“Capital Investment Appraisal Process: The 5 project choice case study”

By Kostas E. Sillignakis

INTRODUCTION

A project, broadly defined, is a way of using resources. It is a decision between undertaking and not undertaking a project is a choice between alternative ways of using resources. “Project appraisal is a process of investigation and reasoning designed to assist a decision maker to reach an informed and rational choice” (Sugden & Williams, 1978:3).

At this assignment we have five different investment projects in replacement plants. The capital investment appraisal process will be used in order to make reasoned recommendations on acceptance or rejections of each project.

1.0 PAYBACK PERIOD

The payback method is the simplest way of looking at one or more major project ideas. “An investment's payback period in years is equal to the net investment amount divided by the average annual cash flow from the investment” (Internet, http://www.computerworld.com/managementtopics/roi/story/html). It tells you how long it will take to earn back the money you'll spend on the project. The formula is:

\[
\text{Formula 1.0} \quad \frac{\text{Cost of Project}}{\text{Annual Cash Inflow}} = \text{Payback Period}
\]

Under the payback method of analysis, projects or purchases with shorter payback periods rank higher than those with longer paybacks. The theory is that projects with shorter paybacks are more liquid, and thus less risky — they allow you to recoup your investment sooner, so you can reinvest the money elsewhere. Moreover, with any project
there are a lot of variables that grow increasingly fuzzy as you look out into the future. With a shorter payback period, there's less of a chance that market conditions, interest rates, the economy, or other factors affecting your project will drastically change (Daffern P., & Walshe G., 1990).

Generally, a payback period of three years or less is preferred. Some advisors say that if the payback period is less than a year, the project should be considered essential (Internet, http://www.eere.energy.gov/buildings/appliance_standards/residential/pdfs/chapter7.pdf).

After we do the calculations with formula 1.0 we have these findings for each project:

<table>
<thead>
<tr>
<th>YEAR</th>
<th>PROJECT (A)</th>
<th>PROJECT (B)</th>
<th>PROJECT (C)</th>
<th>PROJECT (D)</th>
<th>PROJECT (E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(40.000)</td>
<td>(20.000)</td>
<td>(29.000)</td>
<td>(29.000)</td>
<td>(30.000)</td>
</tr>
<tr>
<td>2</td>
<td>(35.000)</td>
<td>(12.000)</td>
<td>(28.000)</td>
<td>(5.000)</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>(27.000)</td>
<td>(4.000)</td>
<td>(16.000)</td>
<td>1.000</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>(15.000)</td>
<td>1.000</td>
<td>7.000</td>
<td>2.000</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>3.000</td>
<td>5.000</td>
<td>0</td>
<td>3.000</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>19.000</td>
<td>7.000</td>
<td>10.000</td>
<td>4.000</td>
<td>15.000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>PAYBACK PERIOD (in years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A)</td>
<td>3.8</td>
</tr>
<tr>
<td>(B)</td>
<td>2.8</td>
</tr>
<tr>
<td>(C)</td>
<td>2.7</td>
</tr>
<tr>
<td>(D)</td>
<td>1.8</td>
</tr>
<tr>
<td>(E)</td>
<td>4.3</td>
</tr>
</tbody>
</table>

PAYBACK PERIOD (in years)
If we assume that the investment took place on 01/01/2003 then, the payback dates will be:

<table>
<thead>
<tr>
<th>PROJECT (A)</th>
<th>Exact Payback date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>28th of September, 2006</td>
</tr>
<tr>
<td>PROJECT (B)</td>
<td>18th of September, 2005</td>
</tr>
<tr>
<td>PROJECT (C)</td>
<td>8th of August, 2005</td>
</tr>
<tr>
<td>PROJECT (D)</td>
<td>28th of September, 2004</td>
</tr>
<tr>
<td>PROJECT (E)</td>
<td>18th of March, 2007</td>
</tr>
</tbody>
</table>

There are a couple of drawbacks to using the payback period method. For one thing, it ignores any benefits that occur after the payback period, so for example, a project that returns $1 million after a six-year payback period is ranked lower than a project that returns zero after a five-year payback. But probably the major criticism is that a straight payback method ignores the time value of money. To get around this problem, we should also consider the net present value of the project, the internal rate of return, as well as the profitability index. (Internet, http://www.toolkit.cch.com/text/P06_6510.asp).

**2.0 NET PRESENT VALUE (NPV)**

The most widely used technique of financial analysis involves calculating net present value (NPV).

Net Present Value (NPV) is a way of comparing the value of money now with the value of money in the future. A dollar today is worth more than a dollar in the future, because inflation erodes the buying power of the future money, while money available today can be invested and grow (Dasgupta A., & Pearce D., 1972).

The term *constant dollars* refers to the net present value relative to a fixed date. The term *current dollars* refers to the unadjusted value of the money. The term *discount rate* refers to a percentage used to calculate the NPV, and reflects the time value of money (Internet, http://www.investopedia.com/offsite.asp?URL=http://www.finaid.org/loans,npv.phtml).
Net Present Value (NPV) has two major advantages over other approaches. First, when used properly, it gives the correct financial decision in all cases. This differentiates NPV from some of the other approaches that have been used in this assignment. Second, NPV is relatively simple to calculate, while other techniques are sometimes complex (Zebre & Dively, 1994).

The net present value method (NPV) of evaluating a major project allows you to consider the time value of money. Essentially, it helps you find the present value in "today's dollars" of the future net cash flow of a project. Then, you can compare that amount with the amount of money needed to implement the project.

If the NPV is greater than the cost, the project will be profitable for you (assuming, of course, that your estimated cash flow is reasonably close to reality). If you have more than one project on the table, you can compute the NPV of both, and choose the one with the greatest difference between NPV and cost.

NPV analysis is generally used to evaluate the project's cash flows, rather than the income from the project that would be shown on an income statement (Internet, http://www.toolkit.cch.com/text/P06_6530.asp).

The Net Present Value (NPV) of a Capital Budgeting project indicates the expected impact of the project on the value of the firm. Projects with a positive NPV are expected to increase the value of the firm. Thus, the NPV decision rule specifies that all independent projects with a positive NPV should be accepted. When choosing among mutually exclusive projects, the project with the largest (positive) NPV should be selected (Internet, http://www.prenhall.com/divisions/bp/app/cfldemo/CB/NetPresentValue.html).

The NPV is calculated as the present value of the project's cash inflows minus the present value of the project's cash outflows. This relationship is expressed by the following formula:
Formula 2.0

\[ \text{NPV} = \sum_{t=0}^{T} \frac{\text{CF}_t}{(1 + r)^t} = \frac{\text{CF}_0}{(1 + r)} + \frac{\text{CF}_1}{(1 + r)^2} + \frac{\text{CF}_2}{(1 + r)^3} + \cdots + \frac{\text{CF}_T}{(1 + r)^T} \]

where

- \( \text{CF}_t \) = the cash flow at time \( t \) and
- \( r \) = the cost of capital.

2.1 INTERNAL RATE OF RETURN (IRR)

The most popular alternative to net present value is the internal rate of return (IRR). The IRR is the discount rate for which a project’s benefits exactly balance its costs and can be thought of as the “break-even” rate. This method has many proponents who find it more concrete and less esoteric than the NPV technique. This advocates criticize NPV since it requires that a discount rate be assumed, and prefer instead to perform one IRR computation rather than calculate the NPV for a variety of discount rates (Pearce D., & Nash C., 1981).

IRR is defined as “The rate of return that would make the present value of future cash flows plus the final market value of an investment or business opportunity equal the current market price of the investment or opportunity. also called dollar-weighted rate of return” (http://www.investorwords.com/cgi-bin/getword.cgi?2564).

IRR is defined by the equation:

\[ \text{NPV}(C, t, \text{IRR}) = 0. \quad \text{Formula 2.1} \]

In other words, the IRR is the discount rate which sets the NPV of the given cash flows made at the given times to zero (http://www.investopedia.com/terms/i/irr.asp).

Unfortunately, the IRR can be difficult to calculate and can give misleading results in some situations, and thus cannot be generally recommended (Zebre & Dively, 1994).
After we conduct the calculations with formula 2.0 and formula 2.1 we have these findings for each project:

<table>
<thead>
<tr>
<th>Cost of Capital</th>
<th>PROJECT A</th>
<th>PROJECT B</th>
<th>PROJECT C</th>
<th>PROJECT D</th>
<th>PROJECT E</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>2402 %</td>
<td>1614 %</td>
<td>969 %</td>
<td>-167 %</td>
<td>-2058 %</td>
</tr>
<tr>
<td>12%</td>
<td>-98 %</td>
<td>756 %</td>
<td>-467 %</td>
<td>-873 %</td>
<td>-4465 %</td>
</tr>
<tr>
<td>16%</td>
<td>-4497 %</td>
<td>-793 %</td>
<td>-3056 %</td>
<td>-2182 %</td>
<td>-8574 %</td>
</tr>
</tbody>
</table>

3.0 PROFITABILITY INDEX (PI)(or Benefit/Cost Ratio)

When resources are limited profitability index (PI) provides a tool for selecting among various project combinations and alternatives. The highest weighted average (PI) can indicate which project to select.

The profitability index (PI) is the ratio of the discounted cash inflows to the discounted cash outflows.

\[
PI = \frac{\sum_{t=1}^{n} \frac{FCF_t}{(1+k)^t}}{IO}
\]

where
- \( FCF_t \) = the annual free cash flow in time period \( t \)
- \( k \) = the appropriate discount rate: that is, the require rate of return or cost of capital
- \( IO \) = the initial cash outlay
- \( n \) = the project's expected lift
NPV = PV of cash inflows - Initial Outlay
=> Accept when NPV ≥ 0

PI = PV of cash inflows / Initial Outlay
=> Accept when PI ≥ 1

(Internet, http://cai.au.edu/webcourses/config/chapter9/bf3701_ch9_m4.html)

After calculating with formula 3.0 we have these results:

<table>
<thead>
<tr>
<th>Cost of Capital</th>
<th>PROJECT A</th>
<th>PROJECT B</th>
<th>PROJECT C</th>
<th>PROJECT D</th>
<th>PROJECT E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profitability Index</td>
<td>Profitability Index</td>
<td>Profitability Index</td>
<td>Profitability Index</td>
<td>Profitability Index</td>
<td>Profitability Index</td>
</tr>
<tr>
<td>10%</td>
<td>1.06005</td>
<td>1.0807</td>
<td>1.0334</td>
<td>0.994</td>
<td>0.93</td>
</tr>
<tr>
<td>12%</td>
<td>0.99</td>
<td>1.0378</td>
<td>0.98</td>
<td>0.96</td>
<td>0.85</td>
</tr>
<tr>
<td>16%</td>
<td>0.88</td>
<td>0.96</td>
<td>0.89</td>
<td>0.92</td>
<td>0.71</td>
</tr>
</tbody>
</table>

4.0 RECOMMENDATIONS

The final step in the appraisal of options is to evaluate together the financial and the non-financial costs and benefit of each option to determine which is the best value for money, taking account, not only the key criteria of effectiveness, efficiency and economy, but also:

- The capital resources available, the effect on the revenue budget and other financial constraints; and
- The dependence of some of the options on uncertain elements and sensitivities.

In carrying out an appraisal, it is important to plan for the monitoring and post-evaluation
of the project. This will provide useful information for future estate management
decision-making and serve as a management discipline (Sugdan R., & Williams A.,
1978).

The Criteria used for each project is listed below. By calculating those ratios and adapt
the below criteria for each ratio we conclude to the Table 4.0.

**Payback period Criterion:**

Generally, a payback period of three years or less is preferred. Some advisors say that if
the payback period is less than a year, the project should be considered essential.

**Net Present Value Criterion:**

\[
\begin{align*}
\text{NPV} > 0 & \quad \Rightarrow \quad \text{Accept} \rightarrow (+) \\
\text{NPV} < 0 & \quad \Rightarrow \quad \text{Reject} \rightarrow (-) \\
\text{NPV} = 0 & \quad \Rightarrow \quad \text{Indifferent} ()
\end{align*}
\]

**Profitability Index Criterion:**

\[
\begin{align*}
\text{PI} > 1.0 & \quad \Rightarrow \quad \text{Accept} (+) \\
\text{PI} < 1.0 & \quad \Rightarrow \quad \text{Reject} (-) \\
\text{PI} = 1.0 & \quad \Rightarrow \quad \text{Indifferent} ()
\end{align*}
\]

**Internal Rate of Return Criterion:**

a) Accept all projects whose IRR exceeds the company’s cost of capital.

\[
\begin{align*}
\text{IRR} > \text{Cost of Capital} & \quad \Rightarrow \quad \text{Accept} (+) \\
\text{IRR} < \text{Cost of capita} & \quad \Rightarrow \quad \text{Reject} (-)
\end{align*}
\]

b) For mutually exclusive projects, choose the project with the highest IRR.
Table 4.0 indicates how many accept and reject points, each project gains, after analyzing the findings from the ratios that we have calculated.

We can easily identify that PROJECT (B) has more acceptance points and then follows PROJECT (C) and PROJECT (A) and last is coming PROJECT (D) and PROJECT (E).

So we have the follow ranking, starting for the project which is best value for money.

1\textsuperscript{st} choice PROJECT (B)

2\textsuperscript{nd} choice PROJECT (C)

3\textsuperscript{rd} choice PROJECT (A)

We wouldn’t recommend Project (D) and Project (E) because is worthless and invaluable.

*We strongly recommend PROJECT (B) as the best solution to Newton plc investment plans in replacing plant.*
5.0 CAPITAL INVESTMENT APPRAISAL PROCESS

Appraisal techniques have been developed over a number of years to assist organizations in both the public and private sectors with decision making on capital spending. It is relevant for all capital spending projects including information technology systems and building projects. (Internet, http://www.wfc.ac.uk/estates/pdfs/manual/Chap13.pdf)

Principles

A capital investment appraisal is a financial assessment of the cost effectiveness of a capital project set against economic criteria. The net present value is the balance of current projected costs and benefits arising from the project, discounted with the current treasury rate (Zerbe R., & Dively D., 1994).

A capital investment appraisal is a means of ensuring value for money in relation to developing an estate strategy and capital project. A capital investment appraisal is not meant to provide an indication of profit or loss for the institution as a whole, but rather a comparison of costs in relation to those areas of the estate where there is an opportunity or an inclination for change (Baum T., & Mudambi R., 1999).

The inputs should therefore only consider situations where the option may increase or decrease cost or value. It is usual to generate a range of options covering the extreme solution (e.g. total relocation) to a ‘do minimum’ approach (Layard R., & Glaister S., 1994).

Once the full range of options has been considered, then the most appropriate and realistic of them should be fully appraised. For instance, if an institution’s accounts are clearly not sufficient to support a multi-million pound redevelopment then this need not be appraised as one of the options, although it should be considered in the first instance to
assess if that is the case. It is important to take into account not only what is preferred but also what is possible (Daffern P., & Walshe G., 1990).

The following steps should be undertaken in the appraisal process:

a) define the objectives

b) consider the options

c) identify, quantify and, where possible, value the costs, benefits, risks and uncertainties associated with each option.

d) analyse the information (e.g. compare the relative merits and demerits of options), and

e) present the results

(Layard R., & Glaister S., 1994)

Capital investment appraisal process is very useful in order to make right financial and consequently management decisions. In our case, helped to identify the weak and strong points of each project. The combination of indexes that we calculated during the appraisal process helped us to analyze by the best possible way our findings. Using the combination of ratios findings together with the criteria for each ratio helped us to have a “view from different angles” for each project. This combination of ratios that capital investment appraisal offers is a valuable management tool for financial decisions.
### Table 4.0 Projects Evaluation

<table>
<thead>
<tr>
<th>Cost of capital</th>
<th>PROJECT (A)</th>
<th>PROJECT (B)</th>
<th>PROJECT (C)</th>
<th>PROJECT (D)</th>
<th>PROJECT (E)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Accept</td>
<td>Accept</td>
<td>Accept</td>
<td>Accept</td>
<td>Accept</td>
</tr>
<tr>
<td></td>
<td>or Reject</td>
<td>or Reject</td>
<td>or Reject</td>
<td>or Reject</td>
<td>or Reject</td>
</tr>
<tr>
<td>Payback period</td>
<td>3.8 Years (+)</td>
<td>2.8 Years (+)</td>
<td>2.7 Years (+)</td>
<td>1.8 years (+)</td>
<td>4.3 Years ()</td>
</tr>
<tr>
<td>10% NPV</td>
<td>2402 (+)</td>
<td>1614 (+)</td>
<td>969 (+)</td>
<td>-167 (-)</td>
<td>-2058 (-)</td>
</tr>
<tr>
<td>PI</td>
<td>1.06005 (+)</td>
<td>1.0807 (+)</td>
<td>1.0334 (+)</td>
<td>0.994 (-)</td>
<td>0.93 (-)</td>
</tr>
<tr>
<td>IRR</td>
<td>11.9% (+)</td>
<td>13.8% (+)</td>
<td>11.3% (+)</td>
<td>9.5% (-)</td>
<td>8.4% (-)</td>
</tr>
<tr>
<td>12% NPV</td>
<td>-98 (-)</td>
<td>756 (+)</td>
<td>-467 (-)</td>
<td>-873 (-)</td>
<td>-4465 (-)</td>
</tr>
<tr>
<td>PI</td>
<td>0.99 (-)</td>
<td>1.0378 (+)</td>
<td>0.98 (-)</td>
<td>0.96 (-)</td>
<td>0.85 (-)</td>
</tr>
<tr>
<td>IRR</td>
<td>11.9% (-)</td>
<td>13.8% (+)</td>
<td>11.3% (-)</td>
<td>9.5% (-)</td>
<td>8.4% (-)</td>
</tr>
<tr>
<td>16% NPV</td>
<td>-4497 (-)</td>
<td>-793 (-)</td>
<td>-3056 (-)</td>
<td>-2182 (-)</td>
<td>-8574 (-)</td>
</tr>
<tr>
<td>PI</td>
<td>0.88 (-)</td>
<td>0.96 (-)</td>
<td>0.89 (-)</td>
<td>0.92 (-)</td>
<td>0.71 (-)</td>
</tr>
<tr>
<td>IRR</td>
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<td>13.8% (-)</td>
<td>11.3% (-)</td>
<td>9.5% (-)</td>
<td>8.4% (-)</td>
</tr>
</tbody>
</table>
REFERENCES


INTERNET

All resources accessed on 1/3/2003.

http://www.toolkit.cch.com/text/P06_6530.asp
http://cai.au.edu/webcourses/config/chapter9/bf3701_ch9_m4.html
www.investorwords.com/cgi-bin/getword.cgi?3257