Finance

3.2 Investment Appraisal

By Alex Arancibia, for Nuevo Mundo High School – Gye, 2012

Sources: - Business and Management for IB, *Paul Hoang,* 2007
- Business and Management for IB, *Peter Stimpson,* 2011
- Business and Management for IB, *Paul Clark, 2009*

“Never let a poor man advise you on investements”
Spanish proverb

- What is an **investment?**
- Investment means purchasing capital goods – such as equipment, vehicles and new buildings – and improving existing fixed assets with the potential to yield future financial benefits

- What is an **investment**?
- Resources as risked in a venture that ***might*** bring future advantages – <u>but not necessarily</u>.

- The Hollywood movie *The 13th Warrior* starring Antonio Banderas cost £107.8 million to produce in 1999. However , it proved to be a poor investment since the world box office sales only amounted to £39.5 million.
- The question is *How do I know how risky is my investment?*

Investment Appraisal

- Investment appraisal is undertaken by using *quantitative* techniques that assess the financial feasibility of the project.
- Quantitative investment appraisal requires the following information:
  - the initial capital cost of t he investment, including any installation costs
  - the estimated life expectancy – how many years can returns be expected from the investment?
  - the residual value of the investment – at the end of their useful lives will the assets be sold, earning additional net returns?
  - the forecasted net returns or net cash flows from the project – these are the expected returns from the investment less the annual running cost.

Investment Appraisal

- Methods of quantitative investment appraisal include:
  - payback period
  - average rate of return
  - net present value using discounted cash flows.

Payback Period

- It refers to the period of time for an investment project to earn enough profits to repay the cost of the initial investment.
- If a project costs $2 million and is expected to pay back $500 000 per year, the payback period will be four years. This can then be compared with the payback on alternative investments.
- Payback period formula (for even flows of income)
  - initial investment ($) / contribution per month ($)

Payback Period

Year	Annual net cash flows ($)	Cumulative cash flows ($)
0	(500 000)	(500 000)
1	300 000	(200 000)
2	150 000	(50 000)
3	150 000	100 000
4	100 000 (including residual value)	200 000

Income flows are uneven

$$\frac{\text{additional cash inflow needed}}{\text{annual cash flow in year 3}} \times 12 \text{ months}$$

$$= \frac{\$50000}{\$150000} \times 12 \text{ months} = 4 \text{ months}$$

Payback Period

- The construction of a new sports complex that costs $1M is expected to generate the following net cash flows in the first 4 years:

Year 1	$210,000
Year 2	350,000
Year 3	480,000

What is the payback period?

Calculating Payback Period

	Net cash inflow	Cumulative cash inflow
Year 1	$210,000	
Year 2	350,000	
Year 3	480,000	
Year 4	450,000	

Mr. Loeb decided to invest $100.000 in his life project: his own seafood restaurant. He's calculated a series of cash inflows at the end of each of the next four years as $50.000, $40.000, $30.000, and $10.000.

Calculate the payback period.

ABC International has received a proposal from a manager, asking to spend $1,500,000 on equipment that will result in cash inflows in accordance with the following table:

Year	Cash Flow
1	$150,000
2	$150,000
3	$200,000

The total cash flows over the five-year period are projected to be $2,000,000, which is an average of $400,000 per year. When divided into the $1,500,000 original investment, this results in a payback period of 3.75 years. However, the projected cash flows reveal that the flows are heavily weighted toward the far end of the time period, so the results of this calculation cannot be correct.

Calculating Payback Period

Gretchen Inc. is planning to undertake another project requiring initial investment of $50 million and is expected to generate $10 million in Year 1, $13 million in Year 2, $16 million in year 3, $19 million in Year 4 and $22 million in Year 5. Calculate the payback value of the project.

Importance of payback of a project

Managers can compare the payback period of a particular project with other alternative projects so as to put them in rank order. Alternatively, the payback period can be compared with a 'cut-off' time period that the business may have decided on – for example, it may not accept any project proposal that pays back after five years.

Importance of payback of a project

- A business may have borrowed the finance for the investment and a long payback period will increase interest payments.
- Even if the finance was obtained internally, the capital has an opportunity cost of other purposes for which it could be used. The speedier the payback, the more quickly the capital is made available for other projects.

Importance of payback of a project

- The longer into the future before a project pays back the capital invested in it, the more uncertain the whole investment becomes.The changes in the external environment that could occur to make a project unprofitable are likely to be much greater over ten years than over two.
- Some managers are 'risk averse' – they want to reduce risk to a minimum so a quick payback reduces uncertainties for these managers.
- Cash flows received in the future have less real value than cash flows today, owing to inflation. The more quickly money is returned to an investing company, the higher will be its real value.

Payback Period

Advantages	Disadvantages
• It is quick and easy to calculate. • The results are easily understood by managers. • The emphasis on speed of return of cash flows gives the benefit of concentrating on the more accurate short-term forecasts of the project's profitability. • The result can be used to eliminate or 'screen out' projects that give returns too far into the future. • It is particularly useful for businesses where liquidity is of greater significance than overall profitability.	• It does not measure the overall profitability of a project – indeed, it ignores all of the cash flows after the payback period. It may be possible for an investment to give a really rapid return of capital but then to offer no other cash inflows. • This concentration on the short term may lead businesses to reject very profitable investments just because they take some time to repay the capital. • It does not consider the timing of the cash flows during the payback period – this will become clearer when the principle of discounting is examined in the other two appraisal methods (average rate of return and net present value).

Payback method – advantages and disadvantages

Average Rate of Return (ARR)

It may also be referred to as the *Accounting* rate of return. It calculates the *average profit* on an investment project as a percentage of the amount invested.

$$\text{ARR}(\%) = \frac{\text{annual profit (net cash flow)}}{\text{initial capital cost}} \times 100$$

ARR

Suppose the purchase of a new computer system that costs $400,000 is forecast to generate the following net cash flows over the next five years (when it needs to be replaced):

Year 1	$100,000
Year 2	$200,000
Year 3	$180,000
Year 4	$120,000
Year 5	$100,000

Calculate the ARR for this project

Year 1	$100,000
Year 2	$200,000
Year 3	$180,000
Year 4	$120,000
Year 5	$100,000

Comparing this figure with the best interest rate allows to see whether the project is worth the risk. If banks are offering a 5% return, then this particular investment project seems relatively attractive.

1. Add all the net cash inflows. Over the five years it adds up to $700,000

2. Project profit: $700k - $400k (initial inv.) = $300k

3. Average annual profit: $300,000 / 5 years = $60,000 a year

4. Calculate the % return to find the ARR: $60,000 / $400,000 = 15%

What does this result mean? It indicates to the business that, on average over the life span of the investment, it can expect an annual return of 15% on its investment.

This could be compared with:

- the ARR on other projects
- the minimum expected return set by the business – known as the criterion rate (the minimum level [*maximum for payback period*] set by management for investment appraisal results for a project to be accepted)
- the annual interest rate on loans – if the ARR is less than the interest rate, it will not be worthwhile taking a loan to invest in the project.

Stiglitz Instruments AG is considering buying a new calibrating machine for $200,000. The extra costs and revenues over its useful life are shown in the table below.

Year	Costs ($)	Revenues ($)	Net Revenues ($)
0	$-200,000	$0	
1	$-5,000	$100,000	
2	$-5,000	$200,000	
3	$-5,000	$100,000	
4	$-5,000	$85,000	
5	$-10,000	$70,000	
Totals			

Calculate the ARR

ARR

Advantages

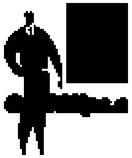
- It uses all of the cash flows – unlike the payback method.
- It focuses on profitability, which is the central objective of many business decisions.
- The result is easily understood and easy to compare with other projects that may be competing for the limited investment funds available.
- The result can be quickly assessed against the predetermined criterion rate of the business.

Disadvantages

- It ignores the timing of the cash flows. This could result in two projects having similar ARR results, but one could pay back much more quickly than the other.
- As all cash inflows are included, the later cash flows, which are less likely to be accurate, are incorporated into the calculation.
- The time value of money is ignored as the cash flows have not been discounted – this concept is considered in the section on net present value.

CASH FLOW			
Time Period	Project One	Project Two	Initial Investment
Year 1	$300,000	$200,000	($750,000)
Year 2	$300,000	$100,000	
Year 3	$300,000	$250,000	
Year 4	$300,000	$300,000	
Year 5	$0	$600,000	
Year 6	$0	$1,200,000	

Study the information in the table below and then answer the questions that follow



Year	Net Cash Flow	
	Project Zebra	Project Eagle
0	$-130,000.00	$-130,000.00
1	80,000	60,000
2	60,000	60,000
3	20,000	60,000

a. Identify
consider

b. Calculate the Payback Period for both projects and comment on your findings.

c. Calculate the ARR on both projects. Assuming that the base interest is 5.25%,

Textile company plans investment

A textile business is planning an investment program to overcome a problem of demand exceeding capacity. It is considering two alternative projects involving newmachinery. The initial outlays and future cash outfl ows are given below. Project Y machinery is forecast to have a life expectancy of just four years.

Year	Project X	Project Y
1	($50 000)	($80 000)
2	$25 000	$45 000
3	$20 000	$35 000
4	$20 000	$17 000
5	$15 000	$15 000
6	$10 000	–

1 Calculate the payback for both projects.

2 Explain which project should be selected if payback is the only criterion used – and why.

3 Calculate ARR for both projects.

4 The business has a cut-off or criterion rate of 11% for all new projects. Would either project be acceptable with this restriction?

5 Taking both the results of payback and ARR together, which project would you advise the business to invest in and why?

6 What additional information would help you advise the business on the more suitable project?

Discounted Cash Flow (DCF)

It's a technique based on the concept of opportunity cost of money and future cash flows.

This additional method considers both the size of cash flows and the timing of them. It does this by discounting cash flows.

Discounted Cash Flow (DCF)

If the effects of inflation are ignored, most people would rather accept a payment of $1000 today instead of a payment of $1000 in one year’s time. Which would you choose? The payment today is preferred for three reasons:

- It can be spent immediately and the benefits of this expenditure can be obtained immediately. There is no waiting involved.
- The $1000 could be saved at the current rate of interest. The total of cash plus interest will be greater than the offer of $1000 in one year’s time.
- The cash today is certain, but the future cash offer is always open to uncertainty.

Discounted Cash Flow (DCF)

This is called taking the ‘time value of money’ into consideration.

Discounting is the process of reducing the value of future cash flows to give them their value in today’s terms. How much less is future cash worth compared to today’s money? The answer depends on the interest rate.

Discounted Cash Flow (DCF)

If $1000 received today can be saved at 10%, then it will grow to $1100 in one year's time. Therefore, $1100 in one year's time has the same value as $1000 today at 10% interest. This value of $1000 is called the *present value* of $1100 received in one year's time.

Discounted Cash Flow (DCF)

Discounting calculates the present values of future cash flows so that investment projects can be compared with each other by considering today's value of their returns.

Discounting – how is it done?

The present value of a future sum of money depends on two factors:

- the higher the interest rate, the less value future cash has in today's money

Discounted Cash Flow (DCF)

These two variables – interest rates and time – are used to calculate discount factors.

Given that receiving money today is worth more than it is in the future, the discount factor can represent either inflation or interest rates.

Discount factors: Present value of \$1 to be received after t years $= 1/(1+r)^t$.

Number of Years	Interest Rate per Year														
	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%
1	.990	.980	.971	.962	.952	.943	.935	.926	.917	.909	.901	.893	.885	.877	.870
2	.980	.961	.943	.925	.907	.890	.873	.857	.842	.826	.812	.797	.783	.769	.756
3	.971	.942	.915	.889	.864	.840	.816	.794	.772	.751	.731	.712	.693	.675	.658
4	.961	.924	.888	.855	.823	.792	.763	.735	.708	.683	.659	.636	.613	.592	.572
5	.951	.906	.863	.822	.784	.747	.713	.681	.650	.621	.593	.567	.543	.519	.497
6	.942	.888	.837	.790	.746	.705	.666	.630	.596	.564	.535	.507	.480	.456	.432
7	.933	.871	.813	.760	.711	.665	.623	.583	.547	.513	.482	.452	.425	.400	.376
8	.923	.853	.789	.731	.677	.627	.582	.540	.502	.467	.434	.404	.376	.351	.327
9	.914	.837	.766	.703	.645	.592	.544	.500	.460	.424	.391	.361	.333	.308	.284
10	.905	.820	.744	.676	.614	.558	.508	.463	.422	.386	.352	.322	.295	.270	.247
11	.896	.804	.722	.650	.585	.527	.475	.429	.388	.350	.317	.287	.261	.237	.215
12	.887	.788	.701	.625	.557	.497	.444	.397	.356	.319	.286	.257	.231	.208	.187
13	.879	.773	.681	.601	.530	.469	.415	.368	.326	.290	.258	.229	.204	.182	.163
14	.870	.758	.661	.577	.505	.442	.388	.340	.299	.263	.232	.205	.181	.160	.141
15	.861	.743	.642	.555	.481	.417	.362	.315	.275	.239	.209	.183	.160	.140	.123
16	.853	.728	.623	.534	.458	.394	.339	.292	.252	.218	.188	.163	.141	.123	.107
17	.844	.714	.605	.513	.436	.371	.317	.270	.231	.198	.170	.146	.125	.108	.093
18	.836	.700	.587	.494	.416	.350	.296	.250	.212	.180	.153	.130	.111	.095	.081
19	.828	.686	.570	.475	.396	.331	.277	.232	.194	.164	.138	.116	.098	.083	.070
20	.820	.673	.554	.456	.377	.312	.258	.215	.178	.149	.124	.104	.087	.073	.061

Discounted Cash Flow (DCF)

To use the discount factors to obtain present values of future cash flows, multiply the appropriate discount factor by the cash flow.

For example, $3000 is expected in three years' time. The current rate of interest is 10%. The discount factor to be used is 0.75 – this means that $1 received in three years' time is worth the same as 75 cents today. This discount factor is multiplied by $3000 and the present value is $2250.

Discounted Cash Flow (DCF)

While DCF can be a useful decision-making tool, even small changes in interest rates can result in a large change in the value of future net cash flows. Today there are several dedicated software programs to help managers calculate DCF of investment projects.

Net Present Value (NPV)

Today's value of the estimated cash flows resulting from an investment.

Money received in the future is worth less than if it were received today. For example, the longer the time period under consideration, the lower the present value of that future amount of money.

Net Present Value (NPV)

It is calculated by subtracting the capital cost of the investment from the total discounted cash flows. The three stages in calculating NPV:

1 *Multiply discount factors by the cash flows. Cash flows in year 0 are never discounted as they are today's values already.*

2 *Add the discounted cash flows.*

3 *Subtract the capital cost to give the NPV.*

Net Present Value (NPV)

Year	Cash flow	Discount factors @ 8%	Discounted cash flows (DCF)
0	($10 000)	1	
1	$5 000	0.93	
2	$4 000	0.86	
3	$3 000	0.79	
4	$2 000	0.74	

Net Present Value (NPV)

Consider a project which costs $350000 and which will produce net revenues over the next five years as follows:

Year	
1	$50,000
2	$80,000
3	$100,000
4	$150,000
5	$130,000

Given a 10% discount rate put the data into net present value. Then compare with its ARR.

Net Present Value (NPV)

An initial investment on plant and machinery of $8,320 will generate cash inflows of $3,411 , $4,070 , $5,824 and $2,065 in first, second, third and fourth year respectively. At the end of the fourth year the machinery will become obsolete and will be sold for $900 . Calculate the present value of the investment if the discount rate is 18%.

Net Present Value (NPV)

Year	1	2	3	4
Cash Inflow	$ 3,411.00	$ 4,070.00	$ 5,824.00	$ 2,065.00
Salvage Value				900.00
Total Cash Inflow				
× Present Value Factor				
Present Value of Cash Inflows				
Total PV of Cash Inflows				
− Initital Investment				
Net Present Value				

Net Present Value (NPV)

Usually, businesses will choose a rate of discount that reflects the interest cost of borrowing the capital to finance the investment. Even if the finance is raised internally, the rate of interest should still be used to discount future returns. This is because of the opportunity cost of internal finance – it could be left on deposit in a bank to earn interest. An alternative approach to selecting the discount rate to be used is for a business to adopt a cut-off or criterion rate. The business would use this to discount the returns on a project and, if the net present value is positive, the investment could go ahead.

Net Present Value (NPV)

Advantages

- It considers both the timing of cash flows and the size of them in arriving at an appraisal.
- The rate of discount can be varied to allow for different economic circumstances. For instance, it could be increased if there was a general expectation that interest rates were about to rise.
- It considers the time value of money and takes the opportunity cost of money into account.

Net Present Value (NPV)

Disadvantages

- It is reasonably complex to calculate and to explain – especially to non-numerate managers!
- The final result depends greatly on the rate of discount used, and expectations about interest rates may be inaccurate.
- Net present values can be compared with other projects, but only if the initial capital cost is the same. This is because the method does not provide a percentage rate of return on the investment (internal rate of return).

Qualitative Investment Appraisal

Investment appraisal techniques provide numerical data, which are important in taking decisions. However, no manager can afford to ignore other factors which cannot be expressed in a numerical form but may have a crucial bearing on a decision. These are referred to as qualitative factors and include the following and can be remembered by the mnemonic PORSCHE:

Predictions (gut feelings): Investment decisions are often based on the intuition of changes in the future, such as predictions of changes in interest rates and income levels.

Objectives: A profit-seeking firm, for example, will prefer to use quantitative methods but a firm with a strong ethical stance may not give financial data such a high priority.

Risk profile: Firms with a low risk profile are less likely to opt for high-risk, high-return investments, choosing instead to opt for lower risk projects with more certain returns. This approach will protect the business if the risk does not pay off.

State of the economy: If consumer and producer confidence levels are high, for example, then higher risk projects might be undertaken. However, if interest rates are forecasted to rise over the medium to long term, the managers may put off many investment plans.

Corporate image: Managers need to consider how an investment project might affect its public relations and corporate image. For example, will the attention and response of pressure groups such as Greenpeace be an issue if the investment project goes ahead?

Human relations: For example, will automation cause mass redundancies? How will the change affect staff morale levels and the corporate image?

Exogenous shocks: Hurricanes and other natural disasters of unquantifiable risk also have to be considered when making investment decisions.