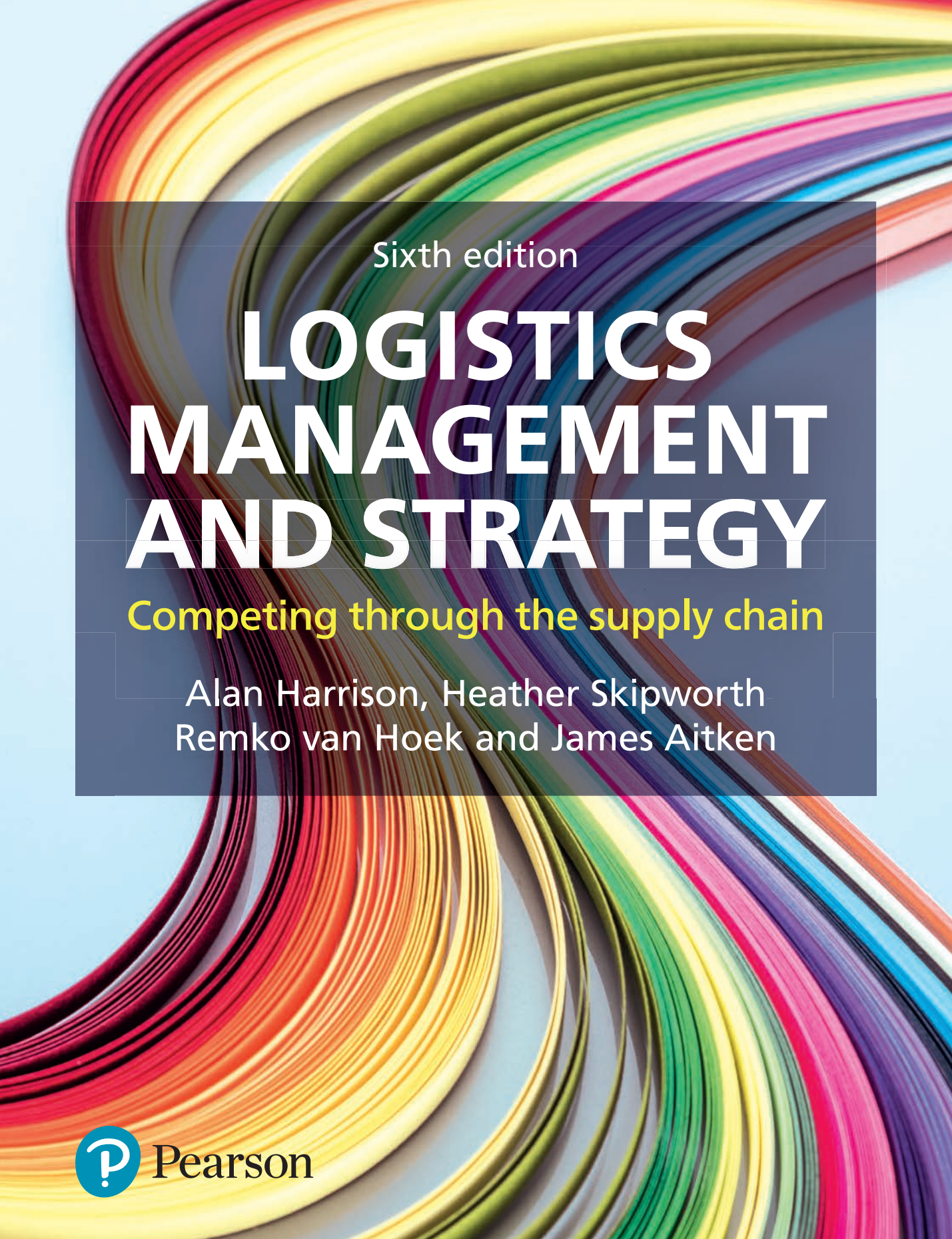
Sixth edition
LOGISTICS MANAGEMENT AND STRATEGY
Competing through the supply chain
Alan Harrison, Heather Skipworth
Remko van Hoek and James Aitken
Pearson

Logistics Management and Strategy

Table 3.12 Four investment appraisal approaches

Investment appraisal approach	Definitions (CIMA, 2005)	Focus	Time value of money
Cost benefit analysis	Comparison between the cost of the resources used plus any other costs imposed by an activity (for example, pollution, environmental damage) and the value of the financial and non-financial benefits	Profitability	Not taken into account
Payback period	Time required for the cash inflows from a capital investment project to equal the cash outflows	Liquidity (cash flow)	Not taken into account
Net present value (NPV)	Difference between the sum of the projected discounted cash inflows and outflows attributable to a capital investment or other long-term project	Profitability over time	Discounted cash flows used
Internal rate of return (IRR)	Annual percentage return achieved by a project, at which the sum of the discounted cash inflows over the life of the project is equal to the sum of the discounted cash outflows	Profitability	Discounted cash flows used

involves collecting all the costs of a proposed investment and comparing them to all the benefits (in terms of cash inflows or savings) and, if the benefits are greater than the costs, it is considered to be a good investment.

The payback period measures the time it takes for a proposed investment to generate cash that equates to the original cost, and the proposal with the shortest payback period is normally the one that is accepted. This approach is concerned with liquidity (cash flows) and minimising risk, rather than profitability because, after the payback period, the cash flows (and their timing) are not taken into consideration.

3.6.2 What are discounted cash flows?

As mentioned earlier, both net present value (NPV) and internal rate of return (IRR) take into account the time value of money by using discounted cash flows. According to Hussey (1989, p. 199) 'this is done by converting future cash flows from the project into equivalent values as at the present time, usually by using discount tables'. This is taking into account the so-called 'opportunity cost', which is the lost cash inflow, that could have been gained from simply investing the capital in a bank and generating interest of say 5 per cent, as illustrated in Figure 3.13. According to Drury (2004, p. 496), 'a firm should invest in capital projects only if they yield a return in excess of the opportunity cost of the investment', in other words, if they generate a greater return than simply putting the cash in a bank.

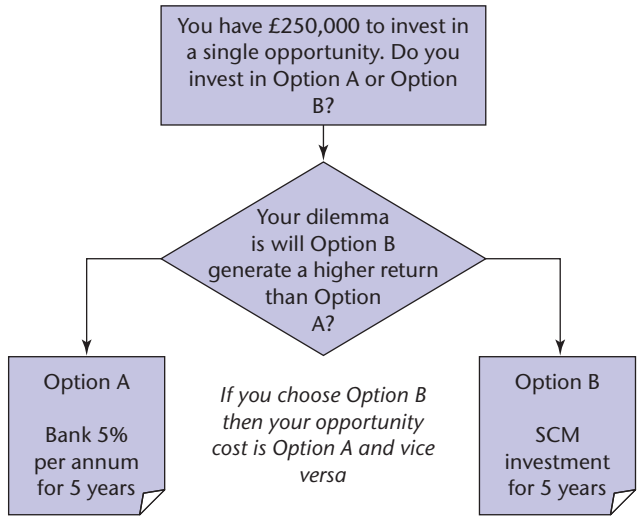

Figure 3.13 **Investment decision considerations taking into account opportunity cost**
(Source: Dr Simon Templar, Cranfield School of Management)

Net present value (NPV) is 'a method of evaluating capital projects by selecting a discount rate to express future cash flows in present-day monetary terms' (Hussey, 1989, p. 209). The discount rate is the rate of interest you could be expected to earn if you did not invest in the project and is called the 'test discount rate' because it tests if this is a good investment. There are three main factors that affect the discount rate (Atrill and McLaney, 2012):

- *interest forgone*: the interest the capital won't earn from, say being deposited in a bank;
- *risk premium*: some investments are higher risk than others. For instance, investing in manufacturing equipment to produce a new range of products, where the demand is highly uncertain, is a greater risk than the case where the products produced are mature with far more accurate sales forecasts. Where the risk is higher, a higher rate of return would be expected to compensate for the increased risk of not getting the expected returns;
- *inflation*: due to inflation in a given country, money devalues each year. However, if both the capital investment (cash outflow) and the returns (cash inflow) are subject to the same rate of inflation, this can be ignored.

Present value curves are available that apply discount rates, in a compound fashion (year on year), examples of which are shown in Figure 3.14. The present value curves for 10 per cent, 30 per cent and 50 per cent discount rates show that, the longer the period of the investment, and/or the higher the discount rate, the lower the present value.

Using the present value curves in Figure 3.14 we can determine how much £1,000 is worth in five years' time by drawing a vertical line up from five years and reading off the present value, which gives a discount factor. We have done this for 10 per cent and 30 per cent in Table 3.13.

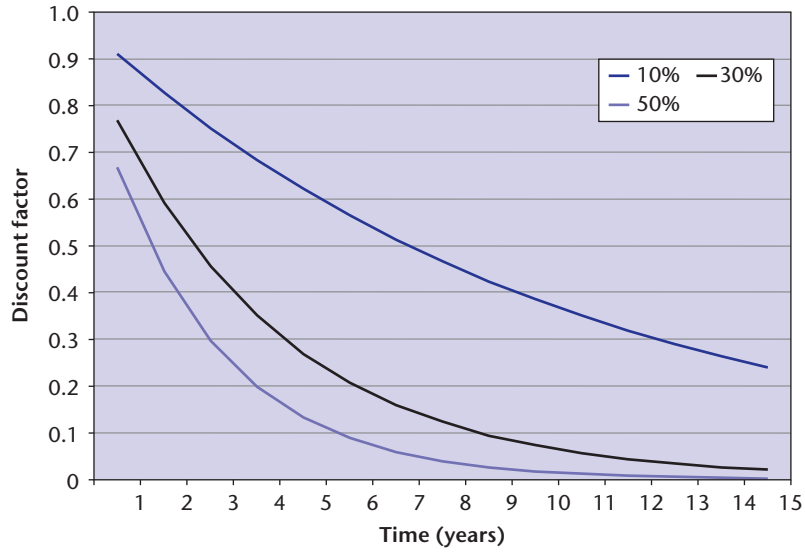

Figure 3.14 **Present value curves for 10 per cent, 30 per cent and 50 per cent discount rates**

(Source: Dr Simon Templar, Cranfield School of Management)

Table 3.13 **The present value of £1,000 in five years using 10 per cent and 30 per cent discount rates**

Discount rate	Discount factor from Figure 3.14	Present value
10%	0.621	£621
30%	0.269	£269

To calculate net present value, both the initial cash outflow for the investment, and the subsequent cash inflows of the returns, must be at present value to enable the calculation of the net present value of cash flows over the life of the asset, as shown in Case study 3.6.

There are three outcomes for net present value (Francis, 1986, p. 302):

- If the NPV is positive it should be accepted.
- If it is zero the investment breaks even.
- If the NPV is negative then the investment should be rejected.

However, where the risk level is difficult to judge, as in Case study 3.6, then it is useful to determine at what discount rate the NPV is zero and therefore the investment is break-even. This is exactly what the internal rate of return (IRR) is, according to Atrill and McLaney (2012, p. 368):

> **The IRR of a particular investment is the discount rate that, when applied to its future cash flows, will produce a NPV of zero. In essence, it represents the yield from an investment opportunity.**

Calculating the IRR can take trial and error, trying different discount rates until you get close to zero NPV. Alternatively, the following formula can be used:

$$IRR = i_1 + \left[(i_2 - i_1)^* \frac{npv_1}{npv_1 - (npv_2)} \right]$$

Where i_1 and i_2 are the two discount rates associated with the corresponding NPVs npv_1 and npv_2.

We will now consider a fictitious case where all four investment appraisal approaches are used, so the strengths and weakness of each approach can be appreciated.

CASE STUDY 3.6

Investment appraisal for a scheduling system at OTIF plc

The supply chain manager of OTIF plc is considering investment into a computerised routing and scheduling system for the distribution operation. The initial capital expenditure will be £25,000 and it is anticipated to have a useful life of five years. Four investment appraisal approaches are used to determine if this is a good investment.

Cost benefit analysis

It is anticipated that the new system will generate the cash savings shown in Table 3.14 by reducing distribution operating costs, associated with fuel consumption, tyre replacement and vehicle maintenance.

Table 3.14 Cash flows associated with the system investment over its five-year life

Year	0	1	2	3	4	5	Total
Cash flows (£)	(25,000)	8,750	8,250	8,000	7,500	7,000	14,500
Cumulative cash flows (£)	(25,000)	(16,250)	(8,000)	0	7,500	14,500	

Note: the brackets indicate a negative cash outflow from the company

Payback period

The cumulative cash flows shown in Table 3.14 demonstrate that after three years the initial capital investment has been paid back by the cash savings each year.

Net present value

First OTIF plc needs to determine the discount rate appropriate for the £25,000 investment in the routing and scheduling system. Inflation was ignored because the same rate applied to both the investment and the returns, so the inflation effect is cancelled out. The company's cost of capital (equivalent to the bank rate) was 10 per cent, therefore it was decided to try discount rates of both 10 per cent and 20 per cent. These are applied to the cash flows for the system investment to give the net present values shown in Table 3.15.

Table 3.15 The NPV for the system investment based on 10 per cent and 20 per cent discount rates

Year	Cash flows (£)	Discount factor based on 10%	PV for 10% discount rate (£)	Discount factor based on 20%	PV for 20% discount rate (£)
0	(25,000)	1.0000	−25,000	1.0000	−25,000
1	8,750	0.9091	7,955	0.8333	7,291
2	8,250	0.8264	6,818	0.6944	5,729
3	8,000	0.7513	6,010	0.5787	4,630
4	7,500	0.6830	5,123	0.4823	3,617
5	7,000	0.6209	4,346	0.4019	2,813
Total	14,500		5,252		(920)

The cost benefit analysis shows that the total cash benefit is £14,500, so it would appear to be a good investment.

The discount rate of 10 per cent gives a positive NPV of £5,252, whilst the 20 per cent discount rate produces a negative NPV of £920. The question arises at what discount rate the NPV zero is and therefore when the investment is break-even. The internal rate of return is the answer.

Internal rate of return (IRR)

The IRR can be approximated by plotting the graph shown in Figure 3.15.

Figure 3.15 Graphical approach to calculating IRR for the OTIF investment

However, this graph assumes a linear relationship between discount rate and NPV, which isn't the case, hence this gives only an approximate IRR. To calculate the IRR, the formula previously stated can be used:

IRR = 10 + [10*(5,252 / (5,2522 − −920))

= 18.51%

Note: Two minuses make a plus

This produces a similar result to the graphical approach.

Summary of results

The results from the four investment appraisal approaches, see Table 3.16, suggest that the proposed investment in a routeing and scheduling system is a good investment. However, these figures do depend on the accuracy of the forecast cash savings that the system is expected to bring.

Table 3.16 Summary of the results from the four investment appraisal approaches

Investment appraisal method	OTIF results
Cost benefit analysis	£14,500
Payback period	3 years
Net present value at 10% discounted rate	£5,252
Internal rate of return	18.51%

(Source: Dr Simon Templar, Cranfield School of Management)

Questions

1 Discuss the strengths and weakness of each investment appraisal approach in terms of the effort or information required to calculate it and the usefulness of the results.

2 Which investment appraisal technique is the most appropriate for profitability, and which is the best for liquidity, in the OTIF case? Explain why.

3.7 A balanced measurement portfolio

Key issues: **How can a balanced set of measures of performance be developed in order to address stakeholder satisfaction and stakeholder contribution? How can process thinking be applied to measures across the supply chain using the supply chain operations reference model?**

Many organisations have suffered from undue emphasis on particular measures of performance within the firm. For example, a preoccupation with labour