THE UNIVERSITY of York

White Rose Centre for Enterprise

CE Entrepreneurship

Investment decision making

Cash Flow

For projects where there is a need to spend money to develop a product or establish a service which results in cash coming into the business in the future, the cash-flow graph resembles an S turned on its side. This classical 'S - curve' is shown in idealistic form in figure 1. In reality this will not always be the case. The slight negative cash flow at the end of the project is the cost of decommissioning or removing the project.

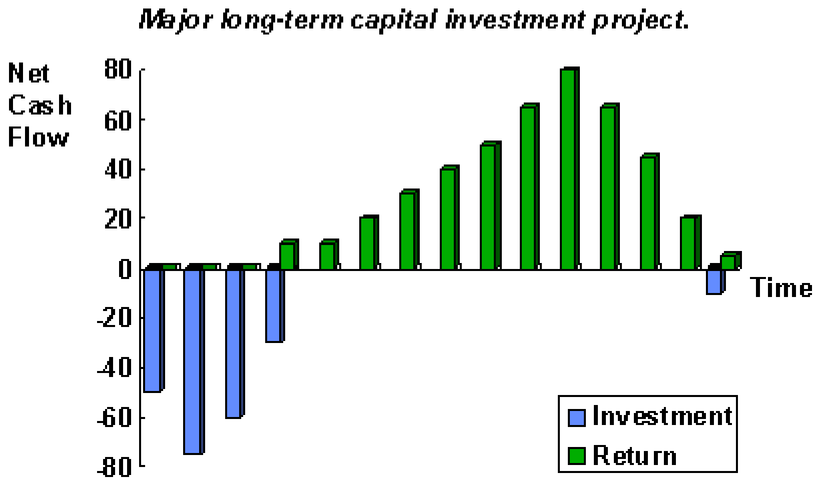

Figure 1. Classical 'S - curve' cash flow profile.

In projects where there needs to be a periodic injection of cash, for example to replace worn out machinery or vehicles, a more cyclic cash flow profile results such as is shown in figure 2.

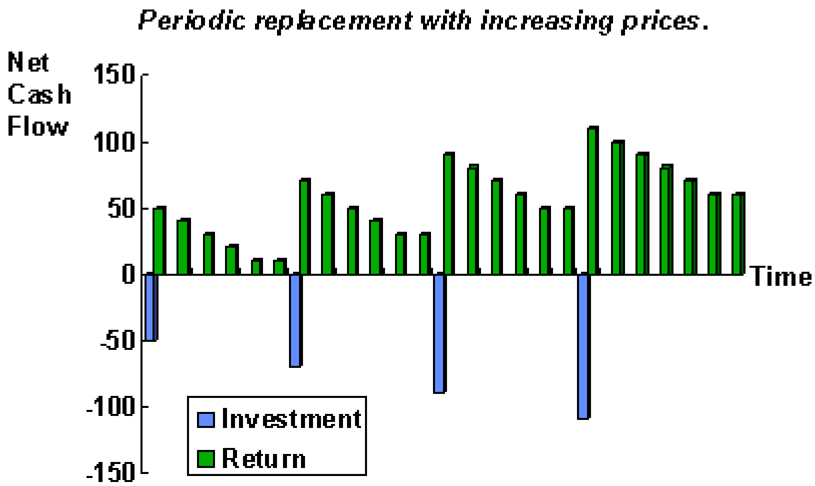

Figure 2. Periodic replacement with increasing prices.

The cash received from sales may also vary over time. A seasonal product typically results in a cyclic cash flow over the years. Figure 3 shows an example of such a cash flow with the up-front investment and a small cash requirement to decommission all the equipment at the end of production.

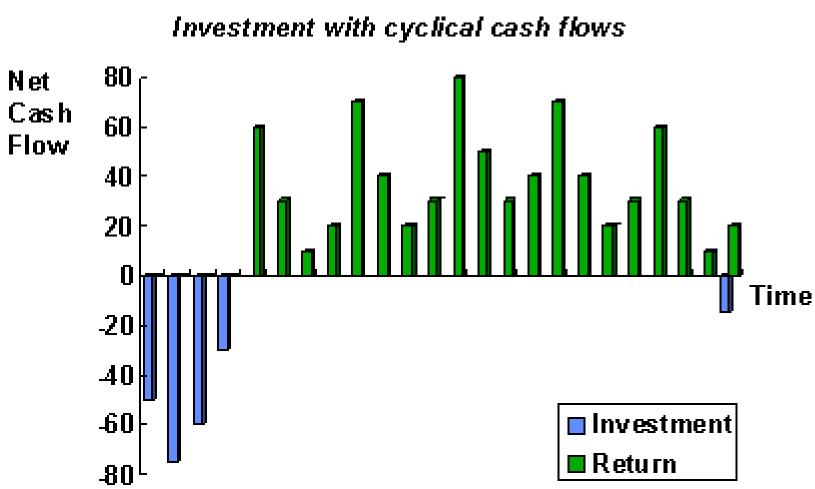

Figure 3. Investment with cyclic cash flows.

In almost all project cases some cash is required at the beginning of the project to produce the product, market the product, establish the distribution chain, etc. This leads to a formal definition of capital expenditure:

> *"Funds spent in the expectation of securing a stream of benefits, which may take some time to start flowing and which may last for some years."*

The amount spent is very often substantial and is used to acquire such things as:

- Land
- Plant or Machinery
- Development of a New Product
- Installation of a New Computer System
- Establishment of a new production process
- Opening of a new market sector

Whether the expenditure of this amount of capital is going to be worthwhile is the subject of capital expenditure appraisal. Capital expenditure appraisal sets out to establish whether:

- a particular capital expenditure proposal is justified in terms of the expected benefits
- if there are alternative proposals which should be undertaken

Consider an example. Table 1 shows the cash flow for three projects, each requires and up-front capital expenditure of £100,000. In the following years the three projects generate different cash from sales, as shown.

	Project A	Project B	Project C
Initial cost (£)	(100,000)	(100,000)	(100,000)
Year 1 cash from sales	15,000	30,000	30,000
Year 2 cash from sales	25,000	30,000	30,000
Year 3 cash from sales	30,000	30,000	30,000
Year 4 cash from sales	30,000	30,000	30,000
Year 5 cash from sales	30,000	25,000	
Year 6 cash from sales	30,000	15,000	
Total cash flow	160,000	160,000	120,000

Table 1. Cash flows for three different projects

The question to be answered is which project is the best one for the company? At first sight the total cash flow, shown in the bottom row could be used. This figure is the accounting return.

Accounting Return

The accounting return of a project is simply the surplus cash at the end of the project as shown by the following equation:

surplus cash = Cash Inflow - (Initial Investment - Residual Value)

from this the average investment can be determined as:

Average Investment = (Initial Investment - Residual Value)/2

Referring to the example shown in table 1, it can be seen that the total net cash flows of projects A and B is identical while that of project C is lower. However the pattern of the cash inflow is different in all cases. Given the normal problems of forecasting the future there is less risk associated with cash received early, compared to that received later. The earlier that cash is received the quicker it can be recycled into new cash generating ventures (or used to pay-off debts). Using this argument project B looks better than project A. Simply looking at the surplus cash, as is the case in the accounting return, we are failing to take into account the time value of money.

To take into account the time taken to recover the investment we can look at the payback period.

Payback Period

The payback period is the time it takes for the cash generated from sales to equal the total cost spent in establishing the project, i.e. zero profit or break-even. Figure 4 shows the cash stream for the three projects in table 1.

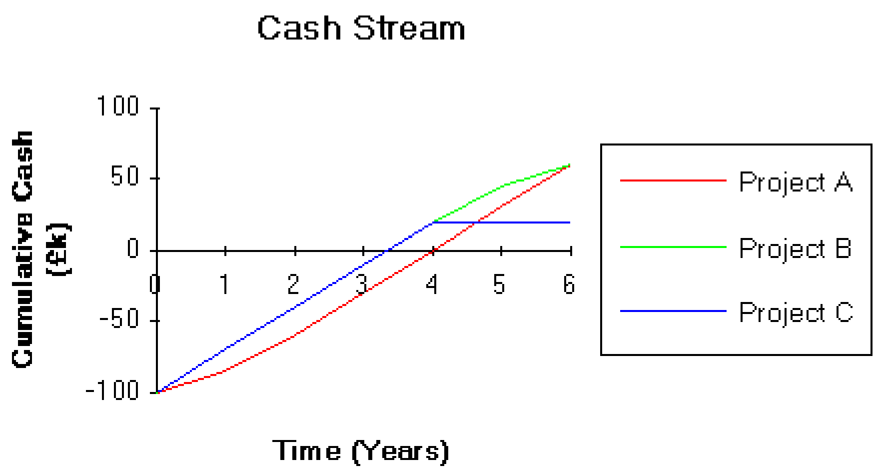

Figure 4 Cash stream for the three projects in table 1.

On the basis of payback, projects B and C would be the preferred ones with project A trailing in third place. Where the payback period method is limited is in that it ignores any cash received after break-even.

Both the accounting return and payback methods are therefore limited in their ability to select the best project to adopt. What is needed is a technique that allows for the time value of money. The usual way of achieving this is through the use of discounted cash flow.

DCF Techniques

The basic principle of the technique is that the value of money changes with time. As an example consider £100 invested at 10% interest rate. In one years time it will be worth £110 and in two years time it will be worth £121. Thus £100 now is worth just the same as £121 in two years time, in monetary terms only. There may well be other reasons why you might want the cash sooner rather than later, but financially they are identical. There is the other assumption in this technique, that we can ignore risk and inflation.

This basic principle provides the mechanism to translate money through time, forwards or backwards. If, at some point in the future, an amount of cash is going to be received, we can determine how much this is worth to us today. The value today will be the amount of money we would need today, invested at the current interest rate, to achieve the amount we will receive at the future time. The amount we would need today is called the present value of the future cash amount. The amount can be positive, indicating that cash will be received, or negative indicating that cash will need to be paid out.

To determine the present value of a future cash amount consider the case where you know you need to pay out £100,000 in 3 years time. How much do you need now to cover your future cash out-flow? If the current interest rate is 4% you will need an amount which would, if invested at 4%, grow to be £100,000 in three years, i.e.:

$$£P \times (1 + 0.04) \times (1 + 0.04) = £100,000$$

Solving for P gives £92,455.62.

In other words to pay out £100,000 in three years time is the same as putting £92,455.62 away now, or paying £92,455.62 out now to the bank.

But what about if you were going to receive £100,000 in three years time? This £100,000 is still worth £92,455.62 to you now, it is as if you have just been given £92,455.62. The present value of £100,000 in three years time is £92,455.62 whether you receive it or pay it out, i.e. whether it is a positive or negative cash flow.

In general the present value of a future cash flow can be determined using the PV equation below:

$$PV = \frac{P}{(1+r)^n}$$

where P is the future cash flow, r is the prevailing interest rate and n is the number of years in the future of the cash flow.

If a project is such that there is a cash flow each year for a number of years into the future, the present value of each cash flow can be calculated and all the present values added together. The result becomes the net present value, or NPV.

Net Present Value

To summarise the process of arriving at the net present value of a future cash stream:

1. Determine the periodic cash flow
2. Determine the present value of each cash flow
3. Sum all present values to give Net Present Value of cash stream.

Referring back to the three project example shown in table 1. The cash flows are given in the table, given the prevailing interest rate the present value of the cash flows can be determined and when summed, the net present value found. Tables 2, 3 and 4 show the analysis for projects A, B and C respectively.

Year	0	1	2	3	4	5	6	
Cash flow	-100,000	15,000	25,000	30,000	30,000	30,000	30,000	
Discount factor	1	0.8929	0.7972	0.7118	0.6355	0.5674	0.5066	
PV	-100,000	13393	19930	21353	19066	17023	15197	
NPV								5963.39

Table 2. Net Present Value of project A

Year	0	1	2	3	4	5	6	
Cash flow	-100,000	30,000	30,000	30,000	30,000	25,000	15,000	
Discount factor	1	0.8929	0.7972	0.7118	0.6355	0.5674	0.5066	
PV	-100,000	26786	23916	21353	19066	14186	7599	
NPV								12906

Table 3. Net Present Value of project B

Year	0	1	2	3	4	5	6	
Cash flow	-100,000	30,000	30,000	30,000	30,000			
Discount factor	1	0.8929	0.7972	0.7118	0.6355	0.5674	0.5066	
PV	-100,000	26786	23916	21353	19066			
NPV								-8880

Table 4 Net Present Value of project C

From this analysis it can be seen the project B is the best when the time value of money is taken into account. Of interest is the NPV of project C which comes out to be negative. What does a negative number mean?

Sensitivity Analysis

With the level of understanding of cash flows and their value in present money terms it is now a straightforward task to produce a model of a project and use it to test to see what happens if something changes. One of the simplest ways of producing a model is using a spreadsheet. Once created the cash flows in the future can be changed and the effects noted, the interest rate can be changed and the effect noted, and so on.

In general the whole project NPV can be analysed from a sensitivity point of view. How much does the NPV change for a 1% change in interest rate? How much does the NPV change for a 1% change in initial capital investment? And so on. Looking at the change in output of the model for a change in one or more of the input data is called sensitivity analysis.