

a primer on

Project Evaluation

(How much can an idea be worth?)

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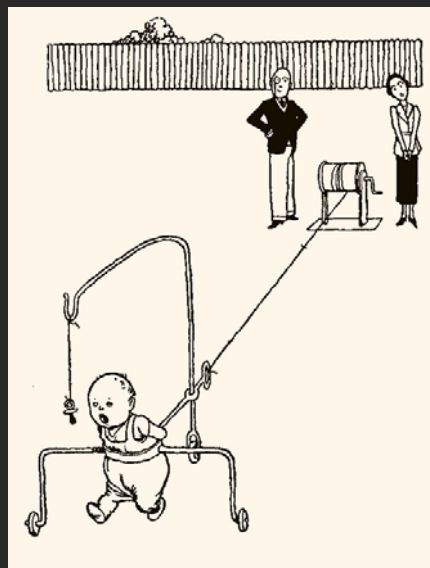
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Coverage

- Investment appraisal
- Cashflow over project lifetime
- Measures of profitability based on cashflow analysis
- Time value of money, discount rate and its effect
- An example of actual IP valuation

You think that you have a seemingly practical idea

What is its utility
(what is it worth?)

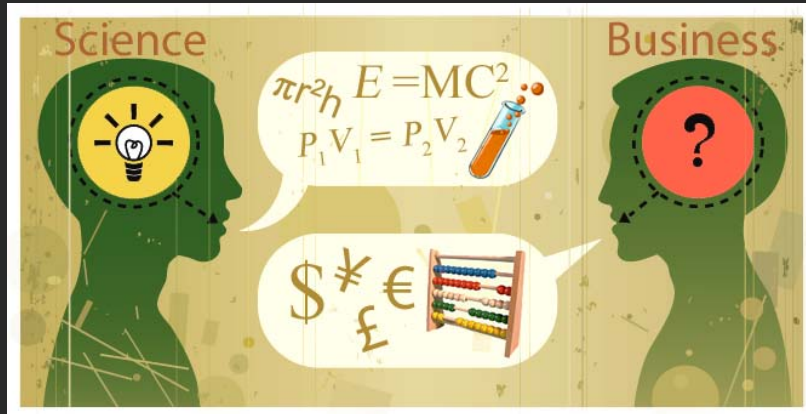


You want to interest industry in your idea

... so that you can sell it (but how much to ask for?)

or

... raise research funding (but why should they risk the funds?)



You have a few choices for the use of your funds

How would you evaluate?



The commercialization of ideas costs money
Projects cost money

Can we afford not to systematically assess where public
R&D funding should go?

Screening Ideas

How should research options be rationally
prioritized?

- Cost-benefit analysis
- Economic/project evaluation

Project Evaluation in Applied Research

- Project expenditure is usually justified by the expectation of a future return
e.g. prestige; goodwill; political advantage; amenity value; social value; economic benefit
- When the **cost of resources and effort** needed to bring a project into being is compared against the **value of the resulting benefits**, the evaluation is **economic or financial**

Project evaluation



Similar species

Economic evaluation; financial evaluation; profitability analysis

Is

- Investigation of cash flow and risk to determine a project's eventual financial benefit
- Assessment of activities that are funded for a defined period of time to perform a specified task
- Appraisal of factors which are quantifiable, measurable and comparable in money terms

Project Evaluation

Is a good tool:

- For ranking or comparing projects



- For the valuation of intellectual property



Project evaluation

- ensures the right project is undertaken



- the right timing



- the best chance of success



- provides information for making good investment decisions



What is the role of project evaluation in business?

Firstly, we need to consider ...

Why companies try new ventures

This is actually the reason **why ...**
you might get **R&D funding** from **industry**

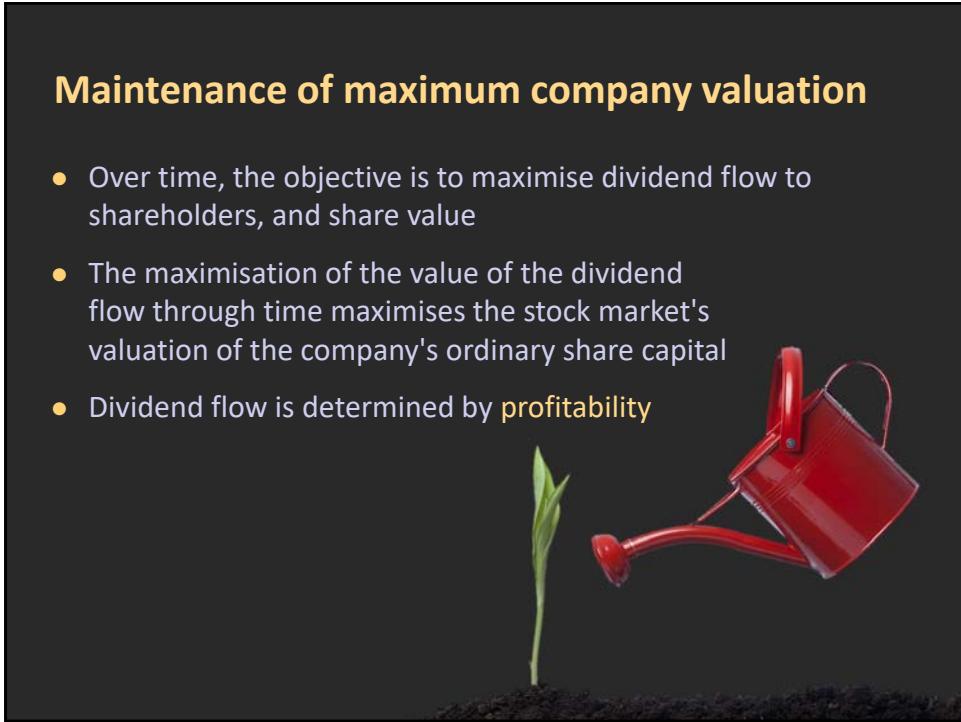
Financial objectives in a commercial organisation

- Decisions are taken by companies so as to maximise owners' wealth
- Owners' wealth can be maximised through maximisation of owners' purchasing power
- Purchasing power can be maximised by:
 - maximisation of dividends
 - and top value of shares when sold



Maintenance of maximum company valuation

- Over time, the objective is to maximise dividend flow to shareholders, and share value
- The maximisation of the value of the dividend flow through time maximises the stock market's valuation of the company's ordinary share capital
- Dividend flow is determined by **profitability**



- Profitability is determined by the success of a company's commercial activity
- To maximise profitability, commercial activity must be appropriate in a commercial environment which is constantly changing in:

market share; competition; product improvement;
new products; lower prices



To increase or maintain profitability, a company can:

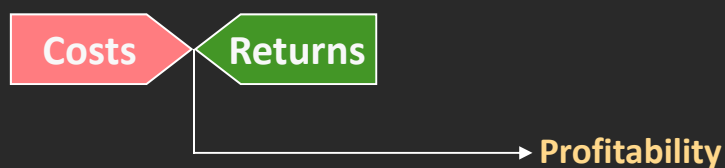
- Increase productivity
- Risk new ventures

Both alternatives require **investment appraisal**

Investment appraisal via profitability analysis

Information from project evaluation

- Is quantifiable, measurable and comparable in money terms
- is based on forecasts or estimates
 - ... monetary costs and timing of the effort and resources
 - ... monetary value and timing of the resulting benefits



Costs

In project proposals, estimation of costs is usually less difficult

- More immediate in time
- Proposers are relatively more familiar with their technology

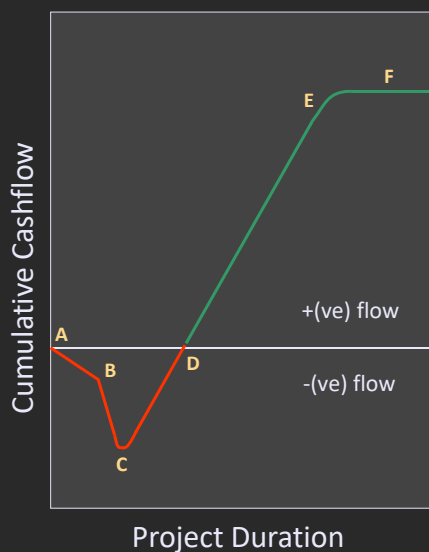
Returns

How returns (revenue) are estimated is usually relatively more difficult for proposers

- Conventions used
- Methodology

Project evaluation involves examining the flow of funds through time

Cumulative cashflow in a project



Future cashflow is referred to as "projected"

- A - B: Development, design and other preliminary activities.
- C: Max. debt accumulated by the project
- C - D: Project starts to earn
D = Break even point
- E: Rate of positive flow decreases.
- F: Plateau; no further cash flows.

How profitable is a venture?

How might this be assessed?

Measures of Profitability

Non-Discounting methods

Payback period (PB)

= number of years from plant set-up to recover all expenses in a project if all the pre-tax profits were used for this purpose

Disadvantages

- provides no indication of the expected return on investment or cash return of a project
- Ignores everything in the time beyond the breakeven point
- Ignores the changing pattern of cash flow with time
- Ignores the time value of money

Measures of Profitability 2

Return on investment (ROI)

The (potential) financial benefit expressed as a percentage of the costs of generating that benefit
e.g.

$$\text{ROI} = \frac{\text{Net profit}}{\text{Total funds invested}} \%$$

Disadvantages

- Ignores the time value of money
- Ignores the changing pattern of cash flow with time

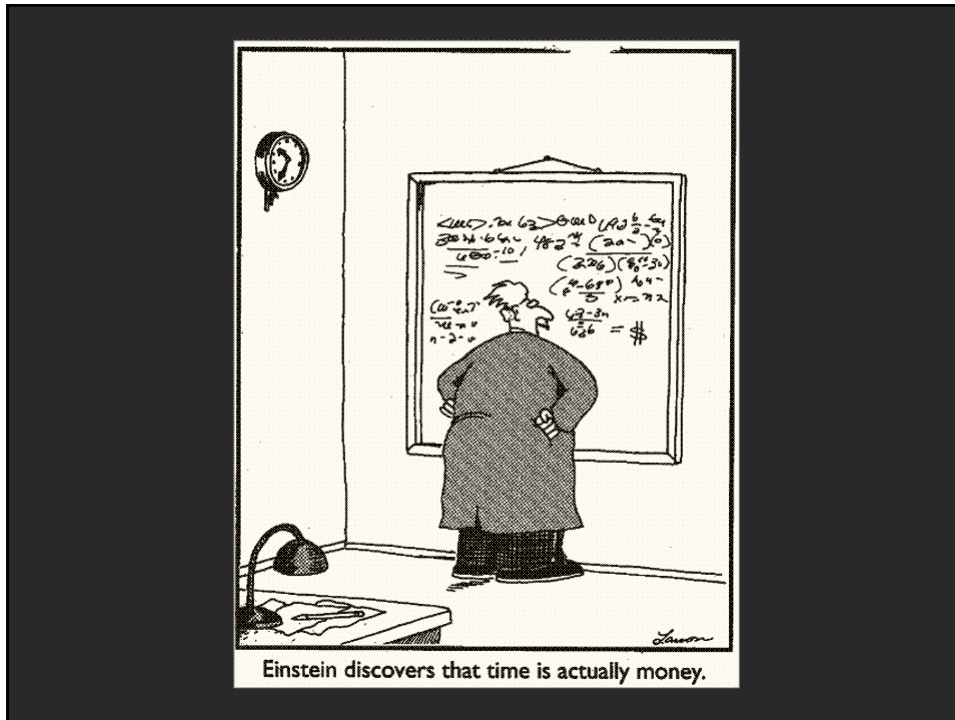
Measures of Profitability 3

The Time Value of Money and Discounting

- Timing preference
Receipt is preferred sooner than later: risk; inflation
- Opportunity cost
The earlier the receipt, the greater the potential for increasing wealth

To account for time value and since projected cash flows are future events, discounting is used

- Discounting brings cash flows to a common time basis for comparison
- Discounting gives the Net Present Value



Measures of Profitability 4

Discounting Methods

- **Internal Rate of Return (IRR)**

The discount rate that reduces to zero, the net present value of a stream of income inflows and outflows

- **Net Present Value (NPV)**

A measure of the absolute economic profit expected as the result of investing in a project (the net value of all cash flows for the project)

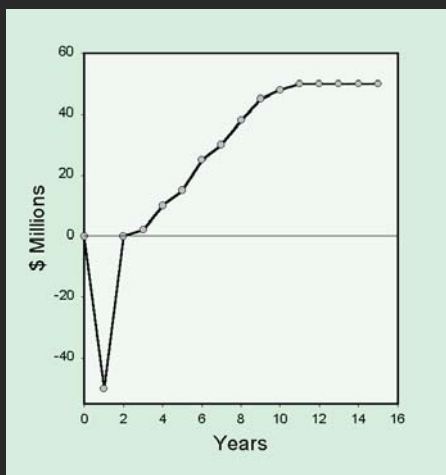
Consider

- **Payback Period analysis**
Measure is **TIME**
- **Return on Investment analysis**
Measure is **%**
- **Internal Rate of Return analysis**
Measure is **%**
- **Net Present Value analysis**
Measure is **\$**

Which measure is useful in valuations of IP?

Projected cashflow of a project

Year	Cashflow
0	0
1	-50
2	0
3	2
4	10
5	15
6	25
7	30
8	38
9	45
10	48
11	50
12	50
13	50
14	50
15	50
Cumulative Cashflow	413

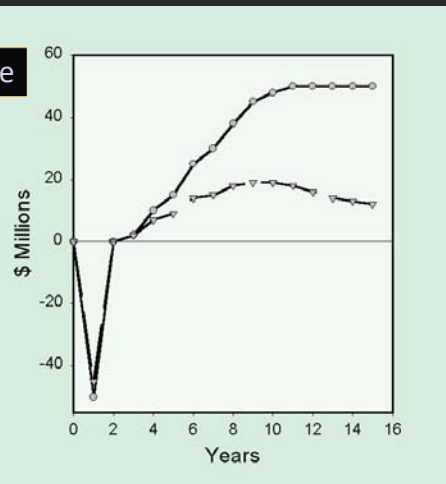


Total cash value from revenue as far away as 15 years in the future

Discounted projected cashflow of a project (NPV)

Year	Cashflow	DR
		10%
0	0	0
1	-50	-45
2	0	0
3	2	2
4	10	7
5	15	9
6	25	14
7	30	15
8	38	18
9	45	19
10	48	19
11	50	18
12	50	16
13	50	14
14	50	13
15	50	12
Cumulative Cashflow	413	130

Discount rate



NPV

Ranking projects by NPV

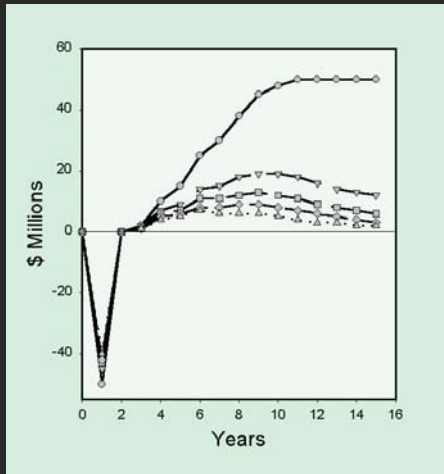
Year	Projects			
	A	B	C	D
0	0	0	0	0
1	-45	-12	-98	-20
2	0	3	20	-25
3	2	5	25	2
4	7	10	30	2
5	9	15	35	5
6	14	20	38	7
7	15	20	40	10
8	18	20	42	15
9	19	20	46	20
10	19	20	50	20
11	18	20	50	20
12	16	15	50	20
13	14	10	50	15
14	13	5	40	10
15	12	0	20	5
NPV	130	171	438	131

$$130 < 131 < 171 < 438$$

- Project C is ranked highest by NPV
- Projects A and D are similar in NPV but have different cashflow patterns.

The effect of discount rate on NPV

Year	Cashflow	Discount Rate	
		10%	
0	0	0	
1	-50	-45	
2	0	0	
3	2	2	
4	10	7	
5	15	9	
6	25	14	
7	30	15	
8	38	18	
9	45	19	
10	48	19	
11	50	18	
12	50	16	
13	50	14	
14	50	13	
15	50	12	
Cumulative Cashflow	413	130	



Year	Cashflow	Discount Rate			
		10%	15%	20%	25%
0	0	0	0	0	0
1	-50	-45	-43	-42	-40
2	0	0	0	0	0
3	2	2	1	1	1
4	10	7	6	5	4
5	15	9	7	6	5
6	25	14	11	8	7
7	30	15	11	8	6
8	38	18	12	9	6
9	45	19	13	9	6
10	48	19	12	8	5
11	50	18	11	7	4
12	50	16	9	6	3
13	50	14	8	5	3
14	50	13	7	4	2
15	50	12	6	3	2
Cumulative Cashflow	413	130	72	37	15

- The further into the future projected revenue is, the lesser the relative contribution to the analysis.
- The bigger the discount rate, the larger this effect is.

Thus, the discount rate

has a profound effect on the estimated value of a project

How are discount rates derived?

- can be subjective
- Systematically such as:

$$K_j = R_f + [b_j \times (k_m - R_f)]$$

where K_j = required return on project (discount rate)
 R_f = risk free rate of return
 b_j = beta coefficient
 k_m = market return

How potential investors can beat you down on price

- Choosing an unfaltering discount rate
- Use the cost of further development to dilute your equity share

How Potential Investors Can Beat You Down on Price 2

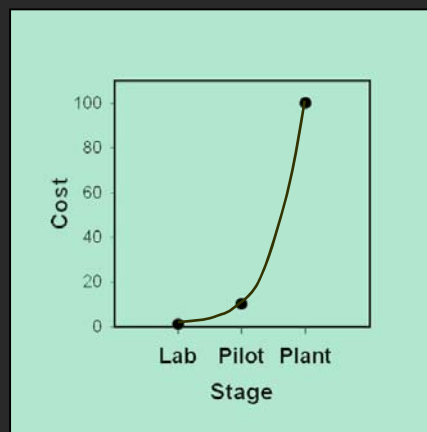
Consider:

- The R&D Spectrum



How Potential Investors Can Beat You Down on Price 3

- Cost escalation from lab to plant



After Hacking (1986)

How Potential Investors Can Beat You Down on Price 4

Your equity share is diluted because
initial investment < total investment required

An example of
Project valuation via NPV

Mycobead
Inoculum for plantation forestry

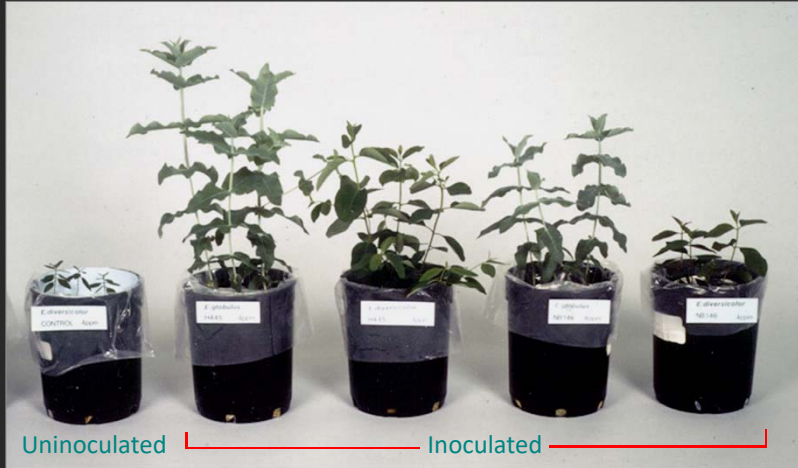
The biological phenomenon

Ectomycorrhizal fungi

Manifest themselves as mushrooms or truffles



An ectomycorrhiza

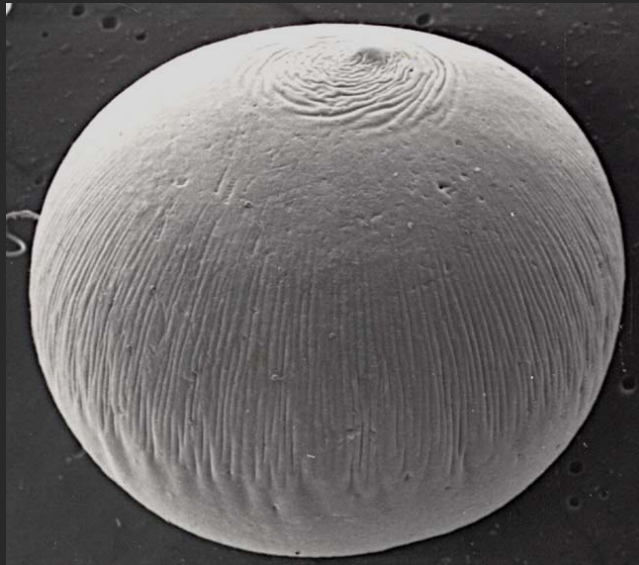


Effect of inoculation with ectomycorrhizal fungi on eucalypt seedlings

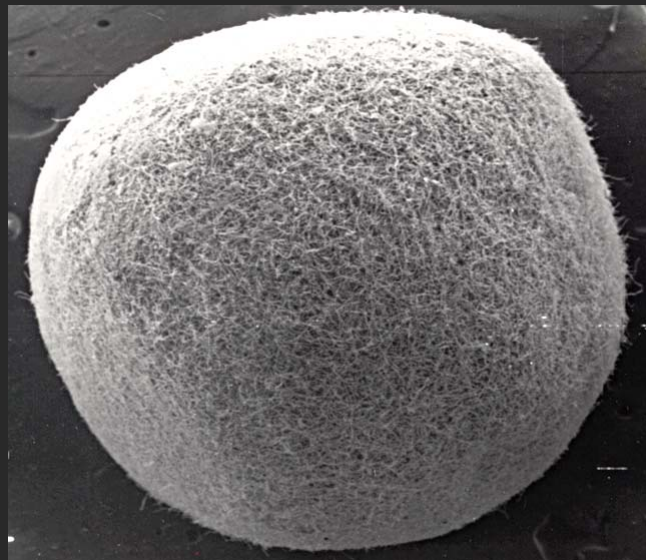
The concept



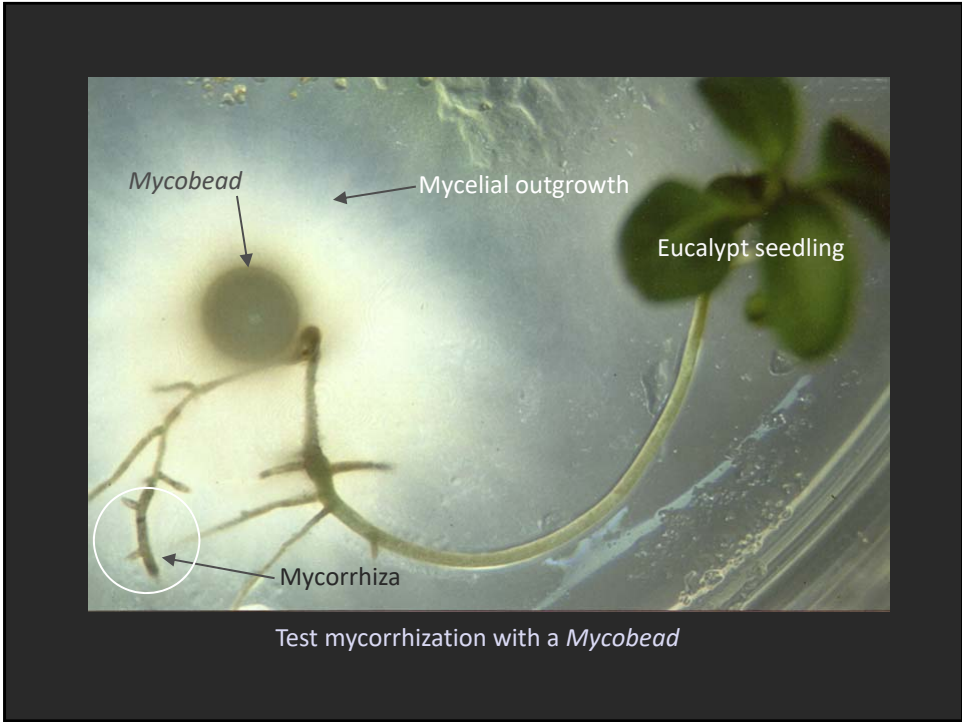
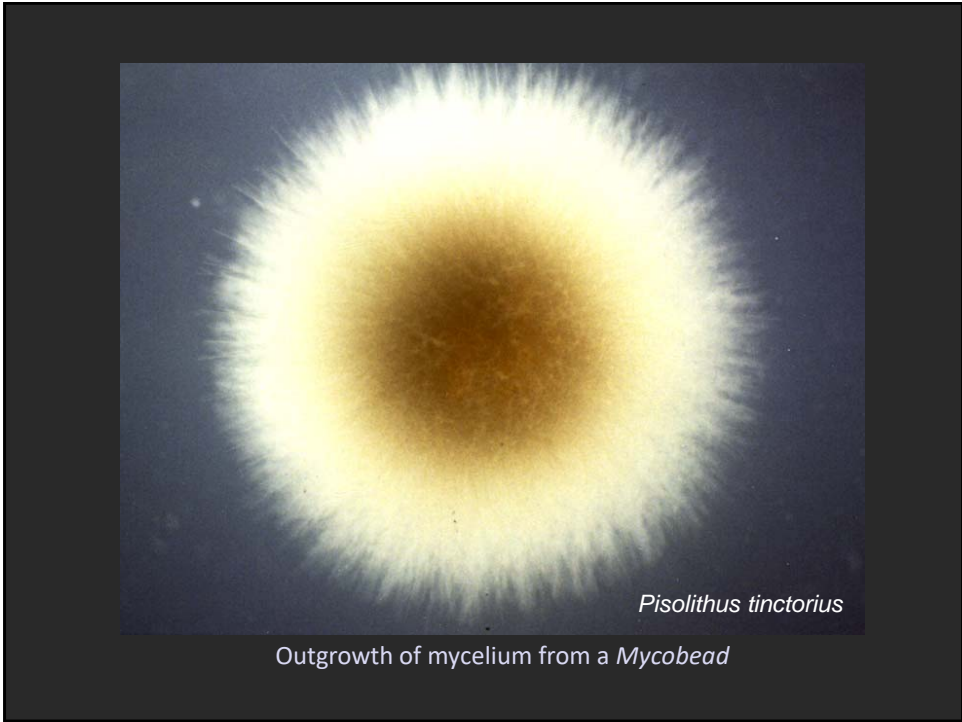
Mycobead inoculum



SEM of bead exterior



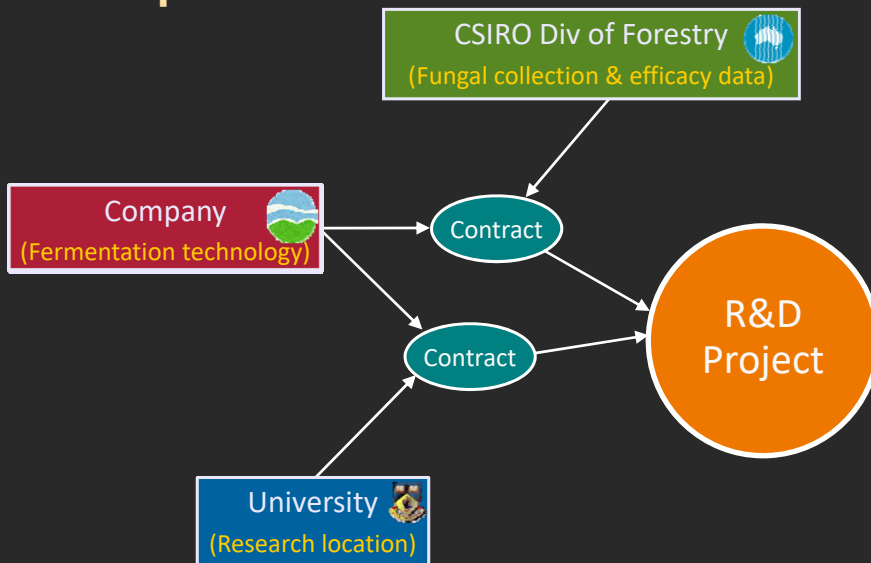
SEM of bead interior





Eucalypt seedlings successfully inoculated with *Mycobead*

The partners



The question

How much would such
technology be worth?

Who were needed in the valuation?

Independent assessments by experts in:



forestry/ectomycorrhiza



fermentation technology



cashflow/profitability analysis (accountants)

Estimation of the unit price of the product

(1989 dollar values)

i. Estimation of plantation costs

Major costings used in an analysis of the economic value of improvement in the growth rate of plantation *E. globulus*.

Item	\$ ha ⁻¹
Annual lease payment for land (6% of land value)	72
Site preparation and establishment	668
Additional weeding (Year 2)	31
Additional fertiliser (Year 5)	96
Annual maintenance (Years 1- 5)	38
Annual maintenance (Years 5 - 10)	25

ii. Calculating the benefit of improved rate of tree growth

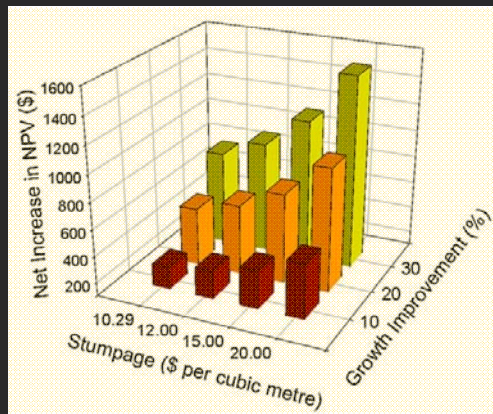
Using a coppiced rotation scenario and assumptions as follows:

- 40 hectare, leased, ex-pasture sites
- Benefit = monetary value (in NPV) of the increase in MAI of plantation trees @ a discount rate of 5%
- Increments @ 10, 20 and 30% over a base MAI of 22 m³ ha⁻¹ year⁻¹

At:

- Stumpage = \$20 per m³
- Growth improvement rate of 30%

The benefit to a plantation is \$952 ha⁻¹ NPV



iii. Unit product price

If the cost:benefit ratio that is the threshold for product adoption = 1:5

Then, the value of growth improvement is $952/5 = \$190$

If planting density is 1000 seedlings ha⁻¹ in a plantation,

Then price that might be commanded by ectomycorrhizal inoculum is

19 cents per dose

Valuation of project worth



Cashflow projection

Inputs

- Revenue
 - Project life
 - Unit product price
 - Market size (Australia and globally)
 - Market penetration
 - Discount rate on projected cashflow
- Costs
 - R&D
 - Fixed costs *e.g.* production plant; office; staff; marketing
 - Variable costs *e.g.* production inputs
 - Tax?
 - Depreciation?

Valuation of project worth



The agreed valuation was **\$A4.2 million** NPV in 1989

[= AUD8.72 million in 2017 (RBA 2018)]

This represents the potential earning capacity of the project and can be used as the **value of the project's IP**

Remember

- NPV is but one method for assessment
- In the end,
There is nothing to sell (no value)
unless there is a buyer



An investor is not likely to appear
unless the numbers line up



rba.gov.au (2016) *RBA: Inflation Calculator*. [online] Available at:
<http://www.rba.gov.au/calculator/annualDecimal.html> [Accessed:
07 Dec 2016].