Investment Appraisal

Chapter 8

CS449-Professioal Issues in Information Technology

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Chapter Outcome

After reading the chapter, you should:

- *understand what is meant by the* time value of money*;*
- *be able to carry out a discounted cash flow analysis to assess the viability of a proposed investment proposal;*
- *be able to interpret a discounted cash flow analysis in commercial terms.*

Introduction

Investment Appraisal

- **A means of assessing whether an investment project is worthwhile or not**
- Investment project could be the purchase of a new PC for a small firm, a new piece of equipment in a manufacturing plant, a whole new factory, etc
- Used in both public and private sector

Introduction

Investment appraisal, is the planning process used to determine whether an organization's long term investments such as:

- New machinery,
- Replacement of machinery, New plants,
- New products, and research & development projects are worth the funding.

It is the process of allocating resources for major capital investment, or expenditures.

<u>The primary goals of investments is to increase the value of the firm to the shareholders.</u>

Introduction

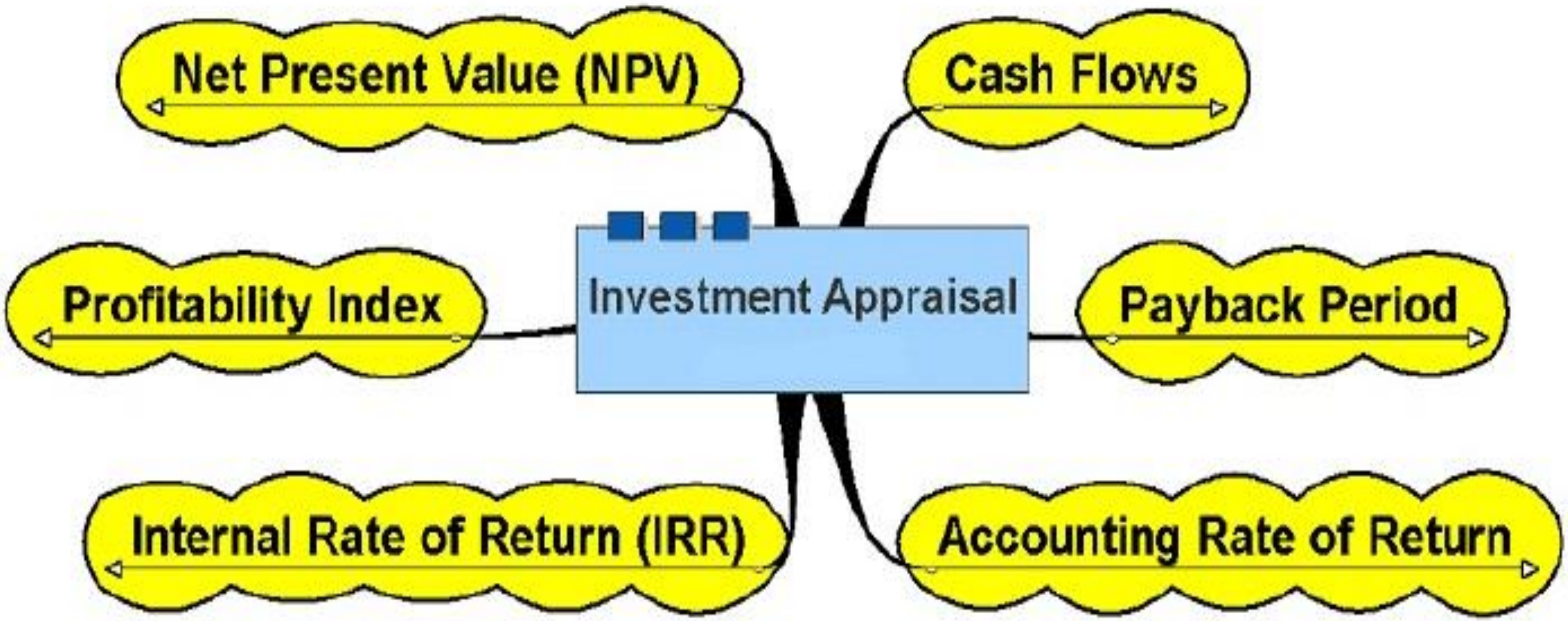
Successful companies are always looking at ways in which they can change, develop and grow.

The senior management has to consider different proposals, like the development of a new product or establishing new branch somewhere else.

Factors that must be taken into consideration include:

- the extent to which the proposals are consistent with the company's long-term plans,
- the risk attached to the proposals,
- the availability of the necessary funds.

Investment Appraisal



Investment Appraisal

One important criterion is the financial one: which of the proposals will give the best return on the investment? Usually it is determined by the method known as discounted cash flow (DCF). It is used for example:

- by investors on the stock market to assess whether the share price of a company is accurately reflected ;to decide whether to purchase capital equipment or to lease it;
- to assess which of several possible projects is the most financially appealing;
- to decide whether a proposed capital project will be worthwhile.

The Time value of Money

A typical Car Sale Advertisement looks like this:

New Wolsey Hornet £8995 or only £500 down and £400 per month for 24 months

Suppose If you have to pay £8,995 cash. Would you be better off at the end of two years paying cash, or at the beginning, or taking the easy payment terms?

The Time value of Money….

Suppose you have £100. You can choose to deposit it with a bank or some other savings organization.

If the rate of interest is 3%, then in a year's time you will have £103. In other words, the promise of £103 in a year's time is worth the same as £100 now. This simple example illustrates what is known as the *time value of money*. It forms the basis of *discounted cash flow analysis*.

In general, if the interest rate is *r* (expressed as a fraction such as 0.03, not a percentage), then the present value of a sum of money *X* due in *t* years time is:

$$\frac{X}{(1+r)^t}$$

The quantity $1 \div (1 + r)^t$ is known as the *discount factor*.

TABLE 8.1 *Discount factors for periods up to five years*

Interest Rate (%)	1	2	3	4	5
3	0.9709	0.9426	0.9151	0.8885	0.8626
4	0.9615	0.9246	0.8890	0.8548	0.8219
5	0.9524	0.9070	0.8638	0.8227	0.7835
6	0.9434	0.8900	0.8396	0.7921	0.7473
7	0.9346	0.8734	0.8163	0.7629	0.7130
8	0.9259	0.8573	0.7938	0.7350	0.6806
9	0.9174	0.8417	0.7722	0.7084	0.6499
10	0.9091	0.8264	0.7513	0.6830	0.6209
15	0.8696	0.7561	0.6575	0.5718	0.4972
20	0.8333	0.6944	0.5787	0.4823	0.4019

The Time value of Money….

To use Table 8.1, we look for the cell in the row for the discount (interest) rate & the column for the time period.

The value in this cell gives the discount factor. Thus the discount factor for a discount rate of 8 per cent over a period of four years is 0.7350.

This means that, if the discount rate is 8 per cent, the present value of a sum of £1,000 payable in four years time is £1000 × 0.7350 = £735.

The Time value of Money….

Now we can tackle the question of buying the car.

The easy terms on offer mean we pay £500 now, £400 at the end of the first month, another £400 at the end of the second month, and so on until the end of the 24th month.

Using discount factors, we can calculate the present value of each of those monthly payments. If we add the present value of all those payments to the £500 that we have to pay as down, we can find the present value of the total payments.

If this is more than £8,995, we shall be better off buying the car immediately.

The Time value of Money

A typical Car Sale Advertisement looks like this:

> **New Wolsey Hornet**
>
> **£8995 or**
>
> **only £500 down and £400 per month for 24 months**

Suppose If you have to pay £8,995 cash. Would you be better off at the end of two years paying cash, or at the beginning, or taking the easy payment terms?

The Time value of Money….

The discount is the rate of interest that we would receive on our £8,995 if we left it in our savings account. Currently this is around 3% /year in the UK.

We, however, need the equivalent monthly rate and this is 0.246 % /month. With this discount rate, the discount factors at the end of the months 1 to 3 are 0.9975, 0.9951, and 0.9926.

The present values of the first three £400 payments are thus £400 × 0.9975 = £399.02, £400 × 0.9951 = £398.03, and £400 × 0.9926 = £397.05.

The Time value of Money….

These calculations are tedious, but can be done easily using Excel, which has a built in function for calculating the net present value at a given discount rate.

The result of applying this function (NPV) to a sequence of 24 payments of £400 with a discount rate of 0.2466 % is a *net present value* of £9,310.30. To this we must add the £500 down payment.

This shows that the NPV of the payments on easy terms is £9,810.30, a difference of £815.3. Clearly it is much better to buy the car for £8,995 if we have the money available.

Applying DCF to a simple Investment Project

The purpose of investment is to produce monetary benefits(Financial profits), for this we need to find their present value.

To do this, we calculate the net cash flows that the project will generate over each year of its life and convert these to a present day value. Then we add these up to get the NPV of the project as a whole.

Applying DCF to a simple Investment Project

For a simple DCF analysis, consider a small computer maintenance company. The company has a transport van to bring computers that cannot be repaired on site.

On busy days, the company has to rent a second van. Let's see is it worthwhile to rent or buy a second van?

Applying DCF to a simple Investment Project…..

A new van will cost £10,000. The annual costs of £500 for insurance & £150 for road tax. The cost of maintenance is around £200 in each of the first two years, £300 in year 3, £400 in year 4 and £500 in year 5.

At the end of the fifth year, it is expected that the van will be sold for around £2,000. The interest rate that the company pays on its borrowings is 10 %.

Van hire costs £30 per day and the van is hired for 100 days a year. All the costs are subject to inflation, which is around 5% over the period, but the resale value of the van is the cash figure expected at the time.

Applying DCF to a simple Investment Project.....

TABLE 8.2 *DCF analysis of van purchase versus leasing*

	Year 0	Year 1	Year 2	Year 3	Year 4
Buying a van					
Van purchase/sale	(10000)				2000
Tax and insurance	(650)	(683)	(717)	(752)	(790)
Maintenance	(200)	(210)	(331)	(463)	(608)
Annual cash flow	(10850)	(893)	(1048)	(1215)	602
NPV of annual flow	(10850)	(812)	(866)	(914)	412
Total NPV	(13030)				
Continuing to rent					
Annual costs	(3500)	(3675)	(3859)	(4052)	(4254)
NPV of annual costs	(3500)	(3341)	(3189)	(3044)	(2906)
Total NPV	(15980)				

Applying DCF to a simple Investment Project…..

The NPV of the cost of continuing to rent is £15,980, as oppose to buying a van is £13,030. We conclude that the company will be better off buying a van.

The main uncertainty is in the number of rental days. If the company’s business expands, it has to rent a van more often, increasing the rental cost so buying would have more of advantage.

If, however, business declined or the company used the existing van more efficiently, the cost of the rental would decrease and the advantage of buying would reduce or even disappear.

Timing of the cash flows

The analysis assumes that the cash flows take place at the start of each period, so that the discount factor for year 0 is 1, or the first payments are at the start of the project so that their NPV is their actual monetary value.

This is realistic for the costs involved in buying the van; the cost of the van itself is due when it is bought, which is effectively the start of the project, while the insurance and the road tax are both due at that point and on the same date in succeeding years.

Only the comparatively small maintenance costs occur at different points during the year.

Timing of the cash flows…..

This assumption about the timing of the cash flows is not, however, valid for the rental option.

The company is likely to have an account with the rental company so that it receives monthly invoices for the rentals in the previous month and the cash flows are distributed throughout the year.

If we assume that ‘on average’ the rental costs are paid half way through the year, we can correct for the result of assuming that the cash flows take place at the beginning of the period by applying a further six-month discount factor to the NPV

Timing of the cash flows…..

This factor is the square root of the annual discount factor, 0.9091, that is, 0.9535.

The resulting NPV is £15,237. The advantage of buying the van is thus slightly less than in the original calculation but is still significant.

Cost of capital

The company pays 10% interest on its borrowings and we assumed that it would have to borrow the money to buy the van.

This is an over-simplification. Even if the company has the cash available to buy the van outright, there is still a cost because the company will lose the income it could have received by investing the money somewhere else, in a suitable interest bearing account for example.

This cost is known as an *opportunity cost*. If the company is able to pay cash for the van, this is the interest rate it would be appropriate to use in the DCF analysis.

Cost of capital…..

As we know, large companies raise money by taking loans (the rate of interest maybe fixed or variable), by the issue of shares (on which dividends may be paid), or by retaining profits.

When a large company invests in new projects, the money required is likely to come from a combination of these. The company’s financial director is expected to carry out complex calculations to balance the cost of money from these different sources and come out with a single figure for the cost of capital, which the company will use in appraising all investment proposals.

Handling inflation

Inflation in a financial context means the fall in the value of money over time. It is usually an annual percentage.

Thus, for example, an inflation rate of 5% means that in one year goods that today cost £100 will cost £105. In two years, they will cost £100 × 1.05 × 1.05 = £110.25.

The inflation rate can vary from time to time and from country to country. Typically, in countries with a stable economy, it will be under 5%, while in countries where the economy is weak and out of control, it can rise to several thousand percent.

Handling inflation.....

The presence of inflation means that the 'monetary' rate of interest, that is, the rate that is normally quoted is actually false.

£100 invested at a quoted interest rate of 10% will be worth £110 in money in a years' time.

However, if the rate of inflation is 5% this £110 will only buy as much as £110/1.05 = £104.76 would buy today.

Thus the real rate of interest is only 4.76%.

Financial cash flows

It is not necessary to include the cash flows associated with borrowing the money to buy the van, that is, the cash inflow when the bank loan is received and the interest payments made to the bank.

The DCF analysis automatically takes these into account so that the same result is obtained whether or not they are included or not.

Assessment of a Software Product Proposal

Let’s consider a company that is assessing a proposal for the development of a software product.

It is estimated that three people will be required for development in the first year and a further person and a half in the second year.

suitable staff cost £35,000/year, including the employer’s pension and national insurance costs.

The product will be released in the second year.

Assessment of a Software Product Proposal…..

After the second year, maintenance is expected to need one person, full-time.

Sales and marketing costs are estimated to be £10,000 in the first year, rising to more than £20,000, for each of the next 4 years.

The product itself is a fairly high-value. It is expected that about 100 copies will be sold over this period, at around £5,000 a copy.

Table 8.3 shows the DCF analysis of the project over a 5-year period, using 10% as the (monetary)cost of capital.

Assessment of a Software Product Proposal…..

TABLE 8.3 *DCF analysis of a proposed software package development*

	Year 0	Year 1	Year 2	Year 3	Year 4
Development cost	105000	55125			
Maintenance			38588	40517	42543
Sales and marketing	10000	21000	22050	23153	24310
Number of sales		10	20	40	30
Revenue		50000	100000	200000	150000
Net cash flow	(115000)	(26125)	39363	136331	83147
Discount factor	1	0.9091	0.8264	0.7513	0.6830
Present value	(115000)	(23750)	32529	102425	56789
Cumulative present value	(115000)	(138750)	(106221)	(3796)	52993

Assessment of a Software Product Proposal…..

After the second year, maintenance is required. In this table, we have shown additional entries for the cumulative present value.

This is the NPV at the end of the first year, the NPV at the end of the second year, and so on.

The NPV of the project over 5-year life is the cumulative present value at the end of year 4, shown as, £52,993.

There are other factors of a project's attractiveness that can be deduced from this table. It is the time required for the project to achieve a positive net cash flow called *pay-back.*

Assessment of a Software Product Proposal…..

For the project in the table, it is little over four years, since the cumulative cash flow at the end of year 3 is (£3796), and the cumulative cash flow is firmly positive by the end of the year 4.

(The term *simple pay-back period* is sometimes used to refer to the payback period calculated without taking into account the time value of money.)

The pay-back period is important in a project like this one because predicting the sales of a software product three or four years ahead is very uncertain.

Assessment of a Software Product Proposal…..

A project that promises a pay-back within two years will therefore usually be preferred to one whose pay-back period is four or five years.

The same thing would not necessarily be true of a project in a more stable industry such as electricity generation, where it is quite normal to look 20 years ahead and to accept projects whose pay-back periods are 10 years.

It is also possible to calculate the internal rate of return (IRR) on the project. This is the cost of capital which would lead to the NPV being precisely zero.

Assessment of a Software Product Proposal…..

This is little difficult to calculate, fortunately, most spreadsheets provide a function for it.

The *IRR* is the maximum cost of capital at which the project would be viable. For the figures in the table it is 23%.

There are times when interest rates can fluctuate quite violently, even in basically stable economies.

This happened in the UK in the mid-1970s and again in the late 1980s.

Assessment of a Software Product Proposal…..

The IRR is a useful guide to the viability of a project. An IRR of 23% at a time when the company's cost of capital is 10% means that the viability of the project will not be affected by any likely increase in interest rates.

A proposal will normally be rejected if its NPV is not positive, if its pay-back period is greater than some pre-set threshold, or if its IRR is less than the current cost of capital.

If a choice must be made, it should probably be those that have the highest positive NPV, that is of the highest IRRs or the shortest pay-back periods.

Pitfalls of DCF

If we use DCF analysis to assess a proposal for developing a software product, then the uncertainty are very much greater. Although an NPV of £52,993 and an IRR of 23% look attractive, we must take into account that:

- most software projects take more effort than expected;
- most software doesn't work very well when it's first released;
- we may not manage to sell as many copies as we expected;
- there is a considerable risk that a competitor will launch a similar product before ours is ready.

Pitfalls of DCF…..

We need to assess how sensitive the project is to such risks.

The way to do this is to carry out a series of DCF analyses with different estimates of the cash flows and the discount rate and see how the results change.

If the project remains attractive under the different sets of assumptions, it is comparatively low risk; if it becomes unattractive under small changes, then it is high risk and should probably be re-thought.

Pitfalls of DCF …..

In the given example, if the sales in year 3 drop from 40 to 20, the cash flow never becomes positive.

Predicting sales this far ahead is very uncertain, so the project should be regarded as high risk.

On the other hand, if the price is increased to £6,000, the NPV rises to £117,420 and the pay-back period falls to two years.

This sensitivity to changes in sales volumes and selling price is characteristic of software product developments.

IRR

Internal rate of return (IRR) is the minimum discount rate that management uses to identify what capital investments or future projects will yield an acceptable return and be worth pursuing.

The IRR for a specific project is the rate that equates the net present value of future cash flows from the project to zero.

In other words, if we computed the present value of future cash flows from a potential project using the internal rate as the discount rate and subtracted out the original investment, our net present value of the project would be zero.

IRR - Definition

This sounds confusing, but it's pretty simple. Think of it in terms of capital investing like the company's management would. They want to calculate what percentage *return* is required to break even on an investment adjusted for the time value of money.

You can think of the internal rate of return as the interest percentage that company has to achieve in order to break even on its investment in new capital. Since management wants to do better than *break even*, they consider this the minimum acceptable return on an investment.

IRR - Formula

The IRR formula is calculated by equating the sum of the present value of future cash flow less the initial investment to zero. Since we are dealing with an unknown variable, this is a bit of an algebraic equation. Here's what it looks like:

Internal Rate of Return

$$\left(\frac{\text{Cash Flows Year 1}}{(1+IRR)^1} + \frac{\text{Cash Flows Year 2}}{(1+IRR)^2} + \frac{\text{Cash Flows Year 3}}{(1+IRR)^3} + \frac{\text{Cash Flows Year 4}}{(1+IRR)^4} \right) - \text{Initial Investment} = 0$$

As you can see, the only variable in the internal rate of return equation that management won't know is the IRR. They will know how much capital is required to start the project and they will have a reasonable estimate of the future income of the investment. This means we will have solve for the discount rate that will make the NPV equal to zero.

IRR - Example

Let's look at Tom's Machine Shop. Tom is considering purchasing a new machine, but he is unsure if it's the best use of company funds at this point in time. With the new $100,000 machine, Tom will be able to take on a new order that will pay $20,000, $30,000, $40,000, and $40,000 in revenue.

Let's calculate Tom's minimum rate. Since it's difficult to isolate the discount rate unless you use an excel IRR calculator. You can start with an approximate rate and adjust from there. Let's start with 8 percent.

IRR – Example....

Internal Rate of Return

$$\left(\frac{\$20{,}000}{(1+8\%)^1} + \frac{\$30{,}000}{(1+8\%)^2} + \frac{\$40{,}000}{(1+8\%)^3} + \frac{\$40{,}000}{(1+8\%)^4} \right) - \$100{,}000 = \$5{,}393$$

As you can see, our ending NPV is not equal to zero. Since it's a positive number, we need to increase the estimated internal rate. Let's increase it to 10 percent and recalculate.

Internal Rate of Return

$$\left(\frac{\$20{,}000}{(1+10\%)^1} + \frac{\$30{,}000}{(1+10\%)^2} + \frac{\$40{,}000}{(1+10\%)^3} + \frac{\$40{,}000}{(1+10\%)^4} \right) - \$100{,}000 = 0$$

As you can see, Tom's internal return rate on this project is 10 percent. He can compare this to other investing opportunities to see if it makes sense to spend $100,000 on this piece of equipment or investment the money in another venture.

IRR – Analysis

IRR is the rate at which the net present value of the costs of an investment equals the net present value of the expected future revenues of the investment.

Management can use this return rate to compare other investments and decide what capital projects should be funded and what ones should be scrapped.