback?

Answer: 2. Agree. 74%
18. When doing evaluations does your organization normally use spreadsheet technique?

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
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Answer: 3. Disagree. 60%

19. Does your organization understand the importance of an NPV method?

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
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</table>

Answer: 1. Strongly agree. 90%

20. Does the payback method used by your organization have anything to do with financial flexibility or decentralized departmental capital budgets?

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
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Answer: 3. Disagree. 54%

21. Is the size of your organization having any influence on the choice of your financing model?

<table>
<thead>
<tr>
<th>Strongly agree</th>
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<th>Disagree</th>
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Answer: 3. Disagree. 54%

22. Is the profitability of the project being considered when deciding to use the NPV?

<table>
<thead>
<tr>
<th>Strongly agree</th>
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<th>Disagree</th>
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Answer: 2. Agree. 74%

The following questions can be answered by selecting more than one answer:

23. Which of the following appraisal methods is likely to be used in your company.

1. Simple payback.
2. Discounted payback
3. Internal rate of return
4. Modified internal rate of return
5. Net present value
6. Minimum attractive rate of return
24. Which of the appraisal method/s was being used before by your company.

1. Simple payback.
2. Discounted payback
3. Internal rate of return
4. Modified internal rate of return
5. Net present value
6. Minimum attractive rate of return

Answer: 1, 2, 3 & 5. 72%

25. Which of the mentioned appraisal method/s is preferred for large projects in your organisation?

1. Simple payback.
2. Discounted payback
3. Internal rate of return
4. Modified internal rate of return
5. Net present value
6. Minimum attractive rate of return

Answer: 3, 4, 5. 80%

26. Which of the below mentioned methods is easier to use by your organization.

1. Simple payback.
2. Discounted payback
3. Internal rate of return
4. Modified internal rate of return
5. Net present value
6. Minimum attractive rate of return

Answer: 1, 2, 3 & 4. 68%

27. Which of the below mentioned methods is/are deemed complicated by your organization.

1. Simple payback.
2. Discounted payback
3. Internal rate of return
4. Modified internal rate of return
5. Net present value
6. Minimum attractive rate of return

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Answer: 4, 5 & 6. 75%
CHAPTER 4: INTERPRETATION OF THE RESULTS AND ANALYSIS

In reaching a conclusion on the results of the survey it is clear that all 6 methods are used in various industries with varying frequencies as indicated in Chapter 3. In addition, it was noted that varying tendencies related to the size of the project involved and the level of skills in an organisation is at the order of the day, at least in the sample of respondents. In other organisations, the liquidity of the organisation influences the decision. Respondents varied on some crucial aspects when coming to the main application of some methods / techniques. It might be lack of thorough understanding or ability to apply a specific method.

Methods such as the payback are still favoured for small projects. Its simplicity is most likely the reason why it is still used. In considering the payback method, its challenges relate to the limitations or shortcomings, in that it does not take into consideration time value of money. For discounted payback method, there is a relatively mixed feeling in its usage. IRR seems to still hold its own as one of the trusted and tested methods due to its popularity. It is most likely to be used in many industries.

NPV remains one of the best for the future. The only disadvantage for organisations is the lack of skills and as it is deemed complex. It can however, be a good indicator for growth in an organisation. MARR is very good in determining the cost of opportunity, used and understood very well. And lastly MIRR is popular as it addresses the short-comings of IRR.

In essence one can conclude that the views iterated in the literature to a large extent matches some of the survey results. Discounted cash flow methods have gained a lot of credibility in the last 50 years. The discounted payback method is a proper solution to the simple payback in that it takes into effect the time value of money. Its only major challenge is that it does not consider cash flows beyond the discounted payback period. For IRR its popularity seems to be the main factor in its selection. Its rate of return is easily understandable. And used in both private and government bonds.

NPV seems to be the future model as it is compatible with many projects. The most important factor about this model is that a rand today will be worth more in the future if it is properly invested. The major disadvantage though is that it assumes that cash flows can be reinvested. MARR is normally related with opportunity cost of an organisation to invest internally or externally in the stock markets. It is a good tool to gauge the growth of an organisation, whether to undertake a project or leave it. MIRR technique is a modification of an IRR model, it normally assumes that cash flows are reinvested at the cost of capital. It eliminates the problems of MIRR.

4.1. Simple payback

In the survey, it showed that this method is still being used in industry as it easy to understand, and reduces the level of uncertainty in an organisation. Participants in the survey indicated that they strongly support the utilisation of this method.
4.2. **Discounted payback method**

The respondents indicated that this technique is used in moderation hence the most prominent response of “agree” in the survey. It has an advantage in that it takes time value of money into consideration.

4.3. **Internal rate of return**

It is still one of the preferred methods, as it uses the discounted cash flow technique. It is widely used due to the expression in percentages and ease of comparison. The response was strongly agree to using it.

4.4. **Net present value**

Very good method and advanced, as is indicated by the “strongly agree” response from the respondents. It is the technique for the future, although complicated.

4.5. **Minimum accepted rate of return**

Good technique and strongly agree to use.

4.6. **Modified internal rate of return**

It is a better product than the normal IRR. Also, strongly agree to use and advanced.
CHAPTER 5: CONCLUSIONS

5.1. Simple payback
As Kerzner [13] states that a company that makes an investment decision only based on payback decision, might be looking at projects with a shorter payback. It also might be for the reasons that it is easy to understand and apply.

Dixon [12] explains payback as simply the number of years required to recover the principal investment. It has two superior uses, it can be used as a basis for accept and reject decision-making. It may also be submitted to directors to take a decision. The manager will just have to check the duration of the investment, and take a decision based on that. His / her rejection reasons will be based on that. In other instances, it might be a requirement by directors throughout the entire organisation. The directors might have to reject all investments which requires a longer payback period. The unfortunate part of this investment type is that it does not take into consideration cash flows after the payback period. The other disadvantage of this method is that it is not consistent with the concept of profit maximisation. It is, however, still used today because of its simplicity. For smaller projects, it is usually good to use, where complicated techniques are an overkill and possibly a waste of time. It is preferred in situations where a firm has some uncertainty in both financial and political issues, or where the rapid technology advances makes it essential. Payback is useful where interest rates are relatively high. Investment managers use it as tool for accepting and rejecting a single investment.

Shtub et al. [26] explains that in its simplest form, payback period is the number of periods usually measured in years that it takes for the accruing of nett undiscounted benefits from the investment.

Its great advantage is that it is simple and can be mostly be used by anyone. In addition, there is the advantage that mid management and technical staff can select proposals in an easy and understandable way.

5.2. Discounted payback
In the survey results it was indicated that this method is not widely used in industry, one of the reasons being that there are better methods in comparison to it.

Parrino et al. [23] explains that to address the problems of simple payback, the discounted payback method is applied. This method accepts that the future cash flows are discounted by the cost of capital. Its advantage is that management can really know how long it will take for a project to reach an NPV of zero. The specific indication is thus that any capital project that meets these criteria must be considered. It is thus an improvement on the previous method, which might lead to accepting negative NPV projects. Its major flaw is disregarding all cash flows after the arbitrary cut off time. It however does not show solid criteria that leads to an increase in the value.
Mott [19] describes the method as better than the Simple Payback in that it takes into consideration time value of money. It always takes longer than the normal payback period as it includes the cost of capital.

5.3. **Internal Rate of Return**

It is defined as the interest paid on the unpaid balance of a loan in order that the payment schedule makes the unpaid loan balance equal to zero when the final payment is made. It is one of the most commonly used methods [21].

There is an advantage in comparing the projects’ IRR’s stock repurchase plan, and potential acquisition with other standard investment strategies. It is also explained as the discount rate at which the NPV reaches zero [5].

In the survey, it is shown that many companies and individuals use it, and that it is widely understood. It is one of the champion methods in capital budgeting.

Dixon [12] explains IRR as the rate of return that is being earned on capital that is tied up. Bearing in mind that it is tied up after allowing the recoupment of the initial investment.

Dixon [12] summarizes the merits of IRR as follows:

1. Discount rate appears as a percentage figure, which makes it more understandable and comparable.
2. Most finance managers and businessmen are familiar with it and the expression of rates of return.
3. It is a break-even discount rate on a project.
4. It also allows for determining the highest discount rate at which the project will be worthwhile.

Newnan et al. [21] explains IRR as the interest paid on the unpaid balance in order that the end payment balance equals to zero.

Dixon [12] further explains that the IRR of a project is a root of a polynomial equation, and the number of roots, or solutions, depends upon the number of turning points that the equation has, this is known as Descarte’s rule. A turning point occurs every time a cash flow changes from positive to negative. It pays to bear in mind that in certain instances it can happen more than once. This method is relative in that returns are measured relative to the initial investment outlay. Another method of determining an IRR of a project is by interpolation. Two discount rates must be identified where one results in a slightly positive NPV and the other a slightly negative NPV. Then the IRR must lie somewhere between the two discount rates. Once it is determined or calculated it should be compared with the firm’s cost of capital, and if it is greater than the cost of capital then the project can be accepted.

Parrino et al. [23] further highlights major weaknesses of this technique as the rate at which cash flows are generated by a capital project and reinvested. It assumes that cash flows are reinvested at the IRR, thus using it may involve overly optimistic assumptions regarding reinvestment rates.
5.4. Net Present Value

In the survey, it is highly rated, and one of the most popular and exact techniques to use. Its accuracy is close to none of the above-mentioned methods.

It is a technique where cash inflows expected in future are discounted back to the present [10].

Dixon [12] refers to an NPV of a project as the value today of the surplus that the firm makes, over and above what it could make by investing at its marginal rate. It gives a definite decision rule. All the projects with a negative NPV should be rejected, and all with positive NPV may be undertaken.

Rudolf [25] explains the Net Present Value as a financial method that can be used to evaluate the overall value of a project, because of its characteristics of being inclusive. One of its important principles is that a rand today is worth more tomorrow if invested, because it generates interests.

Clark et al. [8] describes it as a method which requires discounting all expected after-tax cash flows to present value and then taking the difference between sums of the discounted cash inflows and outflows. Its difficulty is in deciding the appropriate rate of return (the hurdle rate) to use in discounting the cash flows. Its accuracy plays an important part in forecasting of cash flows influences. The question which remains is how the cost of capital should be calculated. This model implicitly assumes that the incremental cash inflows are going to be reinvested in order to earn the firm’s expected rate of return throughout the entire project. NPV of a project shows the amount which a productive value (present value of cash inflows) exceeds or sometimes less than the cost. In order to maximise the firm’s profit, productive values which exceeds or equal their costs needs to be chosen.

Parrino et al. [23] refers the NPV of a project as the difference between the present value of a project’s future cash flows and the present value of the cost involved.

\[
NPV = PV\text{ (Project’s future cash flows)} - PV\text{ (Cost of the project)}
\]

Using this equation, it can be decided which project to select and how much value it will add to the organisation. Experienced managers are required to estimate the rate using this equation.

5.5. Minimum Attractive Rate of Return

Collier et al. [9] explains MARR determination as a political decision in an organisation. They further explain that it differs for public and private projects. Its base or reason for selecting it is to cover the cost of capital in any project. It is also used to determine whether a project will be profitable or not.

Park [22] explains that the initial element to cover is the cost of capital, which remains the required return to make an investment successful. This cost of capital usually includes the cost of debt (rates associated with borrowing) and the cost of equity (the return that share-
holders require). It determines how a firm can raise money (by issuing stock, borrowing or a mix of two).

In a case where opportunities exceed available funds, it must be decided which opportunity or investment must be pursued. If a company places a limit on its capital, MARR is assumed to be equal to this opportunity cost, in most cases which is greater than the marginal capital cost. An organisation might borrow funds to invest in a profitable venture or project, or might return those funds until they are needed for other projects. This technique is thus related to borrowing and lending rate.

5.6. **Modified Internal Rate of Return**

Lumby et al. [17] refers to this technique as founded on an NPV analysis. Cash flows are in this case compounded to a total terminal value. It is also a good technique in that it eliminates the problems of multiple IRR’s.

Parrino et al. [23] explains this method as an improvement of the weaknesses in the IRR method. They mention that using the IRR method may involve overly optimistic assumptions in regards to reinvestment rates. Thus, to eliminate this problem some practitioners prefer using the MIRR method, with this approach each operating cash flow is converted into a future value at the end of the project’s life cycle, and thus compounded or rounded at the cost of capital. The values are then summed up to get a project’s terminal value. The MIRR is the interest rate that equates the project’s cost (PV cost), or cash outflows, with the future value of the projects cash inflows at the end of the project (PV tv) [23]. In the end, each future value is computed by applying the cost of capital as the interest rate, thus the reinvestment rate problem will be eliminated.

5.7. **Suggestions for Future Work**

In this study, it had been demonstrated that NPV will be the best method going forward.

Dixon [12] explains that the NPV method has proved to be the best in most applications as compared to the IRR. As it always can be used in varying circumstances, with different sizes of investments and cash flows.

The IRR method can usually be adapted to take this into account, but these modified versions of the technique are often extremely unwieldy to use, and there is little benefit in using them in preference to the straightforward NPV technique [12].

NPV can easily be adapted to take account of various types of investments and situations. As it had proved on many occasions. It is also relatively easy to use.

The fact that the IRR method is used much more in practice than NPV indicates not that it is more widely understood, but that its flaws are not recognised, as in nearly all cases the NPV is theoretically as good as, or better than, IRR [12].

In the case or its comparison to the IRR, it is theoretically the best. IRR is common but has many flaws.
The study thus indicates that there is merit in pursuing a combined program between academia and practice to establish more compelling reasons for the use of NPV and to address the apparent lack of knowledge regarding its intricacies. The following section provides a departure point for the future work with the more detailed discussion of the NPV.

5.7.1 Summary of merits of NPV [12]

Dixon [12] gives the merits of NPV as follows:

1. Clear, simple and unambiguous in meaning, quantitative values being given. It is relatively clear and simple to use, with quantitative values as its results.
2. It is consistent with the widely-accepted business aim of profit maximisation as it involves maximisation of present values of future cash flows.
3. The discount rate used reflects the returns required by the suppliers of funds, ie. interest rates.
4. Its discount rate reflects the required returns by the financier.
5. The method incorporates time value of money and it is thus superior to non-discounting methods but, in addition, technical difficulties of IRR are avoided.
6. It generally leads to optimal decision-making in that the present value of a firm’s cash resources will be equal to (or larger than) the present values of the cash resources resulting from the use of any other method.

It can be counted on to always give the company a clear picture of the cash resources and a better decision making option.

Net Present Value method requires discounting all expected after-tax cash flows to present value and taking the difference between the sum of the discounted cash inflows and outflows. This difference is called the project’s net present value [8].

Clark et al. [8] indicates that the NPV method requires that all after tax cash flows must be discounted to present value and that the difference between the discounted cash inflows and outflows have to be determined. The project’s net present value is thus determined.

The primary difficulty encountered with NPV is in deciding the appropriate rate of return (the hurdle rate) to use in discounting the cash flows. The accuracy of the forecasts of cash flows influences the selection of a hurdle rate, similarly the use of NPV also depends on the accuracy of those. While the firms’ cost of capital may be used as the discount rate, there exist questions concerning how the cost of capital should be calculated [8].

The main difficulty in NPV is when deciding on the appropriate rate of return. The accuracy in determining the cash inflows and outflows influences the selection of the hurdle rate. That remains the most important factor. The firm’s cost of capital may be used as the discount rate (future studies can aim to validate this).

Two other factors about NPV deserves mentioning [8]:

The NPV model implicitly assumes that the incremental cash inflows will be reinvested to earn the firms required rate of return throughout the life of the project (future studies can aim to validate this too).
The NPV of a project reveals the amount by which the productive value (present value of the cash inflows) exceeds or is less than the cost. Naturally, if we have a choice (if discretionary projects are involved), we choose only those projects whose productive value exceed or at least equal their costs. If the NPV of a project is positive, the amount of the NPV is the amount by which the project will increase the value of the firm making the investment. Thus, selecting that group of projects with the highest total NPV, other things being equal, should maximise the market value of the firm.

Preference is given for the NPV model as the unique evaluation technique. The purpose is to attempt to entirely helps firms to maximise common shareholder’s wealth positions. Whenever equally exclusive projects are being compared, only the NPV model will consistently show the firm the project or portfolio of projects that will maximise the value of the firm [8].

In most cases preference is given to the NPV as the best technique that is mostly used in companies to maximise common shareholders’ wealth. Even when equally exclusive projects are compared the NPV will show a true evaluation.

The NPV of a project is the difference between the present value of the projects future cash flows and the present value of its cost [23].

**In determining future work, it would be interesting to apply the techniques when contemplating the research approach and potential benefits**
REFERENCES


APPENDIX A: SURVEY QUESTIONS

On a scale of A to D, with D being the most important and A being less important.

1. Does your organization use simple payback to evaluate projects?

<table>
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<tr>
<th>Strongly agree</th>
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2. Does your organisation use discounted payback to evaluate projects?

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3. Does your organization use Net Present Value to evaluate projects?

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4. Does your organisation use Internal Rate of Return to evaluate projects?

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5. Does your organisation use Modified Internal Rate of Return to evaluate projects?

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6. Does your organisation use Minimal Accepted Rate of Return in the evaluation of projects?

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7. Does the size of a project determine the type of financing in your organisation?

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8. Is the financing approval in your organisation based on its growth strategy?

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9. Is thorough research being done before the approval of all possible financing methods?

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10. Are existing projects and examples taken into consideration, in order to see what has transpired in similar projects before?

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11. Are there techniques available to enable managers in weighing up the possible future benefits (which have an element of uncertainty) against immediate costs?

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12. Is each project characteristics considered when making a final decision?

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13. Is the duration of paying back the loan considered when financing is approved/applied for?

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14. Are all abovementioned financing methods compared equally in terms of time and value(forecasting)?

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15. Is the economic situation being taken into consideration when making that decision?

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16. Are other options of investing being investigated?

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17. Is the share-value being taken into consideration when deciding on payback?

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18. When doing evaluations does your organisation normally use spreadsheet technique?

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19. Does your organisation understand the importance of an NPV method?

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20. Does the payback method used by your organisation have anything to do with financial flexibility or decentralized departmental capital budgets?

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21. Is the size of your organization having any influence on the choice of your financing model?

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22. Is the profitability of the project being considered when deciding to use the NPV?

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The following questions can be answered by selecting more than one answer:

23. Which of the following appraisal methods is likely to be used in your company.
A. Simple Payback.
B. Discounted Payback
C. Internal Rate of Return
D. Modified Internal Rate of Return
E. Net Present Value
F. Minimum Attractive Rate of Return

24. Which of the appraisal method/s was being used before by your company.
A. Simple Payback.
B. Discounted Payback
C. Internal Rate of Return
D. Modified Internal Rate of Return
E. Net Present Value
F. Minimum Attractive Rate of Return

25. Which of the mentioned appraisal method/s is preferred for large projects in your organisation.
A. Simple Payback.
B. Discounted Payback
C. Internal Rate of Return
D. Modified Internal Rate of Return
E. Net Present Value
F. Minimum Attractive Rate of Return

26. Which of the below mentioned methods is easier to use by your organization.
A. Simple Payback.
B. Discounted Payback
C. Internal Rate of Return
D. Modified Internal Rate of Return
E. Net Present Value
27. Which of the below mentioned methods is/are deemed complicated by your organization.

A. Simple Payback.
B. Discounted Payback
C. Internal Rate of Return
D. Modified Internal Rate of Return
E. Net Present Value
F. Minimum Attractive Rate of Return