



Overview
(/study/app/
hl/sid-
351-
cid-
762729/c

Teacher view



<https://intercom.help/kognity>

**Index**

- The big picture
- Payback period
- Average rate of return (ARR)
- Net present value (NPV) (HL)
- Evaluation of investment appraisal
- Terminology exercise
- Checklist
- Reflection



Table of
contents



Notebook 3. Finance and accounts / 3.8 Investment appraisal



Glossary



Reading
assistance

The big picture

As the demand for microprocessors or logic chips soared in 2021, Samsung, a South Korean electronics company, announced it was planning to invest 30 billion USD to construct a new manufacturing facility in Pyeongtaek, South Korea in the second half of 2022. Large chip manufacturers, such as Intel and TSMC have also announced large investments in their factories to keep up with global demand.

To make such an investment, a business should carry out an investment appraisal. This involves a quantitative and qualitative evaluation of an investment decision.

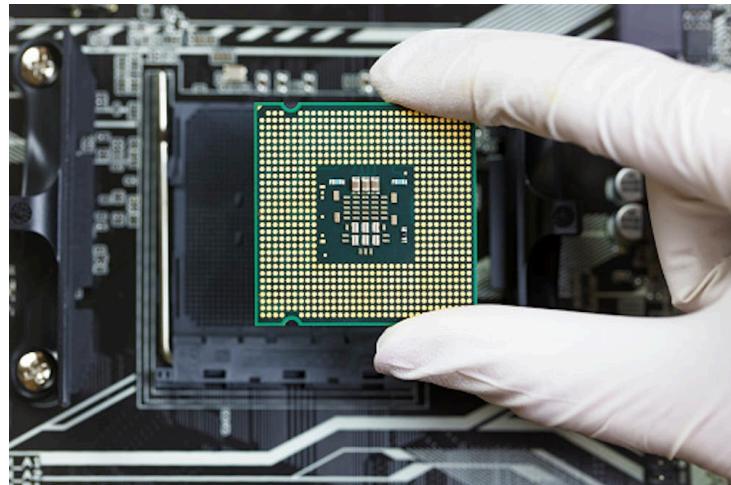


Figure 1. Major manufacturers of microprocessors, such as Samsung, Intel and TSMC, have announced large investments in their facilities to keep up with global demand.

Credit: mikroman6, Getty Images

Investment appraisal uses a range of decision-making techniques to assess investment projects. At any one time, most businesses have some potential investment opportunities they would like to make. These can involve building a new facility, updating a factory or increasing research and development spending.



Businesses do not have unlimited financial resources. Therefore, they have to choose which investments are most likely to bring the greatest profit. Each choice involves an opportunity cost. Investment appraisal helps businesses decide which projects should receive funding and which should be rejected.

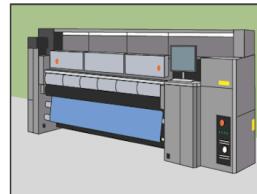
Home
Overview
(/study/app/
hl/sid-
351-
cid-
762729/c



Constructing a factory



Research and development spending



Purchasing new machinery

Figure 2. Businesses have a range of investment options.

This subtopic introduces three quantitative investment appraisal techniques. These are:

- **Payback period.** This expresses the number of years and months it will take for the investment to pay for itself.
- **Average rate of return.** This expresses future cash inflows as an average return on the money the business invests on the project. In other words, what percentage profit can the business expect on average per year when it makes this investment?
- **Net present value (HL only).** This expresses the expected cash inflows in relation to the investment made.

International Mindedness

The quantitative methods outlined in this subtopic will be useful in analysing both domestic investment and foreign direct investment.

It is important to remember that for-profit social enterprises do not always seek to make a profit as their primary goal. However, it is important for these businesses to use investment appraisal to evaluate investment options and choose the more profitable or appropriate one. The profits of for-profit social enterprises and surpluses of non-profit social enterprises may be reinvested for the benefit of the community in innovative technologies, employee training and other sustainable practices.

All businesses, whether for-profit commercial enterprises or for-profit or non-profit social enterprises, will be looking at more than quantitative data to make investment decisions; a full range of qualitative data will also be considered. These will include business objectives, market research, STEEPLE factors, product life cycle analysis and other things. Social enterprises may examine other quantitative and qualitative metrics as well. For example, a school may look at enrolment numbers and literacy rates as an indicator of appropriateness of an investment into modernising school facilities. Social enterprises will be particularly concerned with social and environmental impact, and so data related to impact will be very useful in investment appraisal.

Generally, investment appraisal is used as a forward-looking tool. However, investment appraisal can also be used as a backward-looking tool. When used this way, businesses can reflect on past investments and evaluate their investment strategies. This reflection can help them make better decisions in the future.

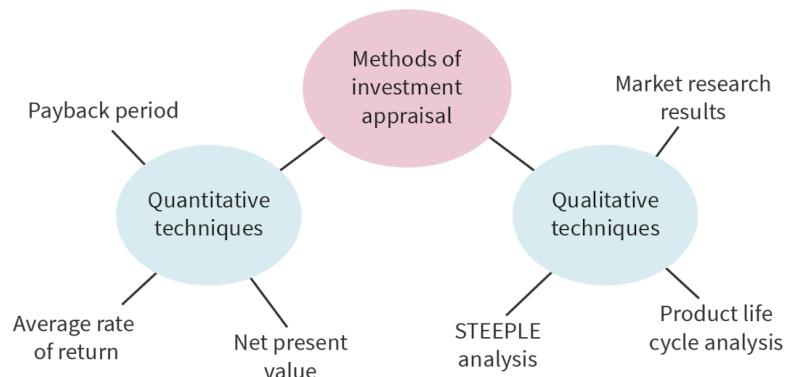


Figure 3. Quantitative and qualitative investment appraisal techniques.

[More information for figure 3](#)

The diagram illustrates the methods of investment appraisal, dividing them into quantitative and qualitative techniques. At the center, an oval labeled "Methods of investment appraisal" is connected by lines to two other ovals on either side. On the left, a blue oval labeled "Quantitative techniques" connects to three concepts: "Payback period," "Average rate of return," and "Net present value." On the right, another blue oval labeled "Qualitative techniques" connects to three concepts: "Market research results," "STEEPLE analysis," and "Product life cycle analysis." This structure represents the bifurcation in investment methods, categorizing different appraisal techniques as either quantitative or qualitative.

[Generated by AI]

Concept

Ethics

Ethics refers to moral principles that govern the behaviour of a person or groups. Every business decision has moral implications, and businesses are often engaged in the question of 'What is the right thing to do?' Ethical responsibilities in business come from the relationships and networks that are formed when business organisations are established.

When dealing with forward looking tools, such as the investment appraisal outlined in this subtopic, it is important to exercise ethical thinking regarding the assumptions built into the tools. The investment appraisal methods rely heavily on assumptions of rates of return for similar projects, inflation, projected sales and capacity usage, and so on.

Small changes to these assumptions may make an investment look profitable and thus beneficial to those making the calculation and thus should be carefully examined.

Learning objectives from the IBDP Business Management guide with assessment objective level:

- **Calculate, compare and evaluate** investment opportunities using the payback period (AO3, AO4)
- **Calculate, compare and evaluate** investment opportunities using the average rate of return (ARR) (AO3, AO4)



- **Calculate, compare and evaluate** investment opportunities using the net present value (NPV)

(AO3, AO4)

Overview
(/study/app/hl/sid-351-cid-762729/c)
3. Finance and accounts / 3.8 Investment appraisal

Payback period

[Investment opportunities](#) [Investment opportunities](#)

The payback period is used to work out the number of years and months it will take for the investment of a business to pay for itself. The payback period attempts to answer the question, 'how long will it be before we get our money back?'

To do this, the business will estimate future cash flow each year. It then determines the month and year in which the cash flows will finally cover the investment cost.

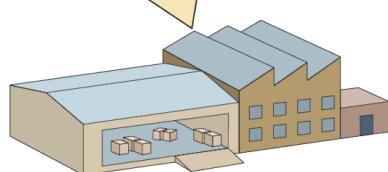
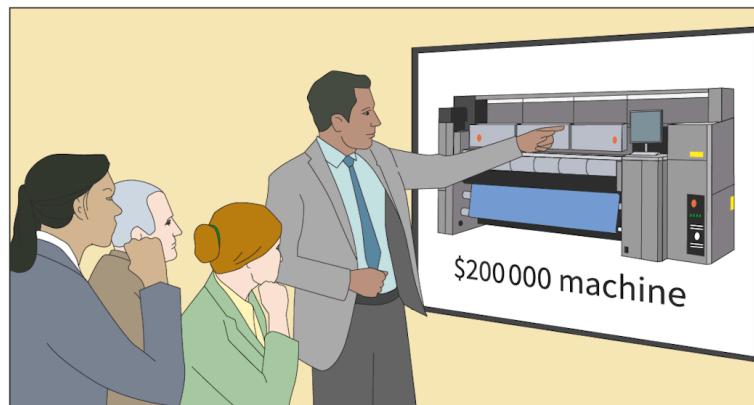
Calculating the payback period

Calculating the payback period of an investment involves the concept of net cash flow, which you learned about in [Subtopic 3.7 \(/study/app/business-hl/sid-351-cid-762729/book/the-big-picture-id-39317/\)](#). Net cash flow is how much cash is left at the end of a period, after all cash outflows have been subtracted. It is calculated using the following formula:

$$\text{Net cash flow} = \text{cash inflow} - \text{cash outflow}$$

When the cumulative (total) net cash flows are equal to the initial investment cost, the business has reached the payback period.

Consider the following example of a manufacturing company that is thinking about purchasing a new \$200 000 machine.



Student view

Overview
(/study/app/hl/sid-351-cid-762729/c)

Figure 1. The payback period can help evaluate the investment.

If the business estimates that its annual future cash flows from the products produced by the machine will be \$50 000, then it will take four years to return the initial investment of \$200 000 (\$200 000 divided by \$50 000 is four).

Step 1: Calculate the net cash flow for each year

Table 1 lists the expected cash inflows and cash outflows the company is likely to experience if it were to purchase the new \$200 000 machine.

In all investment appraisal calculations, Year 0 is where the initial investment cost is recorded. In **Table 1**, you can see the initial investment of \$200 000 in Year 0. Cash inflows are always \$0 in Year 0, so the net flow in Year 0 is always \$0 minus the initial investment cost. In this case, the net flow for Year 0 is –\$200 000.

Table 1. The expected cash flows of a \$200 000 investment. (A negative figure is indicated by putting it in brackets.)

Year	Cash inflow	Cash outflow	Net cash flow	Cumulative net flow
0	\$0	(\$200 000)	(-\$200 000)	(-\$200 000)
1	\$80 000	(\$20 000)		
2	\$140 000	(\$60 000)		
3	\$240 000	(\$120 000)		
4	\$360 000	(\$200 000)		

During the first year of operating the machine, there will be both cash inflows and cash outflows from the machine. These are the revenues (cash inflows) that the business earns from the machine's production and the operating costs (cash outflows) of the machine.

The net cash flow is calculated as follows and then added to the table, as shown in **Table 2**.

$$\text{Net cash flow in year 1} = \text{cash inflow} - \text{cash outflow} = \$80\ 000 - \$20\ 000 = \$60\ 000$$

$$\text{Net cash flow in year 2} = \$140\ 000 - \$60\ 000 = \$80\ 000$$

$$\text{Net cash flow in year 3} = \$240\ 000 - \$120\ 000 = \$120\ 000$$

$$\text{Net cash flow in year 4} = \$360\ 000 - \$200\ 000 = \$160\ 000$$

Table 2. The expected cash flows of a \$200 000 investment (net cash flows added). (A negative figure is indicated by putting it in brackets.)

Year	Cash inflow	Cash outflow	Net cash flow	Cumulative net flow
0	\$0	(\$200 000)	(\$200 000)	(\$200 000)
1	\$80 000	(\$20 000)	\$60 000	
2	\$140 000	(\$60 000)	\$80 000	
3	\$240 000	(\$120 000)	\$120 000	
4	\$360 000	(\$200 000)	\$160 000	

Step 2: Calculating cumulative net cash flows

In order to work out how long it will take to pay back the \$200 000 investment, the business will need to sum the net cash flows over time. Then the business can see how many years and months it will take before the investment cost is covered by the net cash flows. Starting with -\$200 000 and adding the net cash flows each year, the business can work out how long it will take to cover the initial \$200 000 investment amount. This is called working out the cumulative net flow. It is given by the following formula:

$$\text{Cumulative net flow} = \text{cumulative net flow in previous year} + \text{net flow of current year}$$

The cumulative net cash flows are calculated as follows and then added to the table, as shown in **Table 3**.

$$\text{Cumulative net flow in Year 1} = -\$200\,000 + \$60\,000 = (\$140\,000)$$

$$\text{Cumulative net flow in Year 2} = -\$140\,000 + \$80\,000 = (\$60\,000)$$

$$\text{Cumulative net flow in Year 3} = -\$60\,000 + \$120\,000 = \$60\,000$$

$$\text{Cumulative net flow in Year 4} = \$60\,000 + \$160\,000 = \$220\,000$$

You can see that, by Year 3, the cumulative net flow will be positive. This is seen when you add the net cash flow from Year 2 to the cumulative net cash flow from Year 3 (-\$60 000 + \$120 000). So you know that the investment will have been paid back at some point during Year 3.

Table 3. The expected cash flows of a \$200 000 investment (cumulative net flows added). (A negative figure is indicated by putting it in brackets.)

Year	Cash inflow	Cash outflow	Net cash flow	Cumulative net flow
0	\$0	(\$200 000)	(\$200 000)	(\$200 000)

Year	Cash inflow	Cash outflow	Net cash flow	Cumulative net flow
1	\$80 000	(\$20 000)	\$60 000	(\$140 000)
2	\$140 000	(\$60 000)	\$80 000	(\$60 000)
3	\$240 000	(\$120 000)	\$120 000	\$60 000
4	\$360 000	(\$200 000)	\$160 000	\$220 000

① Exam tip

If your ability to carry out an investment appraisal is tested in an examination, you will be given the investment project's cash inflow and cash outflows only. You will be expected to calculate the net flow and cumulative net flow. Do this by setting your work out as in the table above.

Step 3: Calculating the payback period

To find the payback period, you simply need to look down the final column in **Table 3**. In Year 2, you can see that the cumulative net cash flow is still negative (\$60 000). However, in Year 3 this figure turns positive. This means that the payback period has occurred at some point during Year 3.

However, the business would like to know how many months into Year 3 it will take to finally pay back the investment. To find the exact payback period, the following formula is used:

$$\text{Payback period} = \frac{\text{amount left to pay}}{\text{net cash flow in that year}} \times 12$$

Using the example above, you can see that, in Year 3, the cumulative cash flow turned positive. Up to this point, the business had a net cash flow of \$60 000 from using the machine in Year 1 and \$80 000 in Year 2. This together makes \$140 000. So how much of the investment cost is left to pay after Year 2? The business would need another \$60 000 to make a total of \$200 000. Using the formula:

$$\text{Payback period} = \frac{\text{amount left to pay}}{\text{net cash flow in that year}} \times 12$$

$$= \frac{\$60\,000}{\$120\,000} \times 12$$

$$= 6 \text{ months}$$

This means that the payback period for the investment is 2 years and 6 months.

Generally, a business will prefer investments that have shorter payback periods as they bring positive net cash flows more quickly and are less risky.

Exam tip

In the exam, you may be asked to express the payback period in days, weeks or months. To do this, simply adapt the formula to express the value relative to 52 weeks or 365 days in a year as follows:

- $\frac{\$60\,000}{\$120\,000} \times 12 = 6 \text{ months}$
- $\frac{\$60\,000}{\$120\,000} \times 52 = 26 \text{ weeks}$
- $\frac{\$60\,000}{\$120\,000} \times 365 = 182.5 \text{ days}$

Note that the formula for the payback period is **not** provided in the exam formula booklet.

Evaluation of the payback period method

This method gives a simplistic view and only relies on cash flow forecasts, which are estimates. The benefit of the method is its simplicity.

However, there are a number of limitations of this investment appraisal method. Firstly, it ignores the long-term profitability of an investment. A more desirable investment may be overlooked as it has a longer payback period. Secondly, it assumes that future cash flows have the same value as those of today. However, inflation reduces the value of money in the future. So a business would have to account for this when calculating future cash flows. (HL students will learn how to do this later in this subtopic.) And thirdly, different businesses will weigh up the payback period differently in decision-making. Social enterprises may not prioritise the length of the payback period. They may give more weight to qualitative data, such as the social or environmental impact.

3 section questions ^

Question 1

Consider the following data.

Year	Cash inflow (\$)	Cash outflow (\$)	Net cash flow (\$)	Cumulative net flow (\$)
0	0	2000		W
1	1500	1000	X	
2	1800	1200		
3	3500	2800		Y
4	4600	3400		Z

What is the value of W?

<input checked="" type="checkbox"/>	1	(\$2000)	<input checked="" type="checkbox"/>
Overview (/study/app/hl/sid-351-cid-762729/c)	2	\$2000	
	3	\$0	
	4	\$1000	

Explanation

You need to use the following formula in Year 0:

$$\text{Cumulative net flow} = 0 - \text{investment cost}$$

In this example, the investment cost is \$2000, so the cumulative net flow must be (\$2000).

Question 2

Consider the following data.

Year	Cash inflow (\$)	Cash outflow (\$)	Net cash flow (\$)	Cumulative net flow (\$)
0	0	2000		W
1	1500	1000	X	
2	1800	1200		
3	3500	2800		Y
4	4600	3400		Z

What is the value of X?

- 1 \$500
- 2 (\$1500)
- 3 \$700
- 4 \$1000

Explanation

For any year, the net flow is found by subtracting the cash outflows from cash inflows.

$$\$1500 - \$1000 = \$500$$



Student view

Home
Overview
(/study/app
hl/sid-
351-
cid-
762729/c

Question 3

Consider the following data.

Year	Cash inflow (\$)	Cash outflow (\$)	Net cash flow (\$)	Cumulative net flow (\$)
0	0	2000		W
1	1500	1000	X	
2	1800	1200		
3	3500	2800		Y
4	4600	3400		Z

What is the value of Y?

- 1 (\$200) ✓
- 2 \$700
- 3 \$2200
- 4 \$1000

Explanation

The completed table is shown below. The value of Y is (\$200 USD). It is found by adding the net flow from Year 3 to the cumulative net flow from Year 2 (\$900) + \$700.

Year	Cash inflow (\$)	Cash outflow (\$)	Net cash flow (\$)	Cumulative net flow (\$)
0	0	2000	(2000)	(2000)
1	1500	1000	500	(1500)
2	1800	1200	600	(900)
3	3500	2800	700	(200)
4	4600	3400	1200	1000



Student view

3. Finance and accounts / 3.8 Investment appraisal



Average rate of return (ARR)

Overview

(/study/app)

hl/sid-

Investment opportunities Investment opportunities

351-

cid-

762729/c

Average rate of return (ARR) is an investment appraisal technique that expresses the annual forecast returns as a percentage of the initial capital cost. ‘Return’ is another term for net cash flow. Businesses can easily compare different investments using this calculation. Generally, businesses will prefer investments with a higher rate of return.

Calculating the average rate of return

The formula for calculating average rate of return is as follows:

$$\text{Average rate of return (ARR)} = \frac{(\text{total returns} - \text{capital cost}) \div \text{years of use}}{\text{capital cost}} \times 100$$

① Exam tip

You will be given the ARR formula in the IB exam, in the formula booklet.

This formula can be broken down into three steps:

- **Step 1.** Calculate the total net cash flow (returns) over the lifetime of the investment minus the capital cost.
- **Step 2.** Divide the result from Step 1 by the number of years of the project.
- **Step 3.** Divide the result from Step 2 by the project’s initial investment cost. Convert this number into a percentage by multiplying by 100.

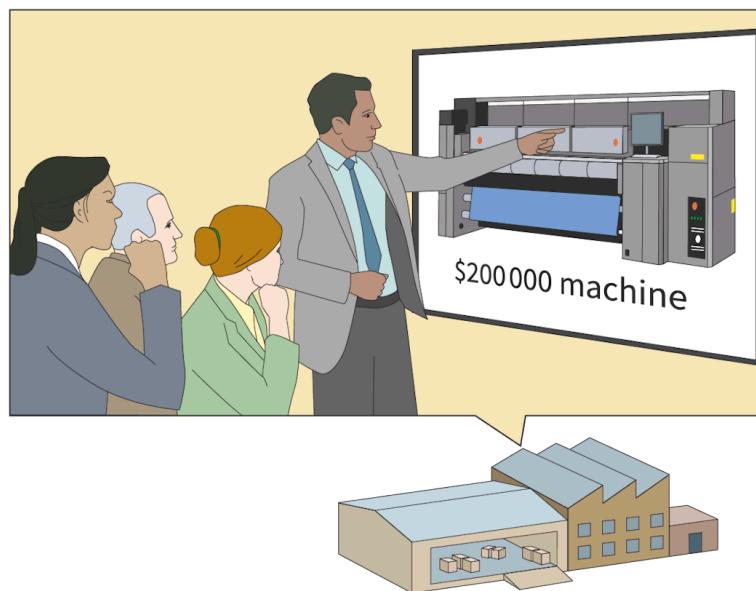


Figure 1. The average rate of return (ARR) investment appraisal method can help evaluate the investment.



Student view

Step 1: Calculate the total net cash flow (returns) over the lifetime of the investment

Overview
(/study/app/hl/sid-351-cid-762729/)

The following calculations are made using the same example from [Section 3.8.1 \(/study/app/business-hl/sid-351-cid-762729/book/payback-period-id-39325/\)](#), of a manufacturing company that is considering the purchase of a new \$200 000 machine. The company is expecting to use the machine for four years. **Table 1** shows the information from net cash flows that were used for the payback period. However, the capital cost in Year 0 has been taken out so that the formula as given in the IB formula sheet can be used.

Table 1. The expected cash flows of a \$200 000 investment.

Year	Cash inflow (\$)	Cash outflow (\$)	Net cash flow (\$)
1	80 000	20 000	60 000
2	140 000	60 000	80 000
3	240 000	120 000	120 000
4	360 000	200 000	160 000
		Total net cash flow (total returns)	420 000

The total returns are \$420 000 and the capital cost is \$200 000, so the first part of the ARR equation, in brackets, would be (\$220 000).

$$\text{Average rate of return (ARR)} = \frac{(\text{total returns} - \text{capital cost}) \div \text{years of use}}{\text{capital cost}} \times 100$$

Step 2: Divide the result by the number of years in use

The \$220 000 calculated in the first step is the total predicted return from the investment over its lifetime of four years after subtracting out the capital cost. However, the average rate of return (ARR) expresses the rate of return for one year. Therefore, you need to divide the total lifetime return of the investment by the number of years that the investment is in use.

$$\text{Average annual return} = \frac{\text{total return over the lifetime of the investment}}{\text{number of years}}$$

$$= \frac{\$220\,000}{4 \text{ years}}$$

$$= \$55\,000 \text{ per year}$$

So this is the value in the numerator of the ARR equation.

Step 3: Divide the result by the initial investment cost of the project

Overview
 (/study/app/business-hl/sid-351-cid-762729/c)
 h/sid-
 351-
 cid-
 762729/c

Finally, you need to express this average return per year as a percentage of the initial investment cost, as shown here:

$$\text{Average rate of return} = \frac{\text{average annual return}}{\text{investment cost}} \times 100$$

$$\text{Average rate of return} = \frac{\$55\,000}{\$200\,000} \times 100$$

Section
27.5%

Student... (0/0)

Feedback

Print (/study/app/business-hl/sid-351-cid-762729/book/payback-period-id-39325/print/)

Assign ▾

🔗 Making connections

You have converted data into percentages many times in your other academic courses. Remember that to convert into percentages, you should multiply by 100.

Interpreting the ARR

In [Subtopic 3.5 \(/study/app/business-hl/sid-351-cid-762729/book/the-big-picture-id-39042/\)](#), you were introduced to profitability ratios. Average rate of return is another way of considering investment profitability. A business may have a minimum average rate of return that it expects investments to achieve. If an investment returns less, then the business may not consider it. Businesses can also compare multiple investment options in order to select those with the highest rates of return.

One comparison that a business can always make is the interest it might receive from holding its money in a bank account. For example, if the same amount money used to purchase a machine (in this example) was deposited in a bank, it may earn a 7% annual return. Compared with a bank, the investment in a machine seems like a very good idea. However, this also has to be compared with all other potential business opportunities. In other words, one would need to look at the opportunity cost of an investment. If another project is predicted to have a higher average rate of return, then that project should be given preference.

Finally, you need to take risk into account. As in the example, the 7% return from interest on a bank account is a low return but with very low risk. This is compared with the 27.5% return from the investment, which likely comes with a greater risk. The business needs to decide whether or not it wants to take on this risk. A [decision tree](#) ([Section 3.3.4 \(/study/app/business-hl/sid-351-cid-762729/book/tool-decision-tree-id-39304/\)](#)) is a tool that can help the business to visualise and calculate different outcomes.

3 section questions ^

X
 Student view

Question 1



Consider the following data.

Overview
(/study/app/hl/sid-351-cid-762729/c)

Year	Cash inflow (\$)	Cash outflow (\$)	Net cash flow (\$)
0	0	(1700)	
1	800	(500)	
2	1250	(850)	
3	1500	(1000)	
4	2100	(1600)	

Calculate total net cash flow.

- 1 \$0 ✓
- 2 (\$1700)
- 3 \$500
- 4 \$1700

Explanation

The table has been completed below.

Year	Cash inflow (\$)	Cash outflow (\$)	Net cash flow (\$)
0	0	(1700)	(1700)
1	800	(500)	300
2	1250	(850)	400
3	1500	(1000)	500
4	2100	(1600)	500
		Total net cash flow	0

The total net cash flow is found by adding all net flows from Year 0 to Year 4. In this case:

$$-\$1700 + \$300 + \$400 + \$500 + \$500 = \$0$$



Student view

Question 2



Consider the following data.

Overview
(/study/app/hl/sid-351-cid-762729/c)

Year	Cash inflow (\$)	Cash outflow (\$)	Net cash flow (\$)
0	0	(1700)	X
1	800	(500)	
2	1250	(850)	
3	1500	(1000)	
4	2100	(1600)	

Calculate the average annual return.

- 1 \$0 ✓
- 2 \$1700
- 3 \$4
- 4 \$5650

Explanation

The table has been completed below.

Year	Cash inflow (\$)	Cash outflow (\$)	Net cash flow (\$)
0	0	(1700)	(1700)
1	800	(500)	300
2	1250	(850)	400
3	1500	(1000)	500
4	2100	(1600)	500
		Total net cash flow	0

Average annual return is:

$$\frac{(\text{total returns} - \text{capital cost})}{\text{years of use}}$$

or

$$\frac{\text{Total net cash flow}}{\text{years of use}}$$

Student view

so:

Overview

(/study/app/business-hl/sid-351-cid-762729/c

$$\frac{\$0}{4 \text{ years}} = \$0$$

Question 3

Consider the following data.

Year	Cash inflow (\$)	Cash outflow (\$)	Net cash flow (\$)
0	0	(1700)	
1	800	(500)	
2	1250	(850)	
3	1500	(1000)	
4	2100	(1600)	

Calculate the average rate of return (ARR).

- 1 0% ✓
- 2 29.4%
- 3 10%
- 4 100%

Explanation

The table has been completed below.

Year	Cash inflow (\$)	Cash outflow (\$)	Net cash flow (\$)
0	0	(1700)	(1700)
1	800	(500)	300
2	1250	(850)	400
3	1500	(1000)	500
4	2100	(1600)	500

Overview
(/study/app/business-hl/sid-351-cid-762729/c)
762729/c

Year	Cash inflow (\$)	Cash outflow (\$)	Net cash flow (\$)
		Total net cash flow	0

Average rate of return is expressed as:

$$\text{Average rate of return (ARR)} = \frac{(\text{total returns} - \text{capital cost}) \div \text{years of use}}{\text{capital cost}} \times 100$$

So:

$$\frac{\$0 \div 4 \text{ years}}{\$1700 \times 100} = 0\%$$

3. Finance and accounts / 3.8 Investment appraisal

Net present value (NPV) (HL)

Investment opportunities

Section

Student... (0/0)

Feedback

Print

(/study/app/business-hl/sid-351-cid-762729/book/net-present-value-npv-hl-id-39327/print/)

Assign

Which is worth more, \$100 today or \$100 in five years' time? The answer is \$100 today.

A unit of money does not have the same value in the future as it does today. There are two factors that play a role here. The first is inflation. Inflation is an increase in the general price level in the economy. It is usually expressed as a percentage change. If prices are rising over time, as is normally the case, then \$100 will not buy as much in the future. A 3% inflation rate means that after one year \$100 will buy only \$97 worth of goods. After another year, with the same inflation rate, that money will buy only \$94.09 worth of goods.

There is another factor to consider relating to the future value of money. If you take your \$100 and put it into a bank, it will earn interest from the bank. If the interest rate you get from the bank is 2%, then after one year you will have \$102, and after two years you will have \$104.40. It is usually the case that a bank will pay a lower interest rate on deposits than the inflation rate. Thus, over time, the value of money in terms of what can be purchased with it, will decline.



Figure 1. Money loses its value over time.

X
Student view

One significant limitation of the investment appraisal methods of payback period and average rate of return is that they assume that cash flows in future years have the same value as those today. However, this is not the case. Another investment appraisal method, net present value (NPV), shows the real value of estimated future

 net cash flows so that the investment appraisal is more accurate.

Overview
(/study/app)
hl/sid-
351-
cid-
762729/c

Discount factor

A discount rate is the rate a business could earn on another comparable investment. When that rate is applied to the expected future cash flows from an investment, these cash flows can be reduced, or ‘discounted’ to reflect today’s value of that future cash flow. By doing this, a business can compare different investment options, even when they involve different lengths of time for execution.

Table 1 shows various discount rates. Looking at the table, you can see that if an 8% discount rate is used, a discount factor of 0.9259 must be applied to the net cash flow figure in the first year.

Table 1. Discount factors.

Years	Discount rate				
	4%	6%	8%	10%	20%
1	0.9615	0.9434	0.9259	0.9091	0.8333
2	0.9246	0.8900	0.8573	0.8264	0.6944
3	0.8890	0.8396	0.7938	0.7513	0.5787
4	0.8548	0.7921	0.7350	0.6830	0.4823
5	0.8219	0.7473	0.6806	0.6209	0.4019
6	0.7903	0.7050	0.6302	0.5645	0.3349
7	0.7599	0.6651	0.5835	0.5132	0.2791
8	0.7307	0.6271	0.5403	0.4665	0.2326
9	0.7026	0.5919	0.5002	0.4241	0.1938
10	0.6756	0.5584	0.4632	0.3855	0.1615

You can now use the discount values above to calculate the present value of a future cash inflow. The formula is:

$$\text{Present value (single year)} = \text{net cash flow} \times \text{discount factor}$$

Concept

Ethics

 Student
view

It is very easy to make the present value of an investment appear larger than it is by using a lower discount rate. If an analyst creating a report wants to make her boss think the investment is worth more, she could lower the discount rate from 6% to 4%. This will give a larger present value and make the investment look more attractive. Be careful when looking at businesses' interest rate assumptions, as they can be easily manipulated.

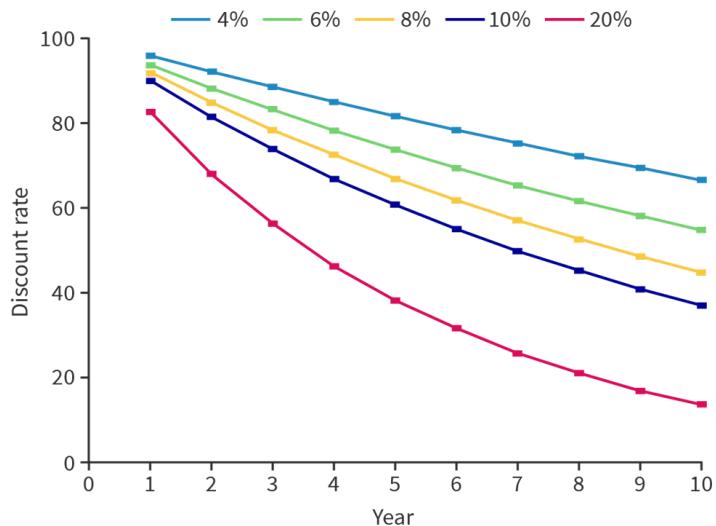


Figure 2. Discount rates affect the size of an investment.

More information for figure 2

The graph shows the impact of different discount rates on investment size over a 10-year period. The X-axis represents the "Year" ranging from 0 to 10, while the Y-axis represents the "Discount rate" with values ranging from 0 to 100.

There are five curves plotted, each representing a different discount rate: 4%, 6%, 8%, 10%, and 20%. The 4% discount rate is represented by the topmost curve, followed sequentially by the 6%, 8%, 10%, and 20% discount rates as you move downward on the graph.

Each curve starts at the top left and slopes downward to the right, indicating a decrease in investment size over time. The steepest decline is seen with the 20% discount rate, showing the greatest reduction in value by year 10, while the 4% discount rate shows the least reduction over the same period.

[Generated by AI]

Calculating net present value

Net present value expresses all future net cash flows from an investment in terms of their present value today. The formula is:

$$\text{Net present value (NPV)} = \sum \text{present values of return} - \text{original cost}$$

ⓘ Exam tip

The formula sheet you are given in the exam includes the NPV formula and a discount table, so you do not need to memorise these. However, you do need to understand how to use them.

Home
Overview
(/study/app/hl/sid-351-cid-762729/c)

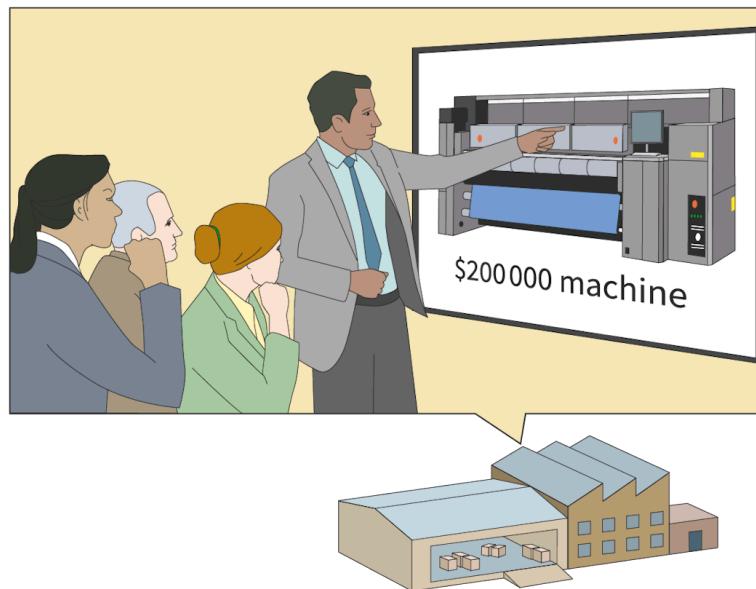


Figure 3. The average rate of return (ARR) investment appraisal method can help evaluate the investment.

The concept of net present value is explained below, using the same example of a company that is considering purchasing a new \$200 000 machine and using the same cash flows as in the previous examples and a discount rate of 10%.

Step 1: Discount the net cash flows in each year

As a reminder, the formula for calculating the present value is below. The discount factor is found in the discount table according to the future year.

$$\text{Present value (single year)} = \text{net cash flow} \times \text{discount factor}$$

$$\text{In Year 1: } \$60\,000 \times 0.9091 = \$54\,546$$

$$\text{In Year 2: } \$80\,000 \times 0.8264 = \$66\,112$$

$$\text{In Year 3: } \$120\,000 \times 0.7513 = \$90\,156$$

$$\text{In Year 4: } \$160\,000 \times 0.6830 = \$109\,280$$

Table 2. Adding a discount rate to net cash flows to determine the present value for each year.

Year	Cash inflow (\$)	Cash outflow (\$)	Net cash flow (\$)	10% discount rate	Present value (\$)
1	80 000	20 000	60 000	0.9091	54 546
2	140 000	60 000	80 000	0.8264	66 112
3	240 000	120 000	120 000	0.7513	90 156

Overview
(study/app)
hl/sid-
351-
cid-
762729/c

Year	Cash inflow (\$)	Cash outflow (\$)	Net cash flow (\$)	10% discount rate	Present value (\$)
4	360 000	200 000	160 000	0.6830	109 280

Step 2: Find the net present value

The next step is to add all the present values and subtract out the original cost of the investment. As a reminder, the formula for net present value is:

$$\text{Net present value (NPV)} = \sum \text{present values of return} - \text{original cost}$$

$$\begin{aligned} \text{NPV} &= (\$54\,546 + \$66\,112 + \$90\,156 + \$109\,280) - \$200\,000 \\ &= \$120\,094 \end{aligned}$$

If net present value is positive, then the investment would have a positive return.

As in previous examples, it may be helpful to lay out the information in a table.

Evaluation of net present value

Like the other investment appraisal methods, net present value has both benefits and limitations. The main benefit is that the method considers the change in value of money over time, which provides the business with a more accurate understanding of the future value of cash flows from an investment. It also allows the business to compare opportunities with different investment periods.

However, a limitation of net present value is that it is more complex to calculate than payback period and average rate of return. Another limitation is that assumptions have to be made about the future value of money, which may be inaccurate. The discount rate chosen to calculate present value could be quite inaccurate depending on future economic conditions. So, these discount rate assumptions need to be analysed critically to ensure that they are not overly optimistic.

3 section questions ^

Question 1

Calculate the present value of the investment outlined below:

Year	Cash inflow (\$)	Cash outflow (\$)	Net flow (\$)	Discount factor	Present value (\$)
0	0	(500)	(500)	1	?

x
Student view

1 (\$500) ✓

Overview

(/study/app

hl/sid-

351-

cid-

762729/c

2 \$500

3 \$0

4 \$1000

Explanation

The present value is found by multiplying the net flow for the year by the discount factor. In this case:

$$(\$500) \times 1 = (\$500)$$

Question 2

Use the data in this table to calculate X.

Year	Cash inflow (\$)	Cash outflow (\$)	Net flow (\$)	Discount factor	Present value (\$)
0	0	(500)	(500)	1	(500)
1	250	0		0.9615	X

1 \$240.38 ✓

2 \$250

3 (\$240)

4 \$500

Explanation

First calculate net flow for Year 1:

$$\$250 - \$0 = \$250$$

Then calculate the present value by multiplying by the discount factor:

$$\$250 \times 0.9615 = 240.375 \text{ or } \$240.38$$

Question 3

Use the data in this table to calculate Y.



Student view

Overview
(/study/app/business-hl/sid-351-cid-762729/c)

Year	Cash inflow (\$)	Cash outflow (\$)	Net flow (\$)	Discount factor	Present value (\$)
0	0	(500)	(500)	1	(500)
1	250	0	250	0.9615	240.38
2	700	(50)	650	0.9246	
			Net present value		Y

1 \$341.37 ✓

2 (\$700)

3 \$600.99

4 (\$341)

Explanation

First calculate the present value of the Year 2 cash flow:

$$\$650 \times 0.9246 = \$600.99$$

Then add up the present values of all cash flows:

$$-\$500 + \$240.38 + \$600.99 = \$341.37$$

3. Finance and accounts / 3.8 Investment appraisal

Evaluation of investment appraisal

Investment opportunities Investment opportunities

Section

Student... (0/0)



Feedback



Print (/study/app/business-hl/sid-351-cid-762729/book/evaluation-of-investment-appraisal-id-39328/print/)

Assign

This subtopic has analysed several quantitative methods of investment appraisal: the payback period, average rate of return and net present value (HL only). Businesses use this information to compare potential investments. For example, instead of investing \$200 000 in a new machine, a business could choose to build a new facility or spend on research and development. If the business is prioritising profits, then it may choose investments that have a short payback period, or higher average rate of return or net present value (HL).



Student view

Home
Overview
(/study/app/hl/sid-351-cid-762729/c



Figure 1. Businesses need tools to evaluate investment options.

Credit: Sadeugra, Getty Images

Imagine that you run a small local hospital that treats a low-income population (a social enterprise) and you are considering purchasing a magnetic resonance imaging (MRI) machine. Such a machine may cost up to \$3 million. It is a significant investment for the hospital. The hospital's administration would need to consider a variety of quantitative and qualitative factors, such as:

- **Return on investment.** What return on investment would the hospital want to obtain?
- **Cost savings.** Would purchasing this machine lead to cost savings in other diagnostic procedures? These cost savings may not be immediately evident when looking simply at return on investment.
- **Break-even.** Most social enterprises should attempt to break even. Would such a large investment prevent the hospital from breaking even for several years?
- **Market share.** Would being the first hospital in the region to have this machine increase the inflow of patients who will use this and other hospital services? This could increase the hospital's market share (and possibly profitability)?
- **Financing.** What kind of financing could the hospital obtain if it were to take out a loan? What would the terms of such a loan be? If the average rate of return on the investment is higher than the interest rate on the loan, it may be a wise investment.
- **Cash flow assumptions.** How confident is the business in its cash flow assumptions? Having incorrect assumptions could result in the investment having a lower rate of return than estimated.
- **The hospital's mission statement.** If the hospital's mission is to provide a high-quality diagnostic service to a low-income population, then a low ARR or a long payback period may not be a pressing concern compared to the quality of service provided to meet human needs.

X
Student view

Overview
(/study/app/hl/sid-351-cid-762729/c)



Figure 2. Qualitative and quantitative considerations need to be considered when making a significant investment.

Credit: Thomas Barwick, Getty Images

Investment is not always a choice. Businesses may also need to make investments because of regulations imposed on them. For example, environmental protection laws may require additional investment in technology to lower a business's pollution emissions. Although positive for society and the environment, such an investment may negatively affect cash flow in the short term.

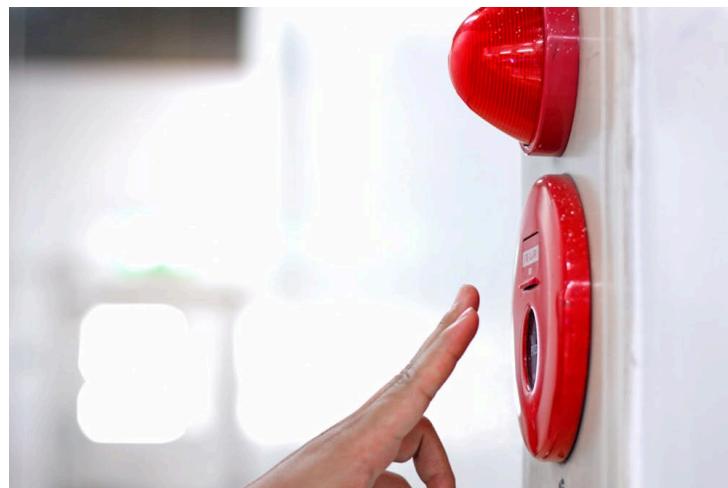


Figure 3. Certain investments — such as in modern fire alarm systems — need to be made because of government regulations.

Credit: Rapeepong Puttakumwong, Getty Images

Businesses may, however, have even more choices for spending their retained profits than investments. They may also use the cash to:

- pay down debts to lower risk and interest payments
- pay dividends to their shareholders
- buy back shares of their own company to boost the stock price

X
Student view

🔗 Making connections

In [Section 3.3.4 \(/study/app/business-hl/sid-351-cid-762729/book/tool-decision-tree-id-39304/\)](/study/app/business-hl/sid-351-cid-762729/book/tool-decision-tree-id-39304/), you learned about the decision tree tool.

This tool can be combined with the three methods outlined here, as well as additional decisions, to come up with the best path for a business to take.

A decision tree can also help investors evaluate risk. A highly profitable but improbable outcome would be reflected in the decision tree with a lower probability of success.

Qualitative techniques

Most investment decisions are based on more than quantitative data. Businesses use a variety of tools to evaluate an investment. You have learned or will learn about all of the following qualitative tools, which can be combined with the investment appraisal techniques from this subtopic:

- **Product life cycle** ([Section 4.5.1 \(/study/app/business-hl/sid-351-cid-762729/book/product-life-cycle-id-39005/\)](#)). This is the product in the growth or maturity phase. If the company believes that sales are going to grow rapidly in the future, as in the case of Samsung mentioned in [Section 3.8.0 \(/study/app/business-hl/sid-351-cid-762729/book/the-big-picture-id-39324/\)](#), then investment should proceed.
- **Boston Consulting Group (BCG) matrix** ([Section 4.1.6 \(/study/app/business-hl/sid-351-cid-762729/book/tool-bcg-matrix-id-37441/\)](#)). Products that are deemed to be stars are predicted to have a bright future, so will normally be priorities for investment funds.
- **STEEPLE analysis** ([Section 1.1.6 \(/study/app/business-hl/sid-351-cid-762729/book/tool-business-plan-id-36505/\)](#)). Results from external analysis may point to future opportunities. It is important to consider the level of risk when an economy is or is not growing. In case of a [multinational company](#), it may be beneficial to look at other external risk factors, such as sovereign ratings.
- **Product portfolio analysis** ([Subtopic 4.5 \(/study/app/business-hl/sid-351-cid-762729/book/the-big-picture-id-39004/\)](#)). This may point towards a gap in a product portfolio that needs to be filled with investment in a new product.
- **Market research results** ([Subtopic 4.4 \(/study/app/business-hl/sid-351-cid-762729/book/the-big-picture-id-38995/\)](#)). Results from interviews or focus groups may point towards a growing market that could be targeted.

When it comes to [social enterprises](#), different qualitative and quantitative data may be used, depending on the social or environmental objectives of the business. For example, schools may use graduation rates when investing in a new safer facility. Non-profit health institutions may look at hospital readmissions after procedures or other health outcomes. Even where two businesses use the same quantitative and qualitative data to inform decisions, social enterprises are likely to place more weight on qualitative data that reflects positive impact.

Case study

South Korean multinational company Kia made a large \$1 billion investment in an automobile production facility in Georgia, USA in 2006. This facility was chosen because of its relatively low cost of production, tax benefits and location. (It was close to major highways for easy transportation of products.) Georgia's weak labour laws and proximity to other related manufacturers were also a factor in the investment. Further, the state of Georgia offered tax breaks and other financial incentives of more than \$79 million, with additional tax benefits over future years of operation.

This large capital investment allowed Kia to increase the number of vehicles sold in the USA from 294 302 (in 2006) to 677 494 (in 2021).

(Source: [Goodcarbadcar](https://www.goodcarbadcar.net/kia-us-sales-figures/#growth) (<https://www.goodcarbadcar.net/kia-us-sales-figures/#growth>)
<https://www.fdiintelligence.com/article/28832>))

Questions

1. Describe two qualitative factors that contributed to making the decision to invest in a production factory in Georgia. [2 marks]
2. Calculate the growth (percentage change) in Kia vehicle sales from 2006 to 2021. [2 marks]
3. Comment on the appropriateness of Kia's investment in Georgia. [2 marks]

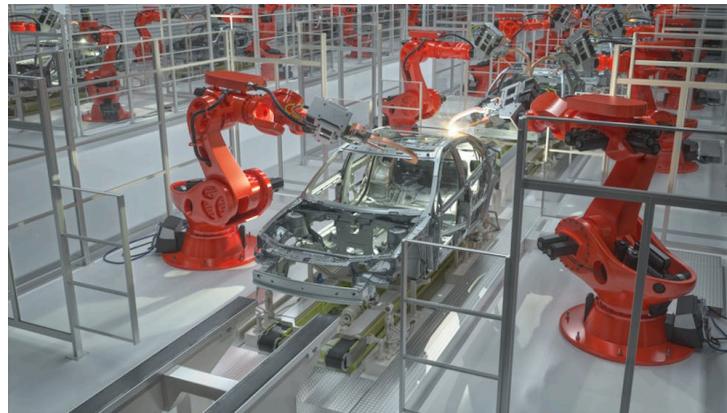


Figure 4. Kia made a large investment in a factory in Georgia, USA.

Credit: xia yuan, Getty Images

Question 1

Possible answers include:

- lower cost of production
- weak labour laws
- tax benefits
- proximity to transportation routes

Describe is an AO1 level command term, requiring a detailed account.

- One mark is given for identifying and vaguely describing two factors.
- Two marks are given for identifying/describing two factors and connecting to the case study.
- To achieve full marks, you must always include theory and application to the case study in your responses.



Overview
(/study/app)
hl/sid-
351-
cid-
762729/c

Question 2

$$\text{Growth in sales} = \frac{(677\,494 - 294\,302)}{294\,302} \times 100 \\ = 130.20\%$$

Calculate is an AO4 level command term that requires numerical answers showing the relevant stages in the working.

- One mark is given for working.
- Two marks are given for working and the correct answer of 130.20%.

Question 3

Kia's car sales in the USA more than doubled (up 130.2%) in the years since the investment was made. This indicates that the investment resulted in a large increase in production and sales. Further, Kia has received tax concessions from the state and has been able to take advantage of the proximity to shipping routes, most likely lowering the manufacturer's costs. Although the full payoff information to make an investment appraisal is not given, it appears that this investment has been appropriate.

Comment is an AO2 level command term, requiring a judgement based on a statement or result of a calculation.

- One mark is given for judgement made with vague support.
- Two marks are given for full judgement made with support from the case study.
- To achieve fully marks, you must always include theory and application to the case study in your responses.

Activity

Learner profile: Thinkers

Approaches to learning: Thinking skills (transfer)

Politooth is a manufacturing facility in Thailand that produces custom made dental implants through the 3D printing process. Politooth has been contracted recently by the Thai government, which has been outsourcing the dental care it provides for its staff to private companies.

Politooth is deciding whether to invest in additional 3D printers. The printers cost 3 million THB and should provide at least five years of active use.

The net cash flows are as follows:

Year	1	2	3	4	5
Forecast annual net cash flow (in THB)	650 000	790 000	650 000	800 000	400 000



Student
view

Questions

1. Calculate

- the payback period
- the average rate of return (ARR)
- NPV at a discount rate of 4% (HL only)

1. Comment on your answer from one of the calculations in question 1.

1. What qualitative data might Polooth use in conjunction with the investment appraisals above in order to make an investment decision?

Question 1**Calculating the payback period**

The cumulative net flow turned positive in Year 5. By the end of Year 4, there was 110 000 THB left to pay back. To calculate the number of days in Year 5 required to pay the rest of the investment, you need to complete the following calculation:

$$\begin{aligned}\text{Payback period} &= \frac{110\,000}{400\,000} \times 365 \\ &= 100.375 \text{ days}\end{aligned}$$

You should round up to 101 days showing that the full repayment will occur after this period. So, it would take Polooth 4 years and 101 days to pay back the investment.

Year	Net cash flow (THB)	Cumulative net flow (THB)
0	(3 000 000)	(3 000 000)
1	650 000	(2 350 000)
2	790 000	(1 560 000)
3	650 000	(910 000)
4	800 000	(110 000)
5	400 000	290 000

Calculating the ARR

$$\text{Average rate of return (ARR)} = \frac{(\text{total returns} - \text{capital cost}) \div \text{years of use}}{\text{capital cost}} \times 100$$

$$\begin{aligned}\text{Total annual returns} - \text{capital cost} &= 3\,290\,000 \text{ THB} - 3\,000\,000 \text{ THB} \\ &= 290\,000 \text{ THB}\end{aligned}$$

$$\text{Average annual return} = \frac{290\,000 \text{ THB}}{5 \text{ years of use}}$$



= 58 000 THB

$$\text{Average rate of return (ARR)} = \frac{58\,000 \text{ THB}}{3\,000\,000 \text{ THB}}$$

= 1.93%

Year	Net cash flow (THB)
1	650 000
2	790 000
3	650 000
4	800 000
5	400 000
Total returns	3 290 000

Calculating the NPV at a discount rate of 4% (HL only)

Net present value (NPV) = \sum present values of return – original cost

$$= 2\,945\,859 \text{ THB} - 3\,000\,000 \text{ THB} = (54\,141 \text{ THB})$$

Year	Net cash flow (THB)	Discount rate	Present value (THB)
1	650 000	0.9615	624 975
2	790 000	0.9246	730 434
3	650 000	0.8890	577 850
4	800 000	0.8548	683 840
5	400 000	0.8219	328 760
		Total returns (present value)	2 945 859

Question 2

The payback method shows that the investment will be recuperated in less than five years and the ARR method shows that there is a positive return on investment. However, the NPV method (HL) shows that, under the assumption of a 4% discount rate, the return is negative.

Question 3

Multiple answers could be accepted. For example, Politooth could look at whether this specific contract may lead to other contracts with the government. The 3D printer may improve the quality of the product provided and help the business build a reputation. It could also help Politooth diversify its product portfolio and revenue streams, making the business more resilient.



Overview
(/study/app/
hl/sid-
351-
cid-
762729/c

Theory of Knowledge

In this subtopic you have been introduced to two (SL) or three (HL) quantitative investment appraisal methods. In addition to quantitative methods, companies also look at qualitative methods to make an investment decision.

- To what extent are the methods used to gain knowledge in investment appraisal ‘scientific’? (IB Business Management guide)

3 section questions ^

Question 1

What could lower the accuracy of a cash flow forecast?

- 1 All these reasons ✓
- 2 Unforeseen external events
- 3 Forecasting too far into the future
- 4 A lack of experience

Explanation

Forecasts are extremely difficult to carry out accurately. Any number of external events can make previously sound forecasts wildly off target. For example, the COVID-19 pandemic was completely unforeseen and sent global demand into decline. Human error will also affect accuracy. If someone is likely to benefit from an investment, then they are likely to increase forecast inflows and reduce forecast outflows.

Question 2

Which of the following is a quantitative method of investment appraisal?

- 1 Average rate of return (ARR) ✓
- 2 STEEPLE analysis
- 3 Boston Consulting Group (BCG) matrix
- 4 Product life cycle ✗

Student view

Home
Overview
(/study/app/business-hl/sid-351-cid-762729/c)

Explanation

Average rate of return (ARR) is the quantitative method of appraisal. It requires the usage of projected returns. The other methods are qualitative.

Question 3

Which of the following is a qualitative method of investment appraisal?

- 1 STEEPLE analysis ✓
- 2 Net present value (NPV)
- 3 Average rate of return (ARR)
- 4 Payback period

Explanation

STEEPLE analysis involves a look at qualitative factors, such as political or technological factors. The other three answers involve quantitative analysis.

3. Finance and accounts / 3.8 Investment appraisal

Terminology exercise

Section

Student... (0/0)

Feedback



Print (/study/app/business-hl/sid-351-cid-762729/book/terminology-exercise-id-39329/print/)

Assign



Student
view

Home
Overview
(/study/app/business-hl/sid-351-cid-762729/c)
hl/sid-
351-
cid-
762729/c

Check that you understand the terminology used in this subtopic by dragging the correct word into each space.

Spending on fixed assets is called . It is sometimes referred to as expenditure. To choose the appropriate investment, a business conducts an investment , which includes different quantitative methods.

The first quantitative method involves calculating the time period over which the investment will pay for itself. This time period is called the and this is the simplest method of appraisal. However, it ignores the quality of the investment and the long-run return.

The second quantitative method involves calculating a rate of return on investment and is called the average

Finally, the third quantitative method discounts future cash flows and compares them with the investment. It is referred to as the value.

[net present](#) [appraisal](#) [rate of return](#) [capital](#) [payback period](#) [investment](#)

Check

Interactive 1. Mastering Investment Terms.

3. Finance and accounts / 3.8 Investment appraisal

Checklist

Section

Student... (0/0)



Feedback



Print (/study/app/business-hl/sid-351-cid-762729/book/checklist-id-39330/print/)

Assign

What you should know

By the end of this subtopic, you should be able to:

- define the following terms: (AO1)
 - payback period
 - average rate of return
 - net present value
 - discount rate
- calculate, compare and evaluate investment opportunities using the payback period (AO3, AO4)
- calculate, compare and evaluate investment opportunities using the average rate of return (ARR) (AO3, AO4)
- calculate, compare and evaluate investment opportunities using the net present value (NPV) (AO3, AO4)



Student view



Overview
 (/study/app/business-hl/sid-351-cid-762729/c)
 hl/sid-
 351-
 cid-
 762729/c

3. Finance and accounts / 3.8 Investment appraisal

Reflection

Section

Student... (0/0)



Feedback



Print

/study/app/business-hl/sid-351-cid-762729/book/reflection-id-48326/print/

Assign

Teacher instructions

The goal of this section is to encourage students to pause at the end of the subtopic and to reflect on their learning. Students can use the questions provided below to guide their reflection. The questions encourage students to look at the bigger picture and to consider how the subtopic's contents might have impacted the way they view the subject.

The following table shows you how each prompt aligns to the DP *Business management guide*:

Prompt #	Syllabus alignment
1	Concept: Sustainability
2	Learner profile: Thinkers
3	Learner profile: Open-minded

Students can submit their reflections to you by clicking on 'Submit'. You will then see their answers in the 'Insights' part of the Kognity platform.

Reflection

In this subtopic you learned about investment appraisal.

Take a moment to reflect on your learning so far. You can use the following questions to guide your reflection. If you click 'Submit', your answers will be shared with your teacher.

1. In this subtopic you explored quantitative methods of investment appraisal. Should investment appraisal incorporate other business goals, such as environmental sustainability?
2. Investment appraisal always involves predicting future cash flows. How can businesses make this prediction as realistic as possible?



Student
view



Overview
(/study/app/business-hl/sid-351-cid-762729/book/the-big-picture-id-39392/)
hl/sid-
351-
cid-
762729/c

3. In [Subtopic 2.3 \(/study/app/business-hl/sid-351-cid-762729/book/the-big-picture-id-39392/\)](#) you learned about intuitive and scientific management as it applies to human resource management. To what extent do these two types of thinking apply to investment appraisal?

⚠ Once you submit your response, you won't be able to edit it.

0/2000

Rate subtopic 3.8 Investment appraisal

Help us improve the content and user experience.



Student
view