Corporate Financial Management

Day 1 Afternoon: Capital Investment Decisions

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Capital Investment Decision-Making

This afternoon, we build upon the financial framework and ratio analysis covered this morning to focus on one of the most critical aspects of financial management: capital investment decisions.

Learning Outcomes for This Session

By the end of this afternoon, you will be able to:

1. Explain the nature and importance of investment decision-making
2. Identify and evaluate the five main investment appraisal methods found in practice
3. Use these methods to reach decisions on investment opportunities
4. Explain the key stages in the investment decision-making process

5. Apply techniques to handle risk in investment decisions

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The Nature of Investment Decisions

Investment decisions represent long-term commitments of substantial resources with uncertain returns. They are among the most consequential decisions finance managers must make.

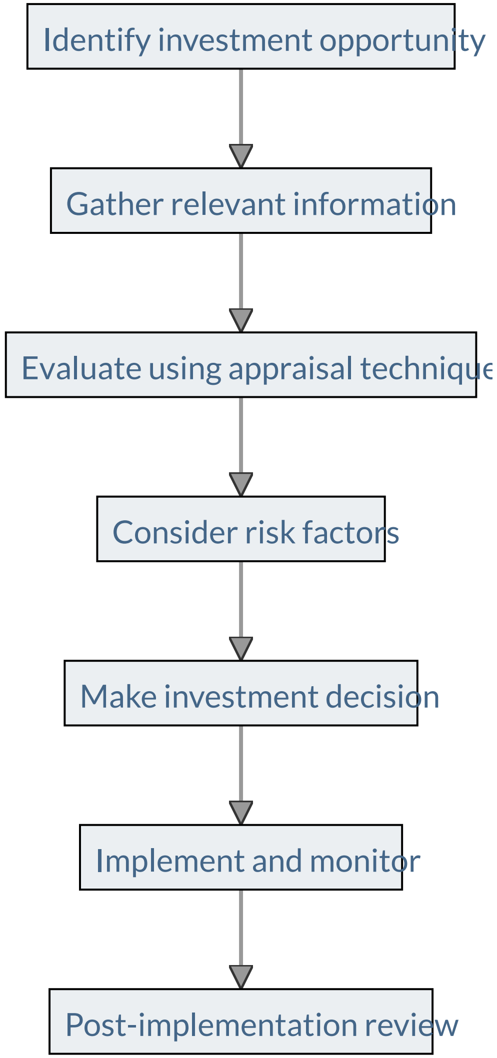
Think of them as “big bets” that organizations make on their future.

Key Characteristics

Capital investment decisions typically involve:

- **Substantial resource allocation**
- **Extended time horizons**
- **Limited reversibility** once undertaken
- **Strategic implications** for the organisation's future direction
- **Multiple risk dimensions**

Investment Decision Framework



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Real-World Example

The pharmaceutical industry provides a classic example of the capital investment decision challenge:

- **Initial R&D investment**: £500m+ (significant upfront capital)
- **Development timeline**: 10-15 years (extended time commitment)
- **Success rate**: Only 1 in 10 compounds receives regulatory approval (substantial uncertainty)
- **Strategic importance**: Defines company product pipeline for decades
- **Market conditions**: Subject to change during the development period

Cash Flows vs. Accounting Profits

A fundamental principle in capital investment appraisal is the focus on cash flows rather than accounting profits.

Key Equation:

$$\text{Cash Flow} = \text{Profit} + \text{Depreciation} + \text{Other non-cash adjustments}$$

Practical example:

For a £30,000 delivery van:

- **Accounting**: £6,000 expense annually for 5 years
- **Cash flow**: £30,000 outflow at purchase

Why Focus on Cash Flows?

- **Cash is objective and measurable**
- **Profits are subject to accounting policies**
- **Cash flow timing directly impacts value**

- **Investment decisions affect cash balances**

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What Cash Flows Are Relevant?

Relevant Cash Flows Are:

- **Incremental** – Those arising directly from the project
- **Future** – Not past/sunk costs
- **After-tax** – Tax implications affect the net benefit

Irrelevant Items Include:

- **Sunk costs** – Previously committed expenditures
- **Non-incremental overhead allocations** – Costs that would exist regardless
- **Interest payments** – Captured in discount rate
- **Accounting conventions** – Such as depreciation

Common Error

Including already committed (sunk) costs in investment appraisal calculations. Once spent, these costs are irrelevant to the decision to proceed.

Projected Income Statement vs. Cash Flow

Consider how an accounting statement differs from the cash flow perspective:

Typical Income Statement

	£000	**£000**
Credit sales revenue	1,200	
Less Cost of sales:		
Opening inventories	100	
Add Purchases	750	
Less Closing inventories	(120)	730
Gross profit		470
Less:		
Credit card discounts	60	
Rent and rates	180	
Other costs	240	

	£000	**£000**
Depreciation of fittings	140	620
Profit for the period		(150)

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Converting to Cash Flow

Key Cash Flow Conversion

To convert income statement to cash flow:

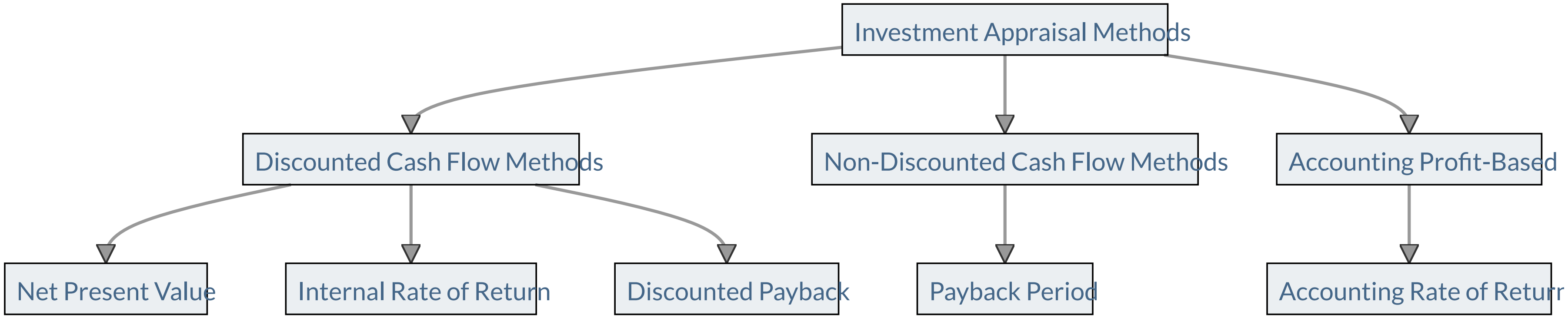
1. Start with profit figure: -£150,000
2. Add back non-cash expenses:
   - Depreciation: +£140,000 (not actual cash outflow)
3. Adjust for working capital changes:
   - Inventory increase: -£20,000 (cash spent but not yet expensed)
4. Adjust for timing differences:
   - Credit sales: adjustment for cash not yet received

> The resulting figure represents the actual cash movement, which may differ significantly from accounting profit.

Investment Appraisal Methods Overview

Five main methods are used in practice to evaluate investment projects:

Classification Framework



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Understanding Time Value of Money

The principle: £100 today is worth more than £100 received in one year's time.
Reasons:

1. **Opportunity Cost**: Present funds can be invested to generate returns
2. **Inflation**: The purchasing power of money typically decreases over time
3. **Uncertainty**: Future cash receipts carry inherent uncertainty

Example:

- If you invest £100 at 5% interest, in one year you'll have £105
- Therefore, £105 in one year = £100 today
- The "present value" of £105 received in one year is £100

Discounted Cash Flow Methods

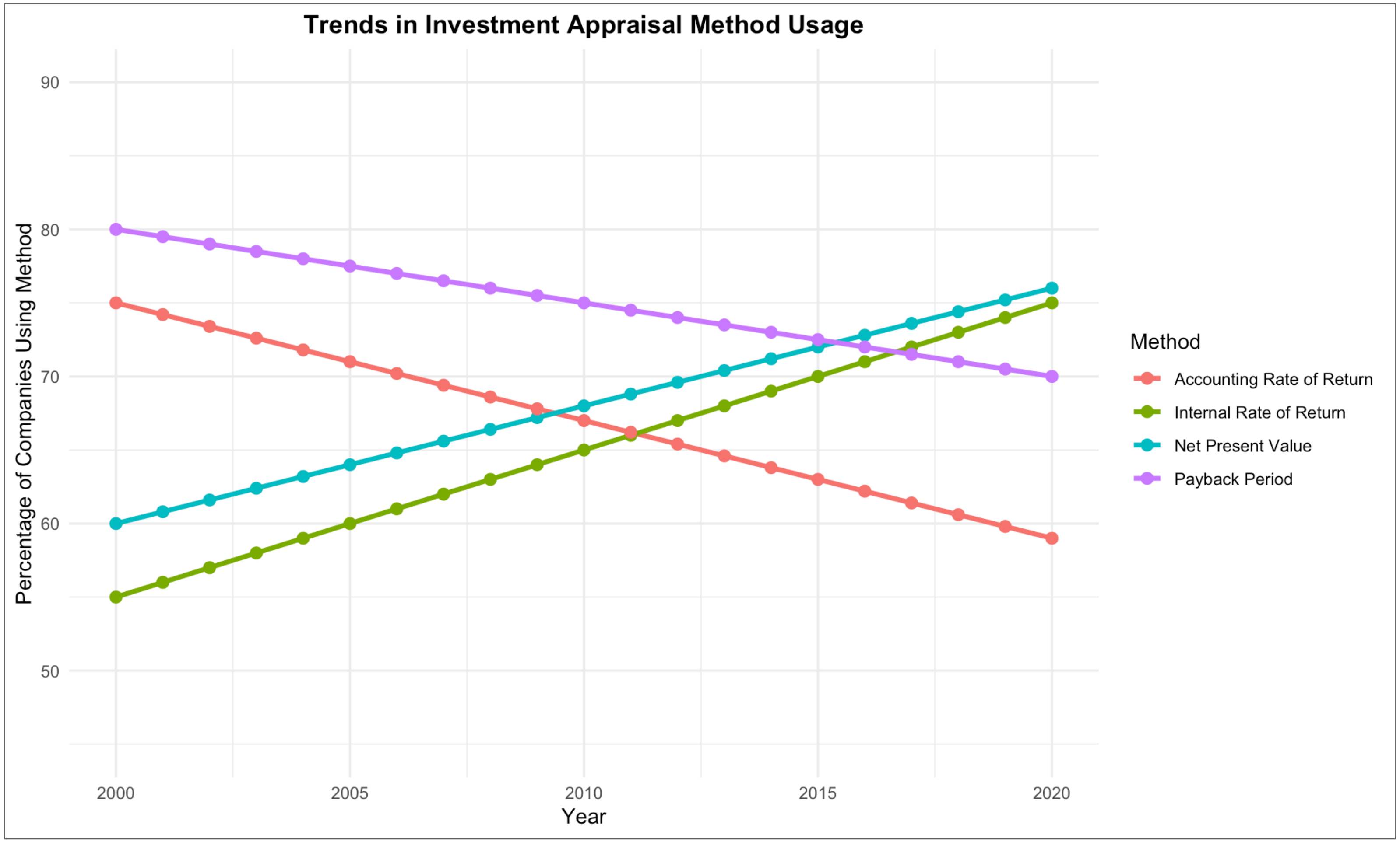
DCF methods explicitly account for the time value of money through discounting.
Discount factors at 10% rate:

- Year 1: $1 \div (1+0.10)^1 = 0.909$
- Year 2: $1 \div (1+0.10)^2 = 0.826$
- Year 3: $1 \div (1+0.10)^3 = 0.751$

Interpretation:

- £1 received in Year 1 has a present value of 90.9p
- £1 received in Year 2 has a present value of 82.6p
- £1 received in Year 3 has a present value of 75.1p

Selection in Practice



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Notice how NPV and IRR usage has been increasing over time, while Payback Period and ARR have been declining.

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Payback Period (PP)

The Payback Period is the time required to recover the initial investment from project cash flows.
Definition: The duration required for cumulative cash inflows to equal the initial investment.

Definition & Calculation

$$\text{Payback Period} = \text{Time until} \sum_{t=0}^{n} \text{Cash Flow}_t = 0$$

Calculation process:

1. Begin with the negative initial investment at Year 0
2. Add each year's cash flow to calculate a running total
3. Determine when this total becomes positive

Decision Rule:

- Accept projects with PP < maximum acceptable period
- Between competing projects, prefer shorter payback

Step-by-Step Example

A project costs £500,000 with the following expected cash flows:

Year	Cash Flow (£)	Cumulative Cash Flow (£)
0	-500,000	-500,000
1	150,000	-350,000
2	180,000	-170,000
3	200,000	30,000
4	120,000	150,000
5	100,000	250,000

Calculation:

At the end of Year 2, £170,000 remains to be recovered.
Year 3 generates £200,000.
Proportion of Year 3 needed = £170,000 ÷ £200,000 = 0.85
Payback period = 2 + 0.85 = 2.85 years

Advantages & Limitations

Advantages:

- **Computational simplicity**
- **Focus on liquidity and capital recovery**
- **Basic risk indicator**
- **Practical application frequency**

Limitations:

- **Disregards cash flows beyond the payback period**
- **Neglects time value of money**
- **Fails to consider investment scale**
- **Often employs arbitrary thresholds**
- **Not aligned with shareholder wealth maximization**

Discounted Payback Period (DPP)

The Discounted Payback Period addresses a key limitation of the standard payback by considering the time value of money.
Definition: The duration required for cumulative discounted cash inflows to equal the initial investment.

Definition & Calculation

$$\text{Discounted Payback Period} = \text{Time until} \sum_{t=0}^{n} \frac{\text{Cash Flow}_t}{(1+r)^t} = 0$$

Calculation process:

1. Convert future cash flows to present value using discount factors
2. Calculate cumulative discounted cash flows
3. Determine when this total becomes positive

Decision Rule:

- Accept projects with DPP < maximum acceptable period
- Between competing projects, prefer shorter discounted payback

Step-by-Step Example

Using the same project with a 10% discount rate:

Year	Cash Flow (£)	Discount Factor	Discounted CF (£)	Cumulative DCF (£)
0	-500,000	1.000	-500,000	-500,000
1	150,000	0.909	136,350	-363,650
2	180,000	0.826	148,680	-214,970
3	200,000	0.751	150,200	-64,770
4	120,000	0.683	81,960	17,190
5	100,000	0.621	62,100	79,290

Calculation:
At the end of Year 3, we’re still £64,770 short of breaking even.
In Year 4, we generate discounted cash flow of £81,960.
Fraction of Year 4 needed = £64,770 ÷ £81,960 = 0.79
Discounted payback period = 3 + 0.79 = 3.79 years

Note: The original calculation shows 3.20 years, but our recalculation shows 3.79 years.

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Advantages & Limitations

Advantages:

- **Accounts for time value of money** – unlike standard PP
- **Maintains simplicity of interpretation** – still tells us “how long until we get our money back”
- **More realistic measure** – based on the actual value of money over time

Limitations:

- **Still ignores cash flows after payback** – misses long-term benefits
- **Arbitrary threshold** – what’s a “good” discounted payback?
- **Not directly linked to shareholder wealth** – doesn’t indicate if value is created

Net Present Value (NPV)

The Net Present Value method is the most theoretically sound approach to investment appraisal, directly linking to shareholder wealth maximization.
Definition: The sum of all project cash flows, discounted to present value.

Definition & Calculation

$$\text{NPV} = \sum_{t=0}^{n} \frac{\text{Cash Flow}_t}{(1+r)^t}$$

Calculation process:

1. Convert all cash flows to present value using the appropriate discount rate
2. Sum all discounted cash flows (including initial investment)
3. The resulting figure represents the net value created by the project

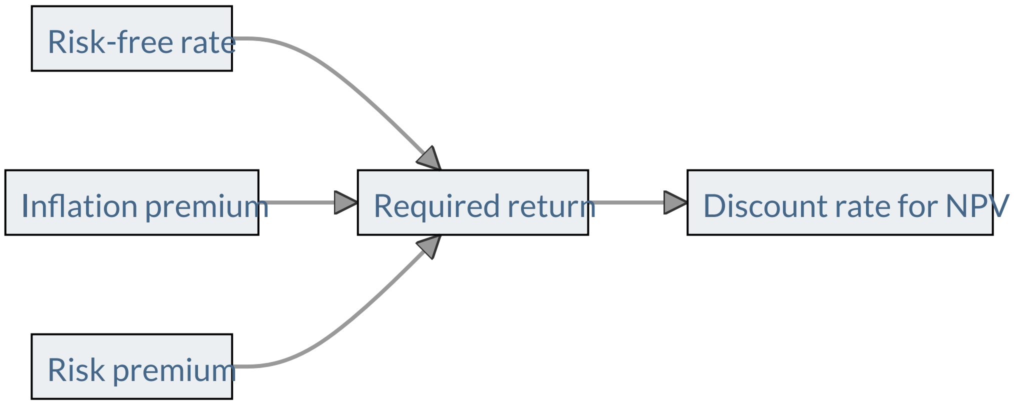
Decision Rule:

- Accept projects with NPV > 0
- Reject projects with NPV < 0
- Between competing projects, prefer higher NPV

Understanding the Discount Rate

The discount rate reflects:

- **Risk-free rate** – return on safe investments (e.g., government bonds)
- **Inflation premium** – adjustment for expected inflation
- **Risk premium** – extra return required for project risks



Example:

- Risk-free rate: 2%
- Expected inflation: 3%
- Project risk premium: 5%

- Resulting discount rate: 10%

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Step-by-Step Example

Using the same project with a 10% discount rate:

Year	Cash Flow (£)	Discount Factor	Discounted CF (£)
0	-500,000	1.000	-500,000
1	150,000	0.909	136,350
2	180,000	0.826	148,680
3	200,000	0.751	150,200
4	120,000	0.683	81,960
5	100,000	0.621	62,100

Calculation:

NPV = Sum of all discounted cash flows

NPV = -£500,000 + £136,350 + £148,680 + £150,200 + £81,960 + £62,100 = £79,290

The positive NPV (£79,290) means the project creates value and should be accepted.

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Intuitive Understanding of NPV

NPV interpretation:

- If NPV = £79,290, the project generates £79,290 more value in present terms than an alternative investment at the discount rate
- It represents the additional value created beyond the required return

Alternative perspective:
If presented with two options:

- Deposit £500,000 in an investment yielding 10% annually, or
- Invest £500,000 in this project

The positive NPV of £79,290 indicates the project delivers greater value than the alternative investment.

Advantages & Limitations

Advantages:

- **Considers all cash flows** – across entire project life
- **Accounts for time value of money** – properly values future cash flows
- **Directly linked to shareholder value** – positive NPV = increased wealth
- **Allows for risk adjustment** – via discount rate
- **Additive across projects** – can combine NPVs of different projects

Limitations:

- **More complex to calculate** – requires understanding of discounting
- **Sensitive to discount rate** – small changes can significantly impact NPV
- **Assumes reinvestment** at the discount rate
- **Provides absolute measure** – doesn’t indicate efficiency of capital use

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Internal Rate of Return (IRR)

The Internal Rate of Return is the discount rate at which a project's NPV equals zero, representing the project's "yield."
Definition: The discount rate that equates the present value of cash inflows with the present value of cash outflows.

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Definition & Calculation

IRR is the value of r that satisfies:

$$\sum_{t=0}^{n} \frac{\text{Cash Flow}_t}{(1+r)^t} = 0$$

In plain English:

1. Find the discount rate that makes the NPV exactly zero
2. This rate represents the project's "break-even" return rate
3. If you could earn exactly this rate elsewhere, you'd be indifferent

Decision Rule:

- Accept projects with IRR > cost of capital
- Reject projects with IRR < cost of capital
- Between competing projects, prefer higher IRR

Understanding IRR Conceptually

IRR interpretation:

- Represents the project's internal efficiency or yield
- Comparable to an effective interest rate on the investment
- If IRR exceeds the cost of capital, the project creates value

Mathematical solution:

- Unlike NPV, no direct formula exists to calculate IRR
- Requires iterative calculation or financial software
- Solves for the discount rate that results in NPV = 0

Step-by-Step Example

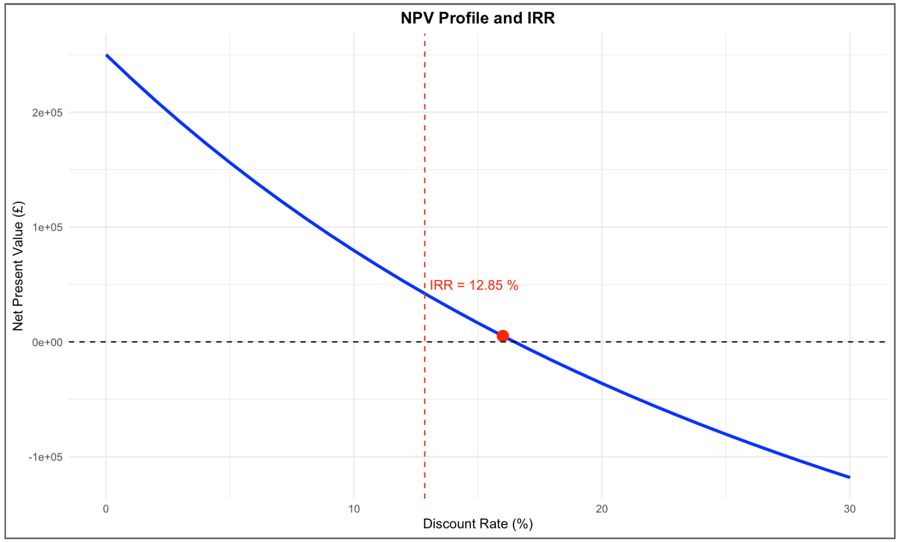
Using the same project cash flows:

Year	Cash Flow (£)
0	-500,000
1	150,000
2	180,000
3	200,000
4	120,000
5	100,000

IRR = 12.85%

Since IRR (12.85%) > Cost of capital (10%), the project is acceptable.

NPV-IRR Relationship



The graph shows NPV at different discount rates. Where the line crosses the x-axis is the IRR.

Key insights:

- At discount rates below IRR, NPV is positive
- At discount rates above IRR, NPV is negative

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- At exactly IRR, NPV is zero

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Advantages & Limitations

Advantages:

- **Intuitive percentage format** – easier to understand “a 12.85% return” than “an NPV of £79,290”
- **Accounts for time value of money** – properly values future cash flows
- **Considers all cash flows** – across entire project life
- **Popular with practitioners** – widely used in industry

Limitations:

- **Multiple IRRs possible** – with non-conventional cash flows
- **Scale of investment not considered** – a small project might have high IRR but create less total value
- **Reinvestment assumption** – assumes cash flows can be reinvested at the IRR
- **Ranking conflicts with NPV** – in some cases, may rank projects differently

- **Not directly linked to shareholder wealth** – high IRR doesn't necessarily mean maximum value

Accounting Rate of Return (ARR)

The Accounting Rate of Return focuses on accounting profit rather than cash flows.
In simple terms: “What is the average accounting return on the investment?”

Definition & Calculation

$$\text{ARR} = \frac{\text{Average annual profit}}{\text{Average investment}} \times 100\%$$

In plain English:

1. Calculate the average annual accounting profit over the project's life
2. Calculate the average investment over the project's life
3. Divide average profit by average investment to get the return rate

Decision Rule:

- Accept projects with ARR > minimum required return
- Reject projects with ARR < minimum required return
- Between competing projects, prefer higher ARR

Step-by-Step Example

A project requires an initial investment of £500,000 with the following profit projections:

Year	Accounting Profit (£)
1	90,000
2	110,000
3	130,000
4	80,000
5	70,000

With a residual value of £100,000.
Calculation:

1. Total profit = £90,000 + £110,000 + £130,000 + £80,000 + £70,000 = £480,000
2. Average annual profit = £480,000 ÷ 5 = £96,000
3. Average investment = (£500,000 + £100,000) ÷ 2 = £300,000

4. ARR = (£96,000 ÷ £300,000) × 100% = 32%

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Advantages & Limitations

Advantages:

- **Uses familiar accounting concepts** – no need to convert to cash flows
- **Simple to calculate** – basic arithmetic only
- **Addresses profitability directly** – based on accounting profit, familiar to managers
- **No discounting required** – avoids complexity of time value calculations

Limitations:

- **Based on accounting profits, not cash flows** – may not reflect actual cash generation
- **Ignores time value of money** – treats profits in Year 1 the same as profits in Year 5
- **No objective benchmark** – what's a "good" ARR is often arbitrary
- **Sensitive to accounting policies** – different depreciation methods can change the ARR

- **Multiple calculation methods exist** – different companies may calculate it differently

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Comparison of Appraisal Methods

Method	Considers Time Value	Considers All Cash Flows	Linked to Shareholder Value	Complexity	Format
Payback Period (PP)	No	No	No	Low	Years
Discounted Payback Period (DPP)	Yes	No	No	Medium	Years
Net Present Value (NPV)	Yes	Yes	Yes	Medium-High	Currency
Internal Rate of	Yes	Yes	Indirectly	High	Percentage

Method	Considers Time Value	Considers All Cash Flows	Linked to Shareholder Value	Complexity	Format
Return (IRR)					
Accounting Rate of Return (ARR)	No	Yes	No	Low	Percentage

Best Practice

Organizations typically use multiple appraisal methods in combination to gain a more complete perspective on potential investments.

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Case Study: Evaluating a New Business Venture

Let's apply these methods to a real-world case:
Evaluating the Potential of Starting a Plumbing Business

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Business Plan Overview

The proposal involves:

- **Year 0**: Initial investment (Equipment: £25,000, Van: £15,000, Advertising: £5,000)
- **Years 1-5**: Operations (Building customer base, hiring employees)
- **End of Year 5**: Exit strategy (Sell business for £30,000, equipment value £8,000, van value £3,000)

Expected cash flows:

- Year 1: £12,000
- Year 2: £18,000
- Year 3: £22,000
- Year 4: £25,000
- Year 5: £26,000 (plus exit values)

Applying PP and DPP

Year	Cash Flow (£)	Cumulative CF (£)	Discount Factor	Discounted CF (£)	Cumulative DCF (£)
0	-45,000	-45,000	1.000	-45,000	-45,000
1	12,000	-33,000	0.909	10,908	-34,092
2	18,000	-15,000	0.826	14,868	-19,224
3	22,000	7,000	0.751	16,522	-2,702
4	25,000	32,000	0.683	17,075	14,373
5	67,000	99,000	0.621	41,607	55,980

Calculating Payback Period:

- At the end of Year 2, we’re still £15,000 short of breaking even.
- In Year 3, we generate £22,000.
- Fraction of Year 3 needed = £15,000 ÷ £22,000 = 0.68

- Therefore, Payback Period = 2 + 0.68 = 2.68 years

Calculating Discounted Payback Period:

- At the end of Year 3, we're still £2,702 short of breaking even.
- In Year 4, we generate discounted cash flow of £17,075.
- Fraction of Year 4 needed = £2,702 ÷ £17,075 = 0.16
- Therefore, Discounted Payback Period = 3 + 0.16 = 3.16 years

Calculating NPV and IRR

Net Present Value (NPV):

Sum of all discounted cash flows = £55,980

Internal Rate of Return (IRR):

IRR = 33.5%

Metric	Value
Net Present Value (NPV)	£ 55,980
Internal Rate of Return (IRR)	33.5%

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Calculating ARR

Year	Cash Flow (£)	Depreciation (£)	Accounting Profit (£)
1	12,000	800	11,200
2	18,000	800	17,200
3	22,000	800	21,200
4	25,000	800	24,200
5	26,000	800	25,200

Calculation:

1. Annual depreciation = (£45,000 - £41,000) ÷ 5 = £800
2. Average annual profit = (£11,200 + £17,200 + £21,200 + £24,200 + £25,200) ÷ 5 = £19,800
3. Average investment = (£45,000 + £41,000) ÷ 2 = £43,000
4. ARR = (£19,800 ÷ £43,000) × 100% = 46.0%

Metric	Value
Average Annual Profit	£ 19,800
Average Investment	£ 43,000
ARR	46.0%

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Decision Recommendation

Based on all five appraisal methods, we can make the following assessment:

1. **Payback Period (2.68 years)**: If the maximum acceptable payback is 3 years, the project is acceptable.
2. **Discounted Payback (3.16 years)**: If the maximum acceptable discounted payback is 4 years, the project is acceptable.
3. **NPV (£55,980)**: The positive NPV indicates the project adds substantial value to the business and should be accepted.
4. **IRR (33.5%)**: If the cost of capital is 10%, the project's IRR substantially exceeds this threshold and should be accepted.
5. **ARR (46.0%)**: If the minimum required ARR is 15%, the project is well above this threshold and acceptable.

Recommendation:

> The investment in the plumbing business appears financially viable across all appraisal methods. The positive NPV and high IRR are particularly encouraging indicators of value creation.

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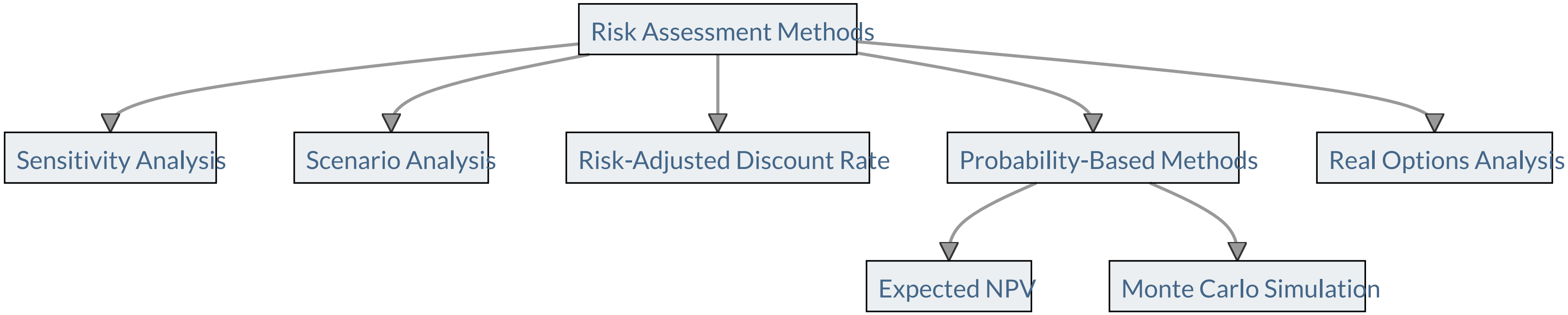
Risk in Investment Decisions

Investment decisions inherently involve risk and uncertainty. Several methods exist to incorporate risk assessment into the appraisal process.

Risk Assessment Approaches



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Sensitivity Analysis

Sensitivity analysis asks: “How much would key variables need to change to make this project unviable?”
Process:

1. Identify key variables (e.g., sales volume, price, costs)
2. Calculate impact of percentage changes in each variable
3. Identify switching points where NPV becomes zero
4. Focus management attention on most sensitive variables

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Sensitivity Analysis Example

For our plumbing business, how much would each variable need to change to make NPV zero?

Variable	Base Value	Change for Zero NPV	Interpretation
Initial investment	£45,000	+124.4%	Low sensitivity
Annual cash flows	As projected	-43.7%	Moderate sensitivity
Exit value	£41,000	-136.5%	Low sensitivity
Discount rate	10%	+23.5 percentage points	Low sensitivity

The project appears robust as it would take substantial negative changes to make it unprofitable.

Scenario Analysis

Scenario analysis evaluates the project under different sets of assumptions.

Scenario	Annual Growth	Exit Multiple	NPV	IRR
Pessimistic	5%	1.0x	£3,250	12.1%
Most likely	10%	1.5x	£22,977	23.9%
Optimistic	15%	2.0x	£48,350	36.2%

Even in the pessimistic scenario, the project still has a positive NPV and IRR above the cost of capital, suggesting relatively low risk.

Expected NPV

Expected NPV incorporates probability estimates for different outcomes:

Scenario	Probability	NPV	Weighted NPV
Pessimistic	0.25	£3,250	£813
Most likely	0.50	£22,977	£11,489
Optimistic	0.25	£48,350	£12,088
Expected value	1.00		£24,390

The expected NPV (£24,390) represents the probability-weighted average outcome. Since this is positive, the project is expected to create value even after accounting for different scenarios.

Risk Attitudes

Different investors have different risk preferences:

- **Risk-averse investors**: Require compensation for bearing risk
  - Example: Retirees protecting their savings
- **Risk-neutral investors**: Focus solely on expected values
  - Example: Large corporations with many diverse projects
- **Risk-seeking investors**: Willing to accept lower expected returns for chance of higher gains
  - Example: Venture capitalists seeking "unicorns"

Most corporate decision-makers are risk-averse, which is reflected in higher hurdle rates, shorter payback periods, and conservative projections.

Investment Decision Process in Practice

The investment appraisal techniques are part of a broader investment decision-making process:

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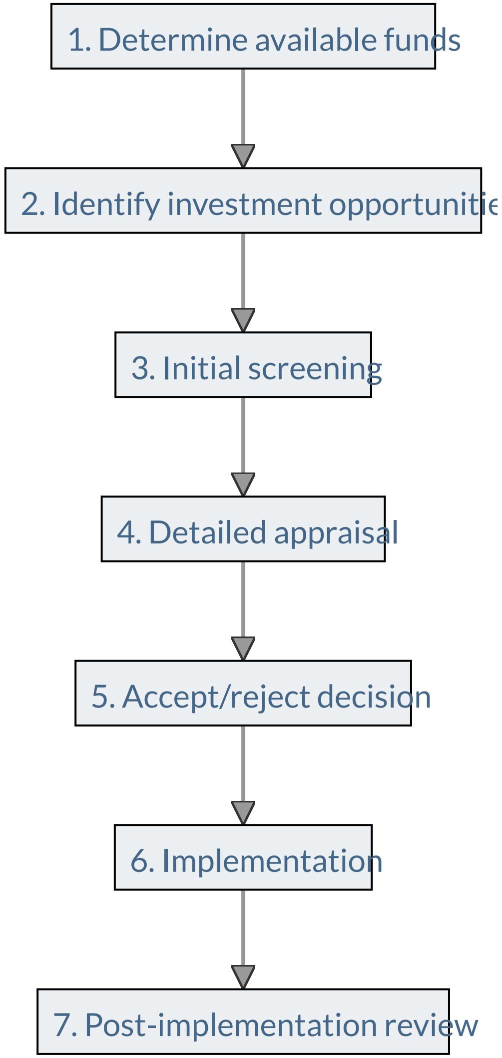

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Beyond the Numbers: Non-Financial Factors

Non-Financial Factors

Financial appraisal provides essential input but should be complemented with consideration of:

- **Strategic fit** with organizational objectives
- **Market position** and competitive impacts
- **Technical feasibility** and resource availability
- **Environmental, social, and governance factors**
- **Regulatory compliance** requirements
- **Organizational capability** and change management

These factors may override pure financial analysis in some cases.

Post-Completion Audit

After implementing capital investments, organizations should conduct post-completion audits to:

- **Compare actual outcomes with projected performance**
  - "Did we achieve what we expected?"
- **Identify reasons for discrepancies**
  - "Why were our forecasts off?"
- **Improve future forecasting and decision-making**
  - "How can we do better next time?"
- **Create accountability for projections**
  - "Who is responsible for the results?"
- **Capture learning for future investments**
  - "What lessons can we apply to other projects?"

Post-Completion Audit: Best Practices

Best Practice

Research shows that companies conducting systematic post-completion audits achieve:

- **More accurate future projections** - Learning from past errors
- **Better investment performance** - Making better decisions
- **Improved organizational learning** - Sharing knowledge across departments
- **Enhanced strategic alignment of investments** - Keeping focus on long-term goals

Key Takeaways

- Investment decisions are among the most consequential in financial management
- Cash flows, not accounting profits, are the basis for sound investment appraisal
- NPV is the most theoretically sound method, directly linked to shareholder value
- Multiple appraisal methods should be used in combination for a complete perspective
- Risk assessment is an essential component of investment decision-making
- The broader organizational and strategic context must be considered alongside financial analysis
- Post-completion audits improve future decision-making

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For Tomorrow

Tomorrow morning, we will explore:

- Sources of finance
- Capital structure decisions
- Cost of capital calculation
- Working capital management

Please review the applied exercises at the end of chapter 5 in preparation for our practical session.

Additional Resources

Core Reading: - Brealey, R., Myers, S., & Allen, F. (2023). *Principles of Corporate Finance* (14th ed.), Chapters 5-7 - Arnold, G. (2020). *Corporate Financial Management* (6th ed.), Chapters 2-4
Additional Resources for Non-Quantitative Students: - Khan Academy - Time Value of Money (online videos) - Investopedia - Discounted Cash Flow (online resource) - Corporate Finance Institute - Excel Templates (practical tools)

Practice Exercises

To consolidate your understanding, attempt these practice problems before tomorrow's session:

1. A project requires an initial investment of £200,000 and is expected to generate annual cash flows of £50,000 for 5 years. Calculate the project's payback period, NPV (using a 12% discount rate), and IRR.
2. Company A is considering two mutually exclusive projects with the following cash flows:

Year	Project X (£)	Project Y (£)
0	-300,000	-300,000
1	100,000	250,000
2	150,000	100,000
3	150,000	50,000
4	50,000	25,000

Using a discount rate of 10%, calculate:

- The NPV of each project
- The IRR of each project
- The payback period of each project
- Which project should be selected and why?

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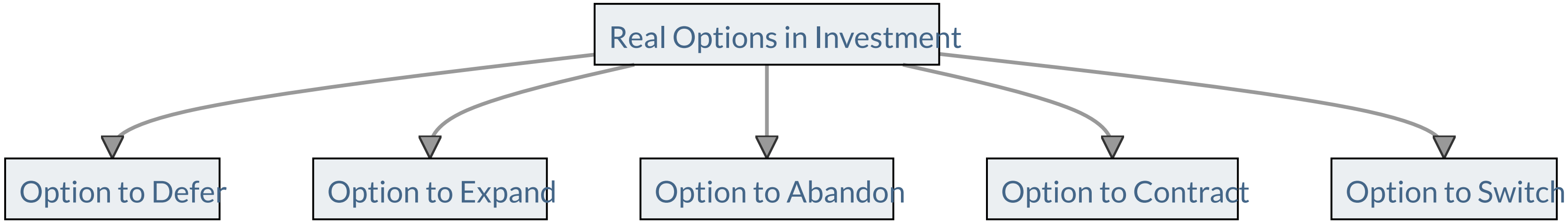
Advanced Topics: Real Options in Capital Investment Decisions

Real options analysis recognises that investment decisions often contain embedded options that can significantly impact project value.

Real Options Framework



Think of real options like house construction: - **Option to Defer**: Buy land but wait to build until market improves - **Option to Expand**: Build deep foundations now to add floors later - **Option to Abandon**: Design for easy conversion to commercial use - **Option to Contract**: Include a separate rental suite - **Option to Switch**: Install dual heating systems (gas/electric)

Common Real Option Types

Option Type	Description	Value Driver	Example
Defer	Ability to postpone investment	Reduces uncertainty	Oil company delaying field development
Expand	Opportunity to increase scale	Captures upside potential	Infrastructure with expansion capacity
Abandon	Ability to exit unprofitable projects	Limits downside risk	Pharmaceutical research termination option
Contract	Option to reduce project scale	Mitigates adverse conditions	Modular manufacturing facility

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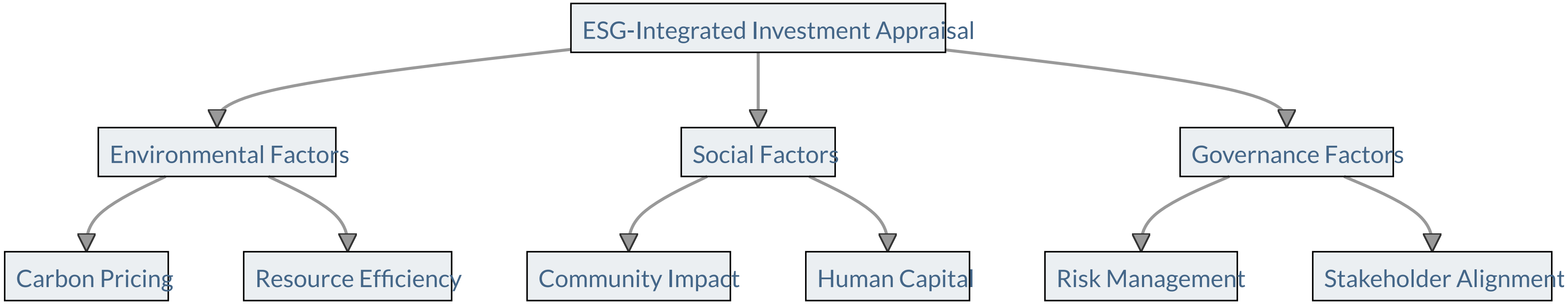
Option Type	Description	Value Driver	Example
Switch	Flexibility to change inputs/outputs	Adapts to market changes	Multi-product production capability

ESG Factors in Investment Decisions

Modern investment appraisal increasingly considers ESG (Environmental, Social, and Governance) impacts alongside financial returns.

ESG Framework



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Quantification Methods

ESG Factor	Quantification Approach	Financial Integration
Carbon emissions	Shadow carbon price	Additional cost per tonne CO_2e
Water usage	True cost of water	Adjusted operating expenses
Community benefits	Social return on investment	External benefit valuation
Human capital	Productivity differentials	Adjusted revenue/cost projections
Governance quality	Risk premium adjustment	Modified discount rate

Advanced Risk Analysis Techniques

Beyond sensitivity analysis, several sophisticated approaches help quantify investment risk.

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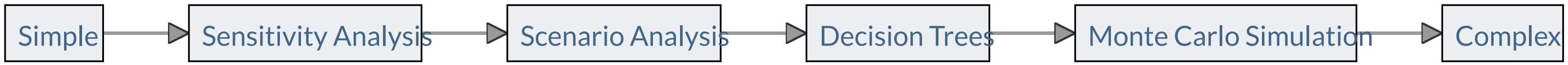
Risk Analysis Spectrum



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Decision Tree Analysis

Decision trees incorporate sequential decisions and uncertain outcomes:

```
                                  High Growth (60%)
                                 /  NPV = £8.2m
                   Expand       /
                  /            /   Moderate Growth (40%)
Initial          /             \   NPV = £5.1m
Investment ─────┤
£4.5m           \                 Stable Growth (70%)
                 \               /  NPV = £3.6m
                  Don't Expand  /
                                \  Slow Growth (30%)
                                 \  NPV = £2.8m
```

Analysis methodology:

- Expected value if expand: (0.6 × £8.2m) + (0.4 × £5.1m) = £6.98m
- Expected value if don’t expand: (0.7 × £3.6m) + (0.3 × £2.8m) = £3.36m
- Optimal decision: Expand (£6.98m > £3.36m)

Final Recap

- Investment decisions require careful, systematic analysis
- Different appraisal methods offer different perspectives
- Consider both financial and non-financial factors
- Incorporate risk analysis for more informed decisions
- Don’t forget to conduct post-completion reviews
- Real options and ESG factors are increasingly important

References

Academic References:

- Damodaran, A. (2022). *Investment Valuation: Tools and Techniques for Determining the Value of Any Asset*, 4th Edition, Wiley Finance
- Dixit, A.K. & Pindyck, R.S. (2021). *Investment Under Uncertainty*, Princeton University Press
- Trigeorgis, L. & Reuer, J.J. (2023). *Real Options Theory in Strategic Management*, Strategic Management Journal, 44(4), pp. 842-878