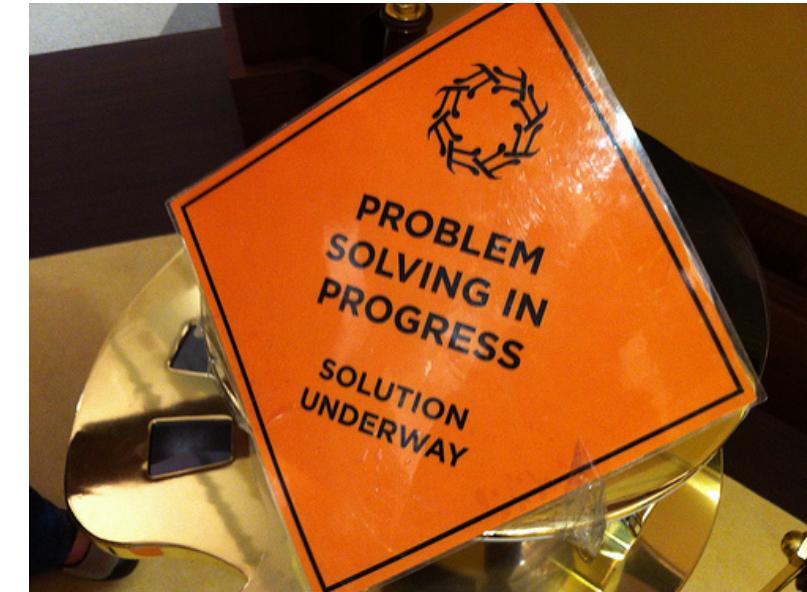


# Solution space

- The real world of Engineering is about the “Solution Space”. We are the professionals who actually do things and provide products and services for society. Some of us might work in feasibility or development but all of us are involved in some form of existing or new product or service - virtual or real.
- Relatively few of you will live your lives in a darkened room thinking great thoughts which you may or may not choose to put on paper.
- Because we are all involved in “Solutions” as Engineers we all have to deal with people and money.



# People and Money

In reviewing the feedback from the final reflection on learning (ROL) of some of the 2016 EngGen 403 class it was interesting to see that some thought money and people would not be part of their engineering degree when they started EngGen303.

Some clearly chose engineering to avoid money and people.

At the time of leaving High School some had the understanding that money was a topic primarily for accountants and that engineers would not get to involved in money.

Engineers need to understand money, but from an engineering perspective rather than an accountant profession viewpoint.

Personally I prefer to think of "value" rather than money.

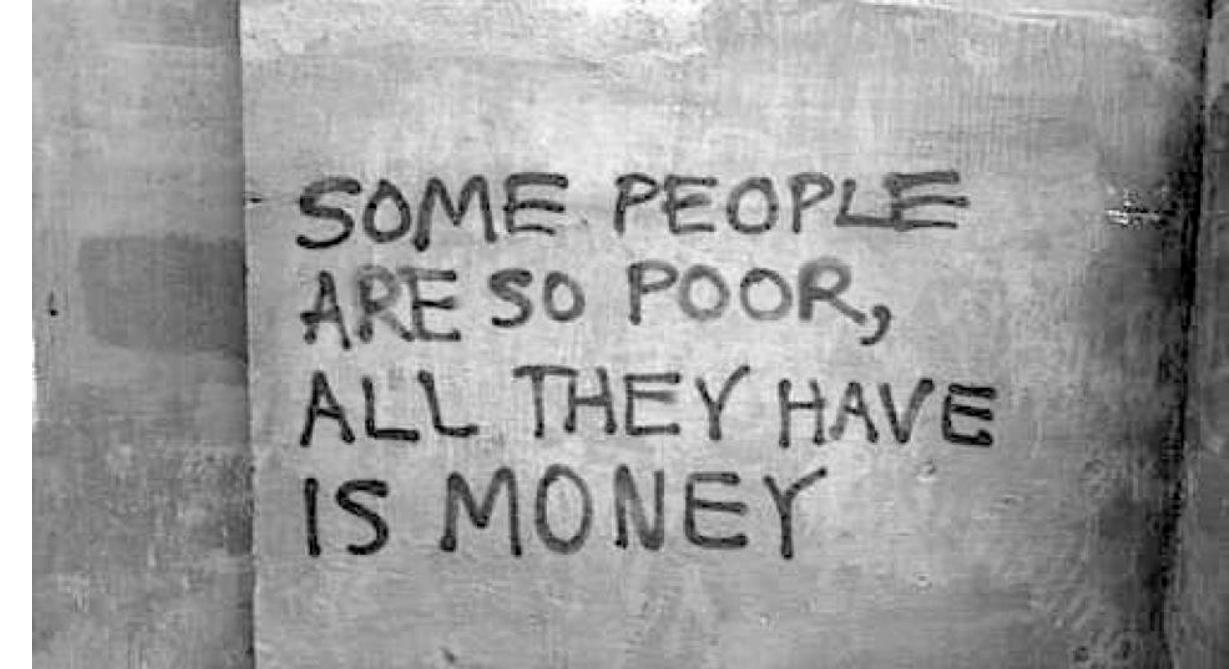
# Value

## **Value has:**

- a sense of time and of risk and reward
- a sense of money required
- a sense of expenses that will be incurred
- a sense of revenue that might be generated
- a sense of taxation and depreciation
- and a sense of social, environmental and economic sustainability.

Asking ourselves what is the “value transaction” is an excellent question.

It is also helpful to thinking of the money required being our own money. If we would not personally invest in some “value transaction” why should others or our company.



# People

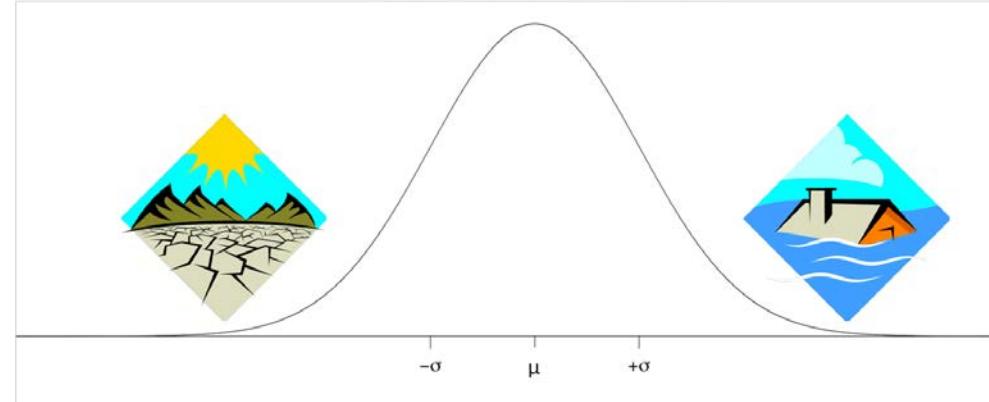
All engineering is associated with some type of business. It might be our business, or somebody else's business, or owned by shareholders, or owned by a community, council or Government.

All businesses have people: the Directors, the boss, the executives, the managers, the workers and others.

If we are Engineers we will deal with people on a regular basis.

People think and have feelings and are simultaneously or in sequence: a joy to be with; or frustrating beyond belief and all points in between.

# Right answer and precision



It is worth pausing to think of maths and physics vs people and value/money.

Maths and physics problems can be precisely defined and often have answers that are accurate to 6 places of decimals.

People and money challenges can rarely be defined in any detail and the answers can rarely be proved right or wrong and hence precision is not possible. Ranges of possible/potential outcomes and probabilities become more useful.

# Therefore what?

Many may be thinking I did not come to engineering school for all this people and money nonsense.

I am not interested in this and do not intend to worry about this. I am far more interested in gaining my Discipline Knowledge.

Unfortunately not a good answer.

Engineering is actually a dual pathway profession:

Pathway #1: discipline knowledge and expertise

Pathway #2: people knowledge and skills, money and business knowledge and skills.

# Can we favour one pathway over the other?

Of course we can as we live in a society where we have individual choice and free will.

However a few things to remember:

Our degree has compulsory papers for both pathways.

We need to pass electives in both pathways to graduate.

The Accreditation of our degree under the Washington Accord requires knowledge in both pathways.

Employers actually value pathway #2 expertise over pathway #1 (in general).

Students who have worked for a few years develop their pathway #2 skills and use little of their pathway #1 knowledge.



# Can we just focus on pathway #2: our interpersonal and business skills?

Big no.

To be an engineer we must think like an engineer and this requires that we have learned discipline specific skills and have understanding of the fundamentals that underpin knowledge in this discipline.

Our ability to think as engineers is critical throughout our careers.

We will never think that perpetual motion is possible, or that any process is truly reversible or that water flows uphill without power input.

Some of you may already be plotting how to pass EngGen303 without getting involved.

Bad news but possible to pass.

We have also been plotting and scheming about how to encouraged you to get involved in EngGen303. By involved we mean coming to lectures all the time and mentally participating in the resulting "combat".

I say "combat" to remind you that interpersonal skills are a "face to face" sport which can only be improved by "face to face" practice.

Learning about Accountancy is possible without coming to class. Learning about Accountancy from an engineering perspective may be possible without coming to class, but you will learn better if you come, listen and participate.

# Can we force you to come to class?

We cannot and are not allowed to do this.

However we get to decide how marks are allocated for this compulsory paper.

We do not intend to reward attendance at class, but we do intend to award participation.

20% of the total marks will be awarded for class participation quizzes and exercises. Mostly this will be electronic during class.

Not coming to class will result in your marks being out of a total of 80%. You get to decide.

Do we understand marks are more important to you generically than learning?

Yes we understand this completely.

Do we understand you need marks?

Yes.

Do we intend you to learn something along the way as you accumulate marks?

Yes if we can.

We will try really hard to help you learn?

Ideally you will be happy to do this provided we are respectful of your need to get marks.



# What level of people and money skills do we want you to have?

We doubt you will ever be at the level of helping folks lying on your office couch without further study, but we want you to understand why some folks take longer for you to get to know and require more patience. We are not experts in psychology, but perhaps some of you might be in the future.

We doubt you will ever be Governor of the Reserve Bank, but a UoA PhD in Chemistry was the CFO of one of the global Oil Supermajors.

# Personality Tests

There are many ways of describing our personalities (who we are).

A common one is Myers Briggs.

This has been used around the world for decades and uses 4 pairs to give an indication of our preferred behaviour:

E vs I (focus our attention)

S vs N (gain information)

T vs F (make decisions)

J vs P (interact with the outer world)

There are thus 16 combinations



# PERSONALITY

What makes you the way you are

**ISTJ**

Doing what  
should be done

**ISFJ**

A high sense of  
duty

**INFJ**

An inspiration to  
others

**INTJ**

Everything has  
room for  
improvement

**ISTP**

Ready to try  
anything once

**ISFP**

Sees much but  
shares little

**INFP**

Performing  
noble service to  
aid society

**INTP**

A love of  
problem solving

**ESTP**

The ultimate  
realists

**ESFP**

You only go  
around once in  
life

**ENFP**

Giving life an  
extra squeeze

**ENTP**

One exciting  
challenge after  
another

**ESTJ**

Life's  
administrators

**ESFJ**

Hosts and  
hostesses of the  
world

**ENFJ**

Smooth talking  
persuaders

**ENTJ**

Life's natural  
leaders

# Different is Different

All combinations are equally valid and there is no right personality.

We can never tell another person they need to change.

**Different is different and we need to accept that.**

Some folks think Myers Briggs is useful to help us understand each other.

Others think the test is a complete waste of time and inaccurate

# What do you think/feel you are?

Have a go at thinking/feeling about yourself and your personality preferences:

E (energy from outside) vs I (energy from inside)

S (solid information) vs N (intuition)

T (logic) vs F (feelings)

J (orderly) vs P (flexible)

# **MB is not accepted by some**

**Some find these sort of tests completely distasteful.**

They do not believe anybody should be put in a box or category.  
I am not qualified to talk about this topic so please regard this as innovative/risky on my part.

I have taken these tests many times so think I am allowed to talk about myself

**I have found this type of testing useful to help me understand myself and improve somewhat**

# How does the test work?

The full test is 100+ questions.

You select between 1 of 2 answers per question.

The questions tend to self check each other.

Some characteristics are expressed in the positive (I like reading good books) and some in the negative (I do not like reading books).

The total score in each of the 8 categories suggests your profile and identifies the 2 more dominant traits

For some questions both answers feel wrong or right but we have to choose.

# Rob

We tend to have 2 stronger characteristics

On any characteristic there is a scale from the extreme left to the extreme right

On some characteristics we tend to be in the middle

Our personalities can change over time

Myers Briggs is one of several ways of understanding ourselves.

Our preference for one of each pair does not mean we can not be happy on the other side of that pair (it may just take a bit more effort)

# Young Rob

ISTJ



Not comfortable in a crowd with strangers – strong I

The facts were the facts – moderate S

Logic was always important – strong T

Things should be planned and orderly – moderate J

Actual feedback {bit extreme}: happiest in a dark cupboard with the door locked.

# Old Rob (today)

ENTP {or INTP}

Fairly close to the **middle on I & E**. Not a cold call salesman but ok with new folks provided they want to talk with me.

**Offscale N** intuition (never let the facts get in the way of my solution). There are all sorts of possibilities. Eagles rule over hedgehogs

Still more interested in logic rather than people's feelings but highly protective towards my family. **Strong T**

Not particularly interested in planning everything. Far happier to be flexible and spontaneous. **Weak P**



# What has Myers Briggs taught me

MB Personality types can be helpful for some folks.

Our greatest strengths are also our greatest weaknesses.

Opposites attract.

Opposites can be tough to deal with in a group environment.

**People are important so we need to be mindful of ignoring F.**

Having both S and N in our groups is useful.

Having both J and P in our group is useful.

# Difference and Diversity

We need to recognise that other folks may have a different personality from us. They will therefore focus on different things, gather information in different ways, make decisions using different criteria and see the world from a different perspective.

Add on top of this our heritage, country of origin, religion, language, social status, influence of our parents and we have considerable diversity in any group here within Engineering.

**Diversity is great if we can manage it.**



# EngGen303 is a safe environment

Take your personality out for a walk. See how easy or hard it is to change from your preferred way of doing things to a non preferred way to help you relate to and work with somebody you have never met.

Try and give your fellow students the benefit of the doubt.

Learn about their background and culture

# First some recap from Wed

Who looked at MB personalities on the internet?

Who decided what their MB personality profile might be?

Who likes themselves?

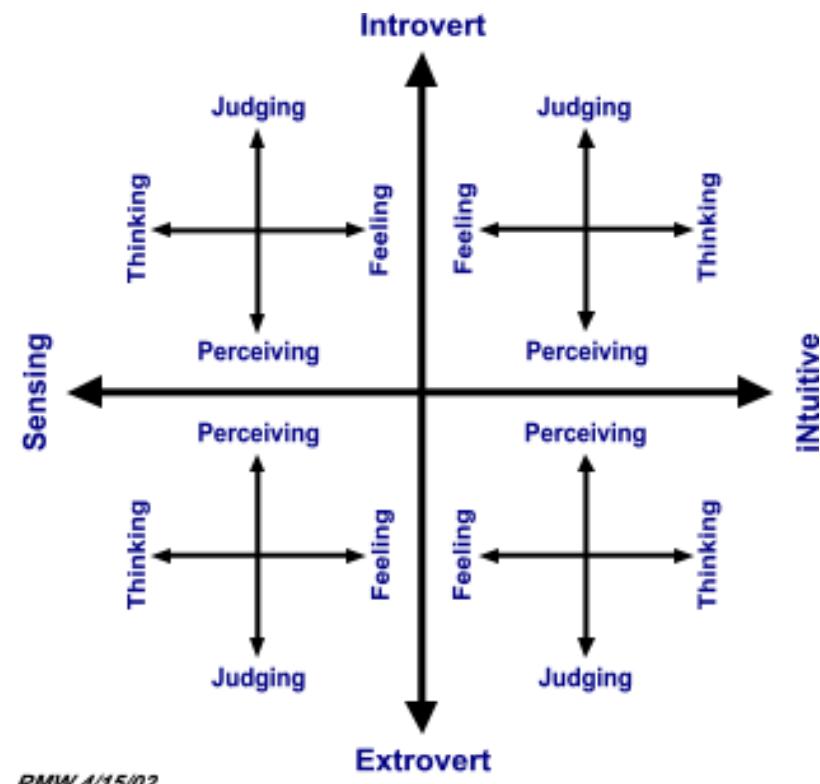
Who is looking forward to using their non preferred personality?



*eat. sleep. revise. And repeat.*

# What do you think you are? Q#1

ISTJ	ISFJ	INFJ	INTJ
ISTP	ISFP	INFP	INTP
ESTP	ESFP	ENFP	ENTP
ESTJ	ESFJ	ENFJ	ENTJ



RMW 4/15/02

# **Groups**

Why is most of an engineer's work performed as part of a group?

# Groups

Why is most of an engineer's work performed as part of a group?

**Question 2:** (choose as many as you want)

- #1. To avoid a single person being too influential
- #2. To make the noisy folks listen
- #3. To make the quiet ones speak
- #4. To get a broad range of options
- #5. Normally gives the best outcome

# Groups

## **Not good if we have no diversity**

Group think (all white males in NASA or anywhere)

Difficult to manage diversity

The rewards and benefit of diversity far outweighs the problems and frustration of managing the diversity



# Groupthink

- <https://www.youtube.com/watch?v=fSTrmJtHLFU>

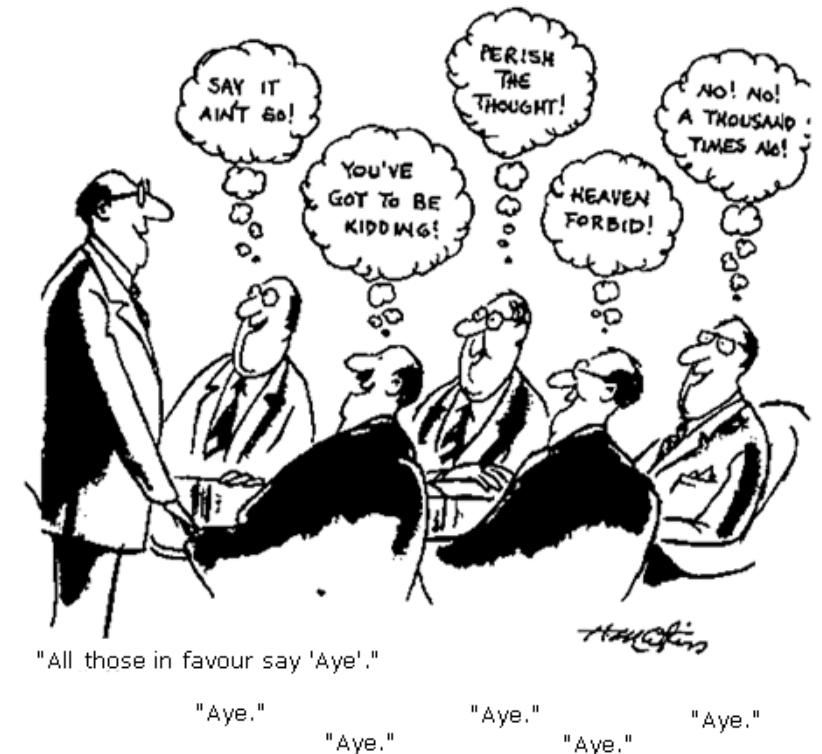
# Groups

## **Not good if we have no diversity**

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Difficult to manage diversity

The rewards and benefit of diversity far outweighs the problems and frustration of managing the diversity



## **Question 3 Y/N**

#1. People are probably the most complex objects in the world:

# Groups



Good idea to get to know the other members of our group as people; before we start to do any work.

We are more forgiving of our friends.

'Seal Team 6' supports its members other above all else.

# Progress check

## **Question 4:** (select only one)

- #1. I {reluctantly} accept groups are worthwhile.
- #2. I am not yet convinced I can not do better work by myself.
- #3. Groups are great because I can free load.
- #4. I am strongly “I” (internal energy) in my personality, but accept I should put effort into learning to contribute as best I can to my group.
- #5. This people stuff is all nonsense, I want to go and learn some real engineering in my specialisation.

# Suggestions: group work

Need a moderator or chair for the discussions.

Noisy ones only get to speak once {duct tape}.

Quiet ones must speak once {raise hand}.

Don't stop the discussion too soon.

Don't let the discussion drag on too much.

Need to reach a majority decision and have dissenters feel and think their views have been listened to and considered.

Must get those who did not agree with the decision to accept that they will work towards the agreed solution and not try and undermine what has been agreed.

Happy team members or former team members.

Choose moderator or chair carefully.



# **Chair/Moderator/Leader**

Ideally the chair assists the group to move towards an agreed solution without imposing their own view too strongly.

Stalin was not noted for requiring team consensus

Great leaders inspire the team to pull together in a common direction (Churchill)



# Conclusion thus far



We can not survive happily in Engineering without dealing with people.

Most work is done in groups.

People all have their own unique personality which we have no right to change.

People with different personalities from ours can be a pain but we have to find some middle ground to work successfully with them.

# First tutorial

Participation in a group to feel and see that we would all naturally take a different individual approach to a specific challenge, but we must select a common approach.

# **Do we need to talk more about people, groups and diversity**

Hopefully you can accept that interpersonal skills are really important for engineers.

Some may have been hoping this was not true – sorry about this.

University is a safe environment; so get on and have a go at learning how to deal with other folks you are not necessarily comfortable with.

Most of us will get to love our partner deeply. However others may always irritate and annoy us.

**Too bad; we still have to work successfully with folks who irritate us.**

# F or T ???

Our greatest strength is also our greatest weakness.

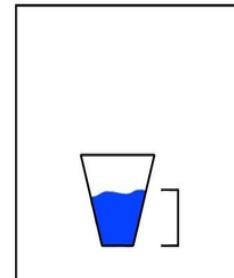
Remember to say hi and ask how somebody is going before jumping into the work stuff.

Worrying overly about whether people like us in a work environment may slow progress.

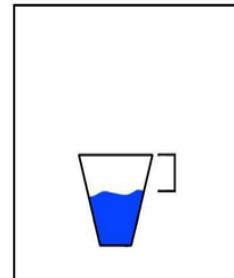
Remember about F when we are forming our life long relationships.

I am moderately T; but offscale F towards my wife, children and grandchildren.

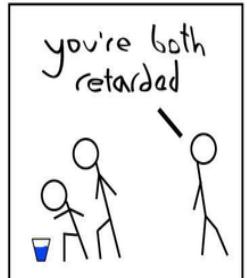
## optimism vs pessimism



WHAT OPTIMISTS SEE



WHAT PESSIMISTS SEE



WHAT REALISTS SEE

# Try and move your behaviour to fit the circumstances

Forming a strong group requires some (E) & (F) folks.

At the frontend of most work big picture and flexibility is important (N) & (P).

As consensus emerges (T) on what will be the best fit solution then detail becomes important to ensure it "will work". (S) & (I)

Planning before execution is critical. (J)

One particular person is probably not suited naturally to all phases of a project.



# Making our Groups work

The more we have to change our preferred behaviour to our non preferred behaviour the more emotional energy we spend and the more difficult it is.

However this probably means we have good diversity in our group and that our group will come up with a well thought out and robust solution.

No free lunch. We get out what we put in.

# Why do we have money?



Could we use something else? Gold?

If we are short of money why not print more?

What about direct barter?

I have apples and want a horse. The person who has a horse does not want apples. What do we do?



Money makes transactions convenient

# Money as a tool of trade



Even as poor impoverished students money has some significance as it is used in our transactions to obtain things we need or want.

Little happens in engineering without money being considered; however it may be best to really think in terms of "value" when we are comparing options.

**Value may be thought of as the sum of social + environmental + economic benefit vs cost.**

In some societies we value transaction in terms of the equivalent numbers of pigs. For most societies money is easier to use than trading pigs.

# Is it Commercial?

Rather than value we often question whether some action is commercial. Does it help the company to make money for its shareholders? This is a complex question as we must be able to pay our employees, pay our creditors/suppliers, pay our interest costs, pay of taxes, pay our equity contribution for new projects, put a little aside as cash reserves for a rainy day; and pay a dividend to our shareholders.

If we are not expecting/calculating to be financially viable as we go forward, we must stop trading now.

**Our new employer wants to know as an engineer do we understand what is Commercial and can we communicate conclusions briefly in appropriate written form to others.**

# Business

In engineering we can not ignore money and this leads us to interactions with business.

Few if any engineering activities occur which are not part of a business. **Thus as engineers we need to be comfortable with business and understand how a business works.**

There are many different types of business but fundamentally most are owned by central or regional Government or by some form of shareholder group which could be community, public or privately based.



# Engineers and Accounting



To be good engineers we need to understand the engineering principles of Accounting.

Accounting is about today and what happened during the year and last year and over history. (No time value of money looking backwards under Accounting)

However if we intend to do something new in our business we need a way to determine the best value option and whether we should or not execute the project. This skill often goes under the heading of Finance or Economics and tends to deal with the future rather than the past. Money has a time value looking forwards – could we do better (risk + reward) putting our money in the bank.

# Accounting and Finance

We will return to these topics later. A few things to consider in the interim:

Capital vs Expense

Balance Sheet

Profit and Loss Statement

Statement of Cash Flows

What is our Profitability?

What is our future Strategy?

How to justify future Investments?

	Cash Flow Statement for Plant 1 (first quarter, 2011)		
	January \$	February \$	March \$
<b>Cash inflows</b>			
Sales:			
retail	20 000	23 000	54 000
public	33 000	36 500	123 000
other manufacturers			
A	1 000 500	2 560 000	2 600 000
B	250 000	250 000	250 000
C	3 400 000	3 200 000	2 800 000
<b>Total inflows</b>	<b>4 703 500</b>	<b>6 069 500</b>	<b>5 827 000</b>
<b>Cash outflows</b>			
Raw materials	3 650 000	3 760 000	4 720 000
Service costs	23 000	23 000	23 000
Leases			
forklifts	11 000	11 000	11 000
equipment	125 000	125 000	125 000
Wages	850 000	990 000	980 000
Other	34 000	67 000	61 000
<b>Total outflows</b>	<b>4 693 000</b>	<b>4 976 000</b>	<b>5 920 000</b>
<b>Cash surplus/(deficit)</b>	<b>10 500</b>	<b>1 093 500</b>	<b>(93 000)</b>

# Accounting and Finance cont.

Business Case for new projects

Funding future projects

Debt and Shareholder Equity

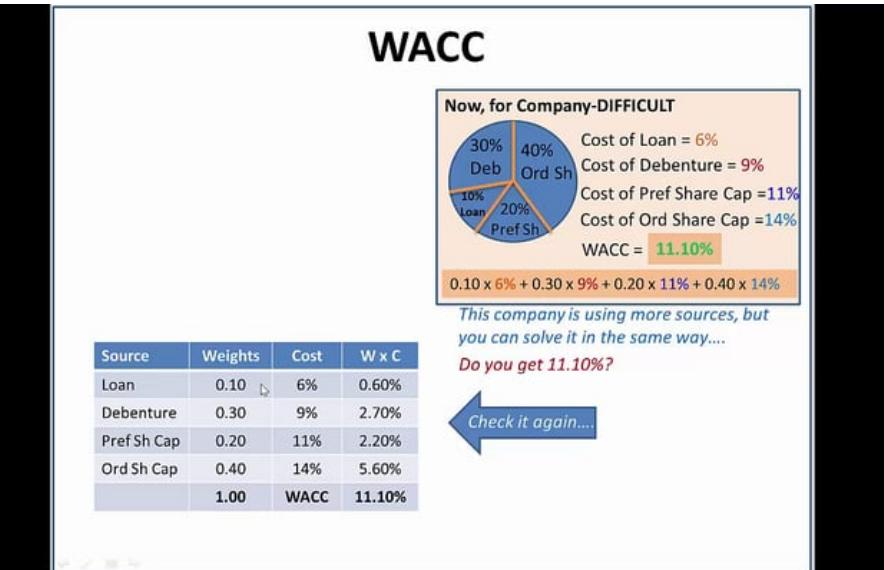
Net Present Value Analysis

Discount rate

Weighted Average Cost of Capital – WACC

Depreciation

Working Capital



# Accounting and Finance cont.

A little early internet reading will greatly help your understanding when we discuss these topics.

If you have a friend doing a conjoin degree in Commerce have a chat with them in exchange for coffee or food.



# To date



Hopefully you have now participated in and understood that your Engineering degree has 2 pathways.

#A: your discipline knowledge

#B: your interpersonal ability, commercial/business/money understanding; and skills required to manage Complexity & Ambiguity leading to Projects and their execution (real or virtual).

**Both are equally important.** We can not be good engineers without being able to travel on both the Highway and the Byway. Those who accept this will progress, those who don't ????

# A quick review of our “Design Process” leading to a Project

Design is a word we use generically that actually has many levels of meaning:

1. Design of a single component related to your discipline
2. Design of and inter connection of several components to form a subsystem in your discipline
3. Design of a system within your discipline comprising several subsystems.
4. Design of a large system across several engineering disciplines made up of discipline systems
5. Design of a major system involving several professions, Governmental agencies and the public where gaining consensus on what is required and how to fund the expenditure can be far more complex than the engineering itself.

# Complexity and Ambiguity aka Systems Thinking



How to approach ugly problems where the group can't see what is required in real time:

1. How to fix Christchurch post the earthquake.
2. The Auckland Harbour Bridge has been hit by a cruise ship and will need 18 months to repair
3. I have infrastructure "hotspots" in Auckland which have in close proximity: water supply, sewage, natural gas pipelines, HV power supply and major transport roads. {A major accident (volcano) at these locations could cripple the majority of the services required to support Auckland}. Impact on NZ GDP?

# Where to start

## **Question #1** (choose 1)

1. Clearly define what is required?
2. Understand the financial resources available?
3. Understand relevant local or overseas experience?
4. Understand how the RMA might apply?
5. Understand the stakeholders?
6. Run and hide?

# Stakeholders {Who}



“Systems Thinking” always starts with Stakeholders.

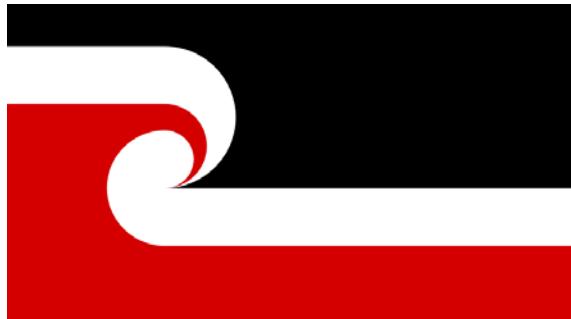
Notice this is not shareholders.

Frequently there are more stakeholders than we initially think.

Aucklanders are stakeholders in the reconstruction of Christchurch as they are taxpayers. Furthermore, expenditure on Christchurch will lead to less expenditure to solve Auckland's traffic/housing problems. Greed or help our less fortunate fellow citizens?

# Individual Stakeholder Requirements {What & Why}

Our next step is to look at the individual Requirements primarily of our important and influential Stakeholders. But we need to be careful not to ignore stakeholder groups who can come back in the future and bites us by stalling what we are trying to do. We might ignore Greenpeace as a pressure group as they never intend to compromise on anything. However we would be foolish, legally, ethically and morally, to ignore Maori interests in NZ as these must be considered.



# Shareholder's divergent individual Requirements

We must consider Requirements on an individual Stakeholder basis as this will show whether important and influential Stakeholders are aligned or have divergent views.

Frequently the public will want a better standard of service than Treasury will recommend be funded by the Government.



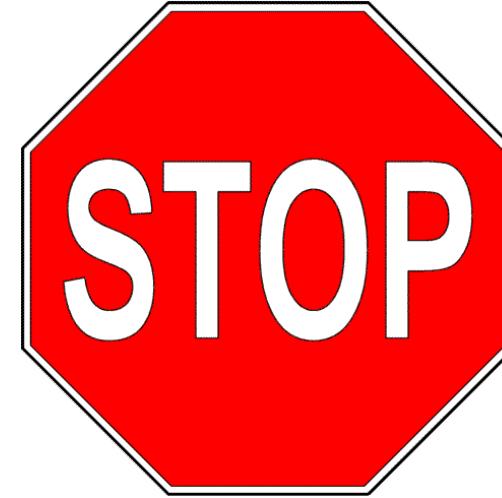
# Common Requirements

The next step is to identify the Requirements that will be supported by most or all Shareholders.

We also need to understand whether lack of major/influential Shareholder agreement on some significant Requirements will lead to such strong Shareholder disputes that the project will not be able to progress.



# Stop if no consensus



It is essential we stop the project if major Stakeholder consensus can not be achieved. If we progress we will have one Stakeholder supporting the project while another Stakeholder actively attempts to undermine and derail the project. This will inevitably lead to a bad project with cost overruns and delays.

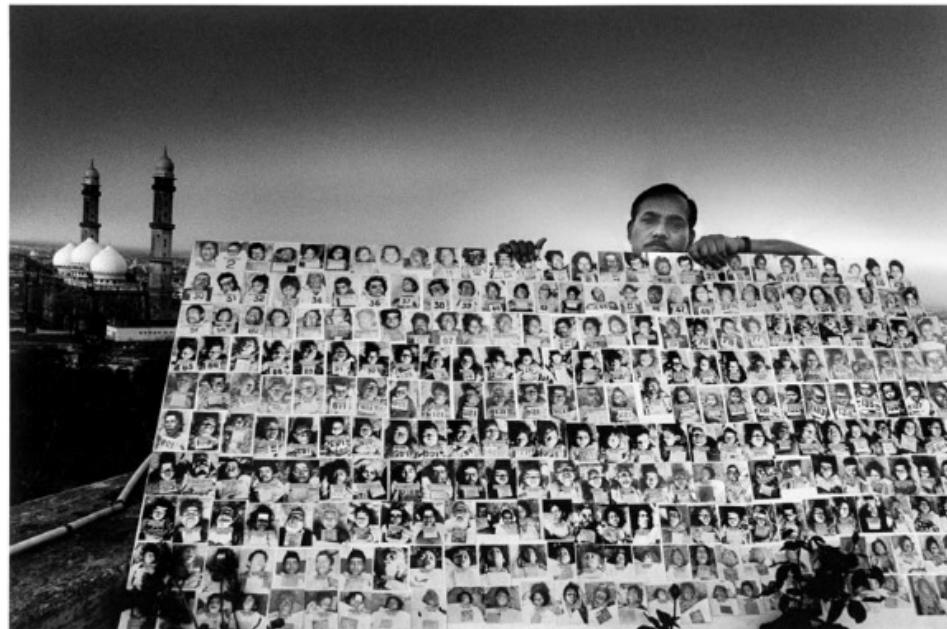
Best to cancel the project at Day#1. This may well cause/force the major Stakeholders to rethink their positions if they both understand the project is essential.

# Saying “No” to a project proposal

This is one of the most important project disciplines.

The world is littered with projects that should never have started that cost millions or billions and achieved nothing but misery.

Bhopal



# Options and their Cost/Benefit

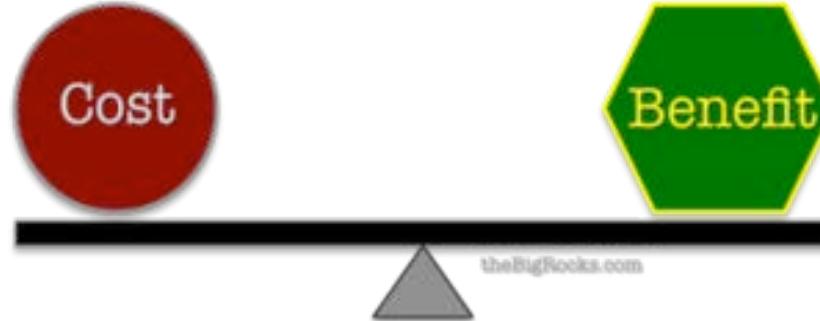
## {How & When}

Once Stakeholders and common Requirements have been agreed the next step is to see what Options may be possible.

**Question #4:** Options (choose 1 or more)

1. We should only select safe options which are based on previous successful experience?
2. Options which only satisfy some of the agreed Requirements should be considered?
3. Brain storming a broad range of options will be helpful?

# Cost/Benefit



Once we have a broad range of potential Options we need to find some way of putting them into merit order. We need to estimate the cost of each and try and quantify the benefits.

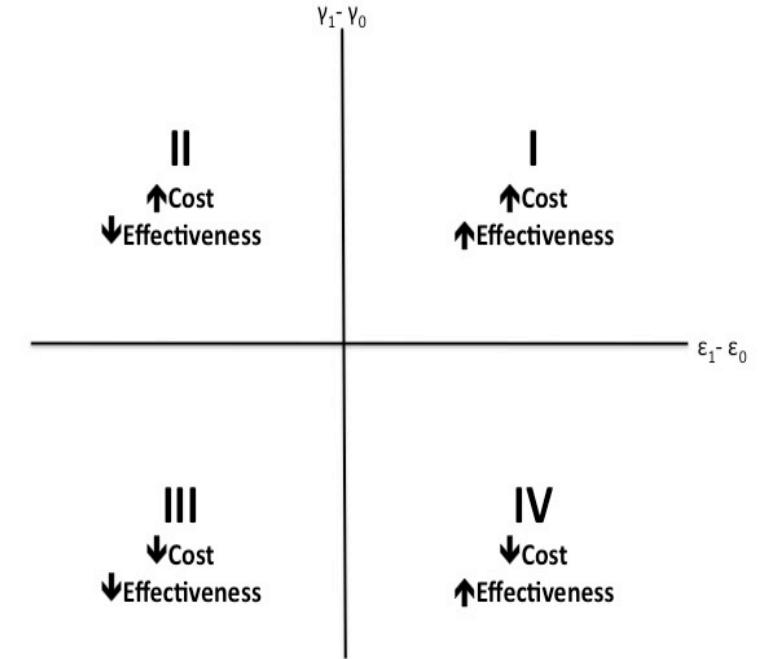
With large ugly “Complex and Ambiguous” projects the benefits may be hard to quantify as we will be looking at “value” in a broad sense rather than looking at simple economic return.

Value will probably have a sense of Social Value + Environmental Value + Economic Value.

# Public vs Private projects

It will probably be easier to evaluate value on a Private Project. Economic return will likely be more important with social and environmental issues being more related to public perception of the Company brand.

For Public projects the analysis will be complex as local or central Government has major responsibility for social outcomes which the private sector does not.



More on this later.

# Recycle



One of the most important steps in Systems Thinking is now to Recycle between: Stakeholders, Requirements and Options to try and find an outcome that:

- Will get barely sufficient Stakeholder support
- Satisfies just enough of the Requirements
- Might be able to squeeze enough funds to execute the preferred option

**Can we identify a least worst answer?**

# EQ



What is EQ?

I will leave you to look it up but having the “EQ of a rock” is not a compliment.

If interpersonal skills can be learnt by experience over time {decades} can we accelerate the process by teaching them {before you graduate} .

My personal answer to this is yes

How to teach?

Socratic method of telling stories and asking questions based on personal experience.

Learning will be more successful for those of you who proactively want to be on the journey with us.

# Personal Sadness



A few seem to indicate they think that understanding and developing interpersonal skills is child's play and can be learned fully at primary school.

If this is your firm view there is probably only so much the Systems Team can do to help you. We will still try.

Poor interpersonal skills may create challenges when you enter the workforce and you may find you are best suited to a technical role without supervising others.

Some thoughts to consider before you finally conclude interpersonal skills are easy or unnecessary.

# For those who understand

Apologies to those who think this is an important topic and are here to learn. We are here to assist you on your journey.

Please assist us {and especially me} to get the right balance of carrot and stick. I know encouragement is good, I just don't always remember.



*I'm sorry.*

# What to learn from this?

**Give your team the credit** when things go well.

**Take the blame** when things go pear shaped.

Be polite to your big boss but look after your team.

You don't do the work; your team does.

Your role is to make your team successful.

If your team is successful you will be promoted.

You don't have to sing your own praises, your team will do this for you by their actions and words

**YOU ARE GOING  
TO WANT TO  
GIVE UP.**

**DON'T.**

# You need to be culturally astute

In some environments the behaviour described would have been severely punished.

You need to think of the culture of your organisation and how to behave within it.

However looking after your team is important if you want them to look after you.

Choose the issues where you are prepared to die in the ditch. Hopefully they will occur only a few times in your career.

I have currently faced the ditch twice and have another ditch event coming up in a few months.

# **As team leader you should**

Security question:

Answer: Give team the credit and take the blame  
yourself

# A generic Business

Let's start by talking about a generic business/company; which could be owned by Public Shareholders, Private Individuals, the Government, Councils or Communities.

Most of these organisations have several different levels:

#1: Shareholders who collectively own the equity of the company

#2: Board of Directors responsible for Governance

#3: CEO and Executive Team

#4: Workforce of managers, supervisors and employees

Note: Other structures are possible. Business and Company are used as interchangeable terms.



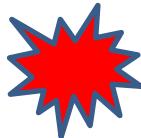
# Business Responsibilities

**Question #1:** What are our primary Company Objectives and Responsibilities: (more than 1 answer ok)

- #1. Satisfy its Shareholders – increase share price and dividends?
- #2. Act responsibly towards its employees (safety, health, environment, employment)?
- #3. Continue to be viable (earn an accounting profit)?
- #4. Grow (requires a Strategy for the future)?
- #5. Be a good community citizen?
- #6. Consider our social responsibility?

# Day to day & future Strategy

**It is difficult for a company to stand still – it is either dying or growing.**



Systems Thinking is most helpful in the execution of Strategy, but it is also useful in day to day management of our business.

# Owner vs Contractor



If we look more into companies there are simplistically 2 types:

- #1. **“Owners”** of assets of some form or other
- #2. Providers of expertise, advice, services who purposely do own no assets and prefer to lease or rent everything > **“Contractor”**

# Contractor Strategy

Contractor Companies also develop growth strategies. These typically involve growing their business without adding any company assets.





# CEO expertise

Our CEO will/must be competent in day to day management but may not have the expertise to personally execute a project aligned with our Strategy. Her/his team can assist but normally our company must buy outside advice from a “contractor” to help develop, plan, justify and execute a project aligned with our Strategy.

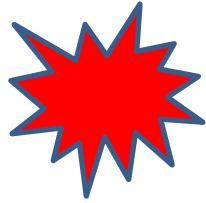
**Best to use a Contractor who understands  
“Systems Thinking”.**

# FID definition

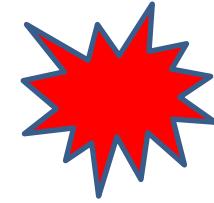
This presentation uses the term FID – Final Investment Decision.

There are many different abbreviations for the same stage in a project. The term FID is used as the point in a project where the CEO (+ her/his Executive) formally go to the Board of Directors of the Company/Business to seek full and final approval to execute the Project and spend all the money involved.

**The Board authorises major expenditure.**



# Importance of FID



As a Director you can be sent to jail for negligent decision making. You must take your Governance role seriously. Thus the Directors will ask the difficult questions during the FID process and ensures all information and conclusions are robust and well thought, out as far as is reasonable.

Risks must be understood and properly mitigated. Uncertainty about the future will remain and uncertainty around marketing assumptions requires the Directors to examine a variety of future scenarios.

Note: interpret “marketing” broadly

# Overall project success

More than 90% of all proposed projects fail to get to FID. Of those that reach FID perhaps 1 in 3 or 1 in 4 are not funded.



# Project Stages

Back to our generic project that supports our Company Strategy. There are simplistically 4 stages:

Stage #1: work required to get to FID - **preFID**

Stage #2: **FID** discussion with the Board and Board approval or rejection

Stage #3: Execution of agreed Project – **postFID**

Stage #4: **Operational phase**

# What does the Board want at FID?

- Sufficient major “Stakeholder” consensus
- Agreed “Requirements” (often called defined project scope)
- “Best Fit Option” (with adequate documentation that we have “Recycled” properly to truly arrive at the Best “Least Worse” Options)
- Detailed understanding of Cost and Schedule
- Sufficient detail on the Execution phase (commercial terms, warranties, safety and quality standards)
- Comprehensive economic benefit analysis of the project including comprehensive marketing and competitor analysis
- Full Risk and Opportunity analysis and appropriate mitigation
- Total confidence that our Proposed Project “will work” as described



# PreFID money and resources

Money and resources are required for Stage #1: preFID. These costs are capitalised (become part of the project capital cost) into the project if it is approved and executed. This project capital is depreciable with some resulting tax shield.

If the project is stopped prior to FID or is rejected at FID; then money spent is charged as an expense (no depreciation tax shield) to the Company Financial Statements. This abnormal expense reduces our financial profit and directly hurts our shareholders. **This abnormal expense can make our company's return for the year look poor.**



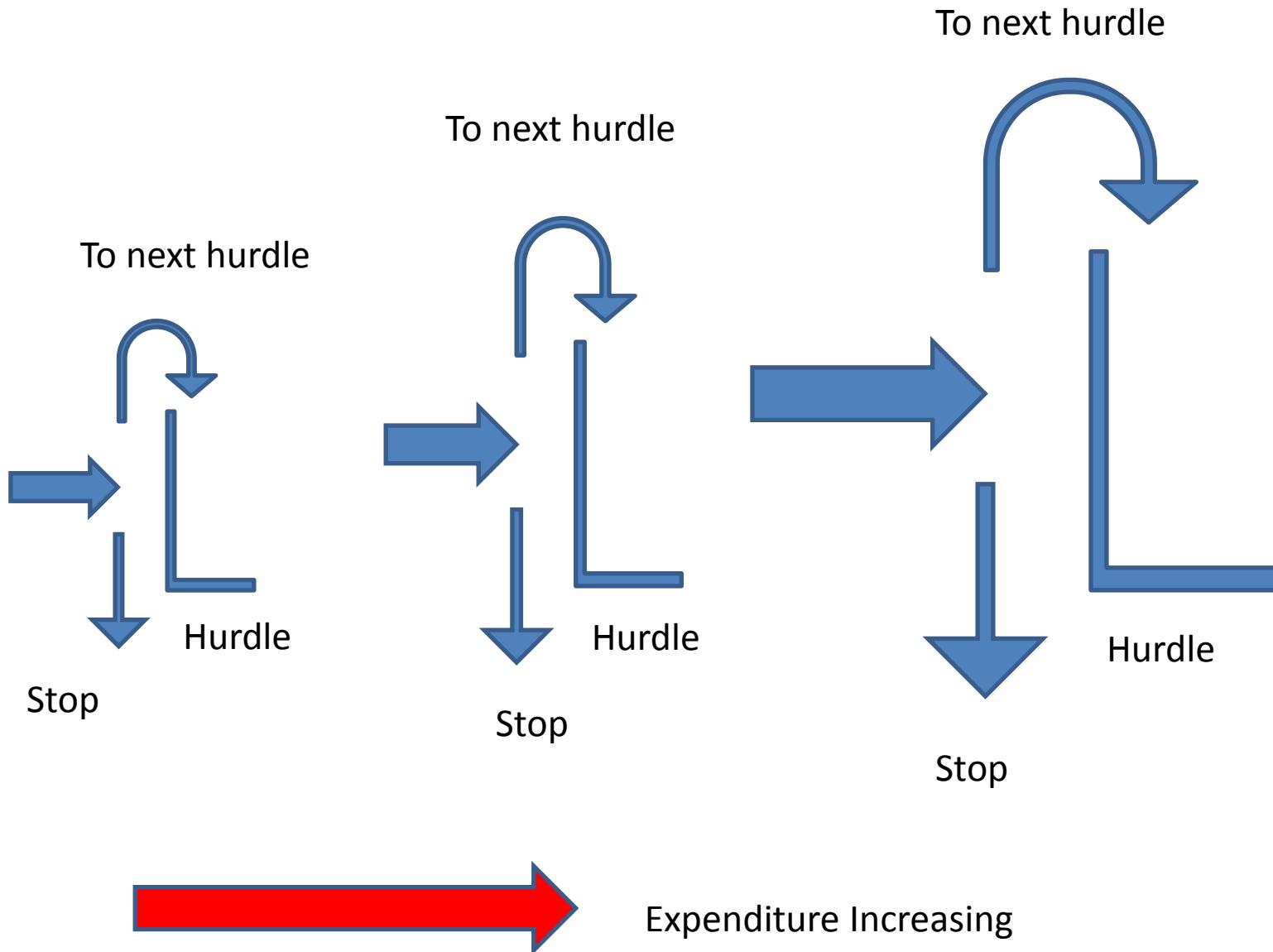
# Dilemma for the Company:

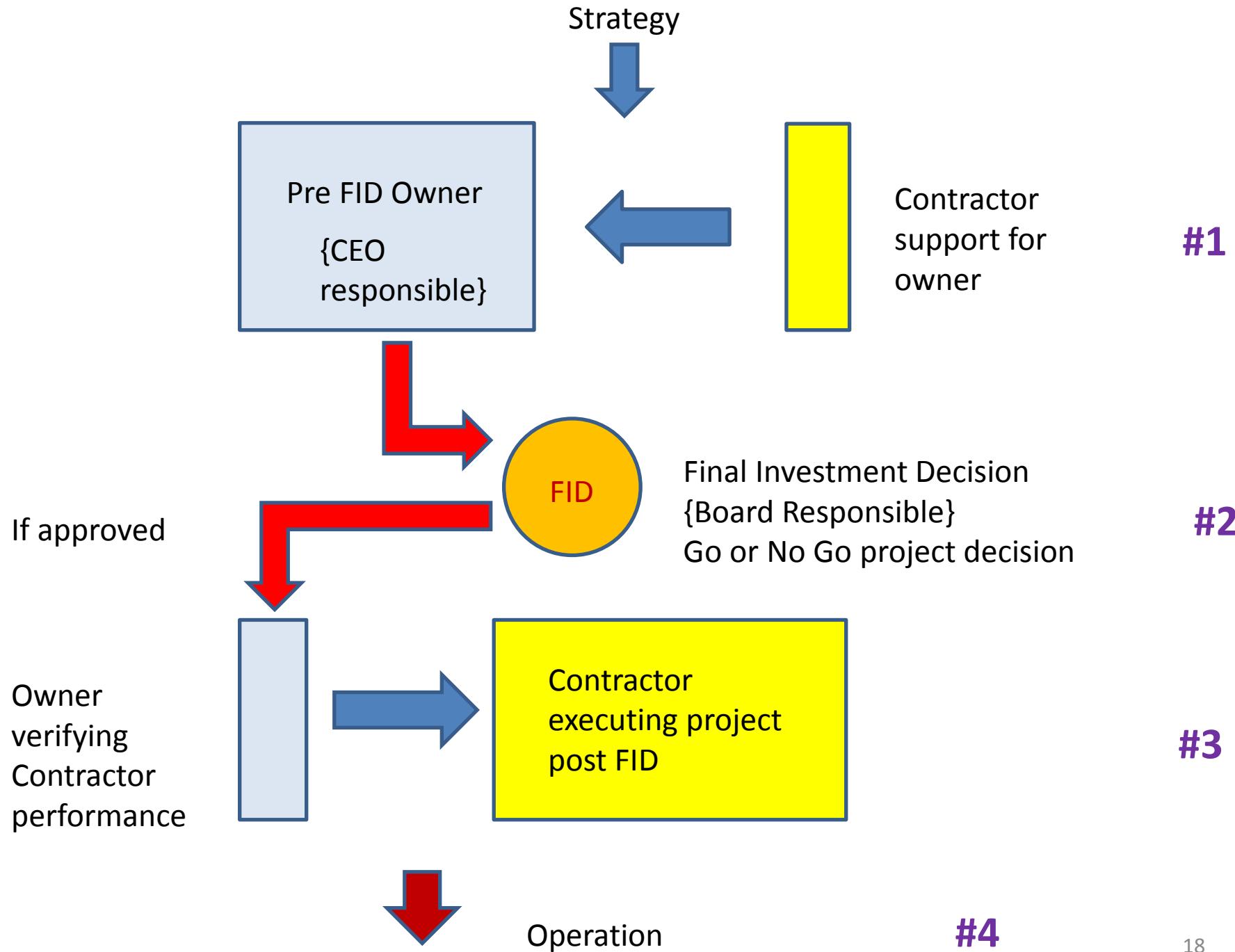


We need to spend and provide sufficient money and resources to ensure a quality FID document to the Board to enhance the probability of FID approval.

However we need to spend minimal money and resources on a project which will become unsuccessful. We must kill poor projects as soon as possible and primarily focus on projects with a high probability of success.

## PreFID substages





# A few hopefully obvious comments on previous slide

**At time = 0:** Complexity/Ambiguity is at its maximum. Strategy is aspirational, but is not executable in detail.

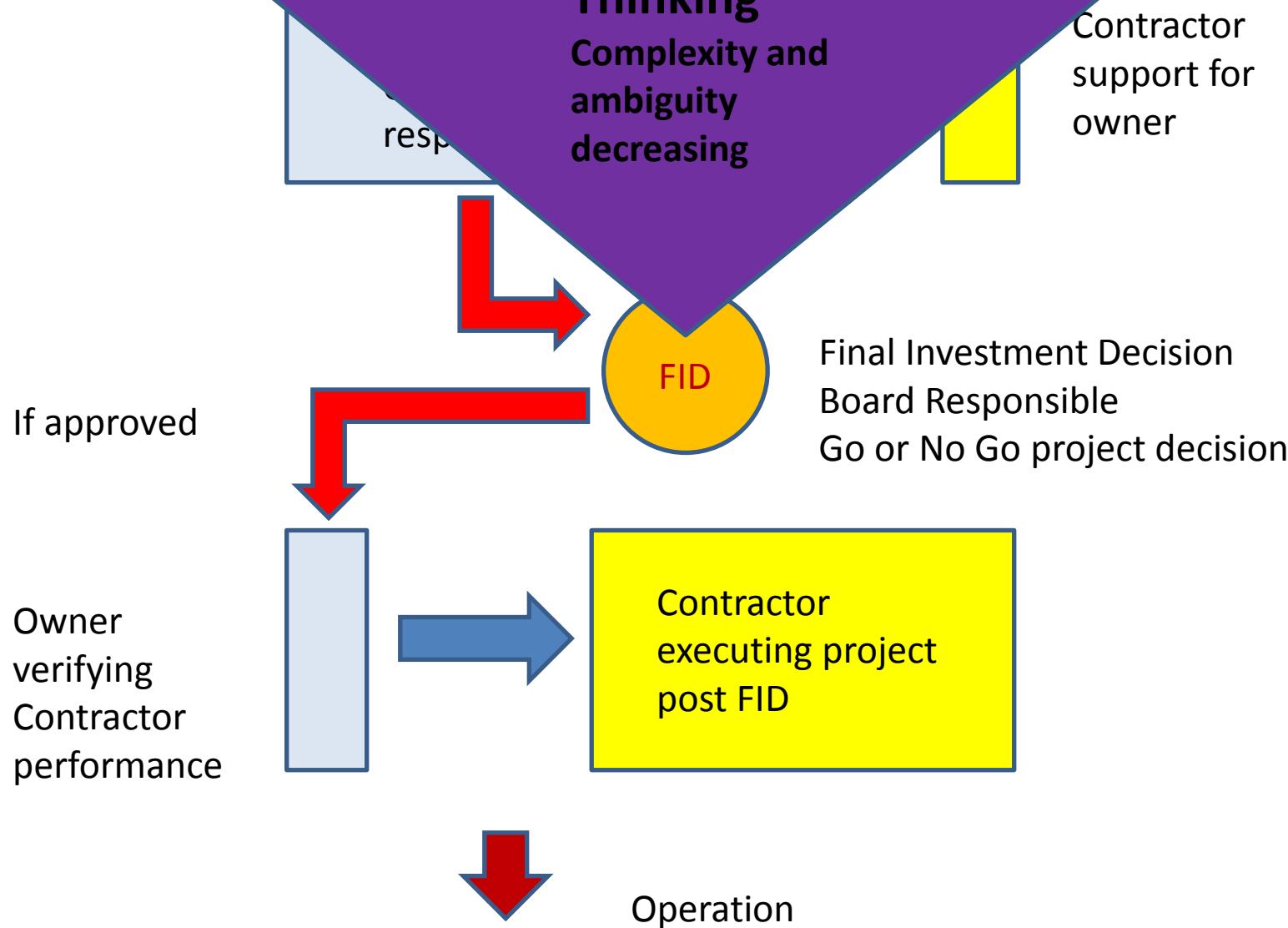
**At time = FID:** Complexity/Ambiguity is understood. Strategy can now be turned into reality.

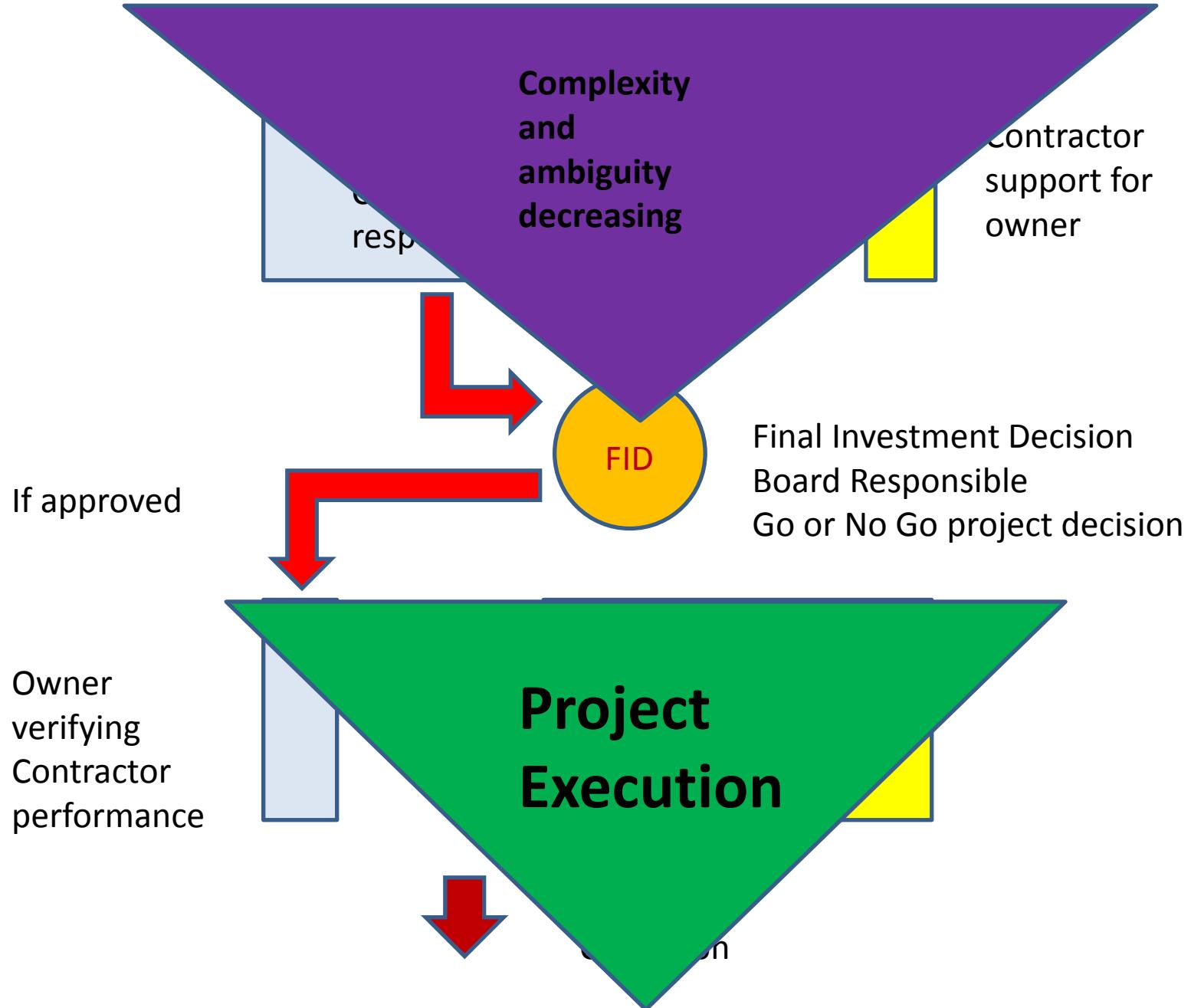
Note: We can not ask for FID approval if we do not know reasonably precisely everything we are going to do.

What, Why, How, When and Where must be decided and explainable to our Board at FID.

# Systems Thinking

Complexity and ambiguity decreasing



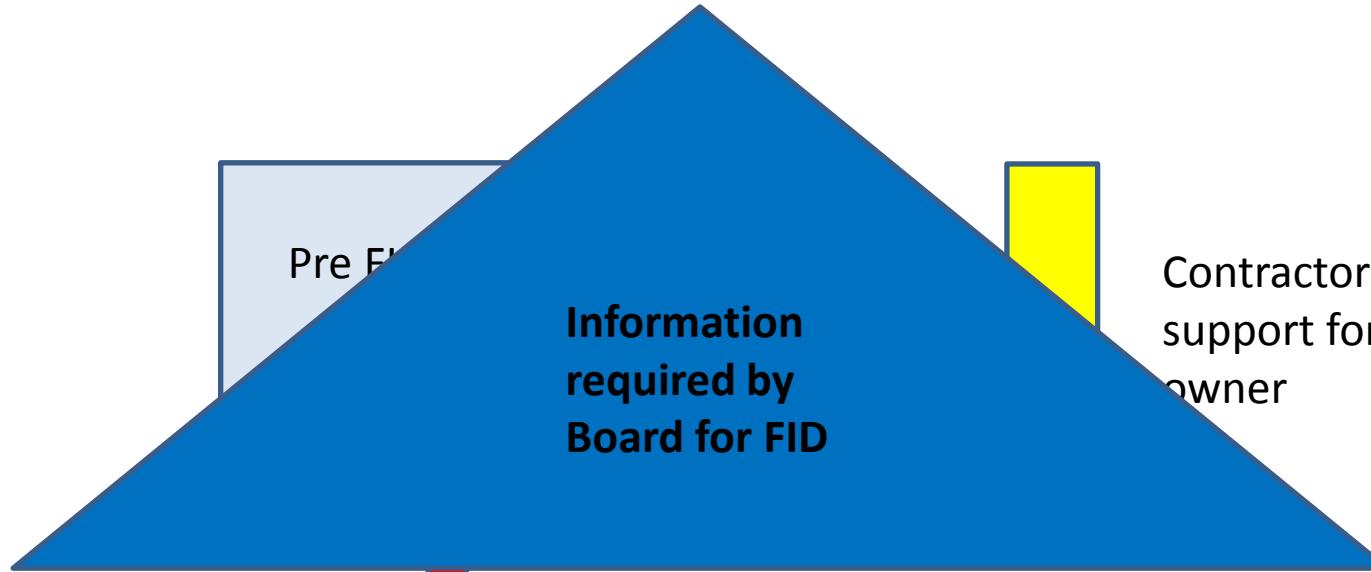


# Pre and Post FID

While preFID and postFID can be represented as separate and distinct phase of our project they are dependent.

We can not progress to FID without good highly level understanding of “How and Where” in postFID/Project Execution. We must understand the scope, cost, schedule and commercial arrangement for the Execution Phase prior to FID.

Likewise success in the Execution Phase (Post FID) is highly dependent on the quality of all the work preFID. The Execution phase is not the time to clarify “What” is to be done and “Why”.



Contractor support for owner

Final Investment Decision  
Board Responsible  
Go or No Go project decision

If approved

FID

Owner verifying Contractor performance

## Project Execution

# Importance of preFID

Systems Thinking is **primarily** concentrated in the Owner's Pre FID phase.

Money spent preFID on poor projects is a major waste of money and resources.

# First supervisory role

Role maybe primarily supervising younger engineers.

You will assist them understand company policies and procedures.

You will help them understand company culture.

You need to make then feel comfortable and welcome and introduce them to other staff and show them around.

Your role will be mainly about getting engineering work done.

You will still do your own engineering work and check the work of your group.

Your role will be 70%+ technical and 30%- people

# First supervisory role

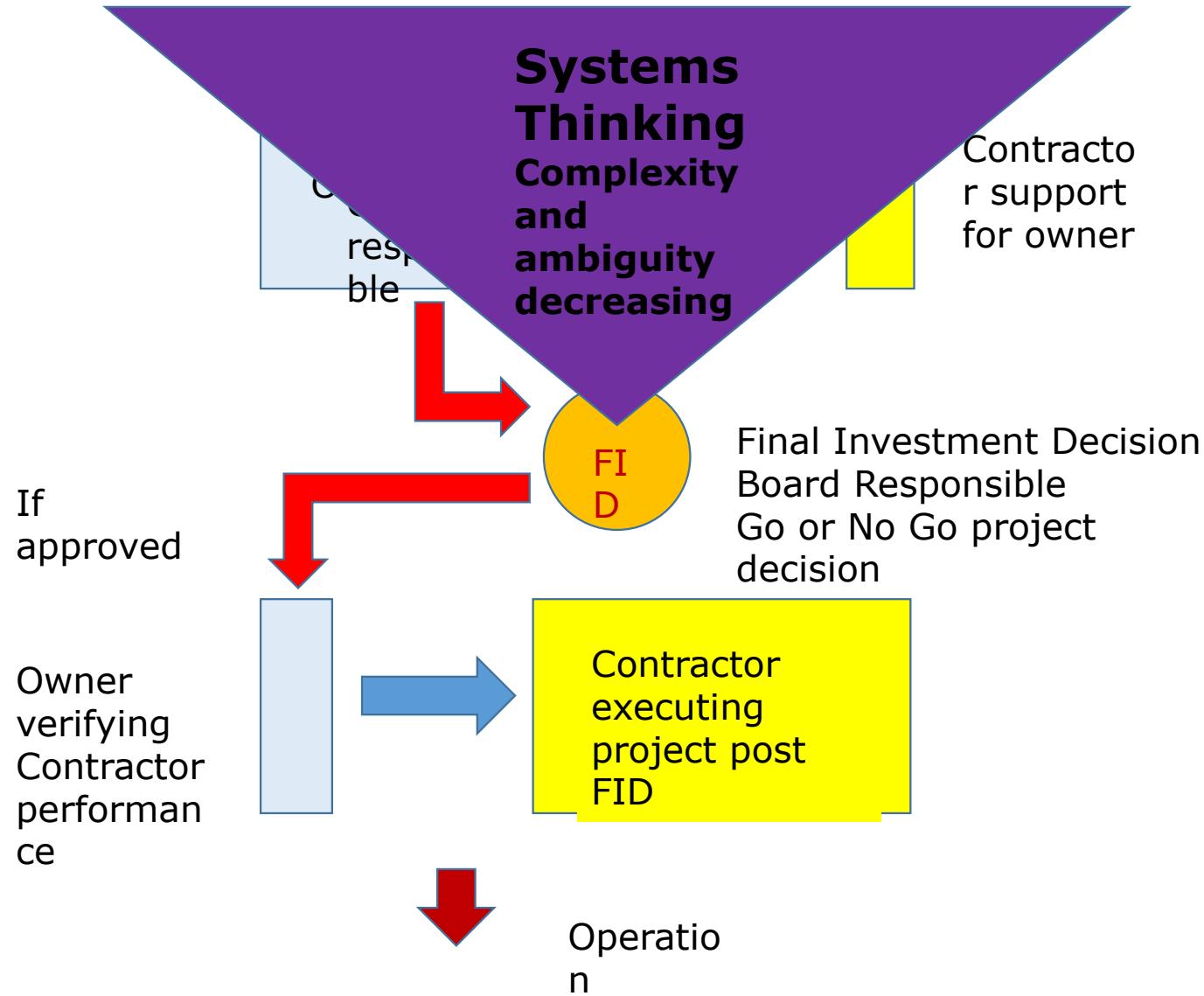
You will be trying to develop a team.

Try not to compete with your team although you will probably understand the work better than your team.

There will be a delicate balance of letting your team make a few minor mistakes to help them learn and getting the work completed on schedule.

The Systems Team is purposely trying to show some of the more advanced people skills that you may wish to use when you are more senior. Understanding where you may want to go with supervision into management will hopefully allow you to set off in the right direction.

When we are young there is a big temptation to want to show we are smart when it comes to the work.



# The purple triangle is Systems

I have decided to build a plant in the southern US to take advantage of the potential arbitrage between plentiful and cheap shale gas and liquids. What this means is the cost of gas feedstock for manufacturing petrochemicals should be profitable as the product price will be greater than the feedstock prices.

# Stakeholders

Company Shareholders, Board and Executive

Local US State Governor, officials and community residents and officials

EPA, state permits for air and water and traffic

Banks to provide debt, and insurance industry for project and operational coverage

Gas supply and transportation; product shipping and marketing, power supply

Technology suppliers and US construction contractors

Plus more

# Requirements

Non recourse financing > banks only have call on the project not the parent company. This is complex and normally means gas supply and product offtake must be financially linked (in a commodity market); and contractor must provide a plant performance warranty (expensive).

This will also impact debt which may be limited to 50% whereas the company would prefer 70%.

Need all permits prior to FID

Need banking and commercial deal prior to FID

Need land

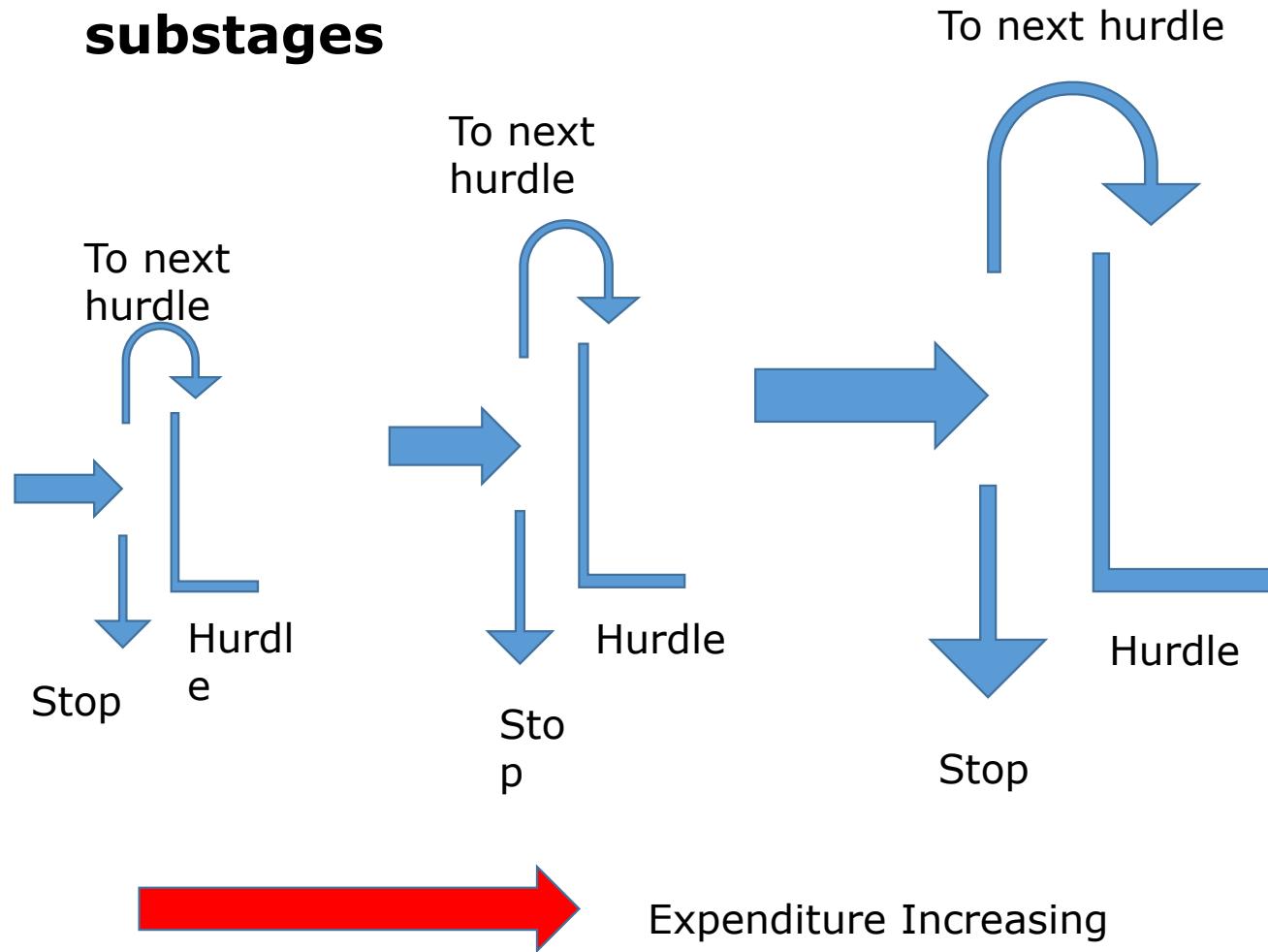
Need gas and product arrangements sorted

Need cost and schedule sorted

# Options

1. Project offered to company by a project promoter. This involved duplicating a previous plant without modification using an Asian contractor with a new office based in the US. This Asian contractor has never executed a project in the US. However they have provided a lump sum price for the template plant construction. No commercial contracts exist and there is no documentation on the plant design and no agreed standards to follow for design.
2. An other approach using a different major US contractor.
3. Increase plant capacity at minor cost.
4. Move away from the template plant to different technology.
5. Look at modularisation.

## PreFID substages



# First hurdle

Build an economic model of the proposed plant to understand the interaction between:

Gas price

Product price

Capex and schedule

Operating cost

Plant capacity and efficiency (gas usage).

Conclusions: economics look ok; progress to next hurdle

## Second hurdle

Meet the project promoter and visit the Asian contractor.

Both talk a good story but have weak personnel without any good industry experience.

Lack of project definition and commercial terms a major fatal flaw. Change orders will be really significant.

Conclusion: advise company that risks of progressing on the proposed basis are too high. Start down the path to a new hurdle using a US major experienced contractor.

This requires project relocation from Houston to California

## Third hurdle

Plant technology is from the 80's.

Can this be improved?

Yes rotating equipment has improved and larger compressors and turbines are now available.

Plant capacity can be increased at low cost.

Progress with this option

## Fourth hurdle

A source of external CO<sub>2</sub> was represented as being available by the project promoter to set the original plant capacity.

On detailed commercial examination this proves not to be the case.

Conclusion: project capacity will be adversely impacted by 25% look for alternative sources of CO<sub>2</sub> or cancel the project or modify the technology.

## Fifth hurdle

Fluegas CO2 recovery technology exists to replace the external CO2.

Due diligence on this option shows our internal CO2 plant would be 2 times proven capacity. No fatal flaws identified. Higher cost involved.

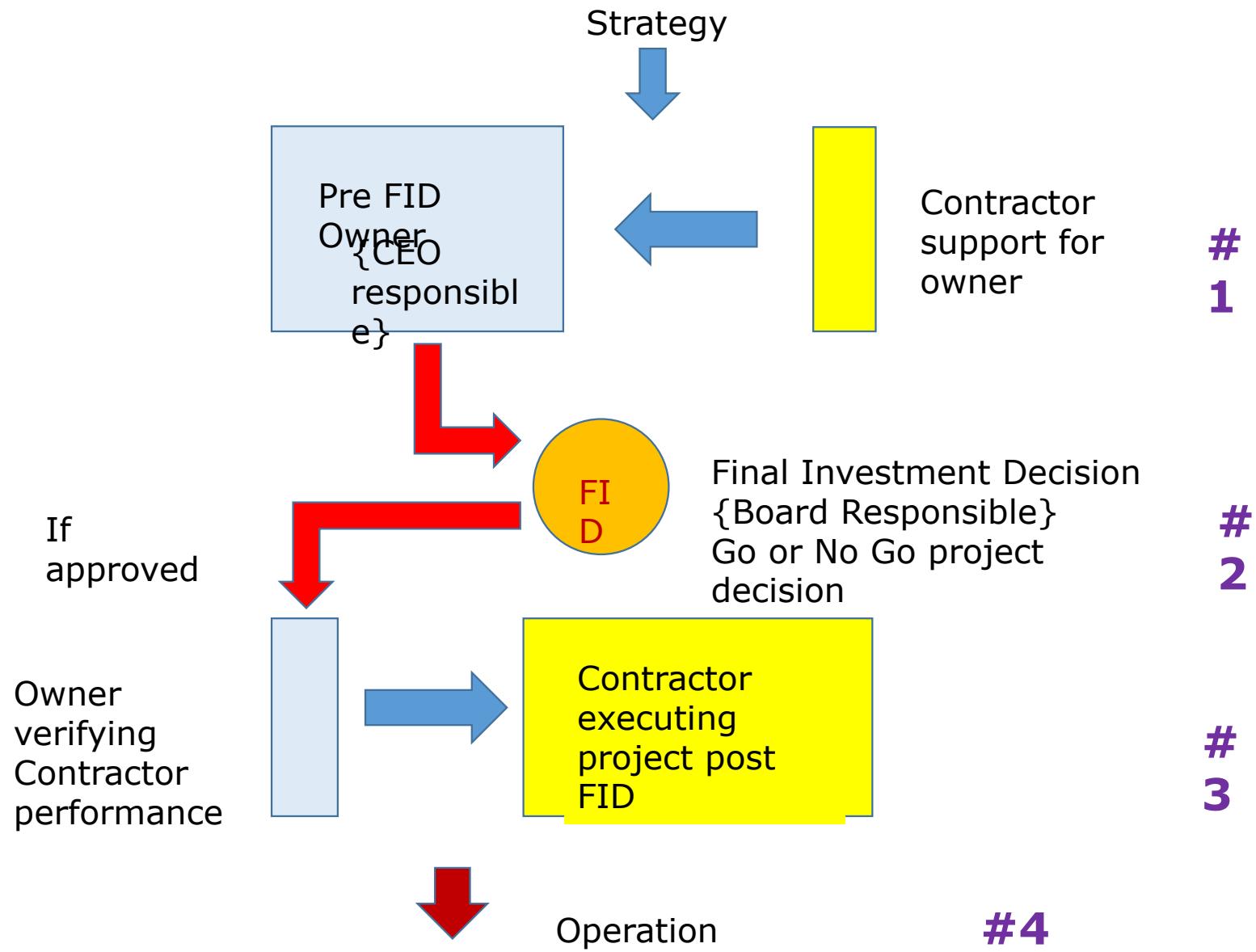
Rerun economics to see if plant still economic  
Conclusions: still ok

## Sixth hurdle

Major personnel problems between contractor and client.  
Cancel the project or resolve. Discussions at senior management level between the client and contractor.  
Conclusion Project should be moved to Houston.

# Other hurdles

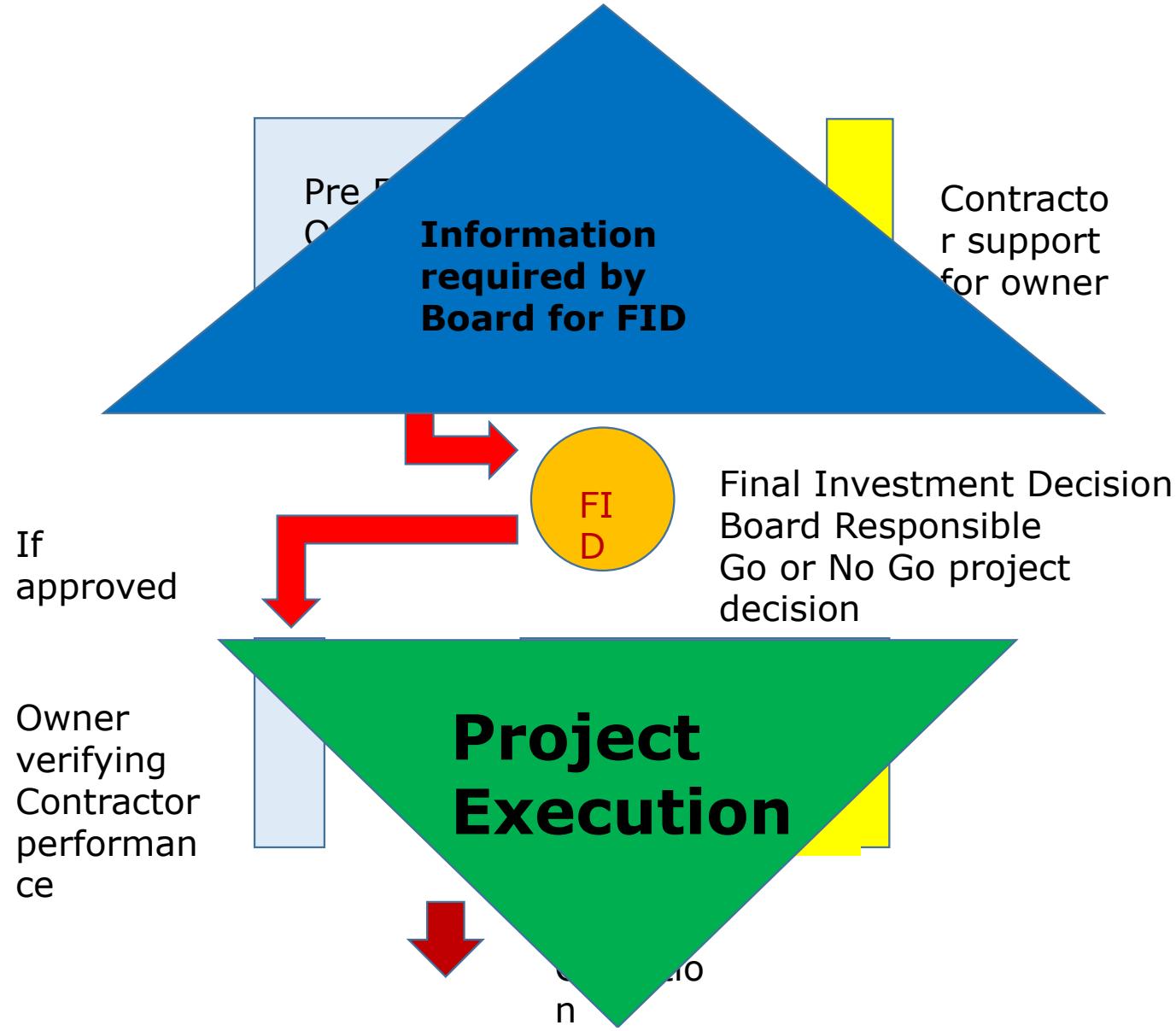
Many more but hope you get the idea



# Status

There have been 2 major cost estimates generated to date and a third is in progress. Economics are marginal but a new partner has joined the project.

FID now expected late 2017



# What do the Board(s) want at FID

Agreed plant capacity and efficiency

Contractor fixed price and schedule with warranties acceptable to banks for non recourse funding

Properly project definition and agreed commercial terms

Full legal documentation including banking covenants for debt

Favourable report by banks ITE (independent technical engineer)

Agreed project and operational phase insurance

Gas supply contracts

Product offtake agreements

Enforceable land option

Agreed port tankage and shipping arrangements

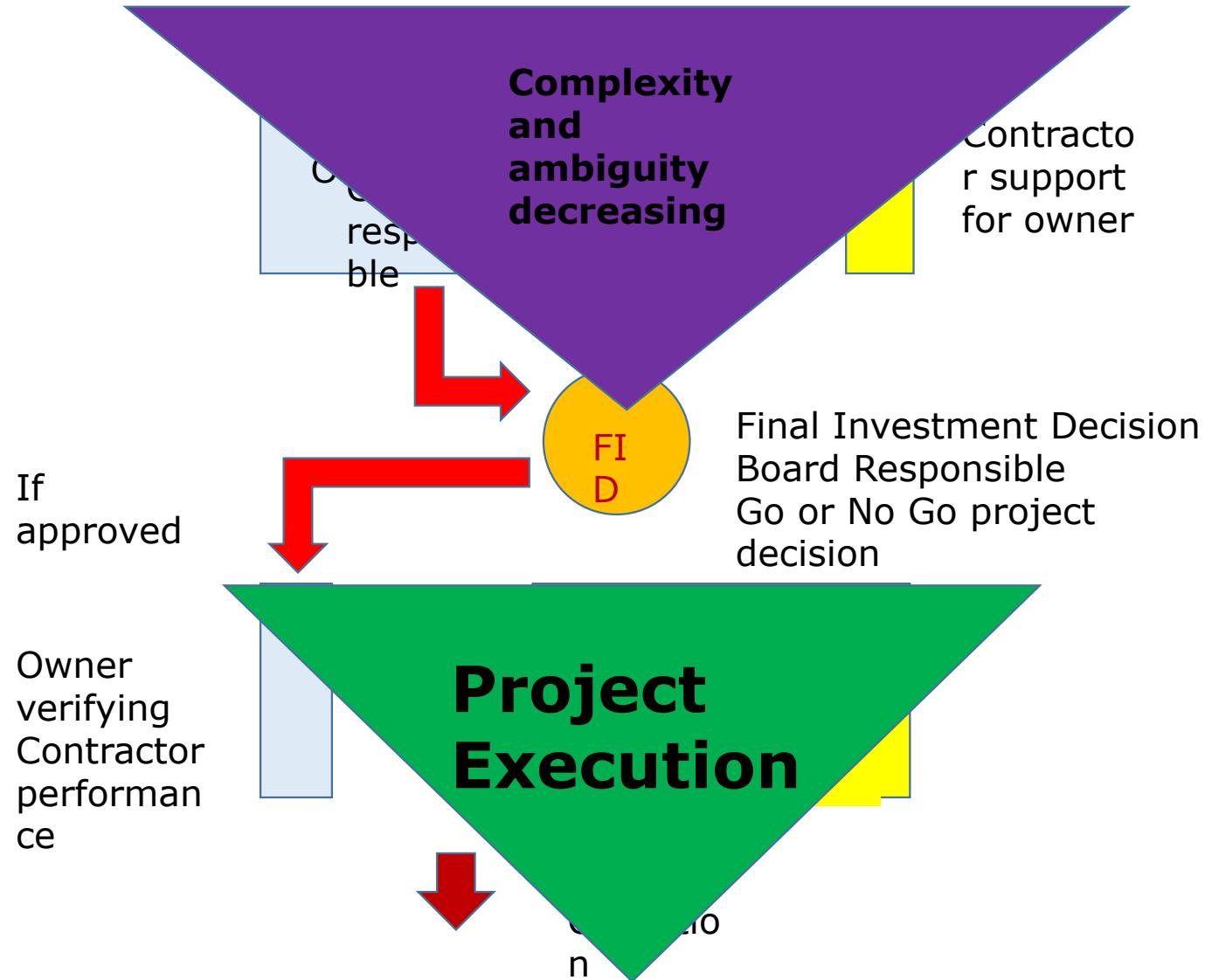
All required permits including module delivery

Detailed economic analysis

# Who signs first?

The Boards will not approve until all the documents are ready to sign.

In essence Board approval means all the agreements become active simultaneously.



# Followup

What do you say if you decide to go with Charlie to the other engineer's office?

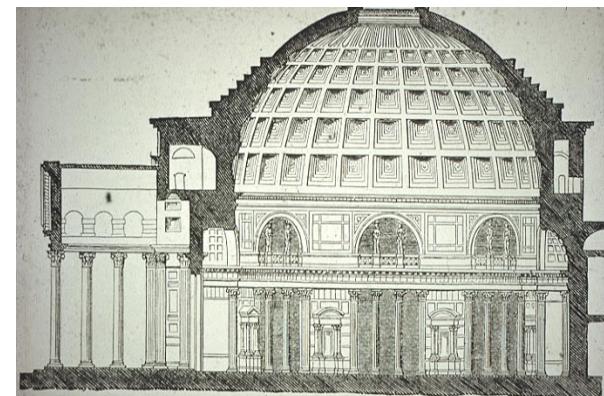
Hi John, Charlie was chatting to me about one of my projects and mentioned your project and that he was coming to see you. I volunteered to come along with Charlie to see if I could help. If this is not what you want I will go back to my office now.

# Execution Phase

Civilisation has been executing projects successfully for many years.

Pyramids 4000 years ago.

Labour management relationships may have changed somewhat; but the planning and organisation and work flow are still much the same.



# **What** and **Why**?

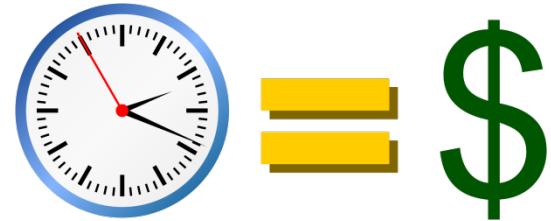
These 2 are closely linked and are at the heart of our Systems Methodology. To remove the complexity and ambiguity associated with **What** and **Why** we need to have “Stakeholder” agreement to our “Requirements” and our selected “Best Fit Option” after adequate recycle.



# How? {and When?}

Clearly involves money. There is no point in having Stakeholder agreement to **What** and **Why** without their agreement on **How** the project is going to be funded.

**How** also involves a good high level understanding of the Execution Phase of our project as we can not set an accurate budget for the execution phase without understanding our commercial arrangements with our contractor, the budget and the schedule (the **When** piece)



# Where?

Probably the easiest one but has the complexity of permits for emissions, operations and construction.



# Execution dilemma



We will talk about this portion of our project in much more detail.

Clearly we would prefer to have developed all the detail of **How** we will execute the project prior to going to request FID from our Board. However this will take time, money and resources. If the Project is not approved this money and resource will be wasted and will become an expense. As with other aspects of our work preFID, we need to understand our Execution phase **sufficiently** to avoid any cost or schedule surprises, but we will not have developed the full detail.

# The Engineering is the easy part

As young engineers we perhaps have a tendency to think that resolving the engineering detail is the most difficult part of any undertaking. I suggest that this is not correct. While the detailed engineering is often complex and difficult it is normally straight forward in comparison with the effort required to get Stakeholder agreement to Requirements, the Best Fit Option after Recycle, and Project Funding.



# Project Business Case

- A Project Proposal (Business Case) **captures** the **reasoning** for **initiating** a project. The logic of the business case is that, whenever resources such as money or effort are consumed, they should be in support of the organisation.
- An example could be that a software upgrade might improve system performance, but the "business case" is that better performance would improve customer satisfaction.

# Options

- Best practice is to consider at least 3 options.

## Do nothing

- Status quo
- Forms baseline to which other options can be compared

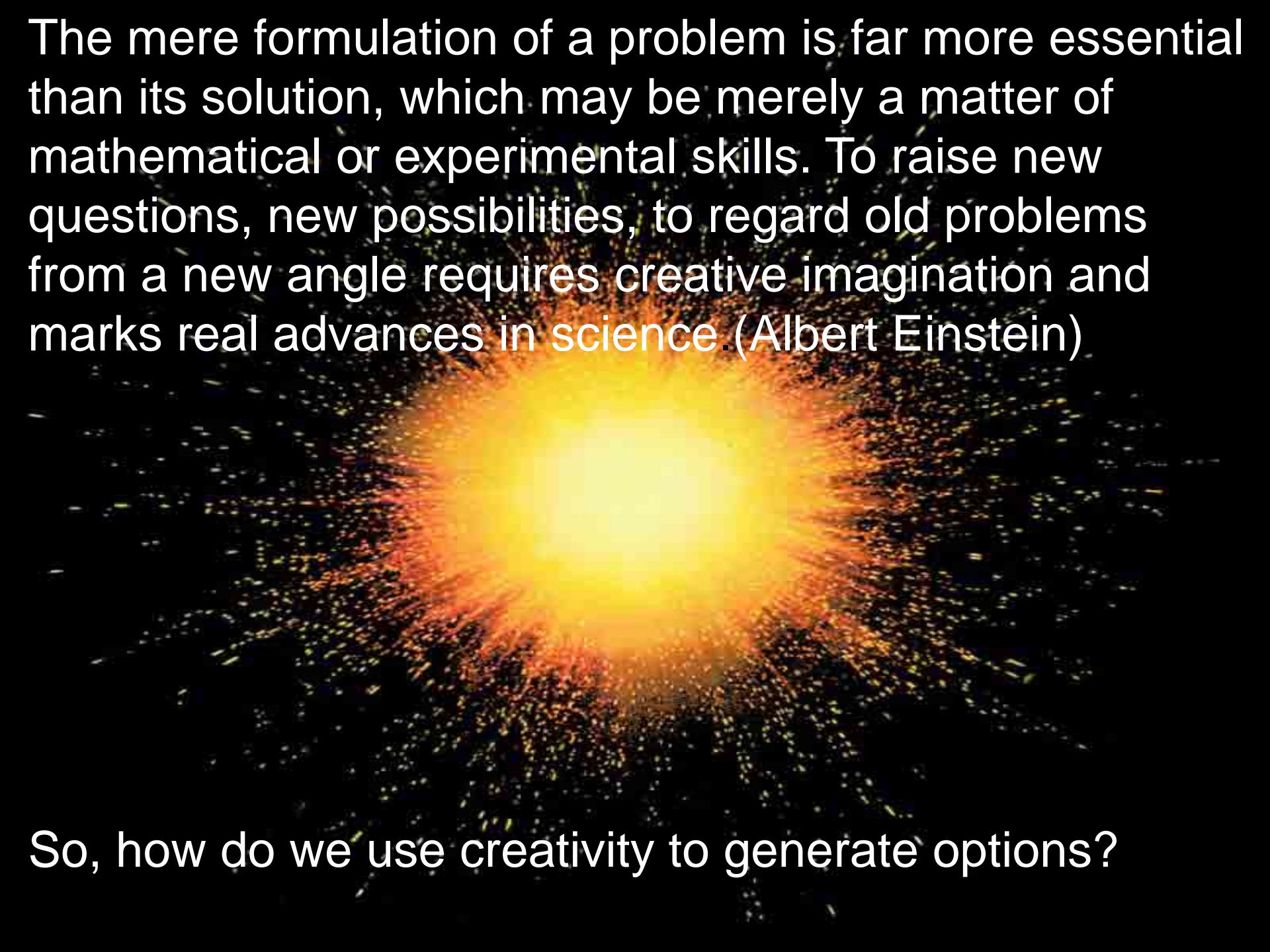
## Do minimum

- Minimum (lowest cost) action that can be taken
- Short term fix

## Do something

- Looking for the optimum
- There may be a single “obvious” optimum
- Consider other options (outside the box)

The mere formulation of a problem is far more essential than its solution, which may be merely a matter of mathematical or experimental skills. To raise new questions, new possibilities, to regard old problems from a new angle requires creative imagination and marks real advances in science.(Albert Einstein)



So, how do we use creativity to generate options?

# Options

## How do we Develop Options?

- From experience
- From developments within industry
- From R&D and academic research
- Through brainstorming and other techniques

Others?

How do we move from precedence  
into problem solving?

# TRIZ

***“Teoriya Resheniya Izobreatatel'skikh Zadatch”***

- Theory of Inventive Problem Solving (TRIZ)
- Based on research into engineering success
- Systematic and rational
- Repeatable
- Takes the Serendipity out of Creativity (TRIZ helps you make that apparently magic leap to find solutions)
- Delivers innovation – with less risk

# History of TRIZ: Genrich Altshuller (1926-98)

- 1946 Patent Officer in Russian Navy
- Discovered pattern in patents, published paper

300,000 patents studied  
1500 problems  
40 solutions



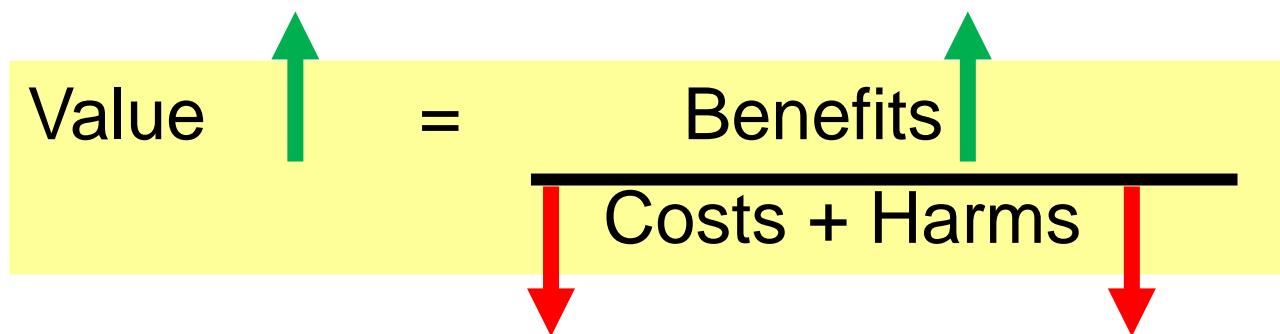
# History of TRIZ: Genrich Altshuller (1926-98)

- 1946 Patent Officer in Russian Navy
- Discovered pattern in patents, published paper
- Sent to Gulag
- 1954 released
- Identified what makes a successful patent
- 1956-1976 TRIZ formulated

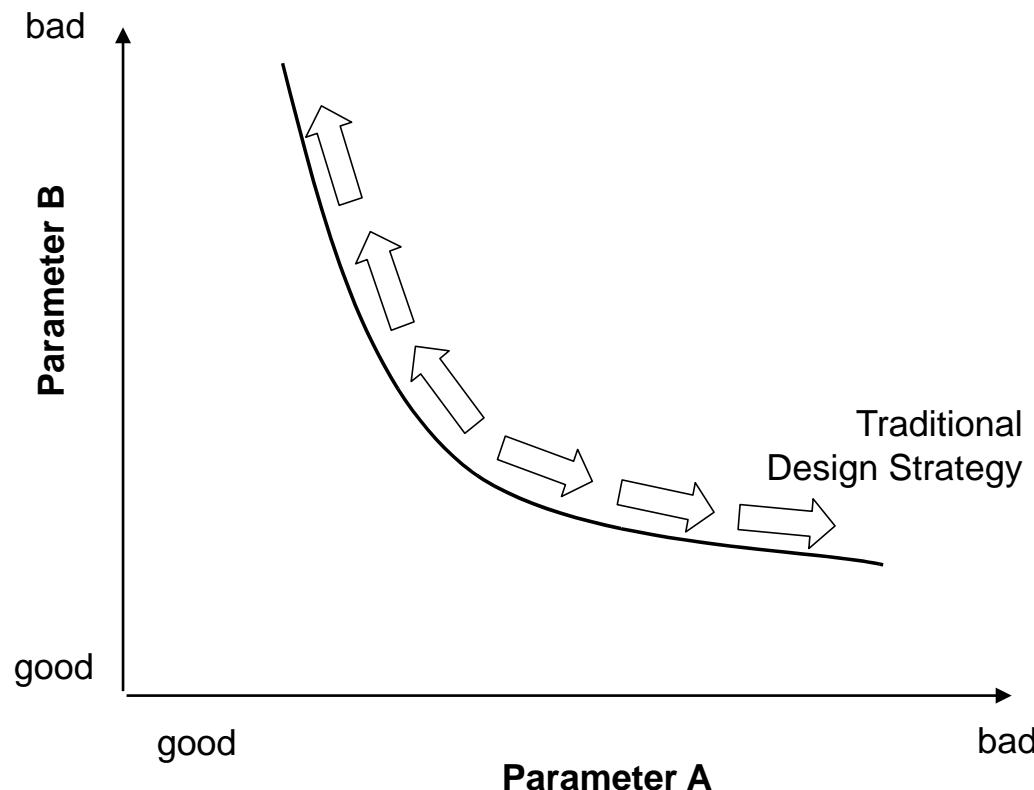


# Ultimate aim of TRIZ: To Increase Value

- All useful improvements to a system increase the system's Value

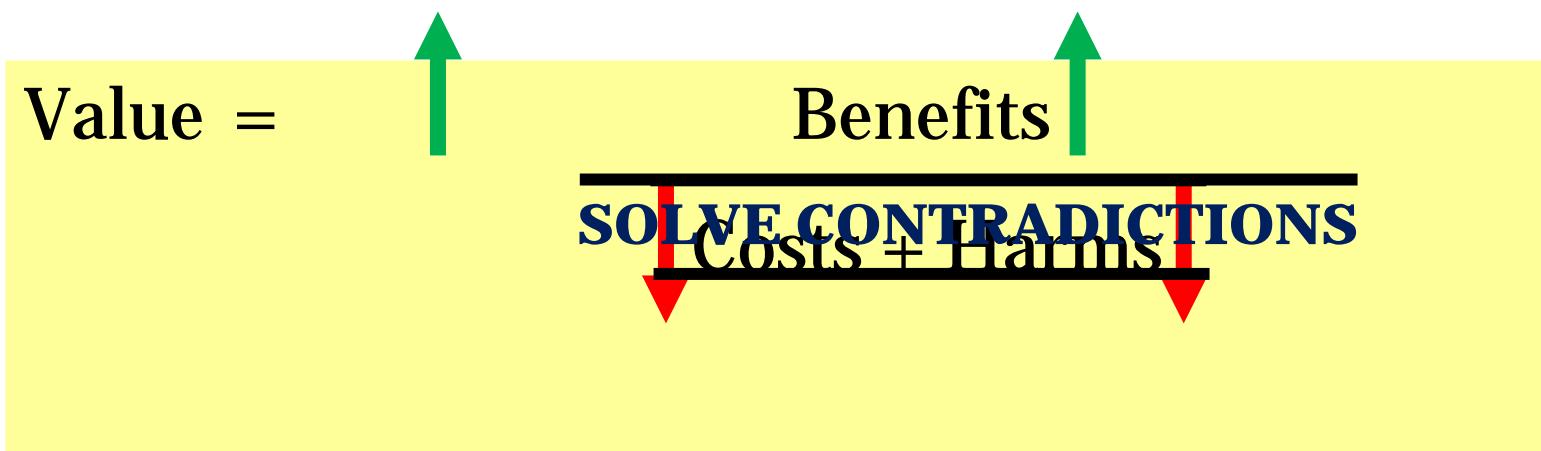


# The Technical Contradiction Curve

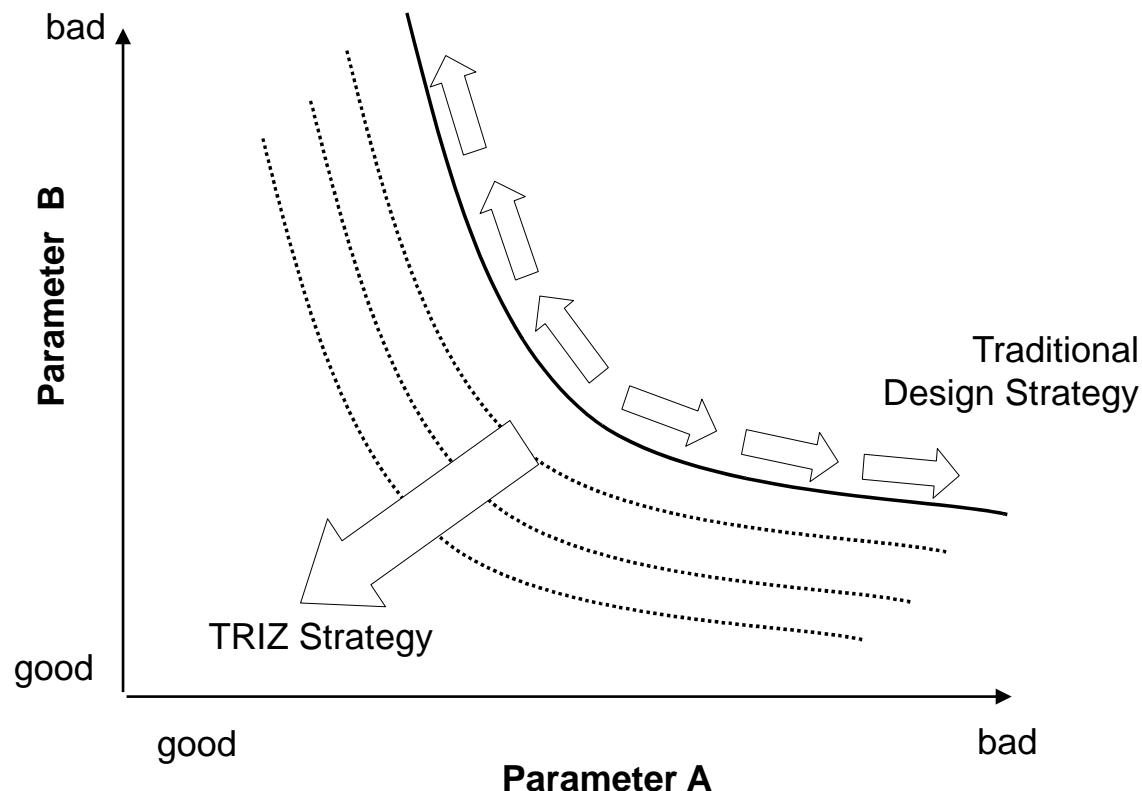


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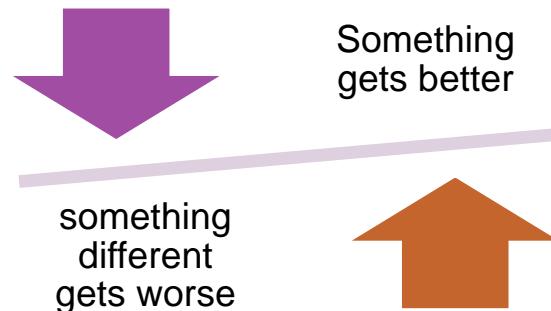
# The Technical Contradiction Curve



# Two Kinds of Contradictions

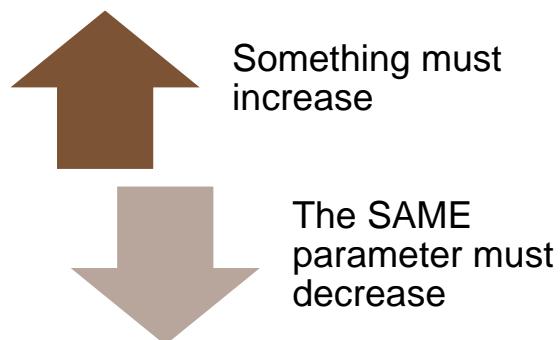
## 1) Technical Contradictions

(e.g. Table...weight vs. strength)



## 2) Physical Contradictions

(e.g. Board Pointer...we want it Short and Long)



# Solving Contradictions

- Altshuller discovered that there was a limited number of ways to solve a contradiction
- There are only **40 Inventive Solutions**
- In all clever patents these are overcome by one of the 40 Inventive Solutions
- All **contradictions** can be described in terms of 39 parameters such as length, strength, power, speed, weight, reliability, temperature, productivity, complexity etc.

# The 40 Principles (First 20)

- Segmentation
- Taking Out
- Local Quality
- Asymmetry
- Merging / Consolidation
- Universality
- Nested Doll
- Anti-weight
- Prior Counteraction
- Prior Action
- Cushion in Advance
- Equipotentiality
- The Other Way Round
- Spheroidality / Curvature
- Dynamics
- Partial or Excessive Action
- Another Dimension
- Mechanical Vibration
- Period Action
- Continuity of Action

# The 40 Principles (Second 20)

- Rushing Through
- Blessing in Disguise
- Feedback
- Intermediary
- Self Service
- Copying
- Cheap Short Lived Objects
- Replacement of Mechanical System
- Pneumatics and Hydraulics
- Flexible Membranes
- Porous Materials
- Colour Change
- Homogeneity
- Discarding and Recovering
- Parameter Change
- Phase Transition
- Thermal Expansion
- Accelerated Oxidation
- Inert Environment
- Composite Materials

# Principles deployed by dogs to solve the drinking problem (Taken from the first 20)

- **Segmentation**
- Taking Out
- Local Quality
- **Asymmetry**
- Merging / Consolidation
- Universality
- Nested Doll
- Anti-weight
- Prior Counteraction
- Prior Action
- Cushion in Advance
- Equipotentiality
- **The Other Way Round**
- **Spheroidality / Curvature**
- Dynamics
- Partial or Excessive Action
- Another Dimension
- Mechanical Vibration
- **Periodic Action**
- Continuity of Action

# Principle 1: Segmentation

## Technical



## Business

- Divide an organisation into different product centres.
- Autonomous profit centres.
- Use a work breakdown structure for a large project.
- Value/Satisfaction segmentation of customer purchase related preferences
- Marketing segmentation by demographics, sociographics, psychographics, lifestyles, etc

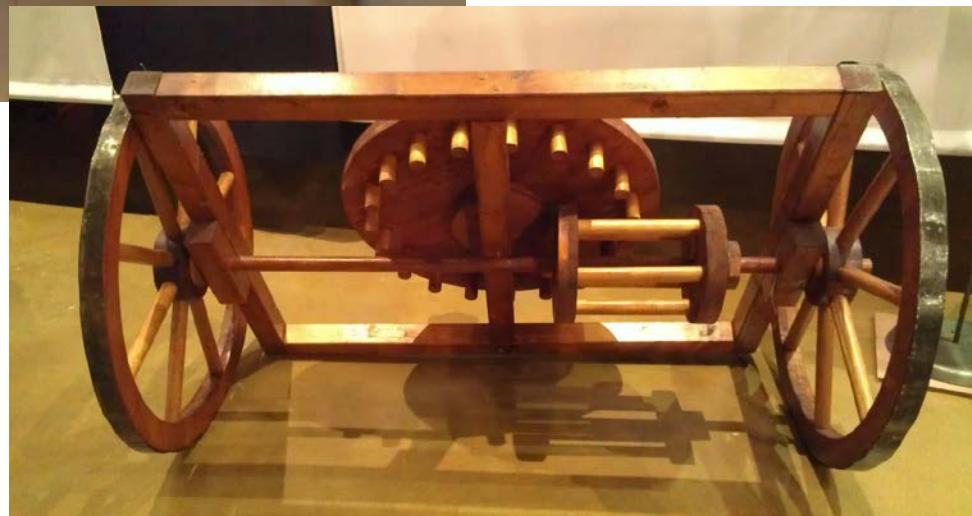
# Principle 2: Taking Out

# Principle 3: Local Quality



## ***Da Vinci's Differential***

- Leonardo Da Vinci invented an early form of the differential gear which allows the wheels to turn at different speeds to aid in cornering



# Principle 4: Asymmetry



## **Auckland Harbour Bridge**

- *The bridge employs a tidal flow traffic management system which allocates an extra lane of traffic to the direction experiencing peak traffic flows*

# Solving Contradictions

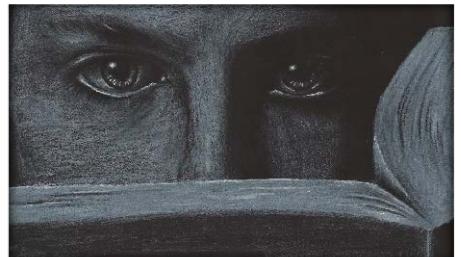
## Technical

- [http://www.triz40.com/TRIZ\\_GB.php](http://www.triz40.com/TRIZ_GB.php)

## Business

- <http://www.triz-journal.com/40-inventive-business-principles-examples/>

**TRIZ - The Classic 40 Inventive Principles**

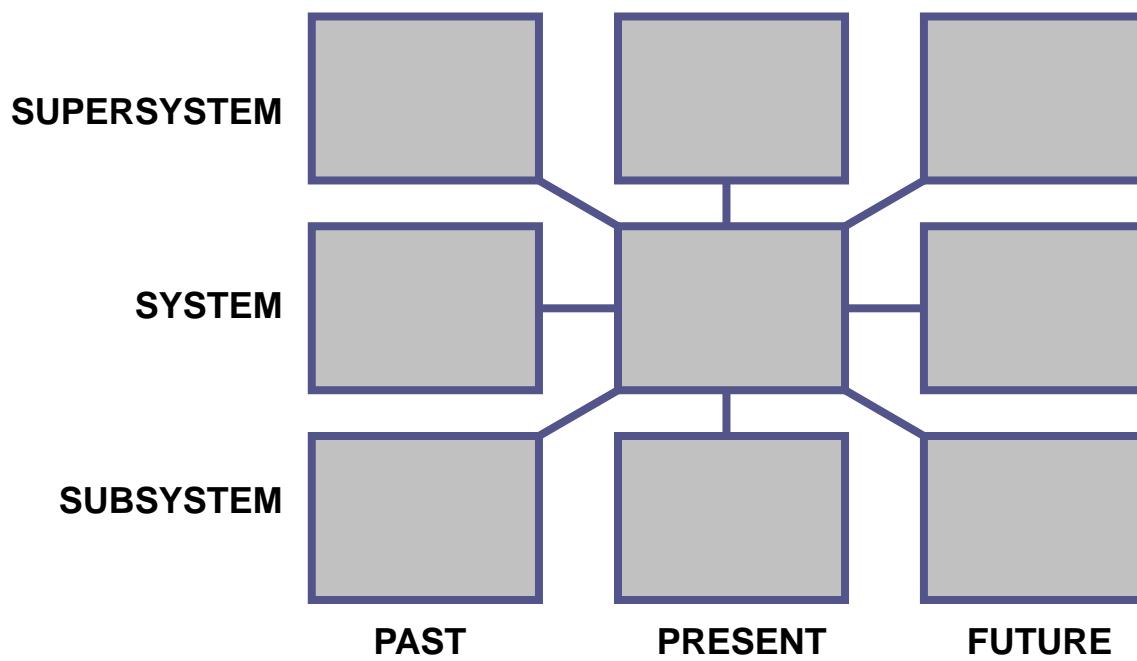


**40 "lenses" with which to view a problem and identify solutions**

## **Worsening Feature**

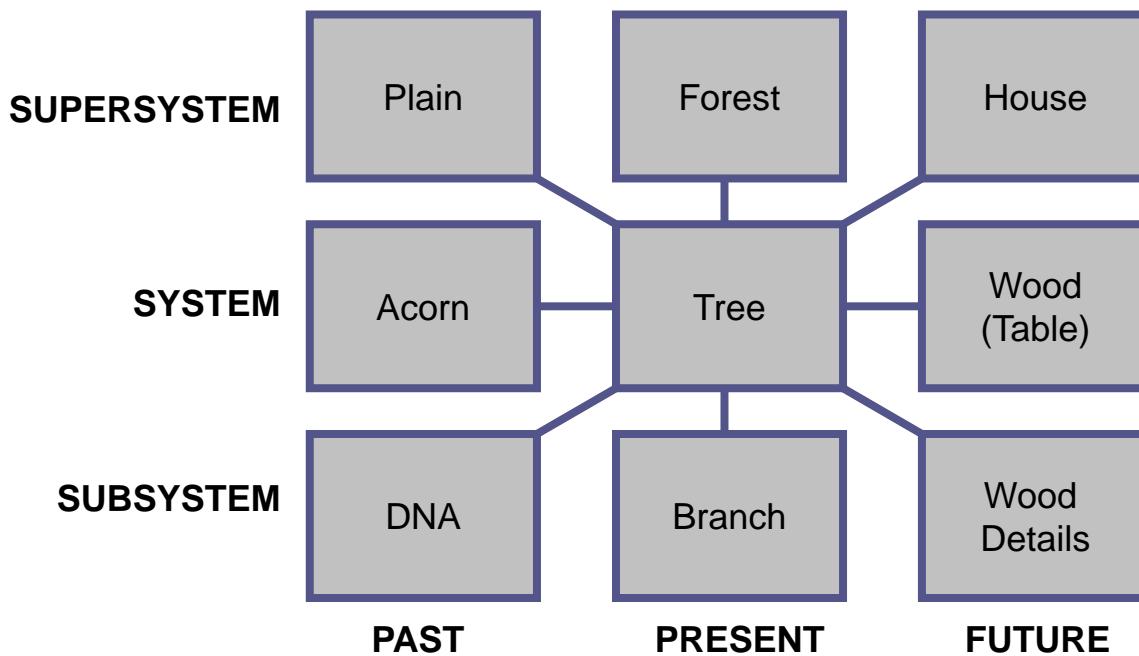
## Improving Feature

# Thinking in Time and Space



# Thinking in Time and Space

## Example:



# A Real Life Example

## NASA's Lunar Lander Problem

<https://www.youtube.com/watch?v=OIJGQ92IgFk>

Function of a lamp?

*To generate light*

Function of the screw base?

*Connect lamp*

Function of a filament?

*To transform electric current into light*

Function of a glass bulb?

*To maintain vacuum*

**DO WE NEED THIS LAST FUNCTION ON THE MOON?**



## Q2) Open-ended question:

**Briefly outline an engineering problem that TRIZ could help identify possible new innovative solutions**

- 1 or 2 sentences
- Define the problem – not the solution
- Best ideas will be used for workshop with Iouri Belski in week 4

# TRIZ Solutions

## Vehicle fires

- 13 inventive ideas

## Vehicle explosions (eg LPG tankers)

- 6 ideas

## Major utility failure

- 9 ideas

## Tower cable impact

- 6 ideas

## Ship peer impact

- 7 ideas

## Ship mast superstructure impact

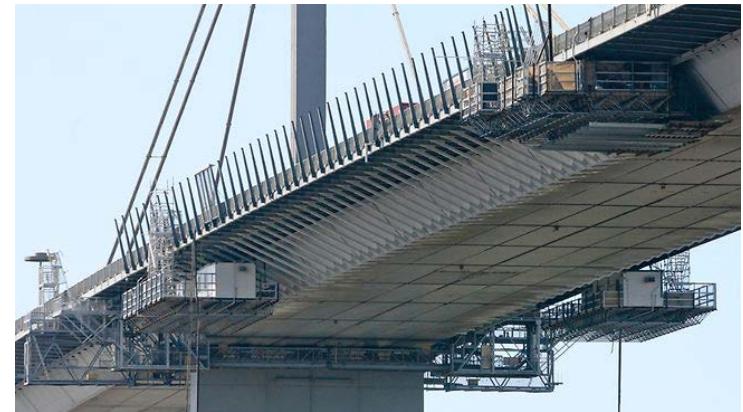
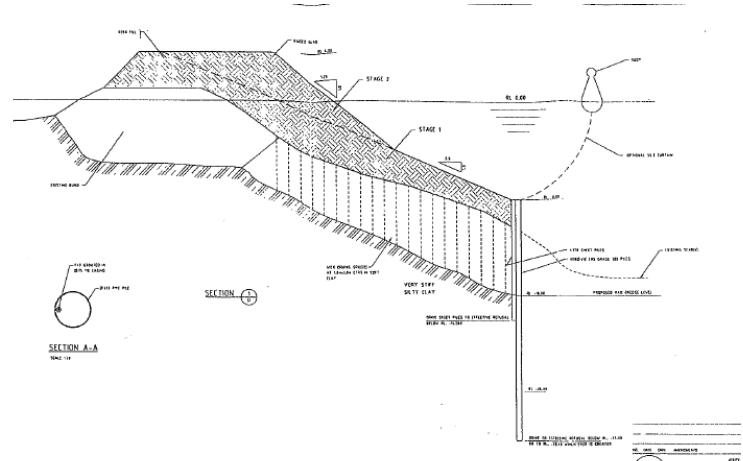
- 4 ideas

## Train impact on minor spans

- 5 ideas

## Debris falling from bridge

- 3 ideas



**53 Inventive Ideas**  
generated from half-day  
TRIZ workshop

# Chartered Engineer Attributes IPENZ

(slightly abridged)

1. Comprehend and apply detailed knowledge of accepted principles underpinning good practice
2. Comprehend and apply detailed knowledge of accepted principles underpinning good practice specific to the jurisdiction
3. Investigate and analyse engineering problems in accordance with good engineering practice
4. Design or develop solutions to engineering problems
5. **Be responsible for making decisions**
6. **Manage engineering activities in accordance with good engineering management practice**
7. Identify engineering risk and apply appropriate risk management techniques
8. **Conduct engineering activities to an ethical standard**
9. Recognise the reasonably foreseeable social, cultural and environmental effects of engineering activities
10. Communicate clearly with others
11. Maintain engineering knowledge and skills
12. **Exercise sound engineering judgement**

# Learning Objectives

By the end of next 3 lectures you should understand:

- Fundamentals of P&L, Balance Sheets and Cashflow
- Time Value of Money

**N.B:**

**Financial Management and Engineering Economics are core knowledge areas and skills for ALL Engineers**



# Financial Statements

Profit and Loss Account

Balance Sheet

Cash flow Statement

# Why do we have Financial Statements?

- Governments (tax)
- Shareholders / investors (return on equity)
- Financial Institutions (debt servicing)
- Suppliers / Customers (cashflow)
- Staff

# **Cost Accounting, Financial Management and Economics**

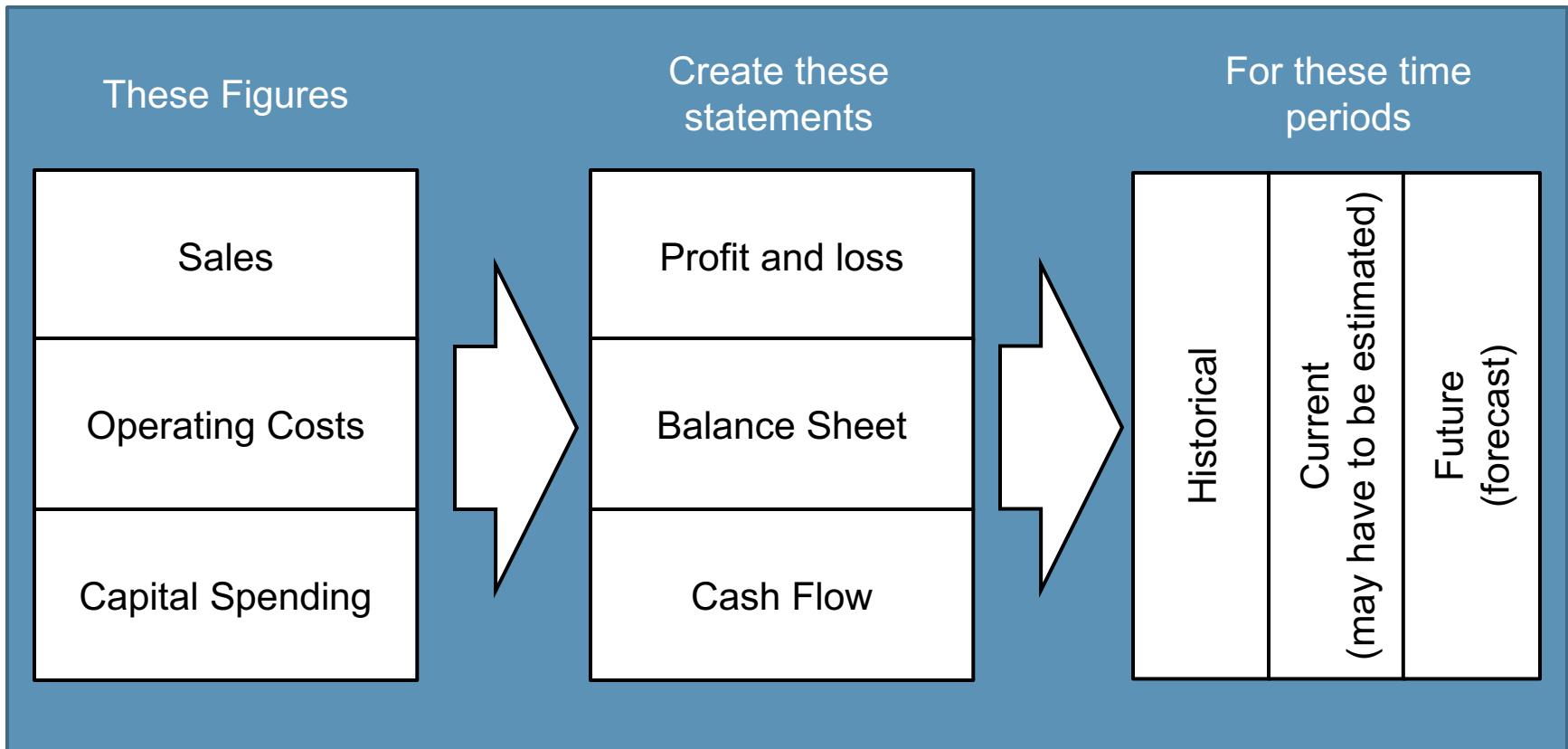
## Cost Accounting

- Recording and reporting
- Emphasis on profit
- Backward looking
- Known outcomes
- Historic costs
- Book values

## Financial Management (Economics)

- Resource allocation
- Emphasis on cash flows
- Forward looking
- Risky possibilities
- Present values
- Market values

# Basic Relationships



# Fundamental Accounting Relationship #1

$$\text{Revenues} - \text{Expenses} = \text{Profit (or Loss)}$$

- This equation defines the *Income Statement* (US) also known as *Profit and Loss Statement* (UK)
- Shows very important “Bottom Line”
- Shows financial flows relative to period of time (e.g. month or year)

# Example Income Statement (Profit and Loss Account)

For the 12 months ended 31 July 2015

	\$ 000
<b>Turnover / Revenue / Sales</b>	\$100
- Cost of Sales	-\$40
<b>Gross Profit</b>	\$60
-Operating Expenses	-\$10
<b>Profit before Charges (EBITDA)</b>	\$50
-Depreciation and Amortisation	\$0
<b>Profit before Interest (EBIT)</b>	\$50
- Net Interest Paid	-\$8
<b>Profit before Tax (EBT)</b>	\$42
-Tax	-\$13
<b>Net Profit (NPAT)</b>	\$29
-Dividends	-\$20
<b>Retained Profit</b>	\$9

# Fundamental Accounting Relationship #2

$$\text{Assets} = \text{Liabilities} + \text{Owners' Equity}$$

- This equation defines the *Balance Sheet*
- The *Balance Sheet* is a snap shot of finances at a moment of time (eg 31 December)

## **Q2) What is the item indicated as ? in Balance Sheet below**

**Fixed Assets**  
(Tangible + Intangible)

+

**Current Assets**  
(Stocks + debtors + Cash)

(=Total Assets)

=

**Current Liabilities**  
(Due within one year)

+

**Long Term Liabilities**  
(= Total Liabilities)

+

?

# Balance Sheet

**Fixed Assets**  
(Tangible + Intangible)  
+

**Current Assets**  
(Stocks + debtors + Cash)

(=Total Assets)

=

**Current Liabilities**  
(Due within one year)

+

**Long Term Liabilities**

(= Total Liabilities)

+

**Equity**

# Example Balance Sheet

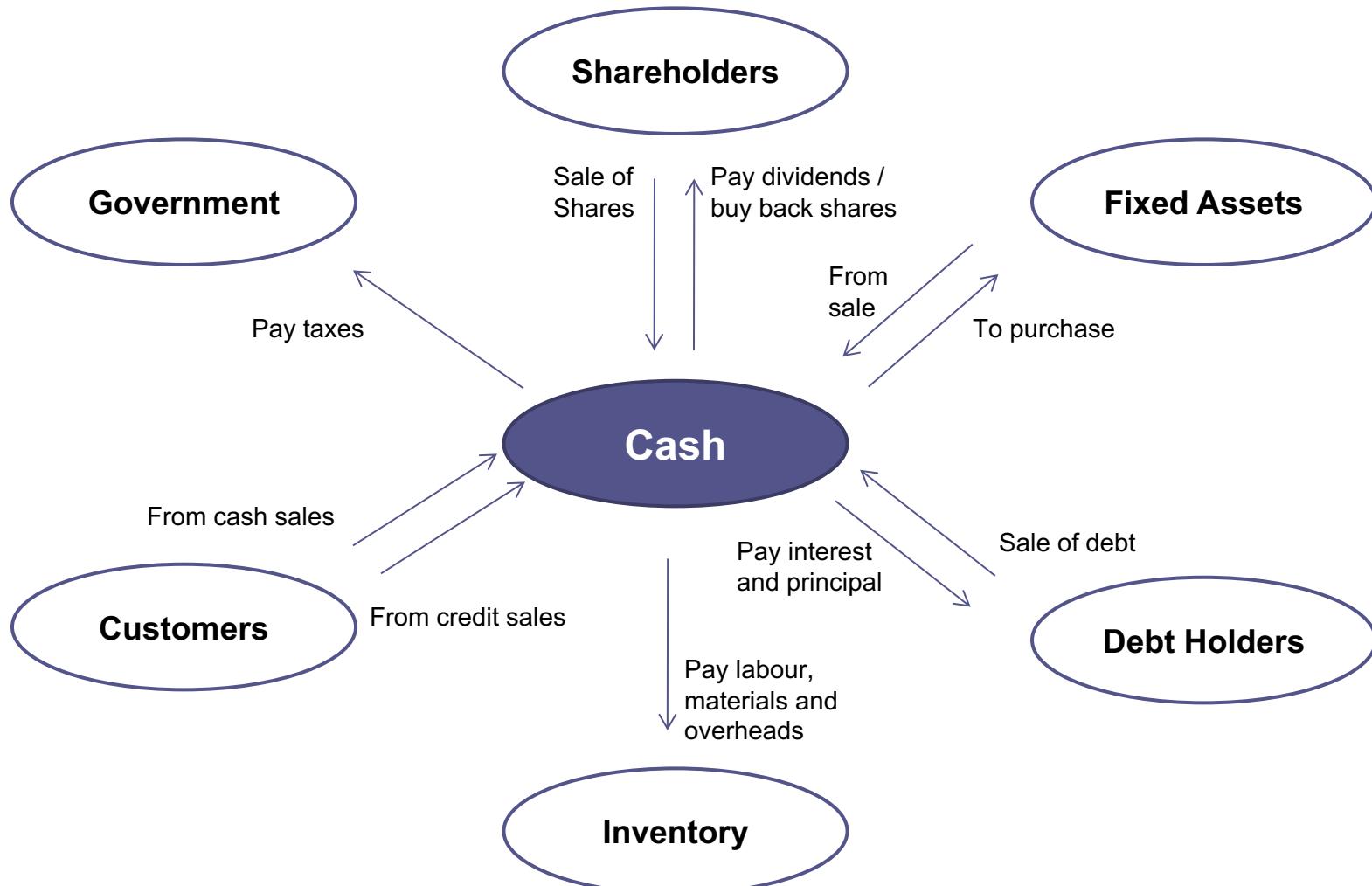
as at 31 July 2015

<b>Fixed Assets</b>	
Tangible assets	\$750,000
Intangible assets	\$0
	<b>Fixed Assets Sub-total</b>
	\$750,000
 <b>Current Assets</b>	
Cash on hand	\$0
Debtors	\$2,000
Cash at bank	\$8,000
	<b>Current Assets Sub-total</b>
	\$10,000
 Total Assets	 <b>\$760,000</b>
 <b>Current Liabilities: amounts falling due within one year</b>	
Short term debt	\$0
Creditors	\$6,000
Tax Due	\$0
	<b>Sub-total</b>
	\$6,000
 Net Current Assets (Current Assets – Current Liabilities)	 <b>\$4,000</b>
Total Assets less Current Liabilities	 <b>\$754,000</b>
 <b>Creditors Due after One Year</b>	
Long term debt	\$250,000
 <b>Net Total Assets</b>	 <b>\$504,000</b>
 <b>Equity</b>	
Ordinary Share Capital	\$1,000
Retained Earnings	\$503,000
	<b>Total</b>
	<b>\$504,000</b>

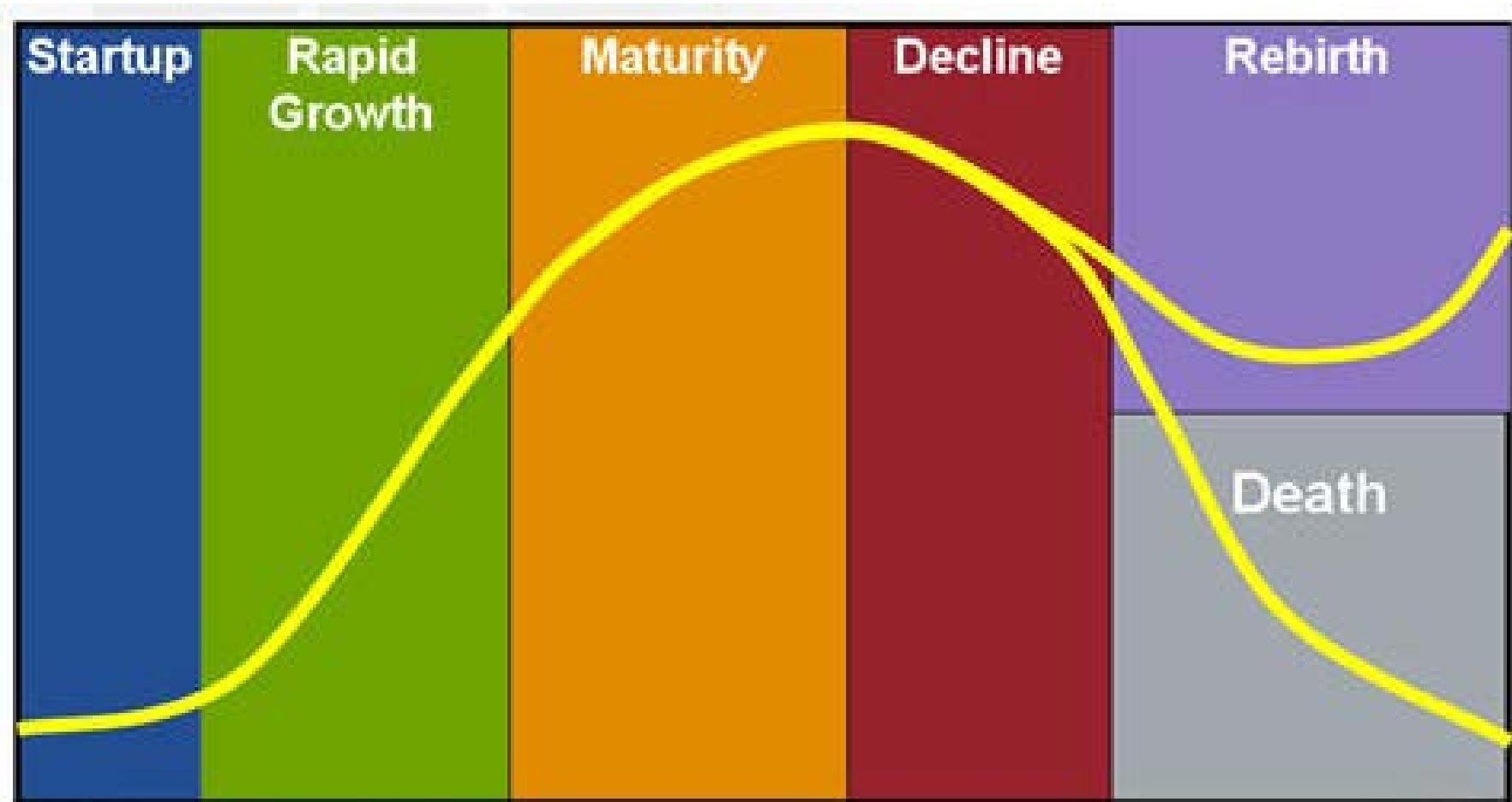
# **Book vs. Market Values**

- Balance sheet records book values, not market values
- Book values are backward-looking; based on value at the time of acquisition
- Book value of fixed assets = historic cost less cumulative depreciation
- Market values are forward-looking; current “sell” values based on expected future returns

# Cash flows for typical firm



# Lifecycle of a Business



# Company X

<b>Fixed Assets</b>	\$m
Tangible assets	\$0.0
Intangible assets	<u>\$10.0</u>
	<b>Fixed Assets Sub-total</b>
	<b>\$10.0</b>
<b>Current Assets</b>	
Debtors	\$0.0
Cash at bank	<u>\$20.0</u>
	<b>Current Assets Sub-total</b>
	<b>\$20.0</b>
Total Assets	<u><b>\$30.0</b></u>
<b>Current Liabilities: amounts falling due within one year</b>	
Short term debt	\$0.0
Creditors	\$1.0
Tax Due	<u>\$0.0</u>
	<b>Sub-total</b>
	<b>\$1.0</b>
Net Current Assets (Current Assets – Current Liabilities)	<b>\$19.0</b>
Total Assets less Current Liabilities	<b>\$29.0</b>
<b>Creditors Due after One Year</b>	
Long term debt	\$4.0
<b>Net Total Assets</b>	<b>\$25.0</b>
<b>Equity</b>	
Ordinary Share Capital	\$25.0
Retained Earnings	<u>\$0.0</u>
	<b>Total</b>
	<b>\$25.0</b>

# Company X – What kind of Company?

<b>Fixed Assets</b>	\$m	For 12 months ending XXXX	\$m
Tangible assets	\$0.0	Turnover / Revenue / Sales	\$0.0
Intangible assets	\$10.0	- Cost of Sales	-\$5.0
	<b>Fixed Assets Sub-total</b>	<b>\$10.0</b>	
<b>Current Assets</b>			
Debtors	\$0.0	Gross Profit	-\$5.0
Cash at bank	\$20.0	-Operating Expenses	-\$1.0
	<b>Current Assets Sub-total</b>	<b>\$20.0</b>	
Total Assets	\$30.0	Profit before Charges (EBITDA)	-\$6.0
<b>Current Liabilities: amounts falling due within one year</b>			
Short term debt	\$0.0	-Depreciation and Amortisation	\$0.0
Creditors	\$1.0	Profit before Interest (EBIT)	-\$6.0
Tax Due	\$0.0	- Net Interest Paid	-\$0.5
	<b>Sub-total</b>	<b>\$1.0</b>	
Net Current Assets (Current Assets – Current Liabilities)	\$19.0	Profit before Tax (EBT)	-\$6.5
Total Assets less Current Liabilities	\$29.0	-Tax	\$0.0
<b>Creditors Due after One Year</b>			
Long term debt	\$4.0	Net Profit (NPAT)	-\$6.5
<b>Net Total Assets</b>	<b>\$25.0</b>	-Dividends	\$0.0
<b>Equity</b>		Retained Profit	-\$6.5
Ordinary Share Capital	\$25.0		
Retained Earnings	\$0.0		
	<b>Total</b>	<b>\$25.0</b>	

# Q1) Company X – What kind of Company?

- A. Start-up
- B. Growth
- C. Mature
- D. Decline

# Q1) Company X – What kind of Company?

- A. Start-up      ✓
- B. Growth
- C. Mature
- D. Decline

# Company Y - – What kind of Company?

<b>Fixed Assets</b>	\$m
Tangible assets	\$2,000.0
Intangible assets	\$0.0
<b>Fixed Assets Sub-total</b>	<b>\$2,000.0</b>
<b>Current Assets</b>	
Debtors	\$100.0
Cash at bank	\$0.0
<b>Current Assets Sub-total</b>	<b>\$100.0</b>
<b>Total Assets</b>	<b>\$2,100.0</b>
<b>Current Liabilities: amounts falling due within one year</b>	
Short term debt	\$0.0
Creditors	\$20.0
Tax Due	
<b>Sub-total</b>	<b>\$20.0</b>
<b>Net Current Assets (Current Assets – Current Liabilities)</b>	<b>\$80.0</b>
<b>Total Assets less Current Liabilities</b>	<b>\$2,080.0</b>
<b>Creditors Due after One Year</b>	
Long term debt	\$500.0
<b>Net Total Assets</b>	<b>\$1,580.0</b>
<b>Equity</b>	
Ordinary Share Capital	\$10.0
Retained Earnings	\$1,570.0
<b>Total</b>	<b>\$1,580.0</b>

# Company Y – What kind of Company?

<b>Fixed Assets</b>	\$m		
Tangible assets	\$2,000.0		
Intangible assets	\$0.0		
	<b>Fixed Assets Sub-total</b>	<b>\$2,000.0</b>	
<b>Current Assets</b>			
Debtors	\$100.0		
Cash at bank	\$0.0		
	<b>Current Assets Sub-total</b>	<b>\$100.0</b>	
Total Assets	\$2,100.0		
<b>Current Liabilities: amounts falling due within one year</b>			
Short term debt	\$0.0		
Creditors	\$20.0		
Tax Due			
	<b>Sub-total</b>	<b>\$20.0</b>	
Net Current Assets (Current Assets – Current Liabilities)	\$80.0		
Total Assets less Current Liabilities	\$2,080.0		
<b>Creditors Due after One Year</b>			
Long term debt	\$500.0		
<b>Net Total Assets</b>	<b>\$1,580.0</b>		
<b>Equity</b>			
Ordinary Share Capital	\$10.0		
Retained Earnings	\$1,570.0		
	<b>Total</b>	<b>\$1,580.0</b>	
		For 12 months ending XXXX	\$m
		Turnover / Revenue / Sales	\$200.0
		- Cost of Sales	-\$120.0
		Gross Profit	\$80.0
		-Operating Expenses	-\$10.0
		Profit before Charges (EBITDA)	\$70.0
		-Depreciation and Amortisation	-\$100.0
		Profit before Interest (EBIT)	-\$30.0
		- Net Interest Paid	-\$50.0
		Profit before Tax (EBT)	-\$80.0
		-Tax	\$0.0
		Net Profit (NPAT)	-\$80.0
		-Dividends	\$0.0
		Retained Profit	-\$80.0

## Q2) Company Y – What kind of Company?

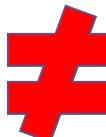
- A. Start-up
- B. Growth
- C. Mature
- D. Decline

## Q2) Company Y – What kind of Company?

- A. Start-up
- B. Growth
- C. Mature
- D. Decline ✓

# Operating Profit vs. Operating Cash Flow

- Operating Profit is based on accruals: Sales (not receipts) and matching costs (not payments)
- Operating Cash Flow is based on receipts and payments

**PROFIT**      **CASHFLOW**

# Depreciation

- Depreciation is  
“The measure of the cost of the fixed asset that has been consumed during the period”
- **Depreciation is charged to the P&L account but is not cash flow**
- Methods of Calculating:
  - Straight line
  - Reducing balance method
  - Sum of the years' digit method
  - Machine Hours

# Fixed Line Depreciation

$$\text{Annual Depreciation} = (I_0 - S^e) / T$$

$I_0$  = Initial Cost

$S^e$  = Expected Scrap Value

$T$  = Asset's useful economic life

- Example:
  - Machine costs \$3,000 and its residual value is estimated at \$1000. Its useful economic life is 4 years.
  - Annual depreciation =  $(\$3,000 - \$1,000)/4 = \$500$

# An Example

<b>Period:</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>Capital investment</b>	\$10,000					
<b>Scrap Value at end</b>						\$0
<b>Revenues</b>		\$15,000	\$15,750	\$16,538	\$17,364	\$18,233
<b>Cost of Sales &amp; Expenses</b>		\$10,000	\$10,500	\$11,025	\$11,576	\$12,155
<b>Depreciation (straight line)</b>		<u>\$2,000</u>	<u>\$2,000</u>	<u>\$2,000</u>	<u>\$2,000</u>	<u>\$2,000</u>
<b>Pre-tax profit</b>		\$3,000	\$3,250	\$3,513	\$3,788	\$4,078
<b>Tax (30%)</b>		<u>\$900</u>	<u>\$975</u>	<u>\$1,054</u>	<u>\$1,136</u>	<u>\$1,223</u>
<b>Profit after tax</b>		\$2,100	\$2,275	\$2,459	\$2,652	\$2,854
<b>Cash flow</b>	-\$10,000	\$4,100	\$4,275	\$4,459	\$4,652	\$4,855
<b>Cumulative Cash flow</b>	-\$10,000	-\$5,900	-\$1,625	\$2,834	\$7,486	\$12,341

# \$ Now or Tomorrow?

# The Time Value of Money



# The time value of Money

- Valuing expected future net cash flows must allow for the time value of money
- Three components
  - Delay (risk free rate of return)
  - Risk
  - Inflation

# Future Values and Interest Rates

## Future Value

- Value to which an investment will grow after earning interest

## Simple Interest

- Interest earned only on the initial investment

## Compound Interest

- Interest earned on initial investment and previous interest re-invested

## Question 3)

- Suppose you invest \$1,000 for 5 years at an interest rate of 8%.
- How much will your investment be worth at the end of year 5 if you are paid compound interest?

# Solution to Question 3

Year	Simple Interest (\$)	Compound Interest (\$)
1	1,080	1,080
2	1,160	1,166
3	1,240	1,260
4	1,320	1,360
5	1,400	1,469



# Future Value

$$F = P \times (1 + i)^N$$

F = Future Value

P = Original Investment

i = Annual interest rate

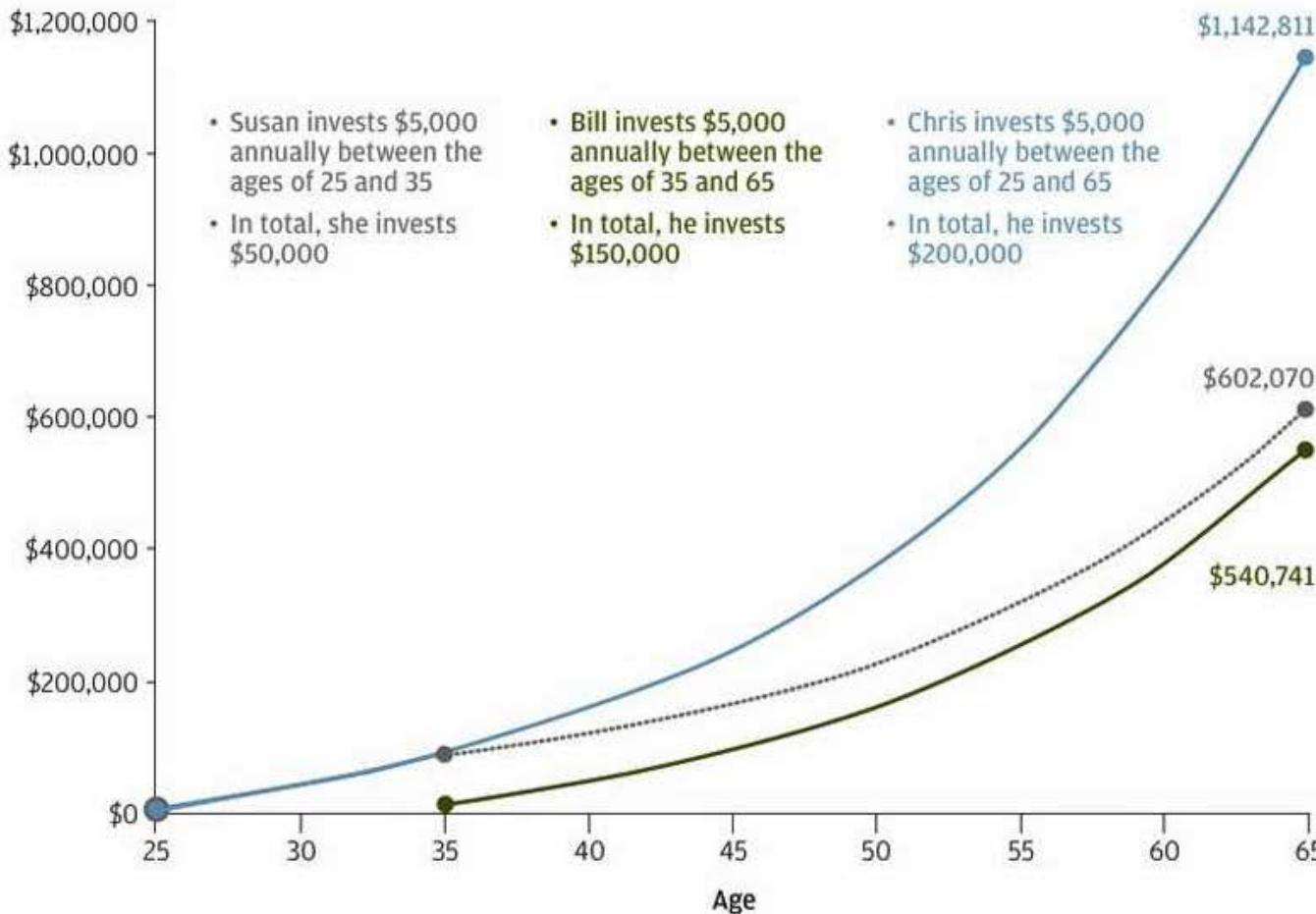
N = Time (years)

Or more generally

i = interest rate per interest period

N = Number of compounding interest periods

## Growth of savings accounts



**Saving fundamentals:**  
Harnessing the power of compounding can greatly impact the amount of savings over the long term.

The above example is for illustrative purposes only and not indicative of any investment. Account value in this example assumes a 7% annual return.  
Source: J.P. Morgan Asset Management.

Compounding refers to the process of earning return on principal plus the return that was earned earlier.

# Present Value

$$P = \frac{F}{(1 + i)^N}$$

F = Future Value

P = Original Investment

i = Annual interest rate

N = Time (years)

Or more generally

i = interest rate per interest period

N = Number of compounding interest periods

# Discounting

- Discounting is simply the inverse of compounding

$$F = P \times (1 + i)^N$$

COMPOUNDING

DISCOUNTING

$$P = \frac{F}{(1 + i)^N}$$

## Question 4

- Suppose you purchase a new computer for \$1,500 payable after 24 months.
- If you earn 8% interest per annum, how much should you set aside today in order to make the payment in two years?

# Solution to Question 4


$$P = 1500 / (1.08)^2$$
$$P = \$1,286$$

# Discounting and the time value of money

- Discount factor reflects the time value of money (delay, risk and inflation)
- Present values allow meaningful comparisons between cash flows with
  - Different amounts of money (different costs and/or revenue)
  - Different time profiles
  - Different risks
- i.e. Discounting provides a consistent method for comparing alternatives (Equivalence Concept)

# Valuing Multiple Future Cash Flows

- Present value of multiple future cash flows is the summation of the Present Value of each component cash flow,  $F_1, F_2, F_3, \dots$

$$P = \frac{F_1}{(1 + i)} + \frac{F_2}{(1 + i)^2} + \frac{F_3}{(1 + i)^3} + \dots$$

- ▶ Assume cash flow occurs at end of period (simple approach)

## Question 5

- Suppose you wish to purchase a car
- A car dealer offers the choice to purchase the car of either:
  - a. \$7,750 cash now,
  - b. An initial payment of \$4,000 followed by two end of year instalments of \$2,000.
- If your cost of money is 8%, which do you prefer?

# Solution to Question 5

Option a): Cash Now  
Immediate payment = \$7,750.00

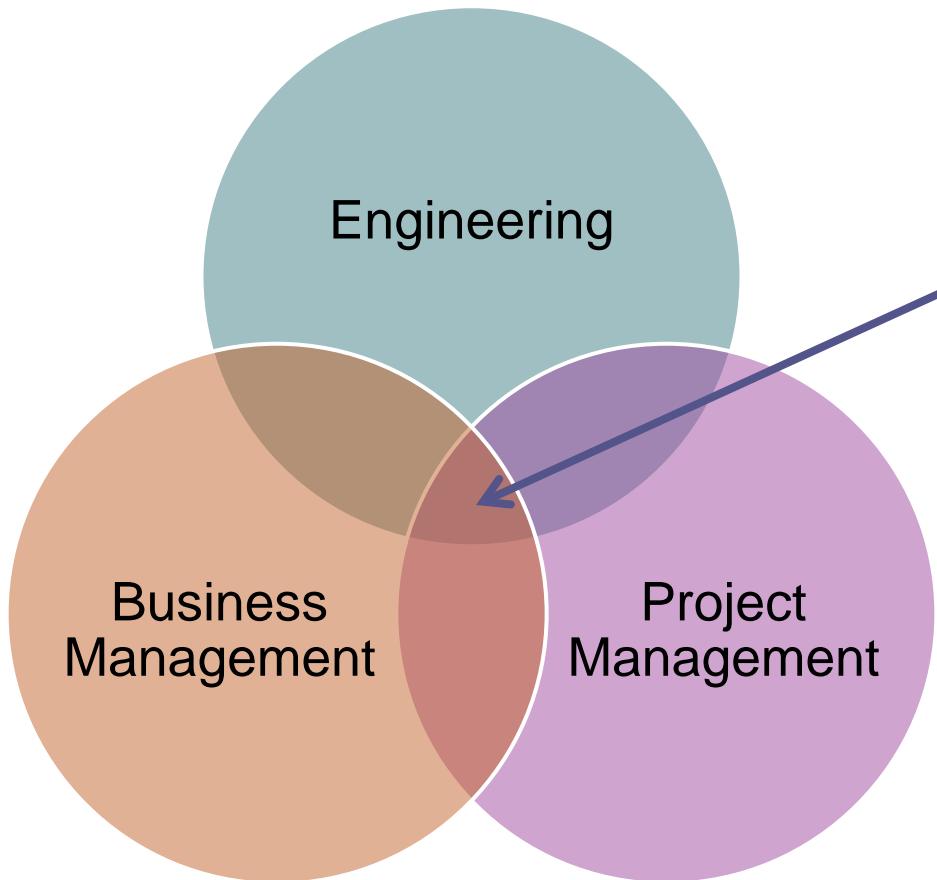
Option b): Installments  
Immediate payment = \$4,000.00  
 $P_1 = 2,000/(1.08)$  = \$1,851.85  
 $P_2 = 2,000/(1.08)^2$  = \$1,714.68  
Total Present Value = \$7,566.53

Decision: Option b  
Payment by installments preferred

# Summary

- Concepts of compounding and discounting are the foundation blocks for much of the cost engineering (eg whole life costing, options analysis, replacement decisions, etc).
- Money has a time value.
- Three basis rules to remember:
  1. Cash flows cannot be added or subtracted unless they occur at the same point in time.
  2. To move cash flow forward in time use the compounding formula.
  3. To move cash flow backward in time use the discounting formula.

# The Investment Decision



The Investment Decision represent the intersection of the fields of project management, business management, and engineering

# Core Principles of Engineering Economics

(Sullivan, Wicks & Koelling)

1. Develop alternatives
2. Focus on differences
3. Use a consistent viewpoint
4. Use a common unit of measurement
5. Consider all relevant criteria
6. Make risk and uncertainty explicit
7. Revisit your decisions

# Alternative Investment Decision Rules

## 1. Rules of thumb

- Payback rule
- Accounting rate of return

## 2. Discounted cash flow (DCF) rules

- Net Present Value (NPV)
- Internal Rate of Return (IRR)

# Valuation

Financial  
Value

=

Present Value of Expected  
Future Net Cash Flows

- Calculated using DCF analysis
- Applications:
  - Investment Projects (e.g. real estate, real assets)
  - Financial Assets (e.g. shares, bonds)
  - Corporate Valuation

# Net Present Value (NPV)

$NPV = PV \text{ of Net Future Cash Flows} - \text{Initial Capital Outlay}$

# The Investment Decision

- The fundamental Rule:

**Acceptance of all projects that contribute towards the maximisation of shareholder value**

- Implications:
  - All project cash flows must be considered
  - Allowance for time value of money

# Estimating Project Cash Flows

- Estimate incremental project cash flows
- Include all indirect costs
- Ignore sunk costs

# An Example

Period:	0	1	2	3	4	5
<b>Capital investment</b>	\$10,000					
<b>Scrap Value at end</b>						\$0
<b>Revenues</b>		\$15,000	\$15,750	\$16,538	\$17,364	\$18,233
<b>Cost of Sales &amp; Expenses</b>		\$10,000	\$10,500	\$11,025	\$11,576	\$12,155
<b>Depreciation (straight line)</b>		\$2,000	\$2,000	\$2,000	\$2,000	\$2,000
<b>Pre-tax profit</b>		\$3,000	\$3,250	\$3,513	\$3,788	\$4,078
<b>Tax (30%)</b>		\$900	\$975	\$1,054	\$1,136	\$1,223
<b>Profit after tax</b>		\$2,100	\$2,275	\$2,459	\$2,652	\$2,855
<b>Cash flow</b>	-\$10,000	\$4,100	\$4,275	\$4,459	\$4,652	\$4,855
<b>Cumulative Cash flow</b>	-\$10,000	-\$5,900	-\$1,625	\$2,834	\$7,486	\$12,341

Q) Is this a good project to invest in ?

# An Example Cont. with NPV

Period:	0	1	2	3	4	5
<b>Capital investment</b>	\$10,000					
<b>Scrap Value at end</b>						\$0
<b>Revenues</b>		\$15,000	\$15,750	\$16,538	\$17,364	\$18,233
<b>Cost of Sales &amp; Expenses</b>		\$10,000	\$10,500	\$11,025	\$11,576	\$12,155
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<b>Cumulative Cash flow</b>	-\$10,000	-\$5,900	-\$1,625	\$2,834	\$7,486	\$12,341
<b>Discount rate</b>	12%					
<b>PV (Cashflow)</b>	-\$10,000	\$3,661	\$3,408	\$3,174	\$2,956	\$2,755
<b>NPV</b>		\$5,953				

# Calculating Project Cash Flows

Project CF = Revenue – Cash Expenses - Taxes

Project CF = Profit after Tax + Depreciation

## Important Notes

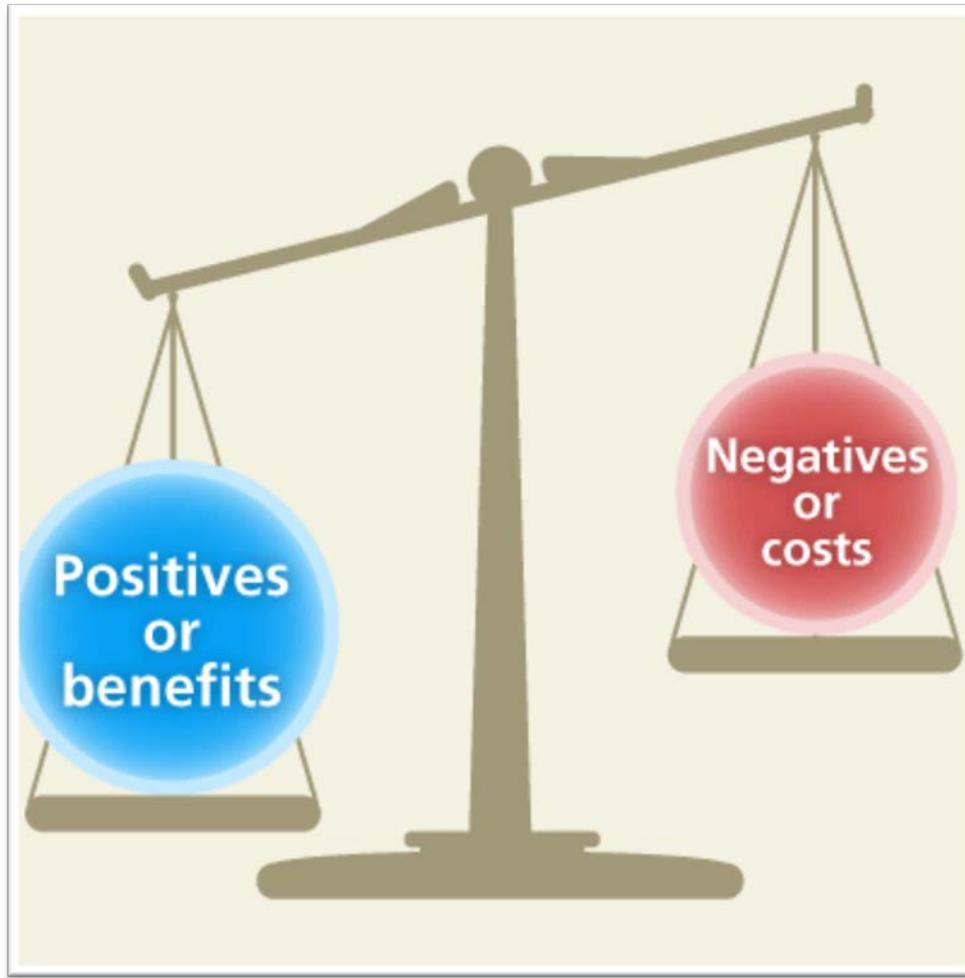
- Don't include interest in calculations because this is accounted for in the applied Discount Rate
- Profit and tax liability calculated as if all equity company

# An Example Cont. with NPV

Period:	0	1	2	3	4	5
<b>Capital investment</b>	\$10,000					
<b>Scrap Value at end</b>						\$0
<b>Revenues</b>		\$15,000	\$15,750	\$16,538	\$17,364	\$18,233
<b>Cost of Sales &amp; Expenses</b>		\$10,000	\$10,500	\$11,025	\$11,576	\$12,155
<b>Depreciation (straight line)</b>		\$2,000	\$2,000	\$2,000	\$2,000	\$2,000
<b>Pre-tax profit</b>		\$3,000	\$3,250	\$3,513	\$3,788	\$4,078
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Discount rate 12%

<b>PV (Cashflow)</b>	-\$10,000	\$3,661	\$3,408	\$3,174	\$2,956	\$2,755
<b>NPV</b>		\$5,953				



## Benefit – Cost Analysis

# Working Capital

We need to buy our raw materials before we can turn them into products (real or virtual).

We need to pay for our raw materials before we have sold our products.

We may need to wait for 30 days after we have sold our products to get the revenue into our bank account.

We need to pay out money before we get money in.

How do we manage this?

We need to have the cash in our bank account to manage this > working capital.

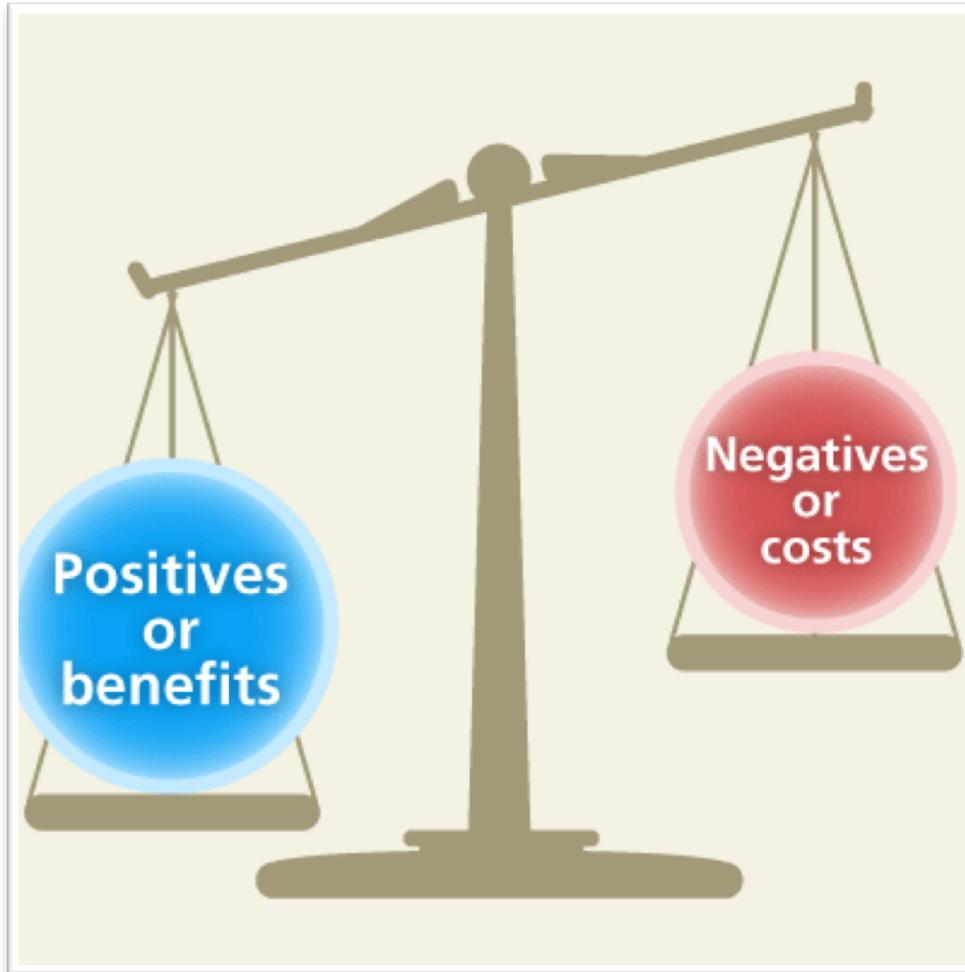


# **EngGen 303**

# **Management for Engineers**

## **Introduction to Finance #4**

Garry Miller  
2017



## Benefit – Cost Analysis

# **Benefit-Cost Analysis**

- Commonly used to appraise public sector projects
- Benefits and costs have to be expressed in same terms (usually monetary terms)
- Takes a “Whole of Life” view of the project

# Methodology

1

- Identify ALL users' benefits (favourable outcomes)
- Identify ALL users' disbenefits (unfavourable outcomes)

2

- Quantify benefits and disbenefits in \$ terms

3

- Identify the Sponsor's costs and quantify them (i.e. \$ terms)

4

- Determine the Present Value of the benefits and disbenefits using a discount rate appropriate for the project

5

- Accept the project if the users' net benefits exceed the equivalent sponsor's net costs

# **Identifying Benefits Example for Transport Projects**

- Travel Time Savings
  - Use \$ per person figure for vehicle-hour travelled (VHT) savings
- Vehicle Operating Cost Savings
  - Use \$ operating costs for vehicle-mile travelled (VMT) savings
- Safety Benefits
  - Use \$ savings from crash reductions

**Important Note:**

Must quantify all benefits and all disbenefits for all users

# Semi- Quantitative Measures of Consequence

IS THE PSYCHOLOGICAL TRAUMA AS BAD AS:	CONSEQUENCE DESCRIBED	SEVERITY SCORE
Dead	Catastrophic	6000
Four limbs cut off		3500
Three limbs cut off	Severe	2150
Two limbs cut off		1300
One arm cut off	Substantial	775
One hand cut off		450
One foot cut off		275
Four broken limbs	Significant	100
Three broken limbs		35
Two broken limbs		12
One broken arm	Slight	4
Sprained ankle		2
Laceration (four stitches)	Negligible	0.5
Cut		0.2
Bruise	Zero	0

# Social Discount Rates



## Projects without Private Counterparts

- Set by government
- Examples:
  - Flood control
  - Water supply (where no privatisation)
  - Public transport

## Projects with Private Counterparts

- Discount rate = Rate that could have been earned had the funds not been removed from the private sector
- I.e. = opportunity cost of capital for similar projects in private sector

# Social Discount Rate

- Published rate: in NZ published by Treasury
- Periodically updated (once per year)

Category	Rate (% p.a.) (April 2016)
Default rate	8.0%
General Purpose office and accommodation buildings	5.0%
Infrastructure and special purpose (single-use) buildings <ul style="list-style-type: none"><li>• Water and energy</li><li>• Prisons</li><li>• Hospitals</li><li>• Road and other transport projects</li></ul>	7.0%
Telecoms, media and technology. IT and equipment, knowledge economy	9.0%

# Benefit-Cost Ratio

$$\text{Benefit/Cost} = \frac{\text{PV (benefits of the proposed project)}}{\text{PV (total costs of the proposed project)}}$$

$$\text{Benefit/Cost} = \frac{\text{PV (B)}}{\text{PV(IIInv)} - \text{PV(MV)} + \text{PV(O\&M)}}$$

Where:

- PV = Present Value
- B = Benefits of the proposed project
- IIInv = Initial Investment in the proposed project
- MV = Market Value at the end of useful life
- O&M = Operating and Maintenance Costs

## **Evaluation (Go / No Go Decision)**

If Benefit-Cost Ratio  $> 1.0$   
then accept project

If Benefit-Cost Ratio  $< 1.0$   
then reject project

# Class Example

- A public project is being considered by local government has the following estimated benefit-cost profile:

Year	Benefit	Cost
0	\$0	\$10
1	\$0	\$10
2	\$20	\$5
3	\$30	\$5
4	\$30	\$8

- Assume the discount rate is 10%
- What is the B-C Ratio (to 1 decimal point)?

# Class Example Solution

Year	Benefit	Cost	Benefit NPV	Cost NPV
0	\$0	\$10	\$-	\$10.0
1	\$0	\$10	\$-	\$9.1
2	\$20	\$5	\$16.5	\$4.1
3	\$30	\$5	\$22.5	\$3.8
4	\$30	\$8	\$20.5	\$5.5
Total			\$59.5	\$32.5

Discount rate                            10%

Benefit Cost Ratio                    1.8

# 2018 Commonwealth Games

## Auckland Benefit/Cost analysis



<b>Quantified Benefits</b>	
<b>Estimated Benefits</b>	<b>NPV (\$m)</b>
New Zealand attendees	\$71
Induced tourism	\$22
“Halo” effects	\$105
Infrastructure	\$930
Television revenue	\$60
Sponsorship, etc	\$45
Total	\$1,232

<b>Estimated Costs</b>	
Bid budget	\$21
Infrastructure	\$930
Operating costs	\$835
Other capital	\$160
Total	\$1,945

<b>Results</b>	
Net present value	-\$713
Benefit cost ratio	0.63

### Unquantified Benefits

National pride  
 International profile  
 Business opportunities  
 Social, cultural and community (incl volunteering)  
 Sports development  
 Event culture  
 Physical regeneration

### Unquantified Costs

Congestion

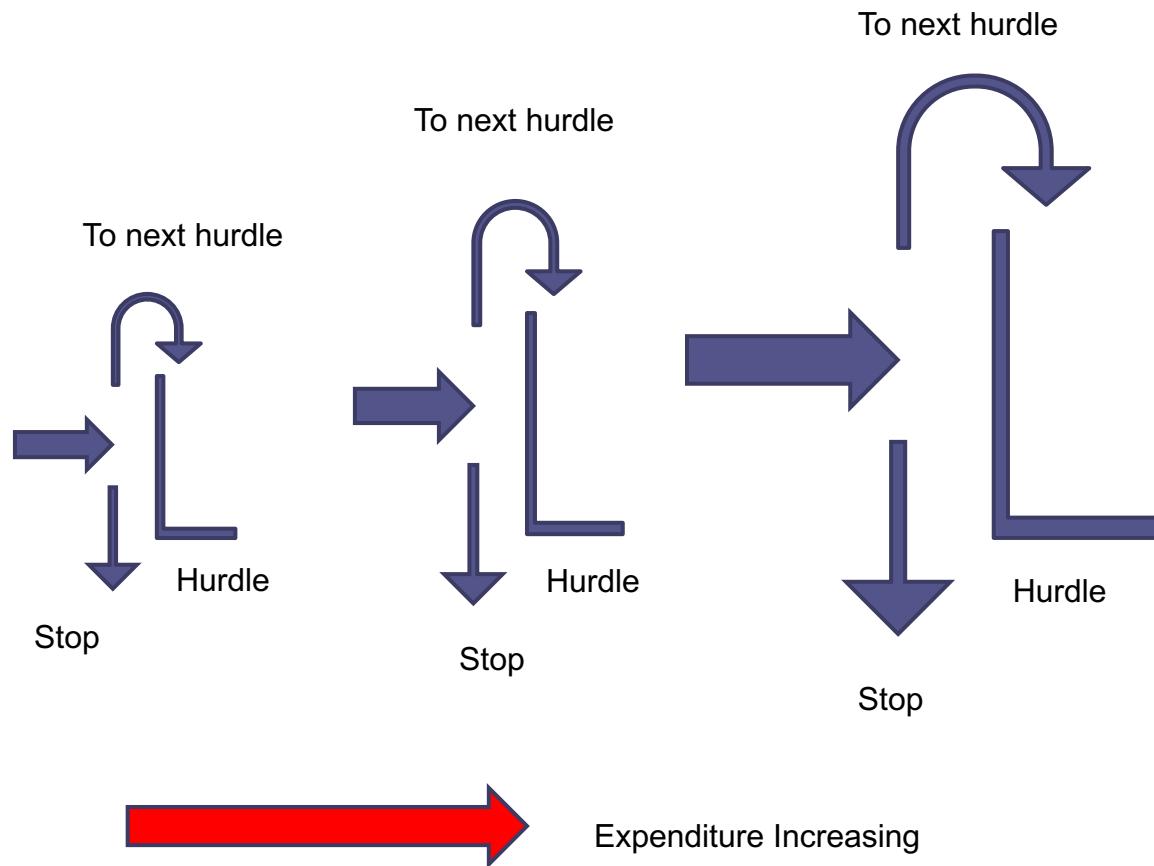


Source: NZ Treasury

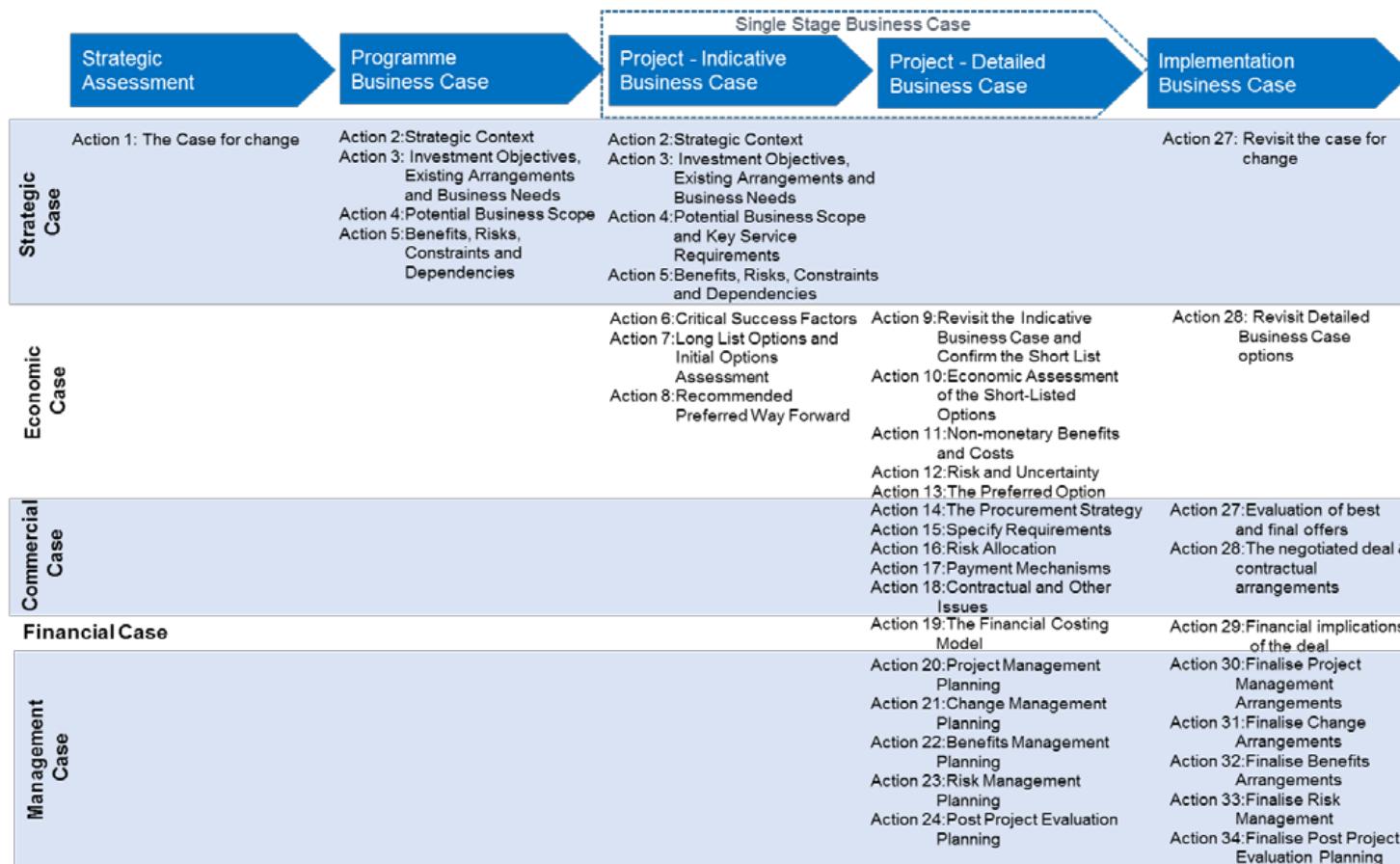
<http://www.treasury.govt.nz/publications/guidance/planning/costbenefitanalysis/guide/58.htm/#ref26>

# Criticisms and Shortcomings of the Benefit-Cost Ratio Method

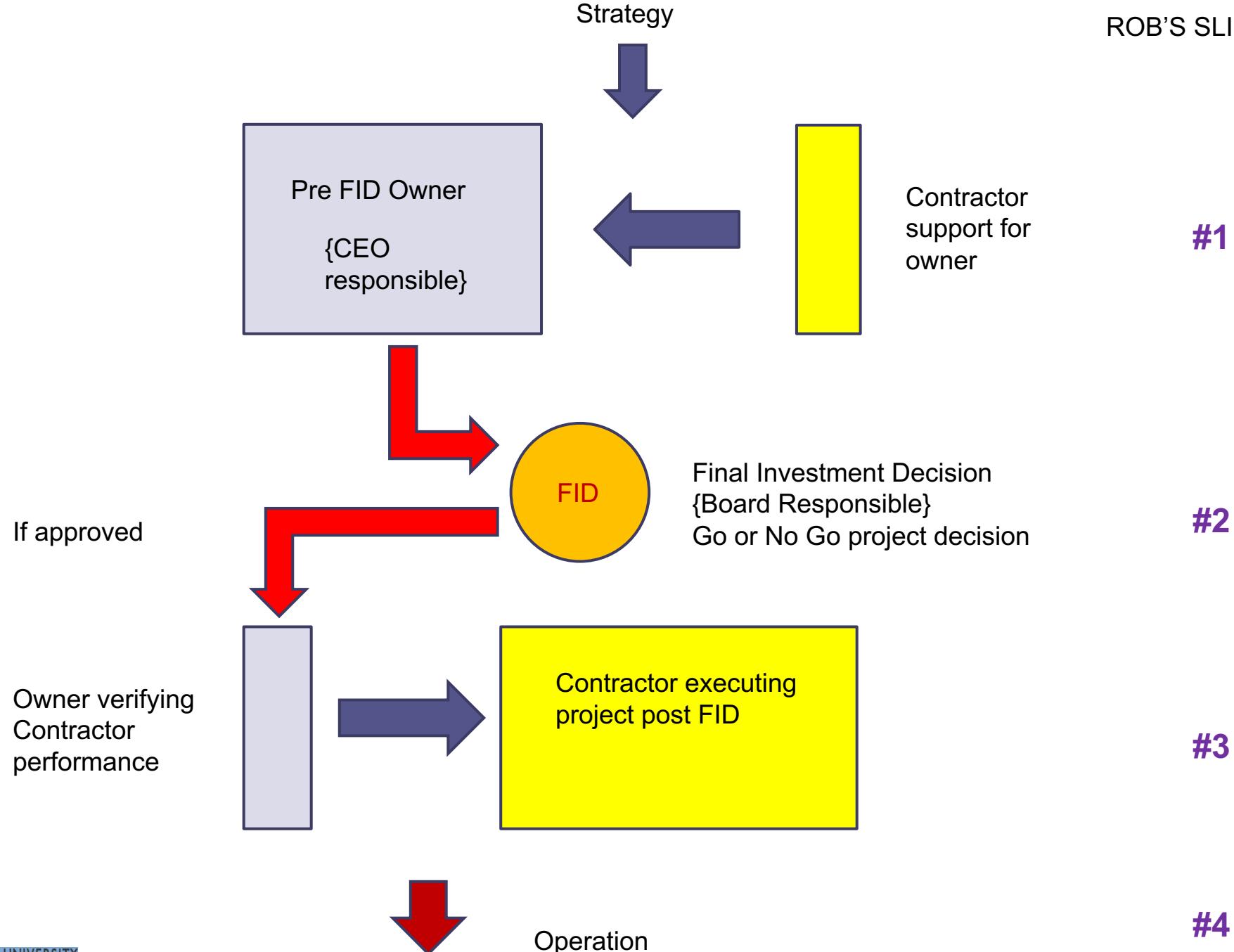
1. Often used as a tool for after the fact justifications rather than project evaluations
  - Often used as justification by the group paying for the analysis
2. Serious distributional inequities
  - One group reaps all benefits
  - Whilst another group bears all costs
3. Qualitative information is often ignored

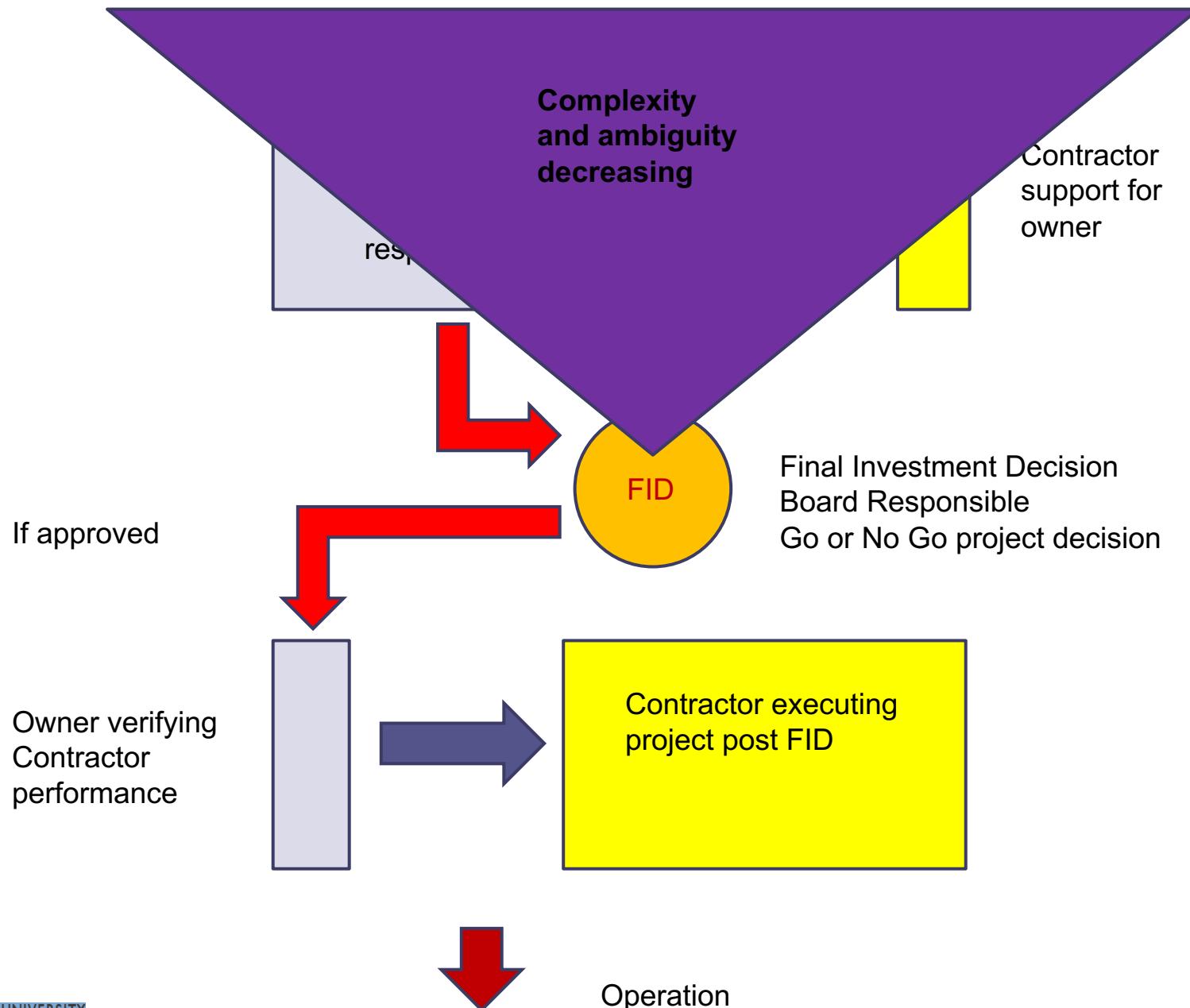


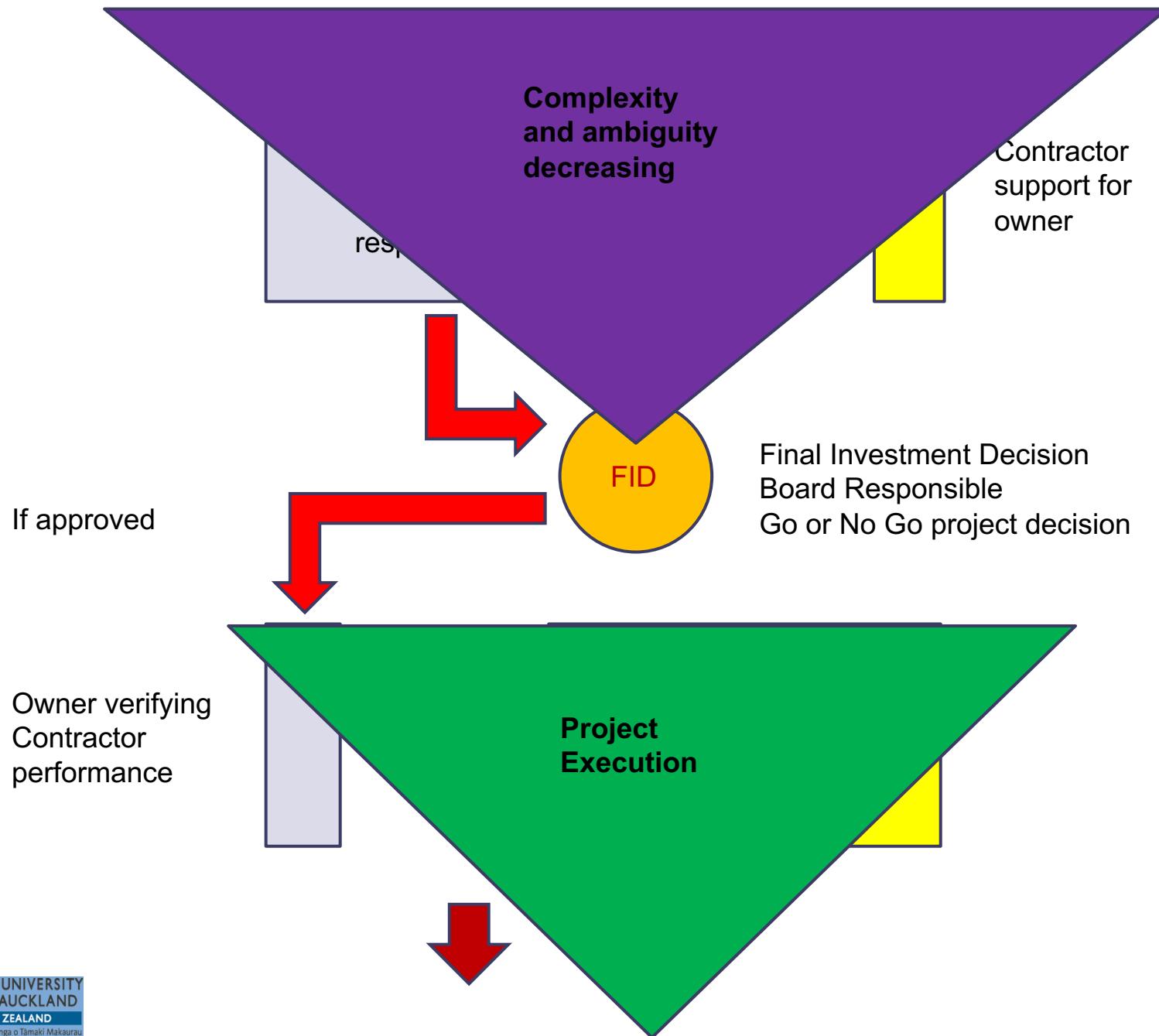
# Better Business Case (BBC)



# **Final Investment Decision (FID) Systems Thinking (Revisited)**







# Summary

- Financial Statements
- P&L, Balance Sheet, Depreciation
- Cashflow
- Time Value of Money
- Compound Interest
- Discounting
- NPV
- Decision Making

# Systems Architecture

Rob Kirkpatrick

April 2017

# System

## What is a System?

- NZ with subsystems of Auckland, Wellington...
- Auckland with subsystems of commercial, residual, transportation...
- Transportation with subsystems of cars, rail, buses, roads, bridges, traffic lights ...
- Rail with subsystems of freight, commuters, tourists...

Drawings to describe our System  
are called Systems Architecture

Do we need drawings to describe our System?

Normally as are engineers we produce drawings.

Question: what is the main purpose of our  
Systems Architecture drawings? Answer in one  
word.

# Systems Architecture

As with most drawings there are some conventions but these do not always work in all circumstances.

1. Start with the subsystems
2. What is the major inputs and outputs from our System? These often enter on the left and leave on the right
3. What flows connect our subsystems?
4. What are our cross system flows? These might be best presented in more of a vertical manner.

# Systems Architecture

It is sometimes useful to produce layered drawings where lower layers add more detail for different flows between our subsystems.

In some disciplines our drawings become a critical part of our project specifications and have commercial and legal status in our project documents.

For our current purposes in EngGen 303 it will be best if we think of our Systems Architecture as primarily a communications tool.

# Systems Architecture

We are trying to communicate to our client the complexity of the problem we are trying to resolve in a way that helps the client's understanding. In a sense our Systems Architecture drawing is also an important marketing document.

Although it may not be a helpful comment: it is easier to tell a poor Systems Architecture drawings as these are difficult to understand and do not clearly communicate what is being recommended.

To judge whether you have created a good Systems Architecture Drawing perhaps show it to a non involved friend and see if they can readily understand your drawing.

## Communication





# Project Management

ENGGEN 303  
Management for Engineers  
Project Management: Introduction

Garry Miller

# Learning Objectives

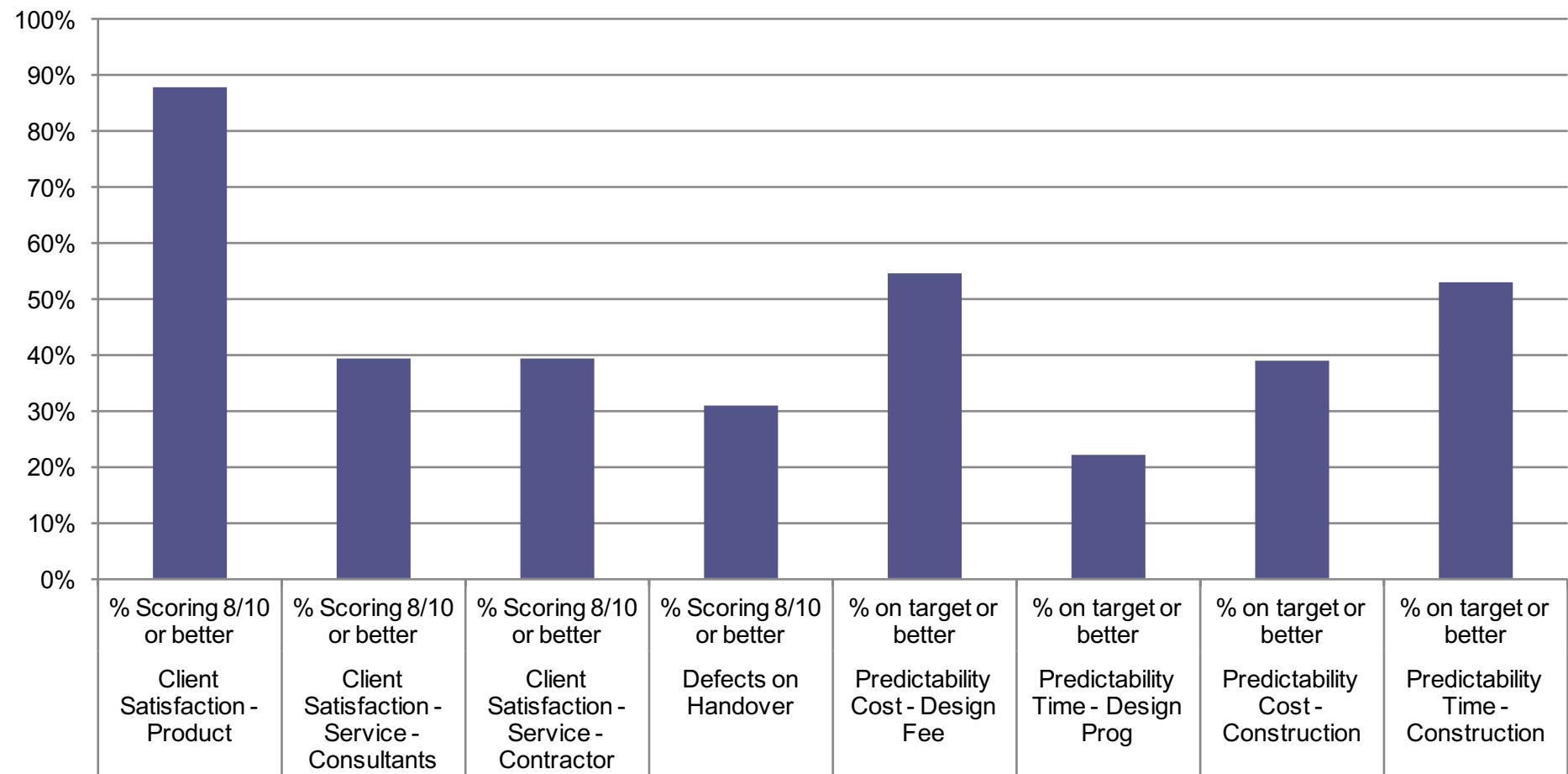
By the end of this series of lectures on Project Management you should understand:

- What is involved in managing a project
- The different phases of a project
- Scope, time, cost and quality management
- A selection of tools used by the Project Manager



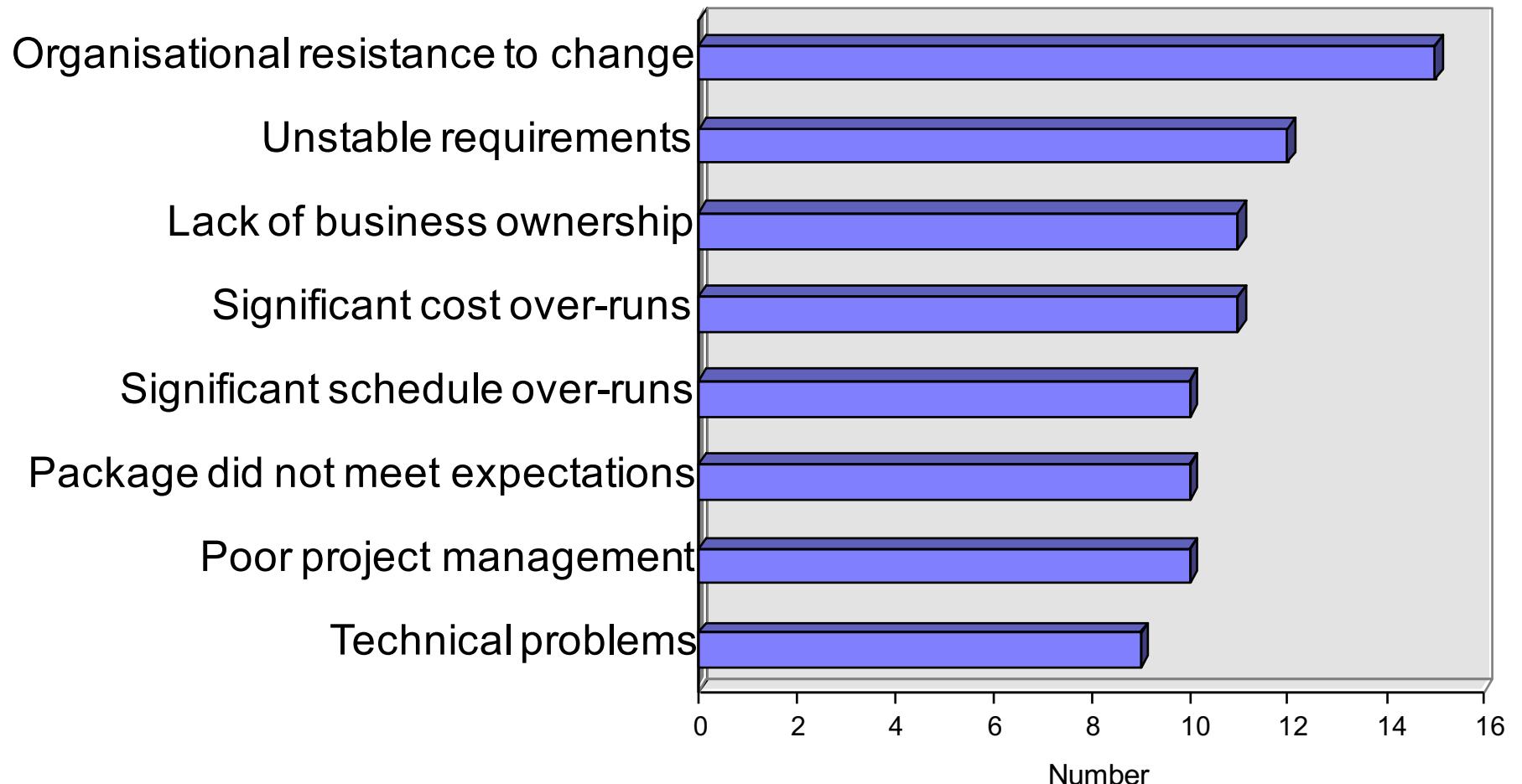
# Performance of Construction Projects in NZ

Industry Average (2006)



Source: Centre for Advanced Engineering, 2007

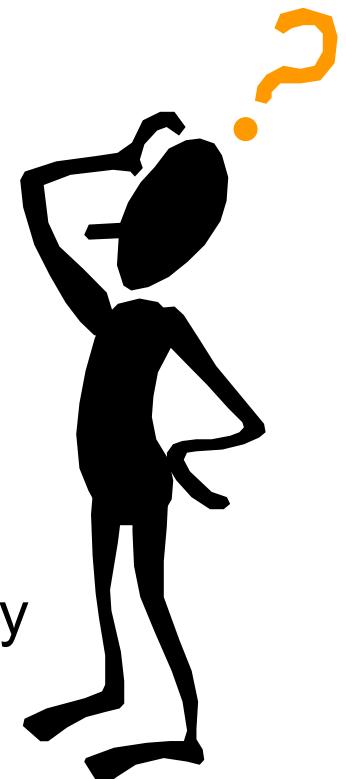
# Common Causes for I.T. Project Failure



Source: KPMG

# Why do Government Projects Fail

1. Lack of clear link between project and organisation's strategic priorities
2. Lack of senior management ownership and leadership
3. Lack of effective engagement with stakeholders
4. Lack of skills and approach to Project Management
5. Too little attention to breaking development and implementation into manageable steps.
6. Evaluation of proposals driven by initial price rather than long-term value for money.
7. Lack of understanding of and contact with the supply industry at senior levels in the organisation.
8. Lack of effective project team integration between clients, the supplier team and the supply chain.



Source: Office of Government Commerce (OGC), 2005

# Project Success

A successful project is one that is completed

- to specification,
- on time,
- within budget,

and ensures a delighted customer (goodwill).

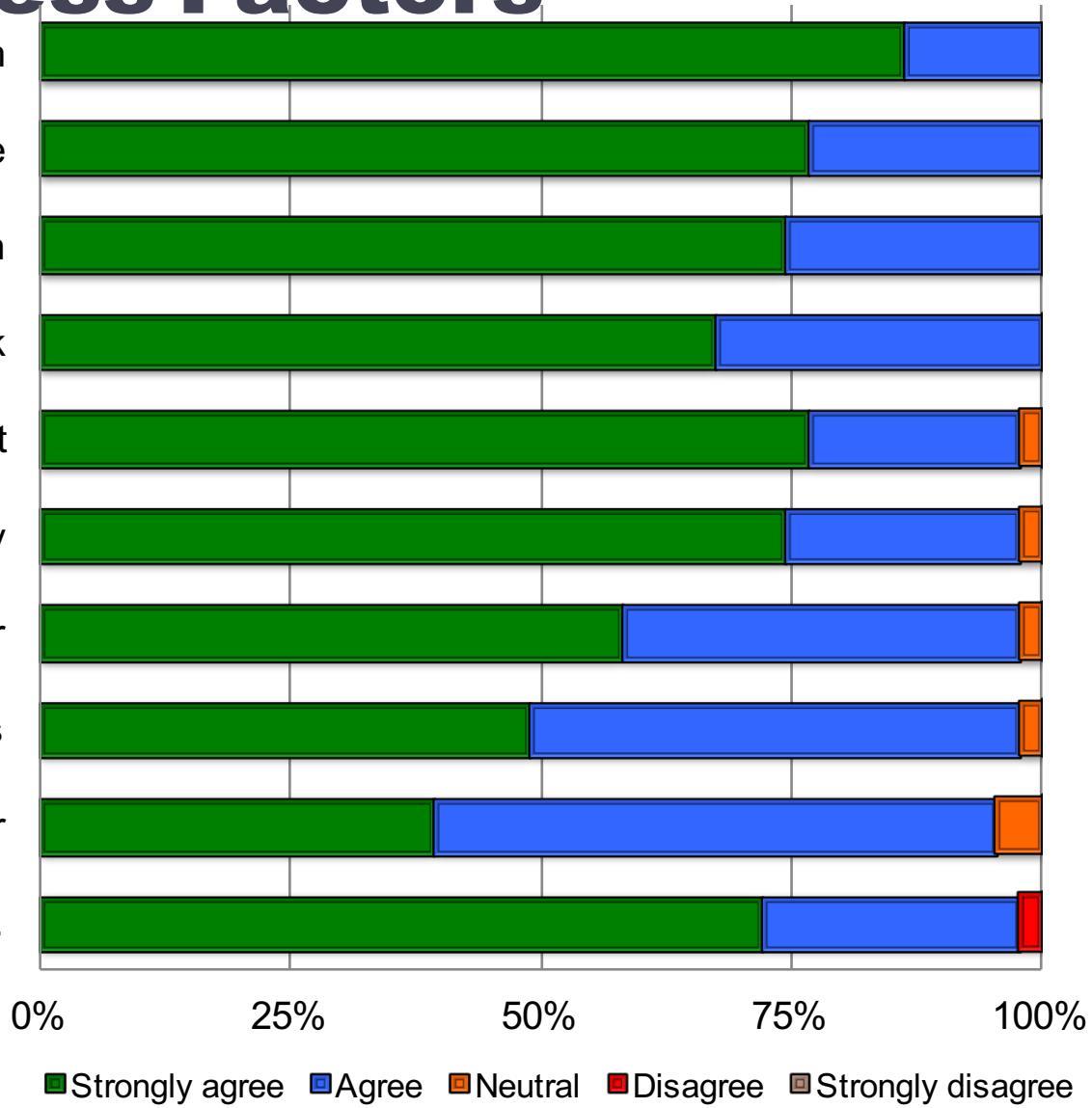
# Project Success Factors

Literature on Critical Success Factors

Ashley et al. (1987)	Pinto and Slevin (1989)	Sanvido et al. (1992)	Belassi and Tukel (1996)	Chua et al. (1999)	Chan et al. (2001)	Nguyen et al. (2004)
Planning effort (construction and design)	Project mission	Well-organised, cohesive team	Project Manager	Project manager competency	Project team commitment	Competent project manager
Project manager goal commitment	Top management support	Contracts that allow for parties to behave without conflict	Project Team	Budget updates	Client's competencies	Adequate funding until project completion
Project team motivation	Project schedule-plans	Experience	Organisation	Project manager commitment and involvement	Contractor's competencies	Multidisciplinary/competent project team
Project manager technical capabilities	Client consultation	Timely and valuable optimization information from all parties.	Environment	Design completion at the start.	Risk and liability assessment	Commitment to project
Scope and work definition	Personnel			Project management authority	End users' needs	Availability of resources
Control systems	Technical tasks			Constructability program	Constraints imposed by end-users	
	Client acceptance			Construction control meetings		
	Monitoring and feedback					
	Communication					
	Trouble-shooting					

# Critical Success Factors

- Effective communication
- A clear understanding of project scope
- Achieving a high degree of cooperation
- Effective management of risk
- Mutual trust and respect
- Ability to resolve conflicts quickly
- Project Manager is an effective leader
- Effective management of variations
- Robust systems by the contractor
- Clear client's brief.



Source: Miller et al. 2012

# **Definition of a Project**

- A project is a temporary endeavour undertaken to create a unique product, service, or result  
(PMBOK)

# What is Project Management?

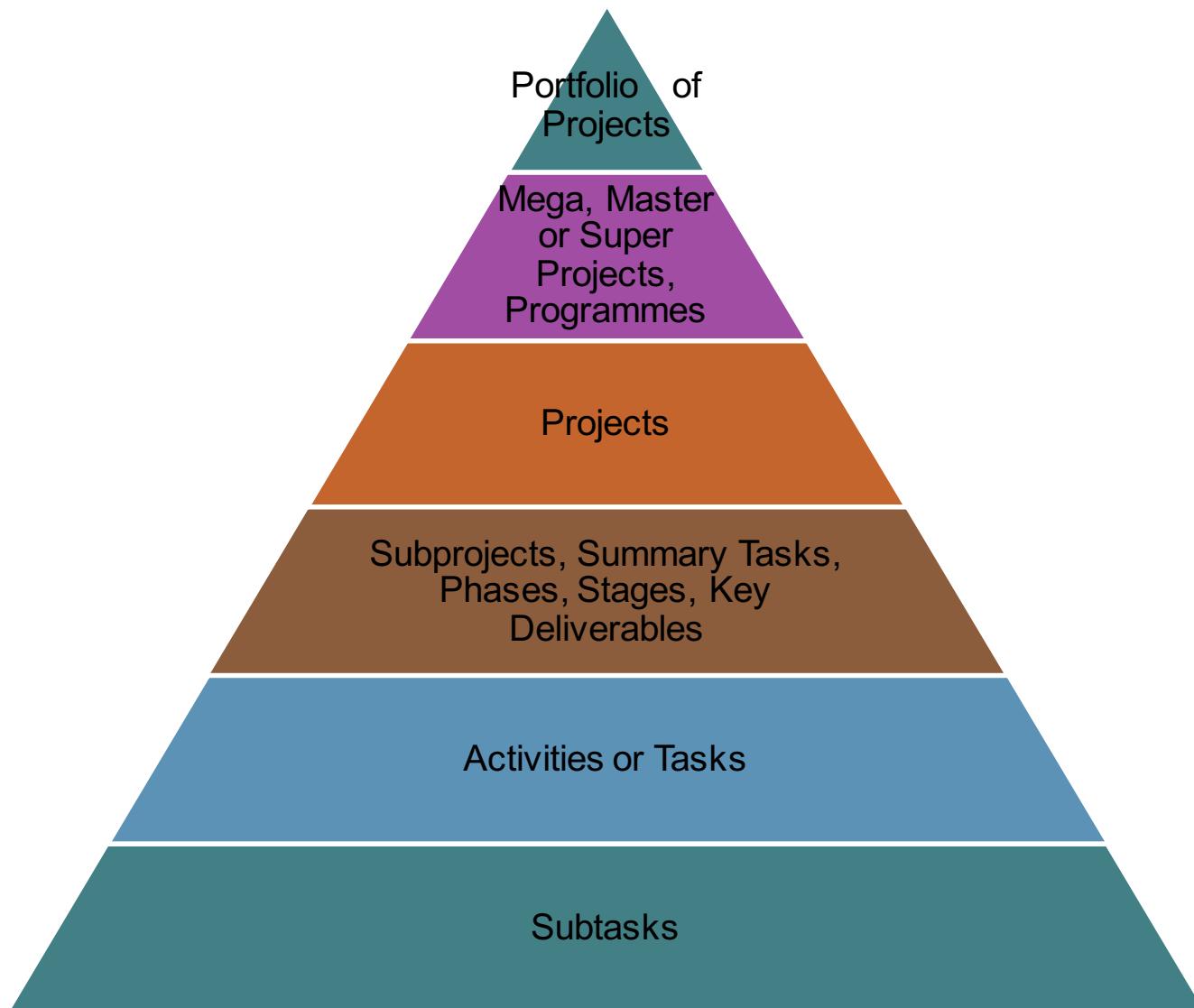
- Project Management is the application of knowledge, skills, tools and techniques to project activities to meet project requirements (<sup>PMBOK</sup>)
- Project Management is the discipline of planning, organising and managing resources to bring about the successful completion of specific project goals and objectives (<sup>Wikipedia</sup>)
- 6Ps

# The 6 Ps

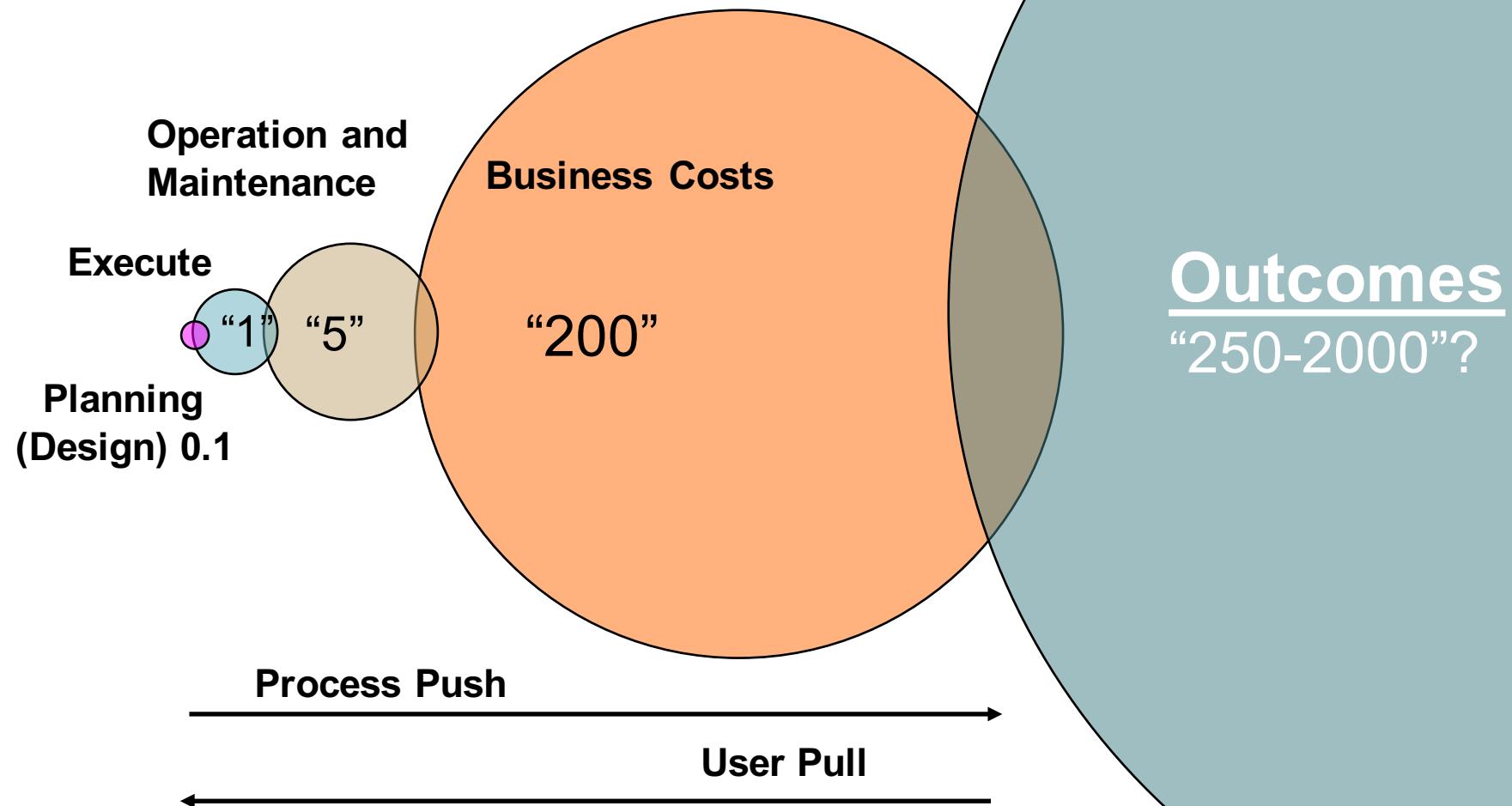
Prior  
Planning  
Prevents  
Piss  
Poor  
Performance...



# Hierarchy of Project Work



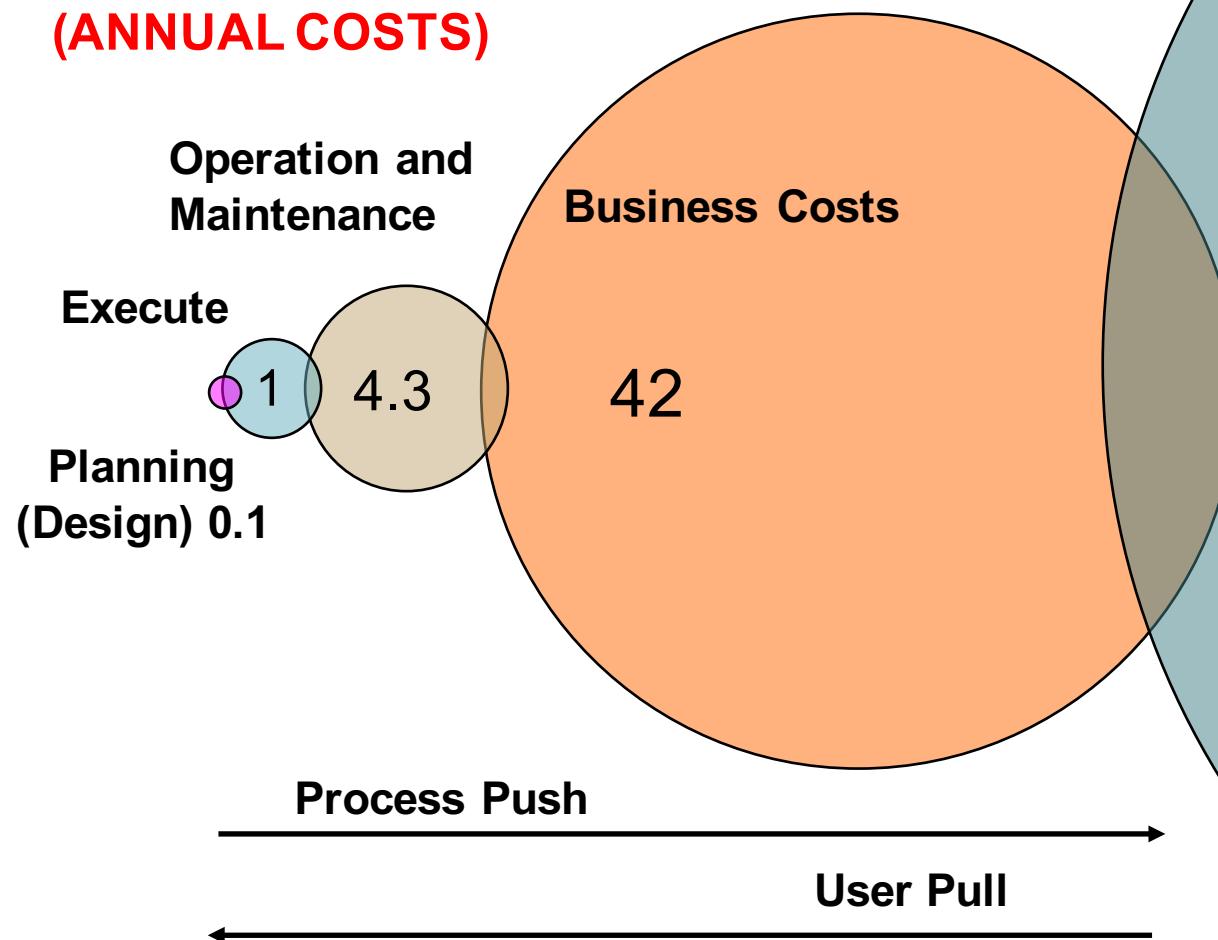
# What the customer really needs



Source: Constructing Excellence

# What the **HEALTHCARE** customer really needs

(ANNUAL COSTS)

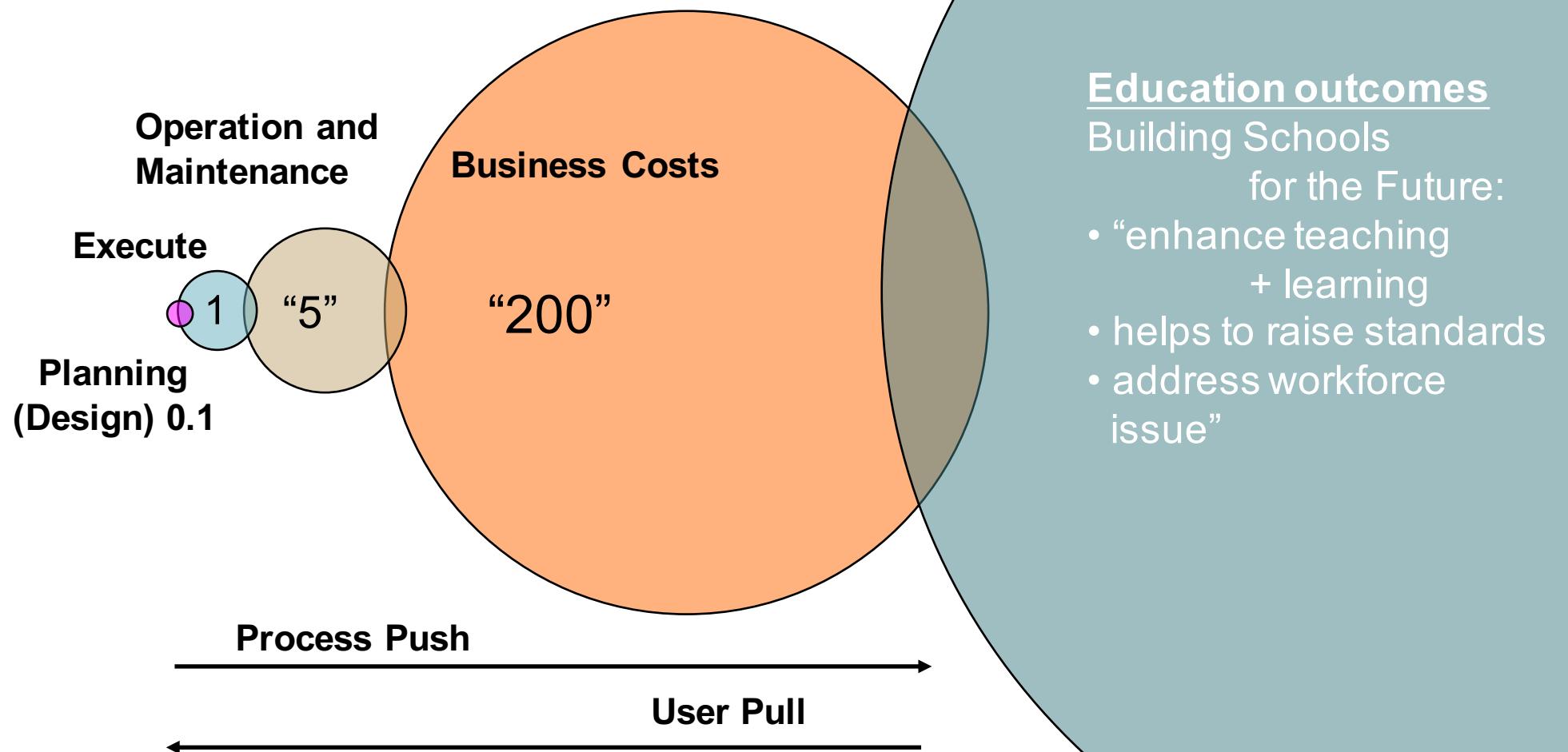


## Healthcare outcomes

- Clinical outcomes
- Hospital-acquired infection rates
- Safety outcomes
- Medication error rates
- Medication rates
- Re-hospitalisation rates
- Length of stays
- Patient transfers
- Costs per unit of service
- Patient satisfaction
- Visitor satisfaction
- Staff morale
- Staff turnover

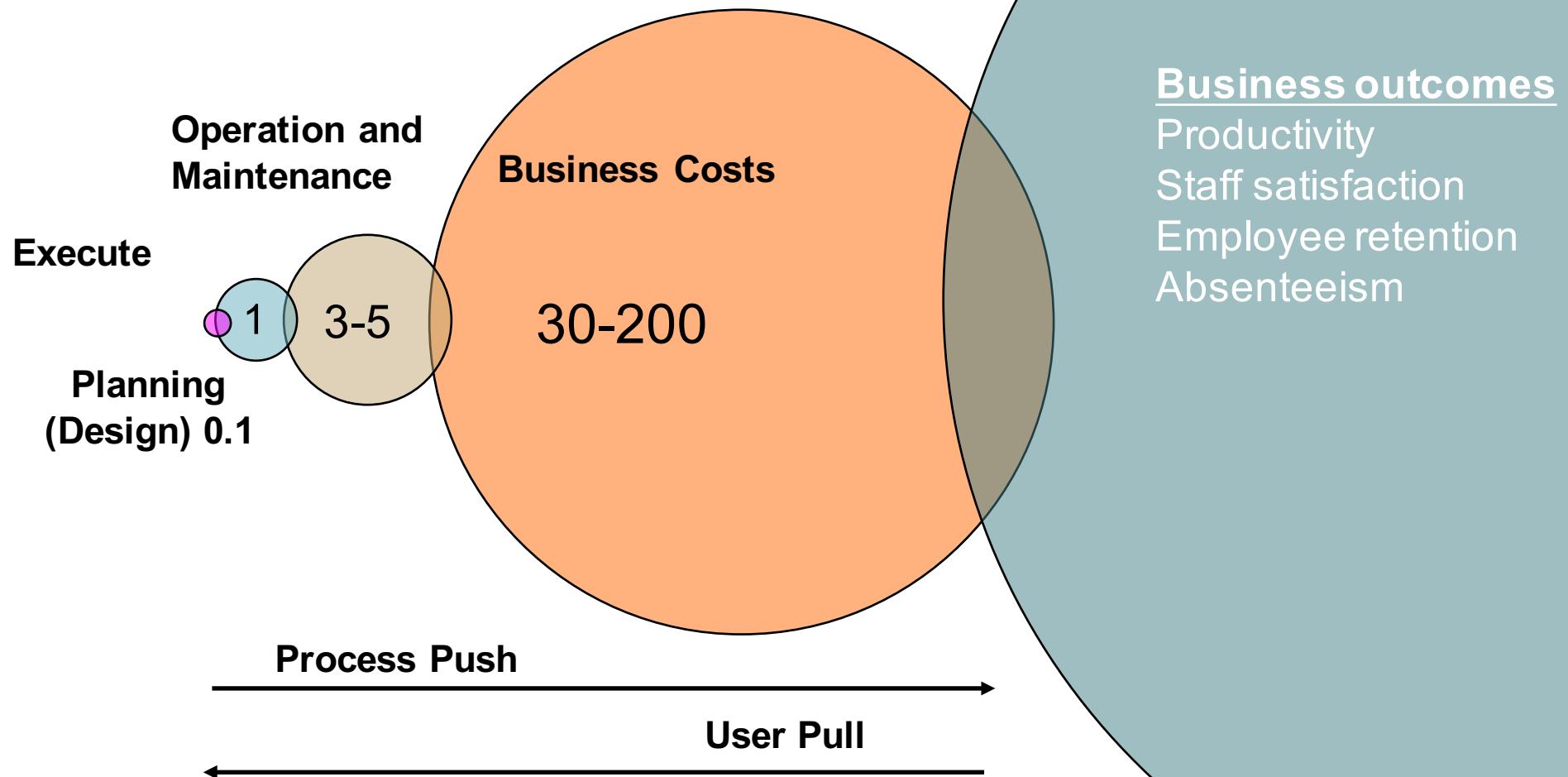
Source: Constructing Excellence

# What the EDUCATION customer really needs



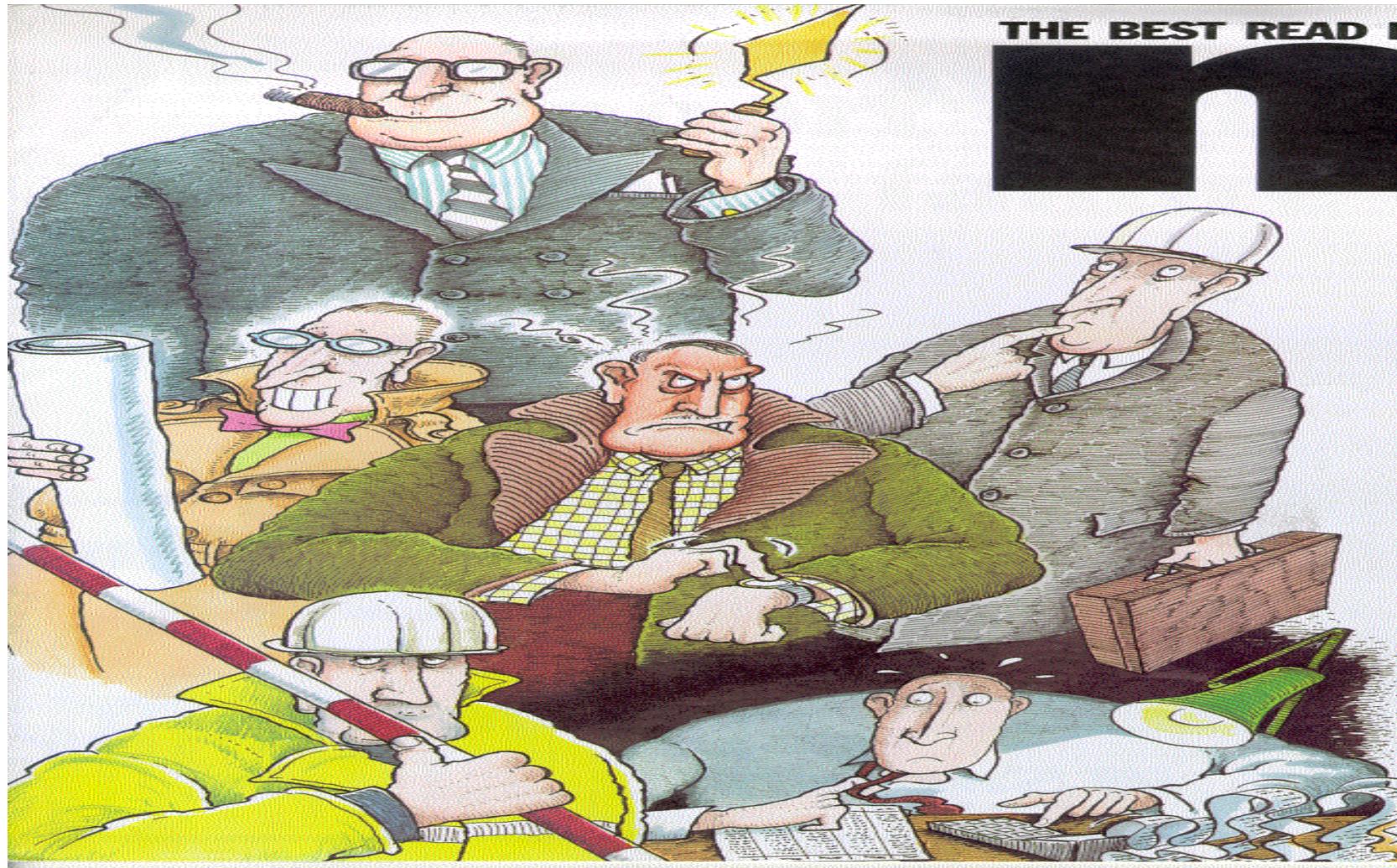
Source: Constructing Excellence

# What the OFFICE customer really needs



Source: Constructing Excellence

# Project Roles



# Project Roles

Sponsor

- Formal authority for project and FUND it

Client

- OWN the project. The project is undertaken for them

Customer

- Ultimately USE the product or service

Project Manager

- DIRECT the project on a day to day basis

Project Board

- Strategic decision makers who GOVERN the project

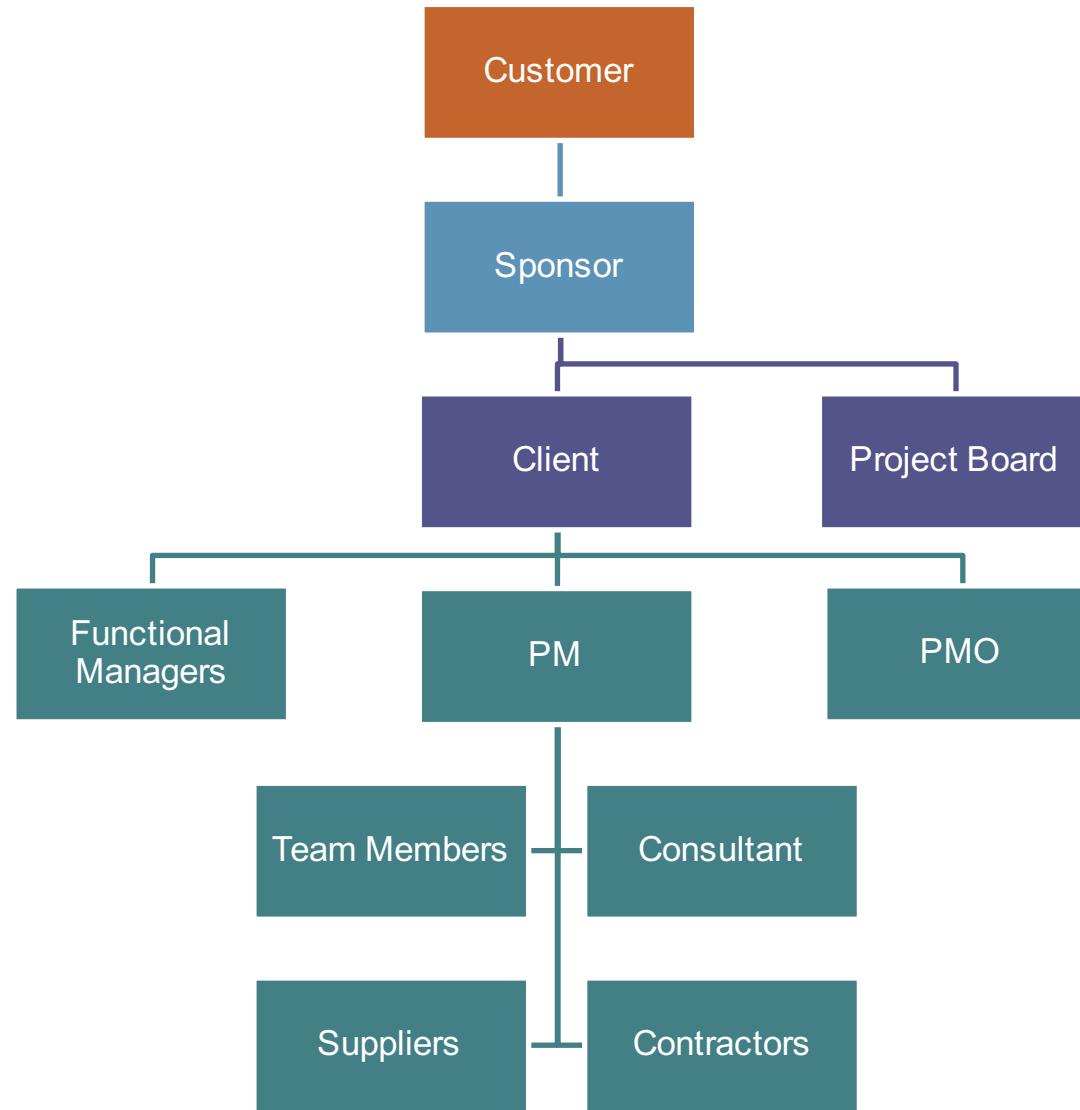
Functional Departments

- RESOURCE the project and receive project deliverables.

Performing  
Organisation

- Enterprise whose employees DELIVER the project

# Typical Relationships



# Project Management Office (PMO)



The **Project Management Office** (PMO) in a business or professional enterprise is the department or group that defines and maintains the standards of process, generally related to project management, within the organization. The PMO strives to standardize and introduce economies of repetition in the execution of projects. The PMO is the source of documentation, guidance and metrics on the practice of project management and execution. (Wikipedia)

# Project Manager

- “The Project Manager is responsible and accountable for the successful delivery of the project (APM Body of Knowledge 5<sup>th</sup> Edition)
- “The Project Manager is principally concerned with the management of change” (Lockyer, K. and Gordon, J 1996)

# Project Vs Functional / Line Management

## Project work

- E.g. Build a bridge, Design & develop a car, Organise a wedding etc

- Defined start and end dates
- Temporary project team
- Usually not done before
- Sometimes cancelled
- Finished date & cost
- Time, cost, quality
- Project life cycle

## Operations based work

- E.g. Maintain financial control, Buy-in components, Produce widgets etc

- No specific dates
- Stable team
- Repetitive, well known
- Existence assured
- Easily calculated \$\$\$
- Max. work within budget
- Continuous life

So...Project Manager is a “Change Manager”.....

# Project Manager's Role

- Assist the sponsor prepare the project business case.
- Prepare the project charter or assist the sponsor to do so.
- Accountable to the sponsor and client for project success
- Define the scope of the project with the sponsor and client.
- Recruit team members, maintain their motivation, and ensure their productive cooperation.
- Negotiate resource needs.
- Prepare the project plan or lead its preparation.
- Assemble the project team, with the agreement of appropriate line managers, and enable their performance.
- Agree the responsibilities, work packages, and performance targets for team members.
- Arrange project procurement contracts.
- Regularly communicate with stakeholders.
- Regularly assess client satisfaction.
- Continuously identify and manage risk.
- Systematically monitor and manage project progress.
- Resolve or escalate project issues.
- Manage the scope of the project and control change.
- Make adjustments (schedule, resourcing, scope) necessary to achieve time, cost and quality objectives (i.e., rebaselining).
- Manage the budget (and preserve the margin).
- Maintain project files and project diary, and apply document version control.
- Manage the project risk/issue/opportunity/change/accident/lessons learned logs.
- Produce the project deliverable(s).
- Prepare a post-implementation report that includes lessons learnt.
- May participate in benefits realisation reviews after project completion/product launch.

Source: Young, (2008): The Framework

# Workplace Health and Safety

**Injuries in NZ workplaces Jan 2008 – to Dec 2013 (Source Stats NZ)**

Industry Description	People in Employment	Fatal Injuries	Severe Injuries	Non-Severe Injuries	Average Annual Fatal Injury Rate per 100,000 in Employment	Average Annual Severe Injury Rate per 1000 in Employment	Average Annual Non-Severe Injury Rate per 1000 in Employment
Agriculture, Forestry and Fishing	163303	137	18052	120821	14	18	123
Mining	6876	30	570	3566	73	14	86
Manufacturing	250773	32	28981	176576	2	19	117
Electricity, Gas, Water and Waste Services	13998	9	1269	9016	11	15	107
Construction	180685	54	20095	135471	5	19	125
Wholesale Trade	117569	5	4931	45308	1	7	64
Retail Trade	221644	3	8759	72661	0	7	55
Accommodation and Food Services	151724	2	4480	45819	0	5	50
Transport, Postal and Warehousing	96305	48	10553	49265	8	18	85
Information Media and Telecommunications	46439	10	510	6789	4	2	24
Financial and Insurance Services	63360	12	401	5824	3	1	15
Rental, Hiring and Real Estate Services	51072	1	1489	15339	0	5	50
Professional, Scientific and Technical Services	199290	1	1792	26068	0	1	22
Administrative and Support Services	118660	2	5943	39150	0	8	55
Public Administration and Safety	106613	13	3971	41871	2	6	65
Education and Training	180873	10	2560	47999	1	2	44
Health Care and Social Assistance	202453	7	9782	61383	1	8	51
Arts and Recreation Services	41257	11	3178	33569	4	13	136
Other Services	79043	5	2905	33301	1	6	70
Not Elsewhere Included	19123	33	3666	190990	29	32	1665
	<b>2311060</b>	<b>425</b>	<b>133887</b>	<b>1160786</b>	<b>3</b>	<b>10</b>	<b>84</b>

# Put H&S as the First Item on the Agenda (don't let it be the elephant in the room)



*Okay, that wraps up the budget for next year. Are we missing anything?*

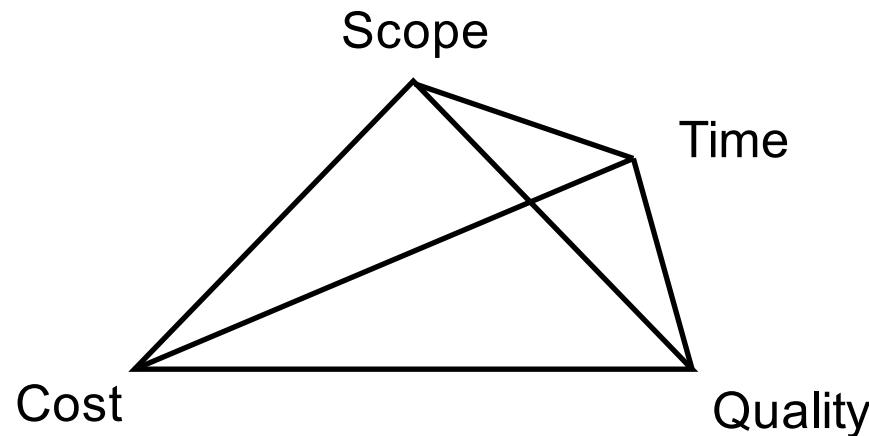
# Learning Objectives

Today we are looking at:

- Trade-offs between Scope, Quality, Time and Cost
- Typical Project Phases
- Project Scope – The WBS



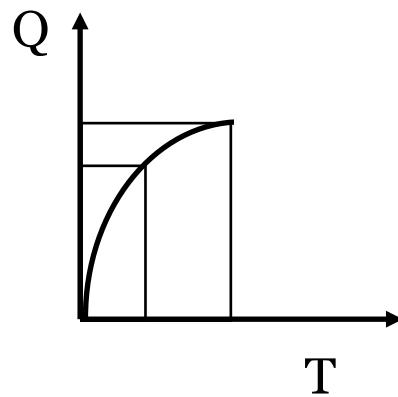
# Key Components of Projects



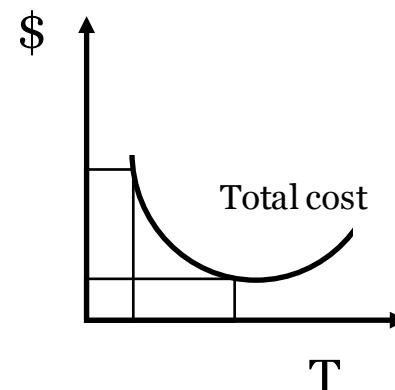
**Exception:**  
H&S is not a  
trade-off with  
parameters

Parameter	Description	Document
Scope	Work required	Work Breakdown Structure
Cost	Upper resource limit	Budget
Quality	Performance standard	Specification
Time	Completion date	Schedule

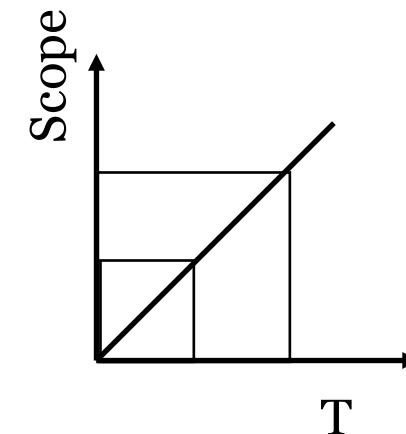
# Typical Relationships between the 4 Key Components



Pareto's Law



Brook's Law



Proportional

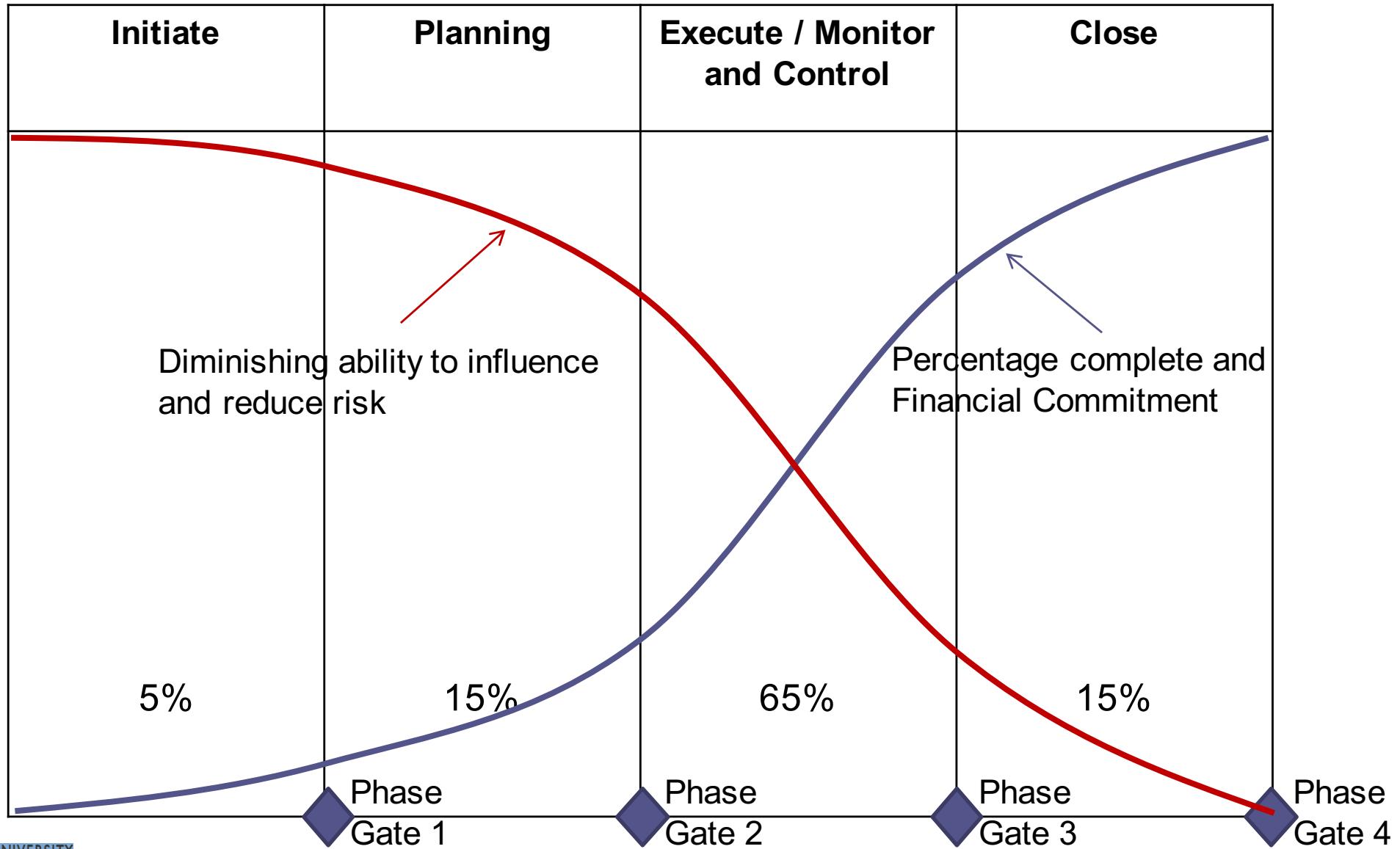
## NOTE

Projects involve trade-offs

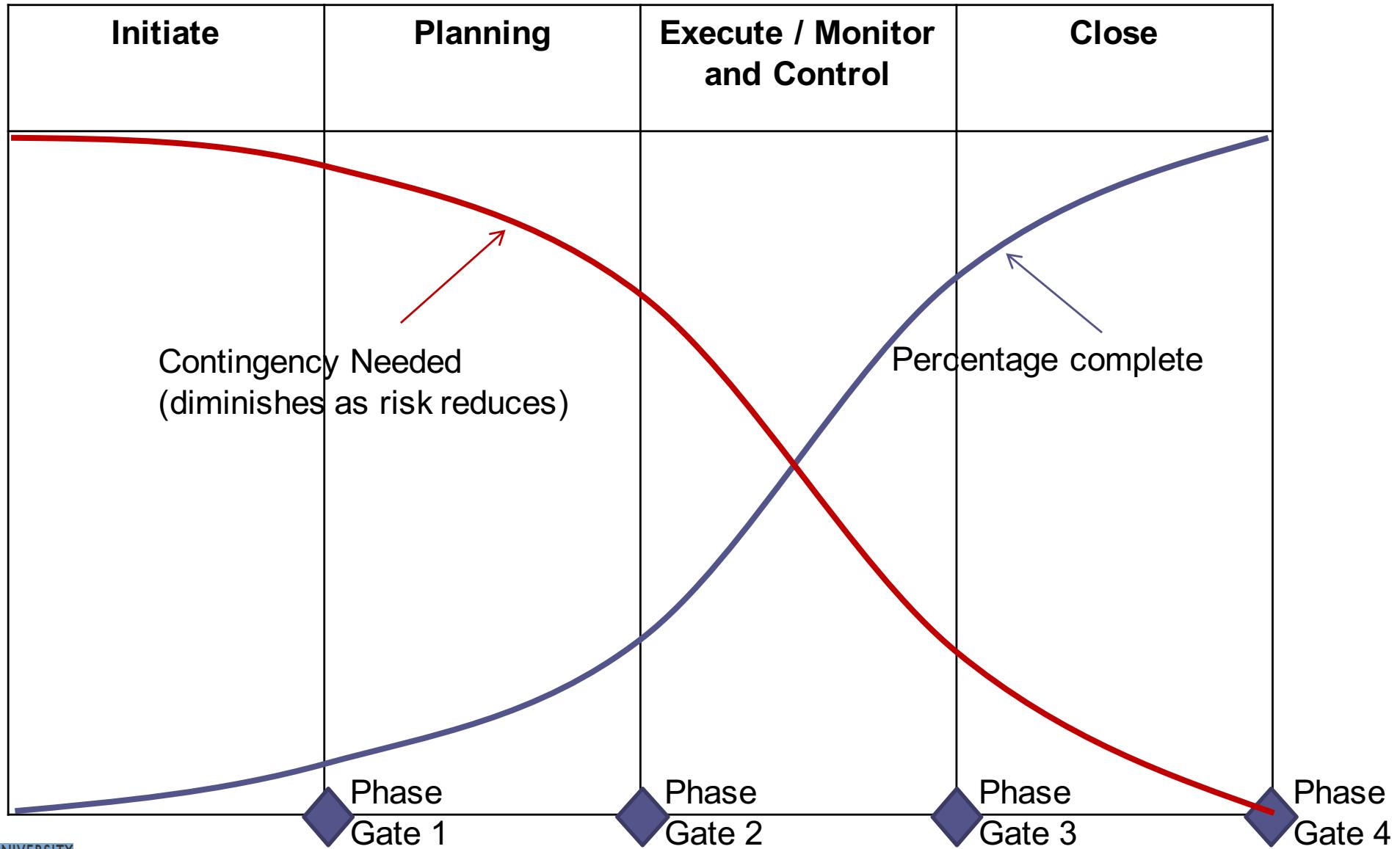
Identify which is the most important parameter

Rank the parameters (if you can)

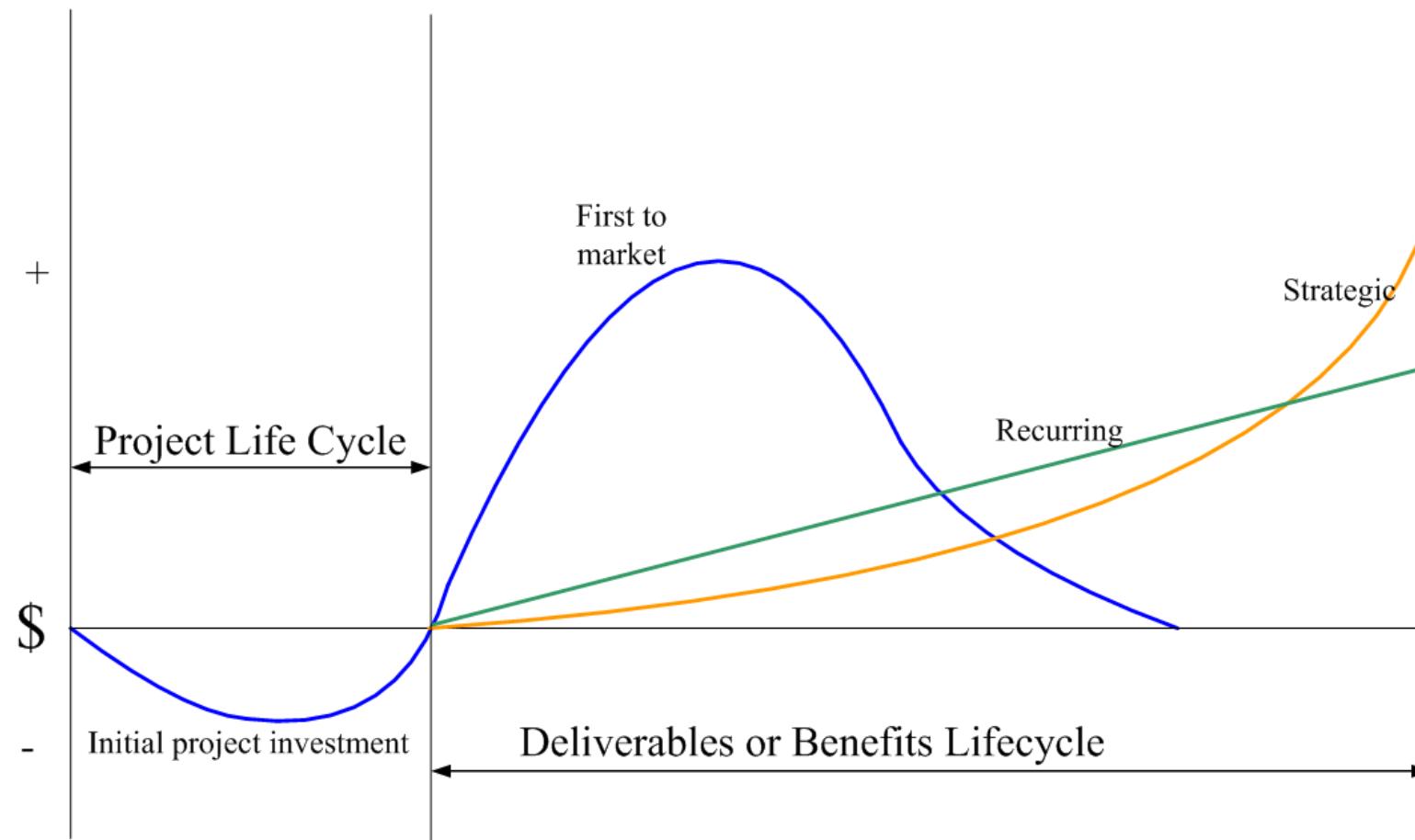
# Typical Project Lifecycle



# Typical Project Lifecycle



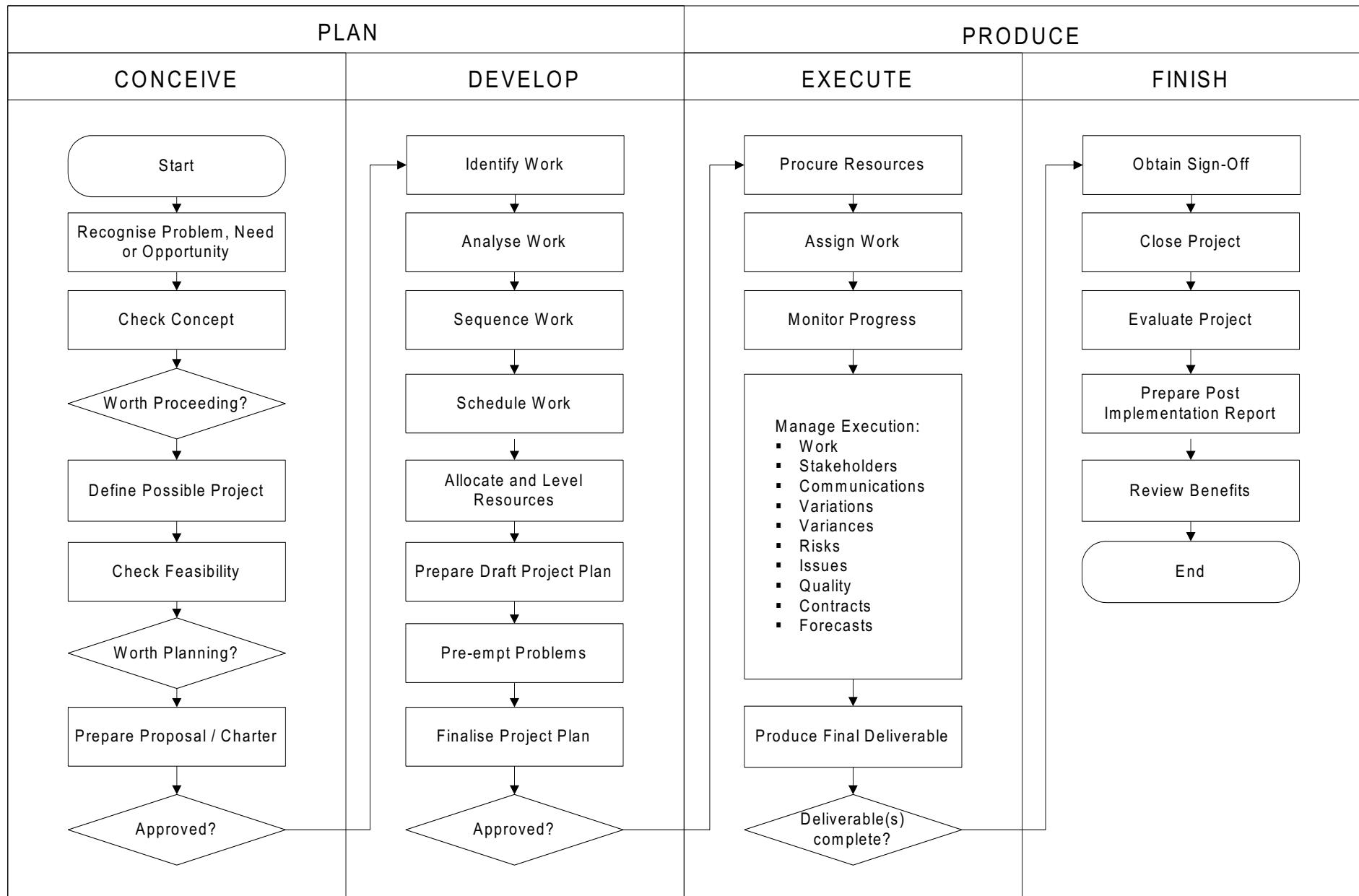
# Project Benefits Lifecycle



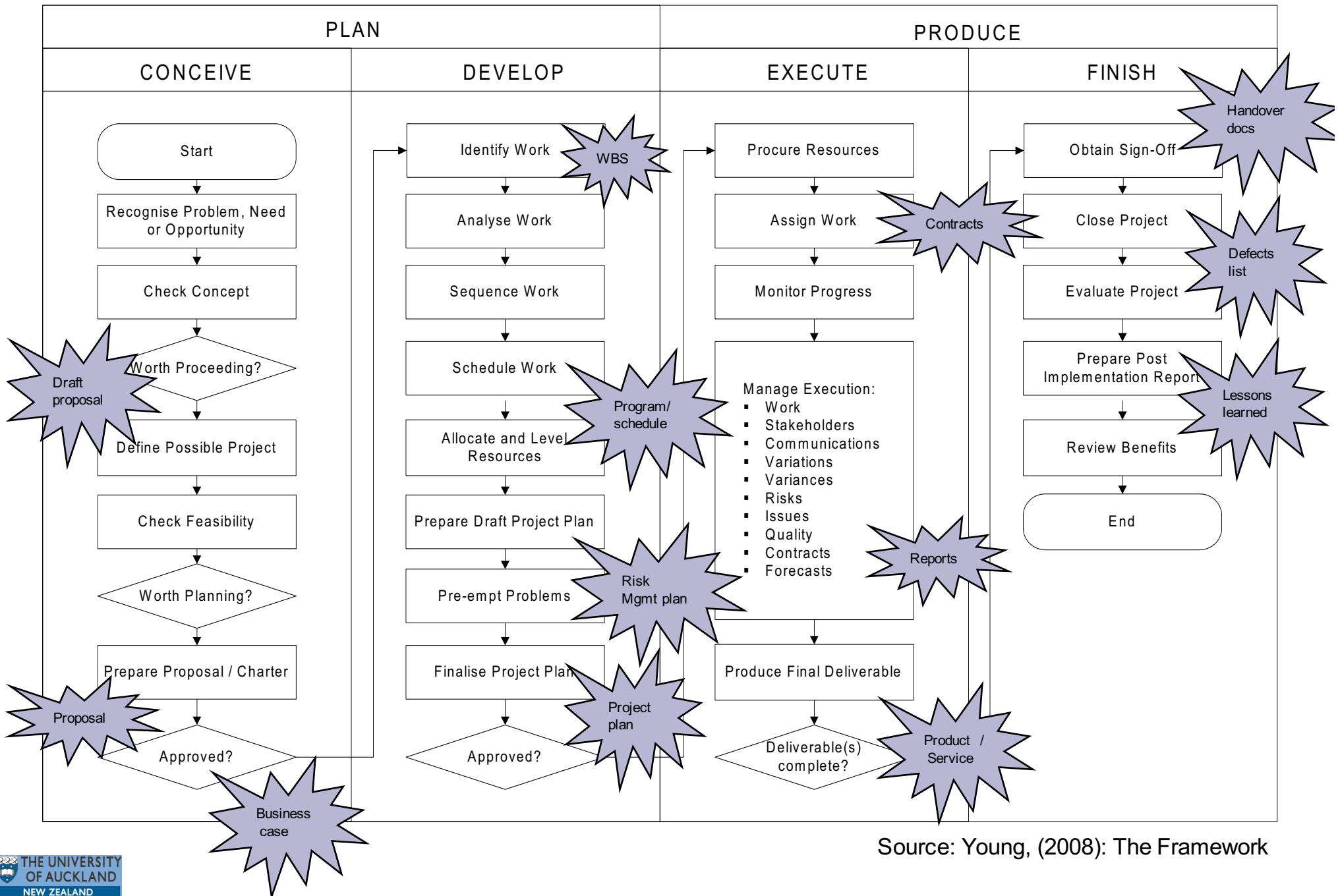
# Key Elements in Project Management

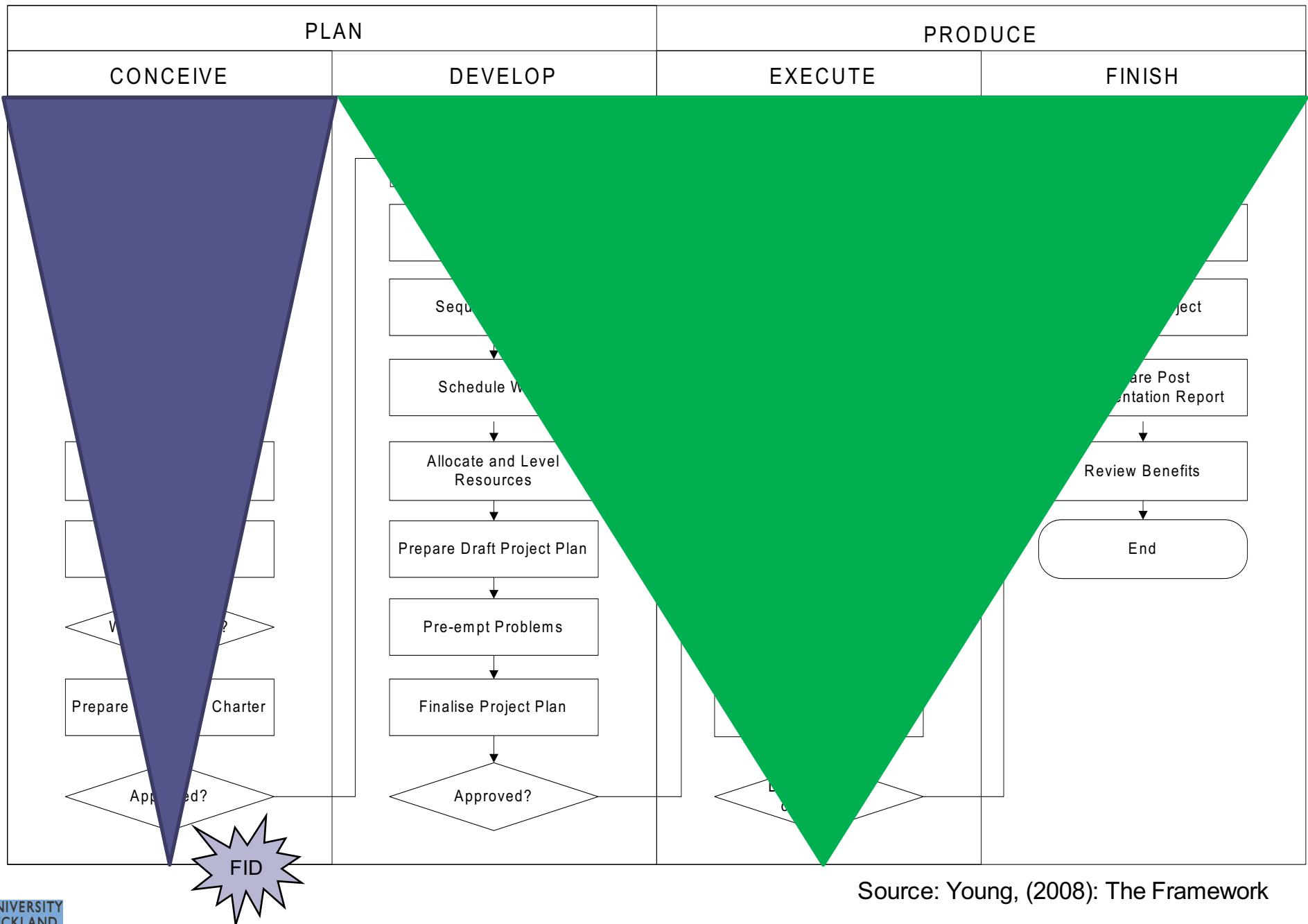
Source: PMBOK 5<sup>th</sup> Edition (slightly abridged)

Knowledge Areas /Process	Initiating	Planning	Execution	Monitoring and Controlling	Closing
<b>Integration Management</b>	• Project Charter	• Develop project management plan	• Direct and Manage Project Work	• Monitor and control project • Integrated change control	• Close project
<b>Scope Management</b>		• Scope planning • Scope definition • Work break down structure		• Scope verification • Scope control	
<b>Time Management</b>		• Activity definition and sequencing • Activity resource estimating • Activity duration estimating • Schedule development		• Schedule control	
<b>Cost Management</b>		• Cost estimating • Budget estimating		• Cost control	
<b>Quality Management</b>		• Quality planning	• Quality Assurance	• Quality control	
<b>Human Resource Management</b>		• Human resource planning	• Acquire project team • Develop project team • Manage project team	• Manage project team	
<b>Communications Management</b>		• Communications planning	• Manage communications	• Control communications	
<b>Risk Management</b>		• Risk management planning • Risk identification • Risk analysis • Risk response planning		• Control risks	
<b>Procurement Management</b>		• Plan procurement	• Conduct procurements	• Control procurements	• Close procurements
<b>Stakeholder Management</b>	• Identify stakeholders	• Plan stakeholder management	• Manage stakeholder engagement	• Control stakeholder engagement	



Source: Young, (2008): The Framework





# Project Manager

- “The Project Manager is responsible and accountable for the successful delivery of the project (APM Body of Knowledge 5<sup>th</sup> Edition)
- “The Project Manager is principally concerned with the management of change” (Lockyer, K. and Gordon, J 1996)

Note: On Larger  
projects may have  
a Project Director

## **Q2) Which aspect of Project Management pyramid to you focus on first?**

- i. Time
- ii. Cost
- iii. Quality
- iv. Scope

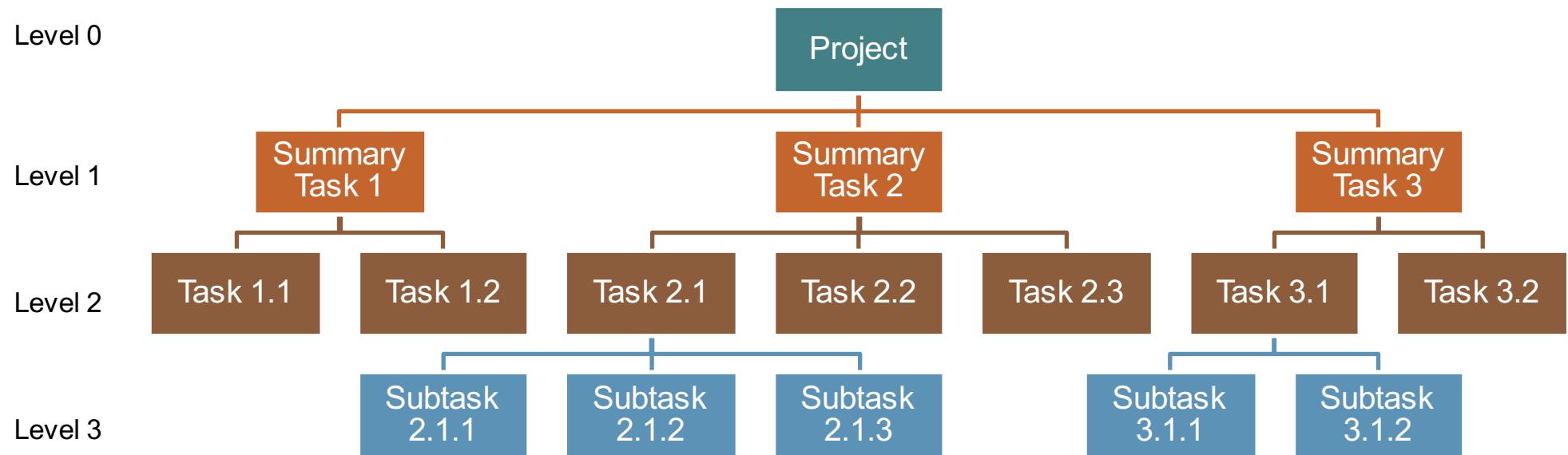
Part b)

Why?

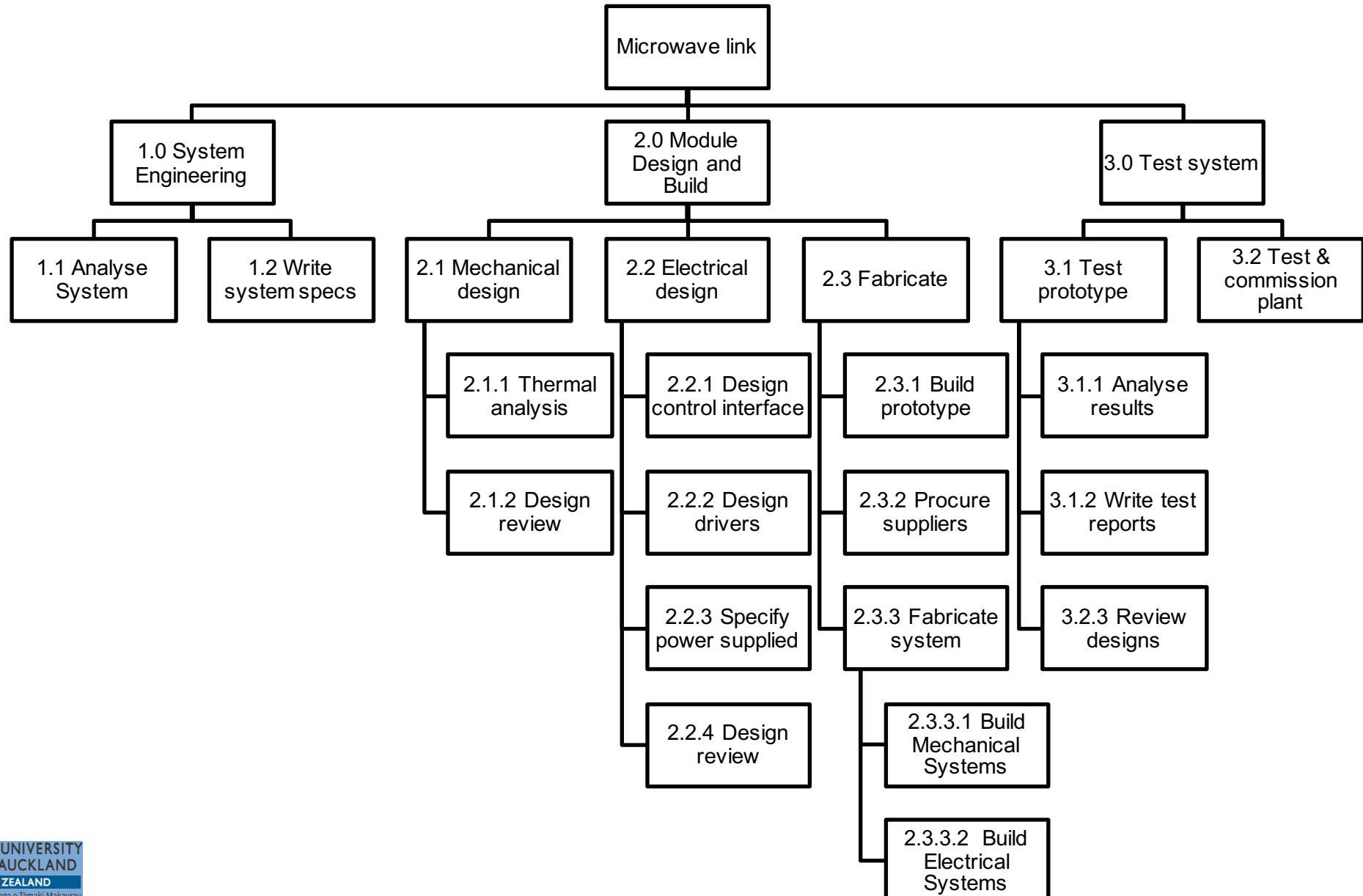
# Work Breakdown Structures

- The first step in the Development Phase
- Purpose of the WBS:
  - Identify **ALL** work required – SCOPE
  - WBS defines and organises the total scope of work
  - The basis of detailed project planning
  - The WBS provides a global, yet detailed view of the project.

# Presenting a WBS



# WBS Example



# Notes on Preparing a WBS

- The WBS shows work content, NOT execution sequence
- Brainstorming or mind mapping
- WBS developed Top Down
- Tasks must add up to Summary Tasks
- Task names include Verb and a Noun
- Each task must be clearly defined such that its completion is obvious
- Codify to help referencing for change control
- Include all elements against which funds are to be expended

# Uses of the WBS

- Define areas of responsibility, staffing etc
  - Use for costing and budgeting
  - Change control (coding system)
  - Coding is important for control – cost, quality, scope and time
- 
- Note: WBS may change as the project proceeds

# Learning Objectives

By the end of this lecture on Project Management you should understand:

- Project Time Management
- Critical Path Analysis
- Introduction to Cost Estimating



# What To Estimate?

- Duration – elapsed time between start and finish of activity
- Effort – number of sustained /continuous hours work
- Cost - Cost/hour, overhead, material used etc.

## Tips

Document assumptions

Don't estimate alone

Use experts where possible

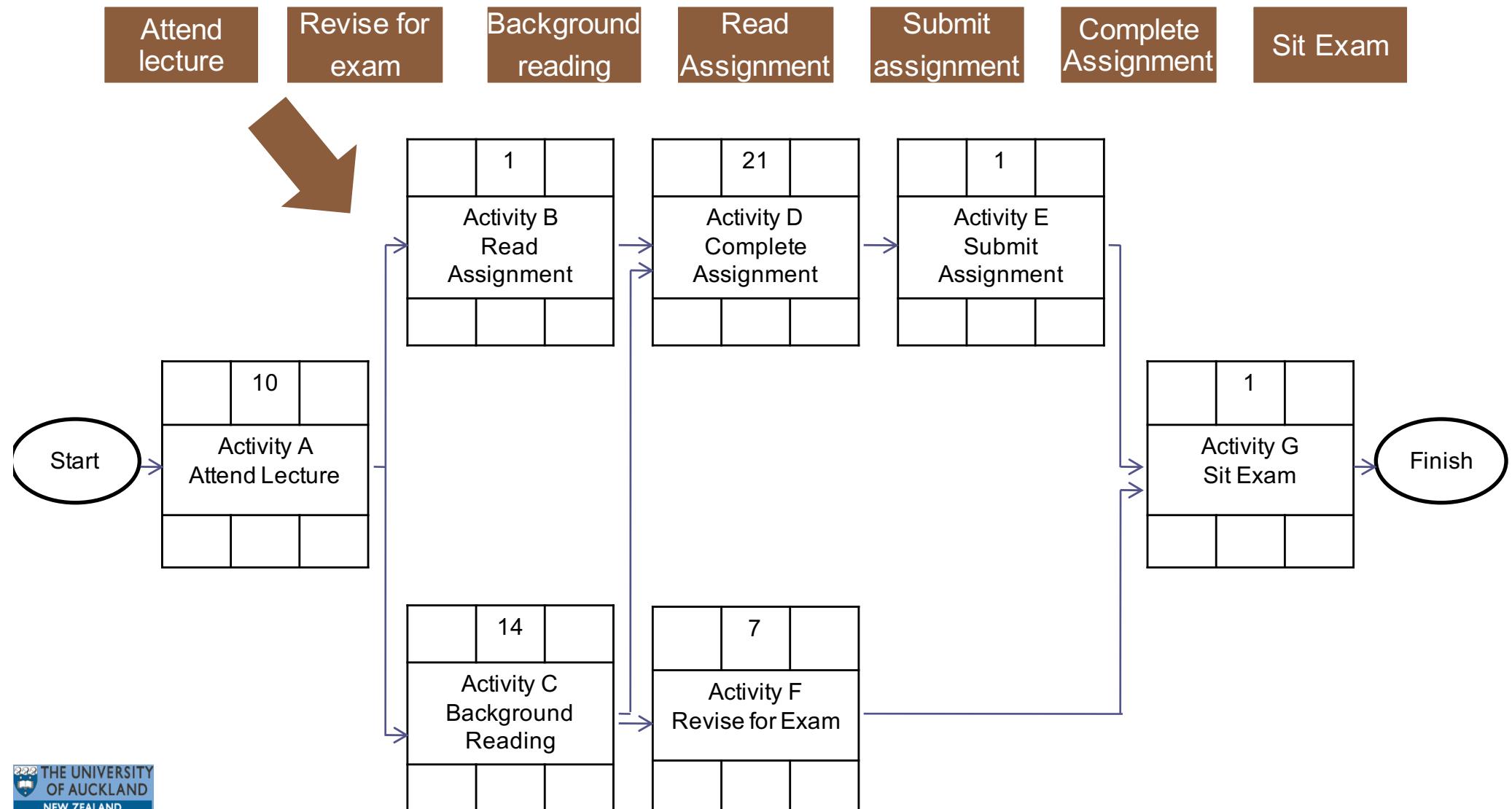
Use a process / references / databases

# **Project Time Management (Scheduling)**

‘The process used to determine the overall project duration and when activities and events are planned to happen. This includes identification of activities and their logical dependencies, and estimation of activity durations, taking into account requirements and availability of resources.’ (Source: APM BoK 5ed)

# Sequencing - Dependencies

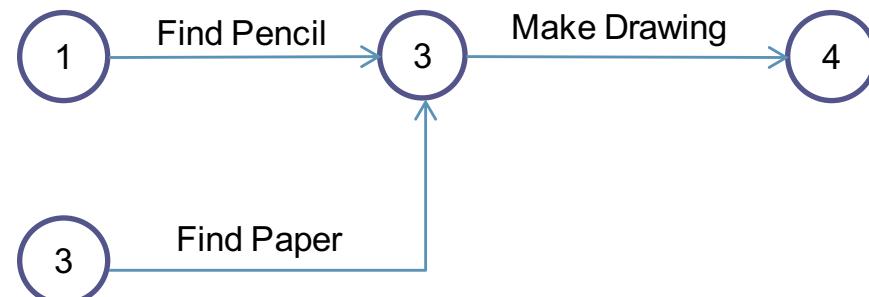
- Re-order your WBS



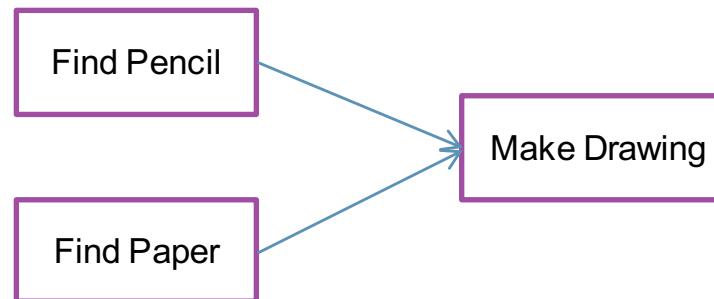
# Network Analysis – Critical Path Method

There are two types of Network:

## 1. Activity on Arrow



## 2. Activity on Node



By convention the most commonly used method in modern project management is the precedence diagram using 'Activity on Node'

# Network Analysis: Definitions

**Activity**

- Description of Activity and Reference Number

**Duration**

- Time (units)

**E.S.T.**

- Earliest start time

**E.F.T.**

- Earliest finish time

**L.S.T.**

- Latest start time that will not delay project.

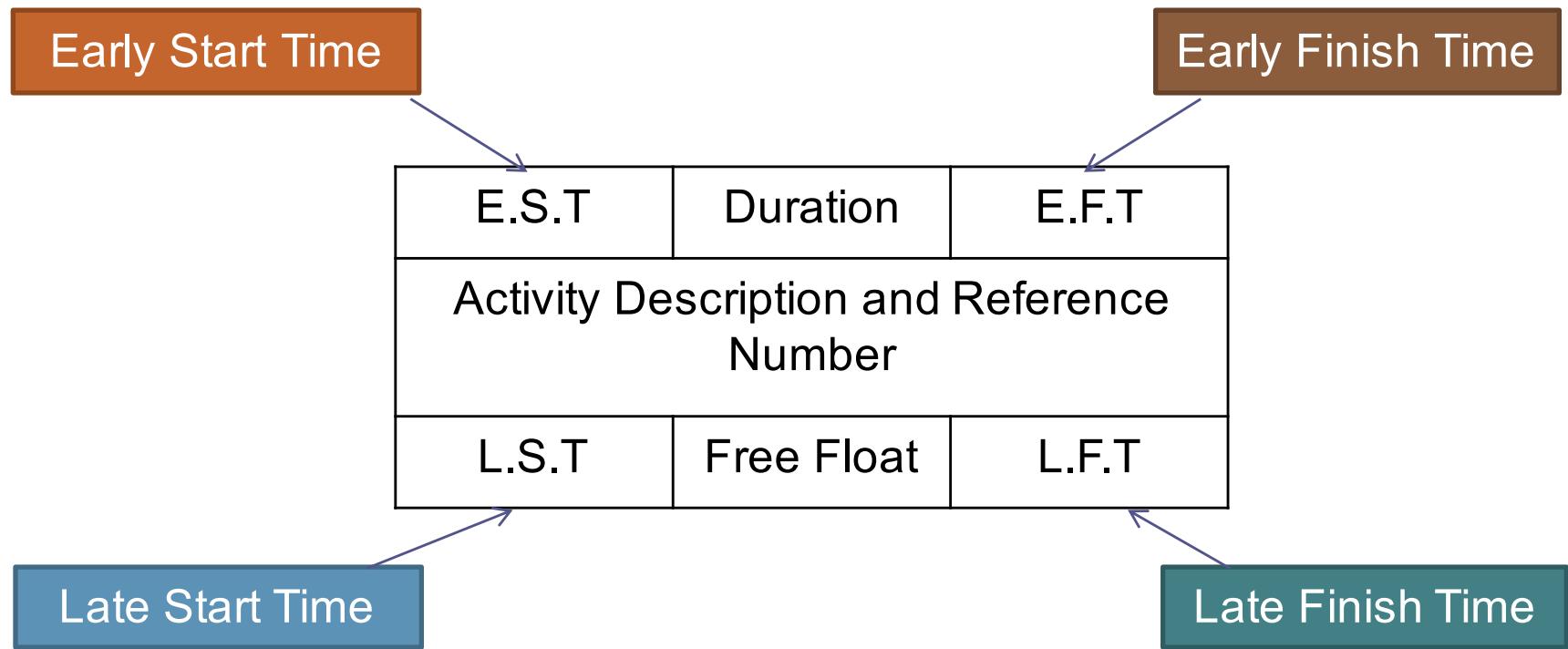
**L.F.T.**

- Latest finish time that will not delay the project.

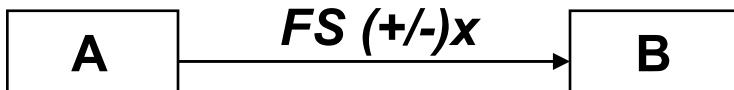
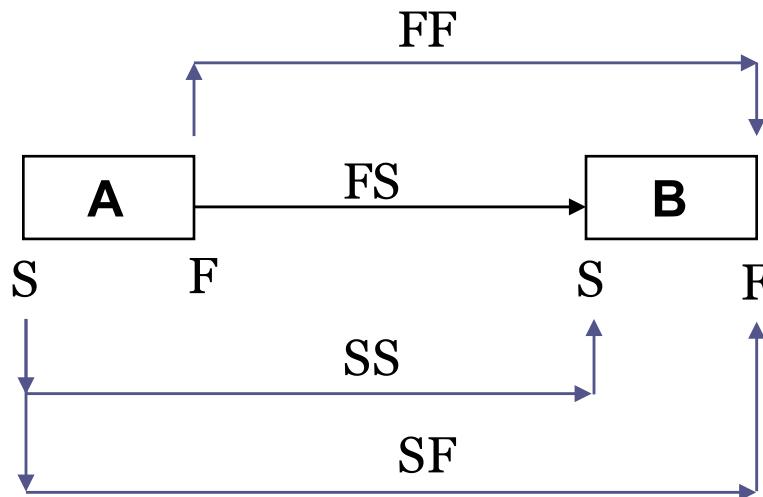
**Free Float**

- Free Float = (L.S.T. - E.S.T.) or = (L.F.T. - E.F.T.)

# Activity on Node Conventions



# Representing Activities: Network Logic



## Dependency Types

Finish to Start (normal)

Start to Start

Start to Finish

Finish to Finish

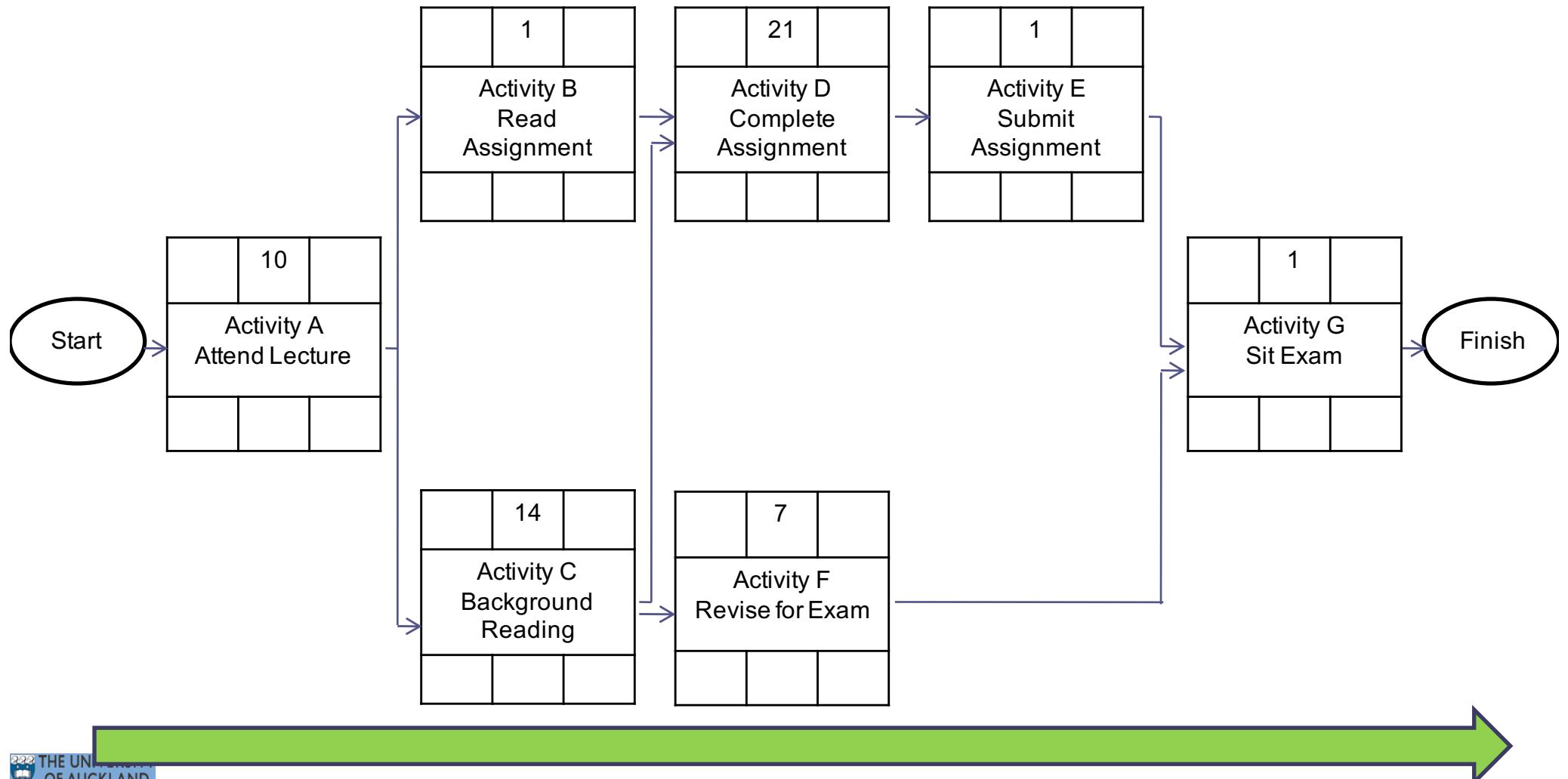
## LAG/LEAD

We can also have “offsets” to the immediate – e.g. a delay to B starting after A has finished – e.g. a warm up period for a kiln.

Positive or negative e.g. start the kiln before the end of A so no delay.

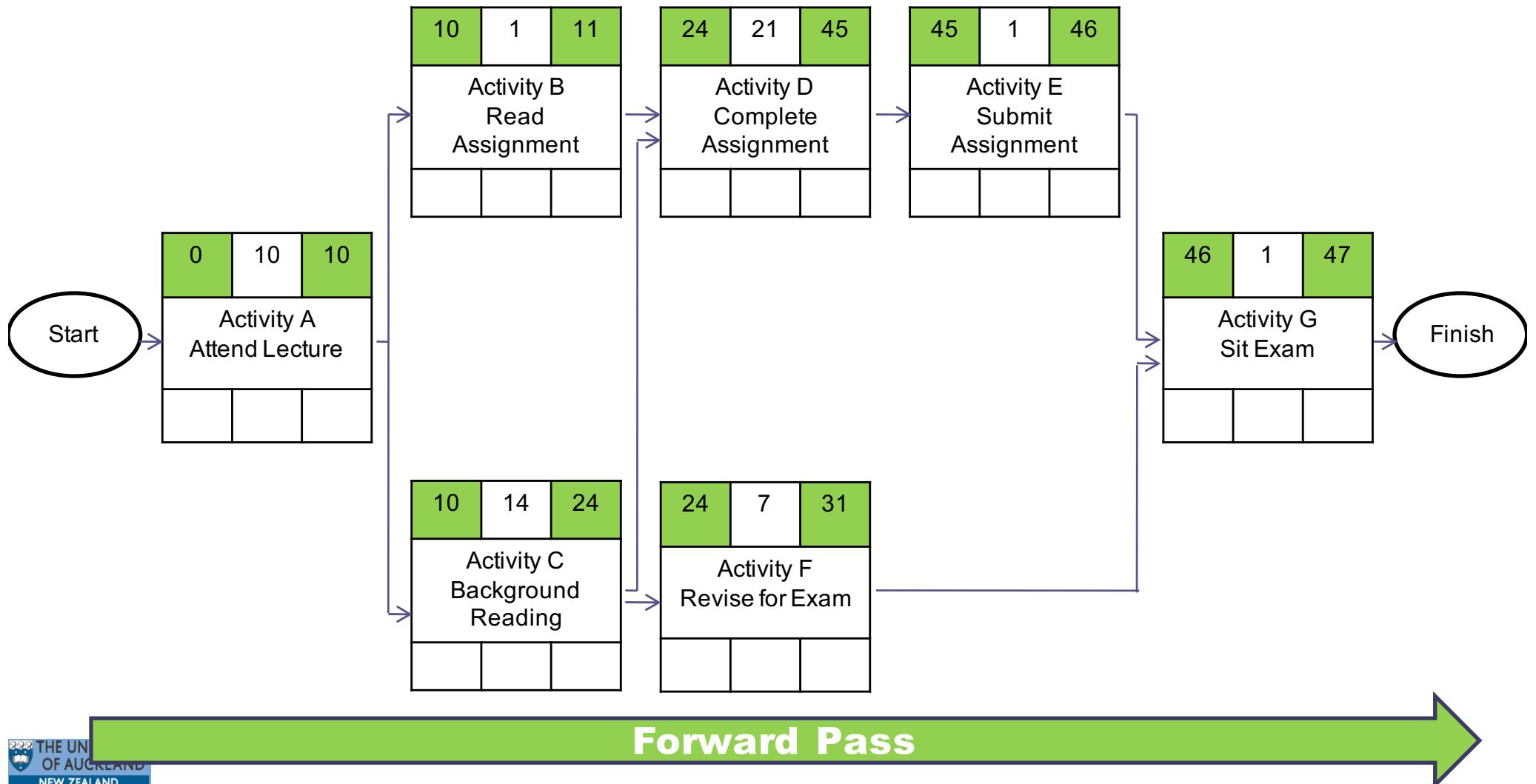
# Creating a Network Diagram

## Step 1: Logical Sequence



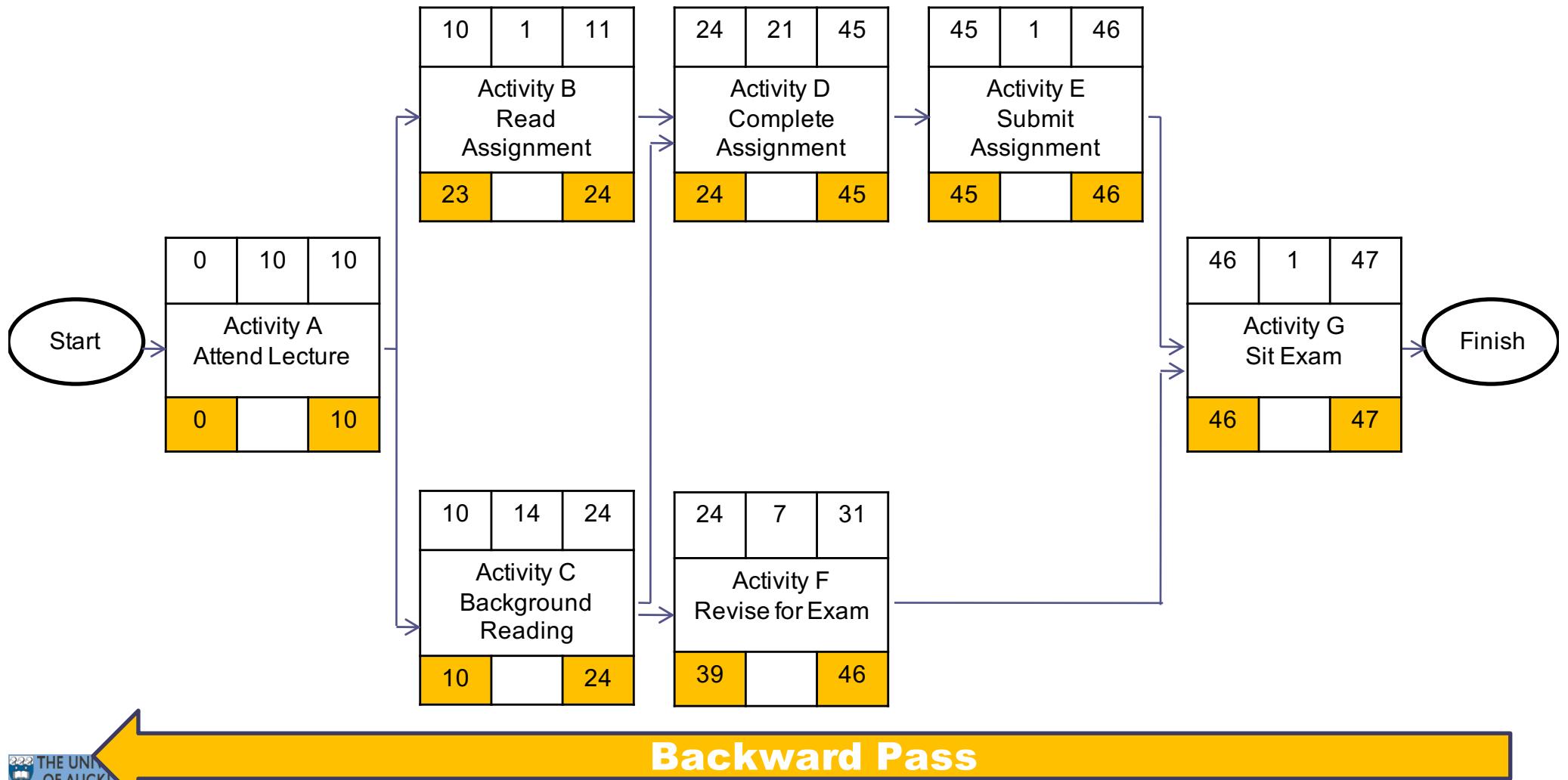
# Creating a Network Diagram

## Step 2: Forward Pass



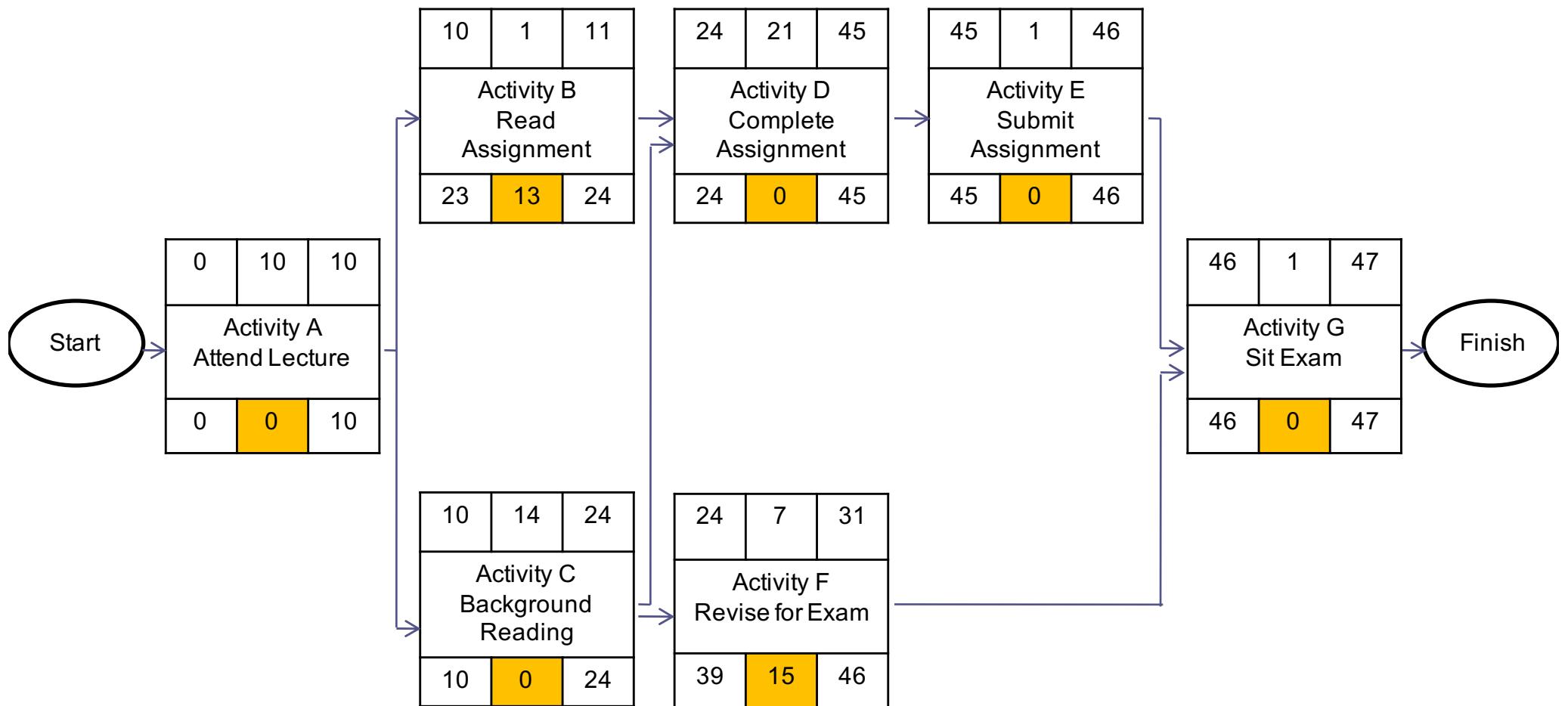
# Creating a Network Diagram

## Step 3: Backward Pass



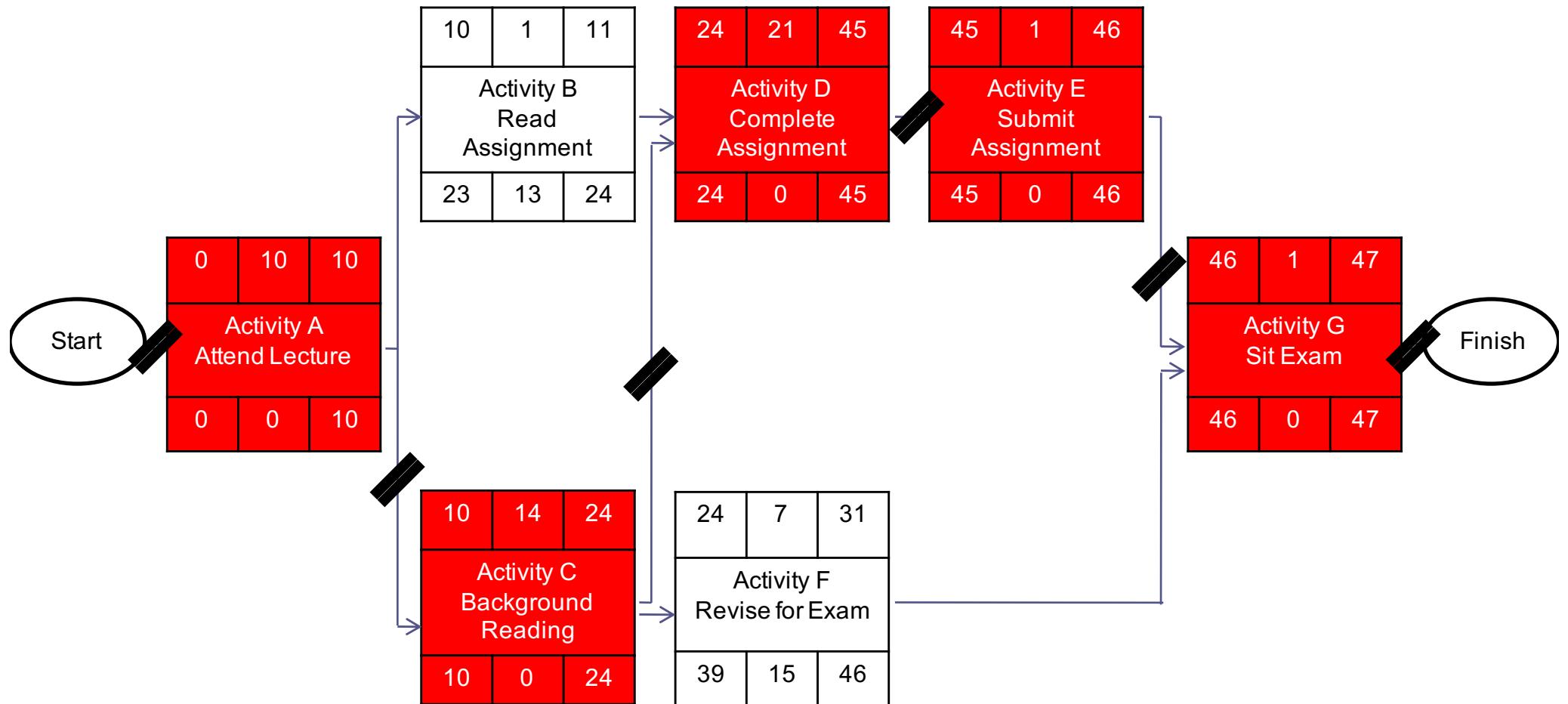
# Creating a Network Diagram

## Step 4: Calculate Float



# Creating a Network Diagram

## Step 5: Identify Critical Path



# Critical Path

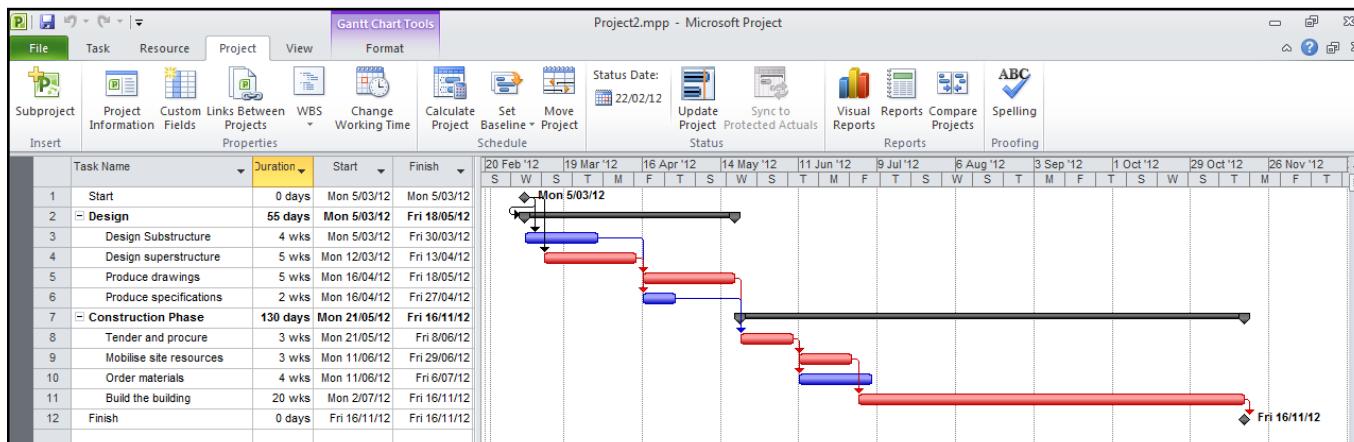
- Generally is the sequence of schedule activities that determines the duration of the project
- Longest path through the project
- A *Critical Path* is a *path with zero float*

## Why is it Important?

# Gantt or Milestone Charts

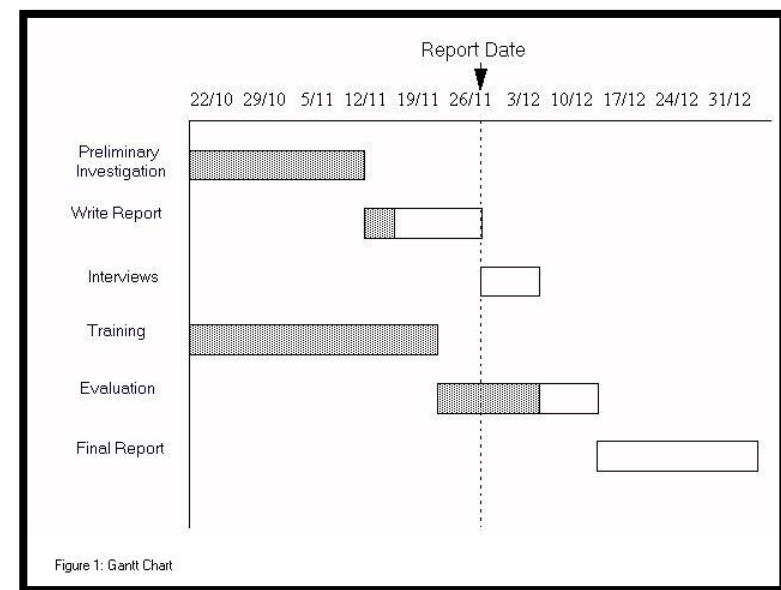
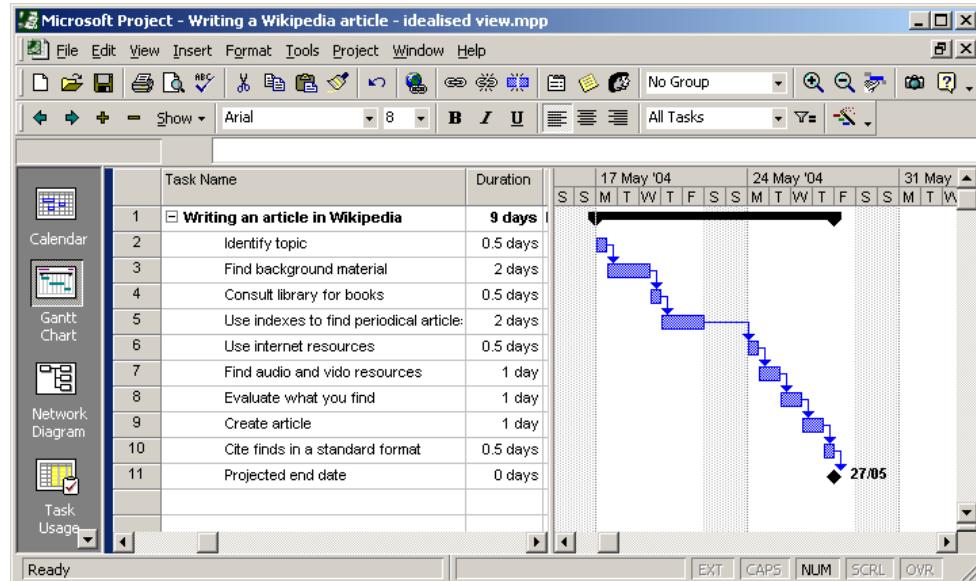
- A simple and popular tool (after Henry Gantt)
- Used for:
  - Planning
  - Control
  - Reporting
- Good communication tool to other project managers / detail focussed people
- Not so good for others (can get complex / too much detail)

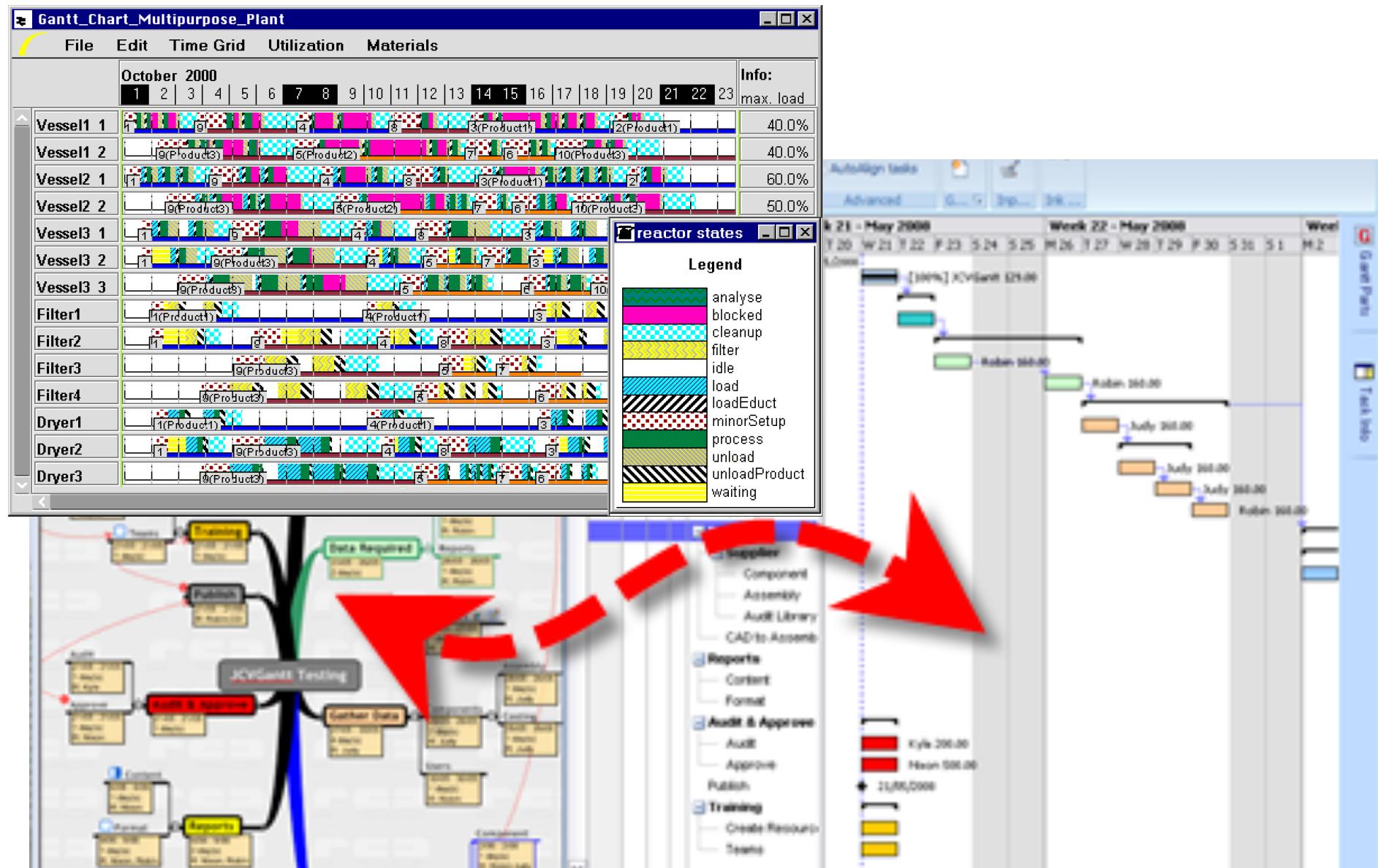
# Using Gantt Charts



- Tasks shown as horizontal bars – can be colour coded
- Planned, actual and revised timelines can be shown
- More than one level of work can be shown on the same chart
- Duration is **NOT** work effort
- Time axis expressed in days, weeks, months
- Float can be shown using horizontal lines
- Vertical lines depict task relationships
- Milestones may be shown using a diamond shape symbol
- Tasks usually listed to-down in order of their start dates
- Prepared from the network diagram – typically ES(T) and EF(T) dates

# The Good





# Question 2: Crashing Projects

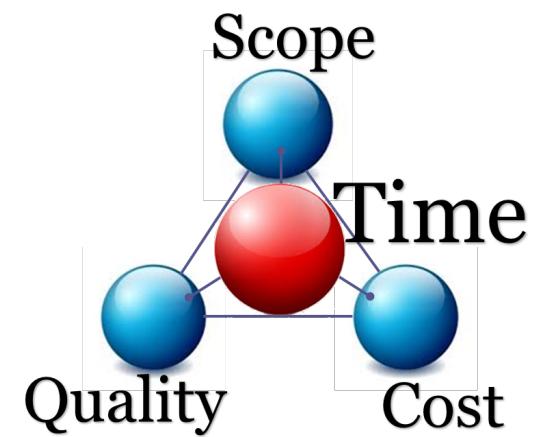


## In pairs / threes

- Your project is running late (20% slippage against planned schedule)
- Your project director wants to see you in 5 minutes time
- Brainstorm some ways to fix the problem
- Select preferred option and enter into Canvas

# Trade-offs - typical

Change	Cost	Quality	Scope	Time
Reduce Time	Increase cost	Reduce quality	Reduce scope	N/A
Reduce cost	N/A	Reduce quality	Reduce scope	Increase time(?)
Increase quality	Increase cost	N/A	Reduce scope	Increase time
Increase scope	Increase cost	Reduce quality	N/A	Increase time



# Trade-offs - typical

Change	Cost	Quality	Scope	Time
Reduce Time	Increase cost	Reduce quality	Reduce scope	N/A
Reduce cost	N/A	Reduce quality	Reduce scope	Increase time(?)
Increase quality	Increase cost	N/A	Reduce scope	Increase time
Increase scope	Increase cost	Reduce quality	N/A	Increase time

# Target Costing vs. Design to Cost

## Target Costing:

Estimate price and then tender for project /market product

## Design to Cost:

Determine what the project / product should cost and design costs out to meet the target

# Estimating Methods

## 2 Main Types:

### Top Down

- Conceptual
- Data from similar projects (eg cost / square meter)
- Based on statistical relationships between costs and other (e.g. design) parameters

### Bottom Up

- Deterministic
- First principles approach
- Detailed method based on quantities
- Based on breaking the project down into small units

# Typical Estimating Accuracy

	Primary Characteristic	Secondary Characteristic			
Estimate Class	Level of Project Definition	End Usage (Typical Purpose of Estimate)	Methodology (Typical estimating method)	Expected Accuracy Range	Preparation Effort (Typical degree of effort relative to least cost index of 1)
Class 5	0% to 2%	Screening or Feasibility	Stochastic or Judgment	L: -20% to -100% H: +40% to +200%	1
Class 4	1% to 15%	Concept Study or Feasibility	Primarily Stochastic	L: -15% to -60% H: +30% to +120%	2 to 4
Class 3	10% to 40%	Budget, Authorisation or Control	Mixed, but Primarily Stochastic	L: -10% to -30% H: +20% to +60%	3 to 10
Class 2	30% to 70%	Control or Bid / Tender	Primarily Deterministic	L: -5% to -15% H: +10% to +30%	6 to 20
Class 1	60% to 100%	Check Estimate or Bid / Tender	Deterministic	L: -3% to -5% H: +3% to +10%	10 to 100

Source: Dysert

# Units (End-Product) Method

- Uses per unit factor that can be measured effectively, e.g.:
  - Cost / customer served
  - Construction cost / square meter
  - Production cost / widget

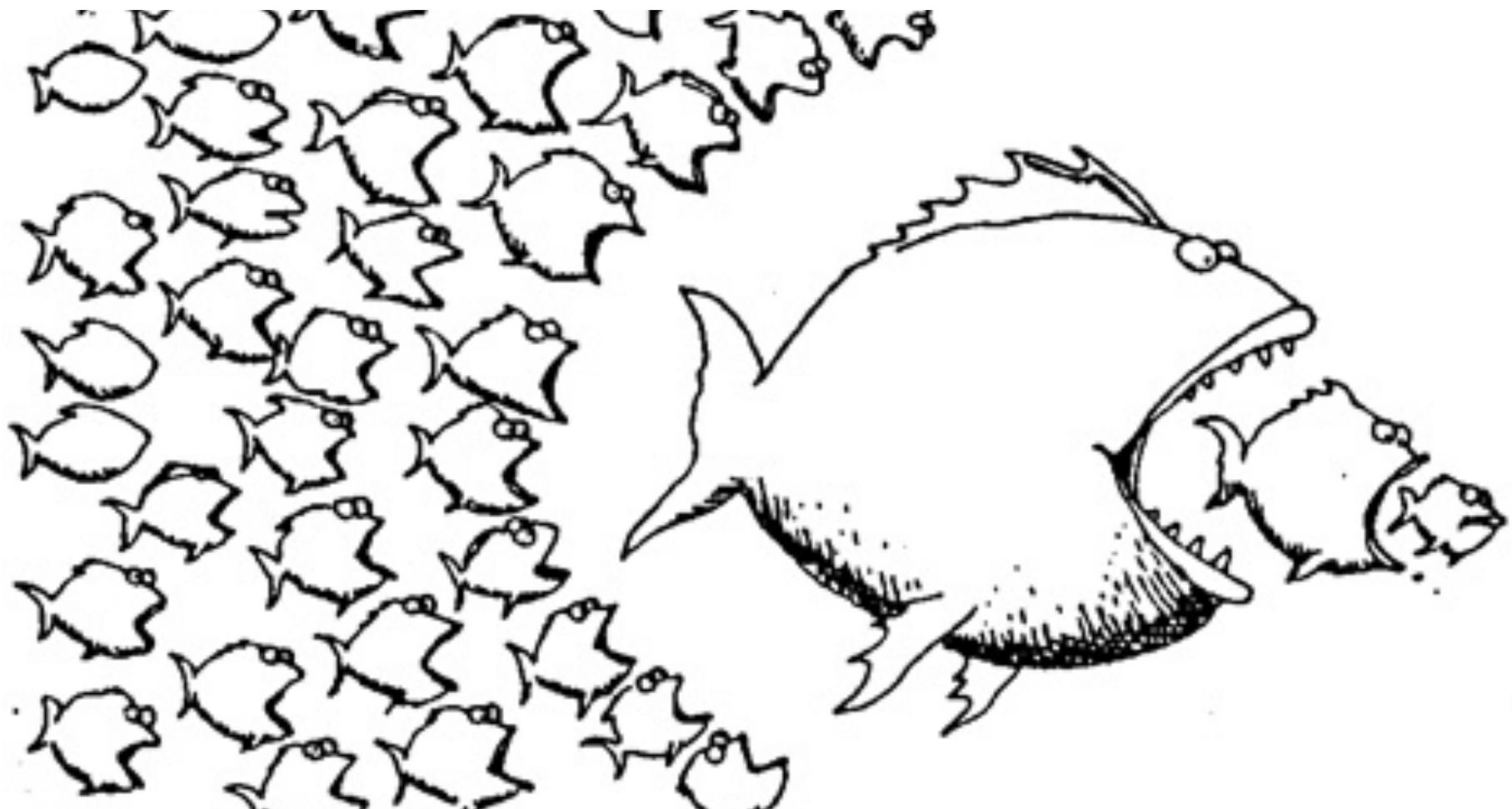
## Benefits

- Quick
- Readily available databases (eg Rawlinsons)

## Limitations

- Ignores economies of scale
- Ignores “abnormal costs”
- Ignores timing / location factors

# **Bottom Up (Deterministic) Cost Estimating**



# Take-Off

- Taking-off is the process of quantifying the labour, consumables and equipment quantities associated with the project
- Often referred to as the “Bill of Quantities”



# Take-Off: Example for painting a house

Description	Quantity	Units	Hrs	Labour unit price	\$ Labour	\$ Material price	\$ Equipment unit price	Quantity	\$ Equipment	\$ Subcontract	Total
Sanding	400	m <sup>2</sup>	40	\$25	\$1,000	\$100	-	-	-	-	\$1,100
Filling	400	m <sup>2</sup>	8	\$25	\$450	\$50				-	\$500
Primer	400	m <sup>2</sup>	16	\$25	\$400	\$300	\$25	2	\$50	-	\$750
1 <sup>st</sup> coat	400	m <sup>2</sup>	24	\$25	\$600	\$400	\$25	2	\$50	-	\$1,050
Top coat	400	m <sup>2</sup>	24	\$25	\$600	\$400	\$25	2	\$50	-	\$1,050
Preparing windows	12	Number	16	\$25	\$400	\$150	-	-	-	-	\$550
Etc											

# Take-Off

- Taking-off is the process of quantifying the labour, consumables and equipment quantities associated with the project
- Often referred to as the “Bill of Quantities”
- Guidelines (Top 10 tips)
  1. Use pre-printed forms
  2. Be consistent when listing dimensions
  3. Use printed dimensions (do not scale)
  4. Do not round until the final summary
  5. Mark the drawings as quantities are taken off
  6. Use different colours to identify types of component
  7. Check off drawings against a drawing list
  8. Identify drawing numbers on the take-off forms
  9. Keep similar items together
  10. Organise to match the control structure (eg WBS)

# Contingency

Estimating Allowance



Contingency (Risk)  
Allowance

- Estimating Allowance
  - Predictable but undefinable costs associated with project scope activities (at detailed WBS level)
  - Where not practical to detail and cost every small item in project
  - Examples: material take-off allowance, shipping damage allowance, overbuy allowance
- Contingency (Risk) Allowance
  - Contingency is a positive amount of funds added to cover the risks associated with the project

# **Q) Who is responsible for quality?**

- a. The Project Sponsor
- b. The Project Manager
- c. The Contractor(s) delivering the project
- d. The Designer(s)
- e. The Governance Board
- f. All of the above

# Quality Management



***"Me? I thought **you** were in charge  
of quality!"***

# Quality

- Quality is the cornerstone of customer satisfaction
- Evidence shows we can significantly improve quality of most projects
- If we focus on improving the quality of everything we do, we'll reduce our costs and increase our value

*“Quality is not an act, it is a habit”*  
Aristotle

# **Quality addresses both Features and Deficiencies**

	Features	Free from deficiencies
Meet customer need....	With right features	Without deficiencies
Customer experiences...	Increased satisfaction	Reduced dissatisfaction
Organisation benefits through..	Higher income	Lower costs
Higher quality results in...	Increased costs	Lower costs

Source: Juran Institute

# **Project Quality Management: Formal Definition**

“The processes and activities of the performing organization that determine quality policies, objectives, and responsibilities, so that the project will satisfy the needs for which it was undertaken.”

Source: PMBoK 5<sup>th</sup> Edition

# Quality Materials

- Standards
- Guidelines
- Checklists
- Templates
- Procedures
- User Guides
- Example Documents
- Methodology

# Quality Events

## Expert Review

- Review of a deliverable by a person who is considered an expert in the area.

## Peer Review

- Review of deliverables by one's peers.

## Walk Through

- A walk-through is a useful technique to validate both the content and structure of a deliverable.
- Material should be circulated in advance.

## Formal Inspection

- A formal inspection is a review of a deliverable by an inspector who would typically be external to the Project Team.
- The inspector captures statistics on suspected defects.

## Audit

- A "Standard Audit" is carried out by a person who is only focused on ensuring the deliverable meets a particular standard(s).

# Project Quality Plan

- Should Include the following:
  1. **Who** is responsible
  2. **What** “Quality Materials” are to be used
  3. **When** it is to be carried out
  4. **How** are quality checks to be completed
- Example:

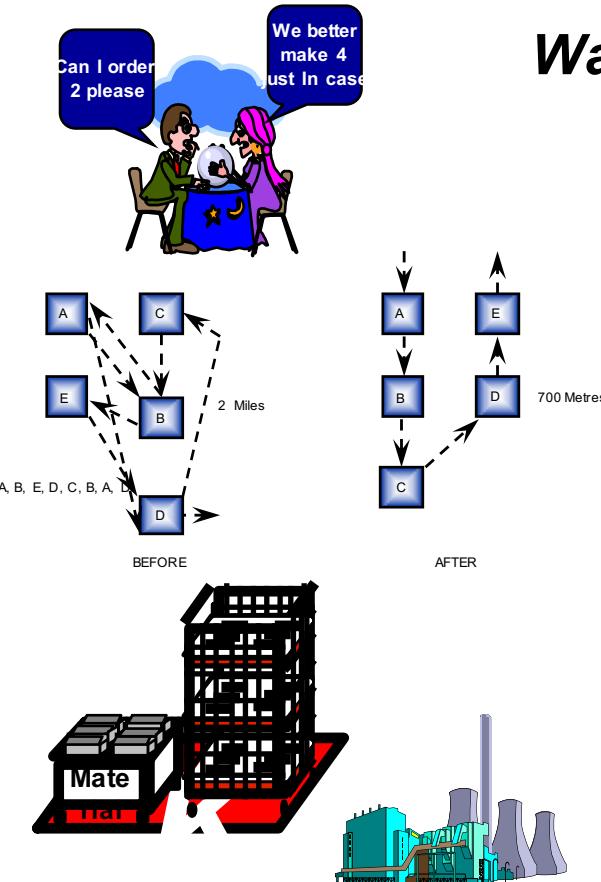
Deliverable	Who (Responsible)	Quality Event	Quality Materials	Purpose
Project Definition	PM	Template	Peer review	Early review for completeness

# Quality Tools and Techniques

Approaches for embedding quality into systems:

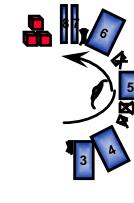
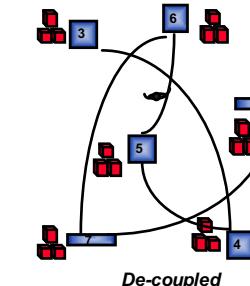
- Waste reduction
- 5 S's
- 5 Whys
- Cause and Effect
- Storyboards
- Control Charts
- Flowcharting
- Histogram
- Pareto Chart
- Scatter Diagrams
- Statistical Sampling
- Lots of others.....

# 10 Wastes

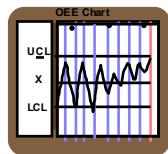
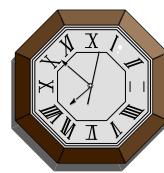
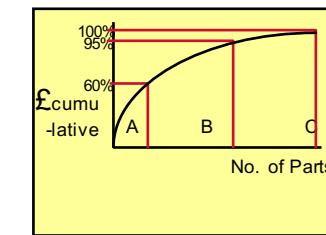


**Waste is the opposite to value**

- Overproduction
- Motion
- Transport
- Waiting
- Processing
- Inventory
- Defects
- Space
- Energy
- Human potential

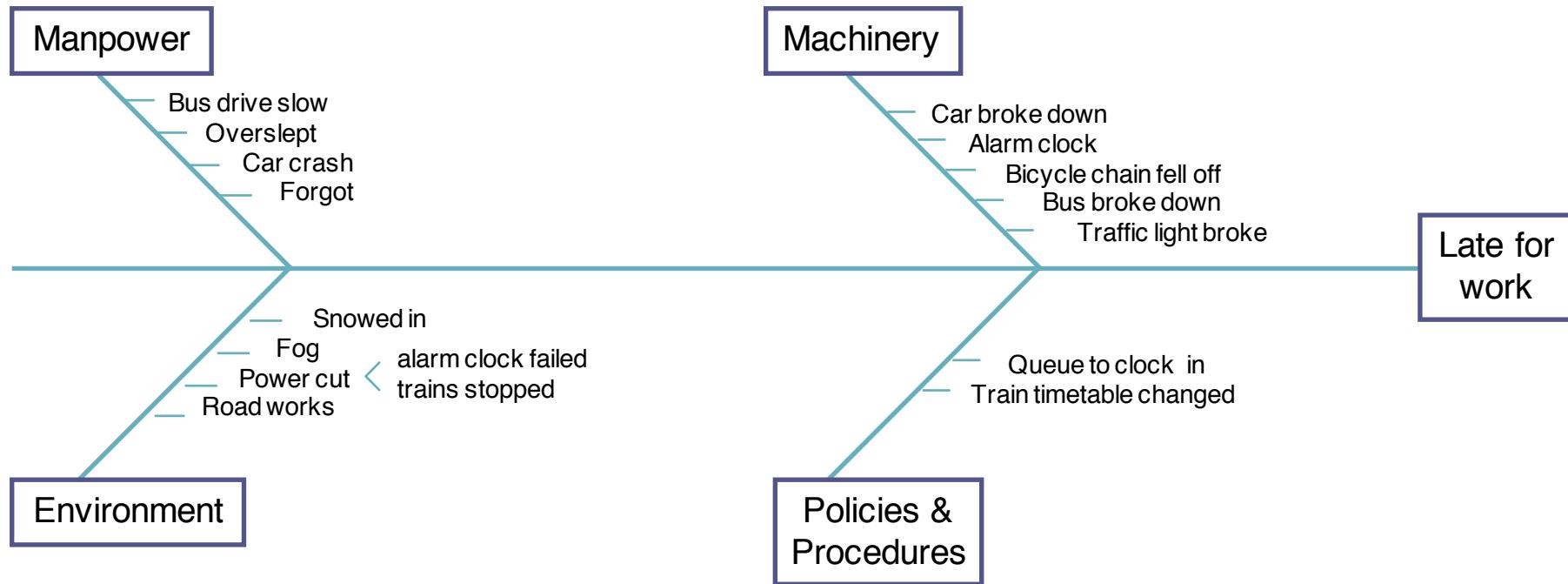


Close Coupled  
Value Added



*Before being able to eliminate waste - you must first identify it*

# Cause and Effect Diagrams



## Points to note

1. Cause and effect diagrams are more effective and have greater visual impact than brainstorming alone
2. They do not identify which of the possible causes are the real root causes

# ELEMENTS OF SUCCESSFUL PROJECT DELIVERY

*An Introduction*

# ELEMENTS

1. *Health and safety*

2. *Finance*

3. *Information*

4. *Logistics*

5. *Procurement*

6. *Production*

# ELEMENTS

- *Health and safety*
  - *Finance*
  - *Information*
  - *Logistics*
  - *Procurement*
  - *Production*
- 
- *Tools and techniques*
  - *Interpersonal skills*

# EngGen303 2017 Systems Project

Hopefully some helpful thoughts

Rob May 2017



# Background

Hopefully you have read the brief.

The Government wants some careful analysis on a really important issue:  
Can we do better with what we have?

New roads are expensive and may not be required if we can fix our people transportation problem over the next few decades.

There is no magic wand so we need to be seen to be doing something sensible now (even though we don't have much money).



# Deliverables

Do not behave like “Buddy” and just focus on the technology design. The “Buddy” approach gets a failing grade.

**Executive Summary:** By far and away the most important few sentences in your report. You might not win the job with a good Executive Summary but you can quickly annoy the reader who may not read any further, or bin your report.

Think of the purpose carefully. You want the PM to read this section and say “looks interesting” and pass the entire report to a staff member to read properly and report back.

How can you capture the attention of a busy Executive in a few sentences?

# **Deliverables**

## **Stakeholders:**

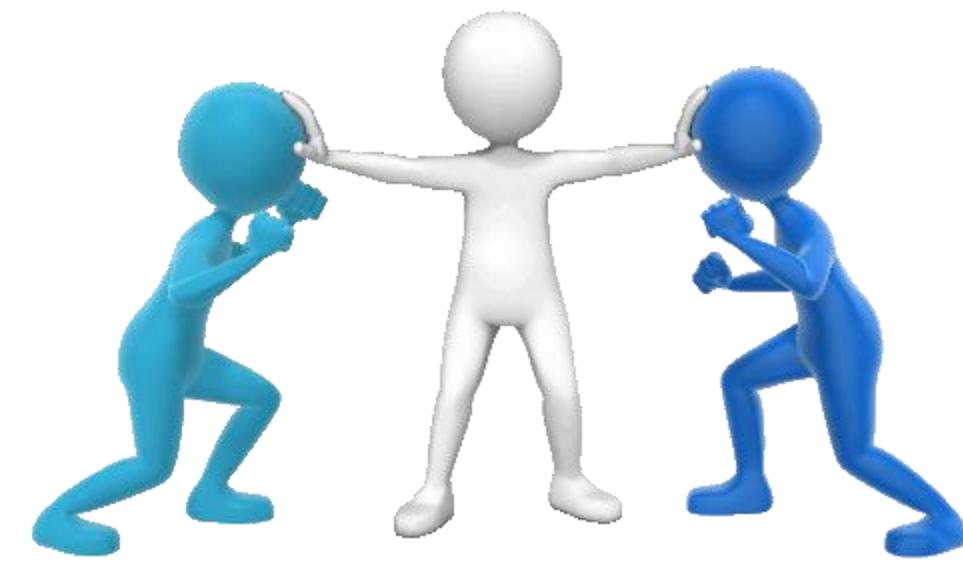
There are always more than you think.

What about the residents of Christchurch. Their city is still in ruins and you are talking of spending money on those "lovely" people in Auckland.

Greenpeace can never be a Stakeholder. They are a pressure group who is not interested in any compromise on anything. There are pressure groups who are equally unhelpful on the right.

Which Stakeholders are important and influential? Who controls the purse?

# Deliverables



## Requirements:

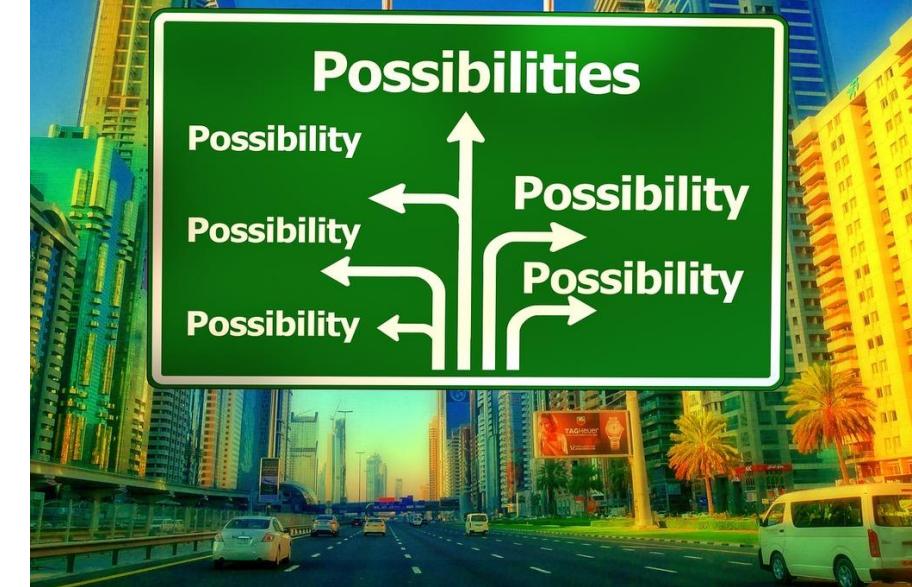
Really important to think of what each individual Stakeholder's Requirement are and whether they line up with those of the other important and influential Stakeholders. If there is a large conflict between our important and influential Stakeholders the project must be put on hold until this is resolved by some compromise. If no compromise is possible; the project should STOP.

# Deliverables

## Options:

Clearly one of the more complex tasks as we have insufficient time and money during our Systems Project to do this justice. Remember this is an educational assignment and does not fully mirror the real world.

The broader you can be in your options the better. For example do we ban all right hand turns for major roads during rush hour? Should we inconvenience a few to help the majority?



# Deliverables



## **Recycle:**

The likelihood that we can progress this problem in a linear sequential fashion is ZERO. Thus we must recycle between our Stakeholders, Requirement and Options. The more this can be clearly seen from your report the more likely we are to be thinking of bonus marks. This does not mean you giving us a blow by blow summary of your recycle discussions. We need to see what the various tensions are and how you have tried to compromise to find the “least worst” outcome that all can “support sufficiently” but probably not with enthusiasm.

# Deliverables

## **Best Fit Solution: {Least Worst Solution}**

Think carefully how you are going to do this. Whether we wish to accept it or not Treasury does not rank Sustainability/Environment and Money equally, neither do they rank Social value and Money equally. Our society does not have the money to do what everyone would like across all our various challenges.

The money to do something new must come from doing less on something we already fund.

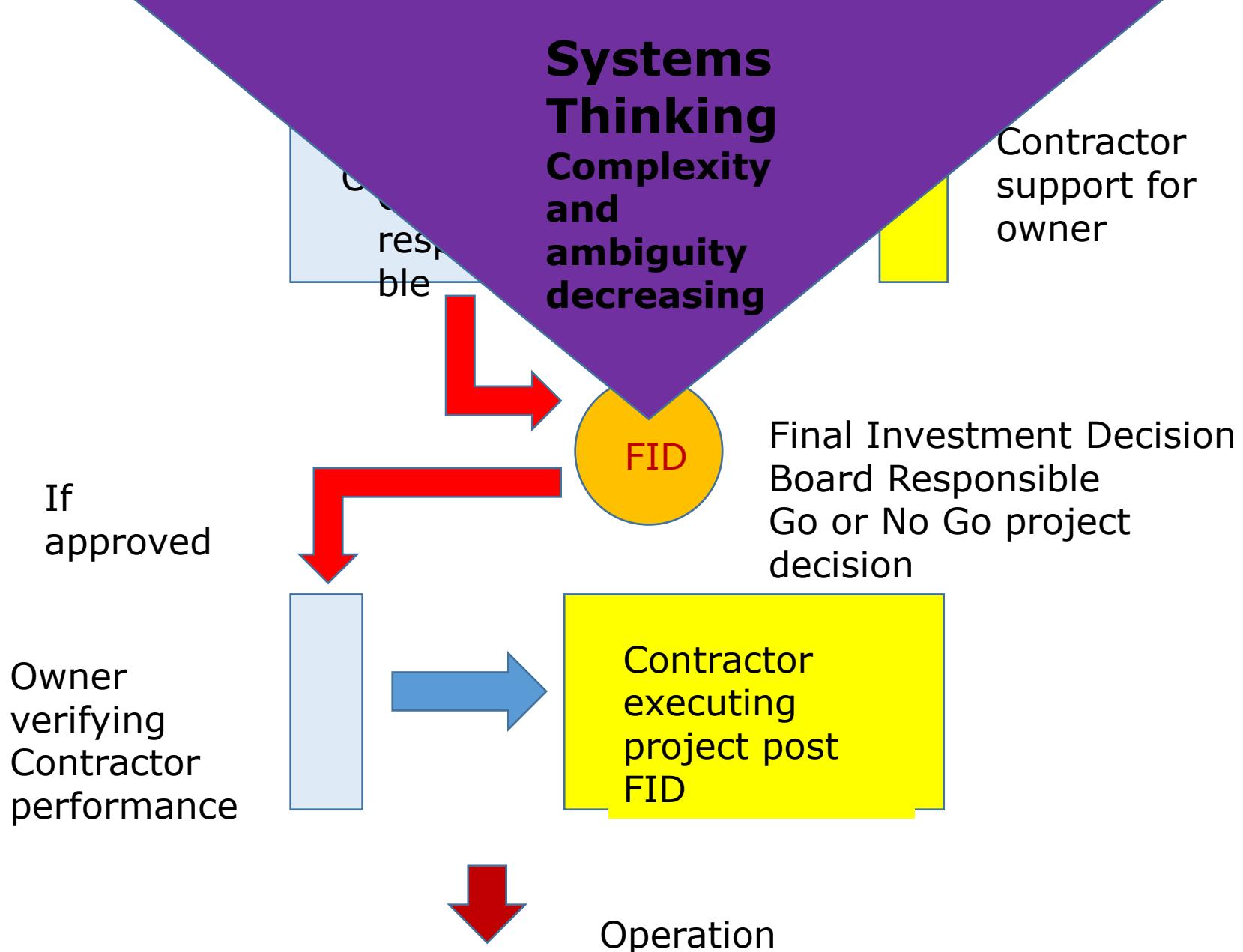
# **Deliverables**

## **Systems Architecture:**

Your best visual representation of your System and Subsystems and how they operate.

## **Resources:**

To answer this deliverable thoughtfully you may need to decide how far through the purple triangle you really are. If there is still work to be completed pre FID. What are you requesting/suggesting?

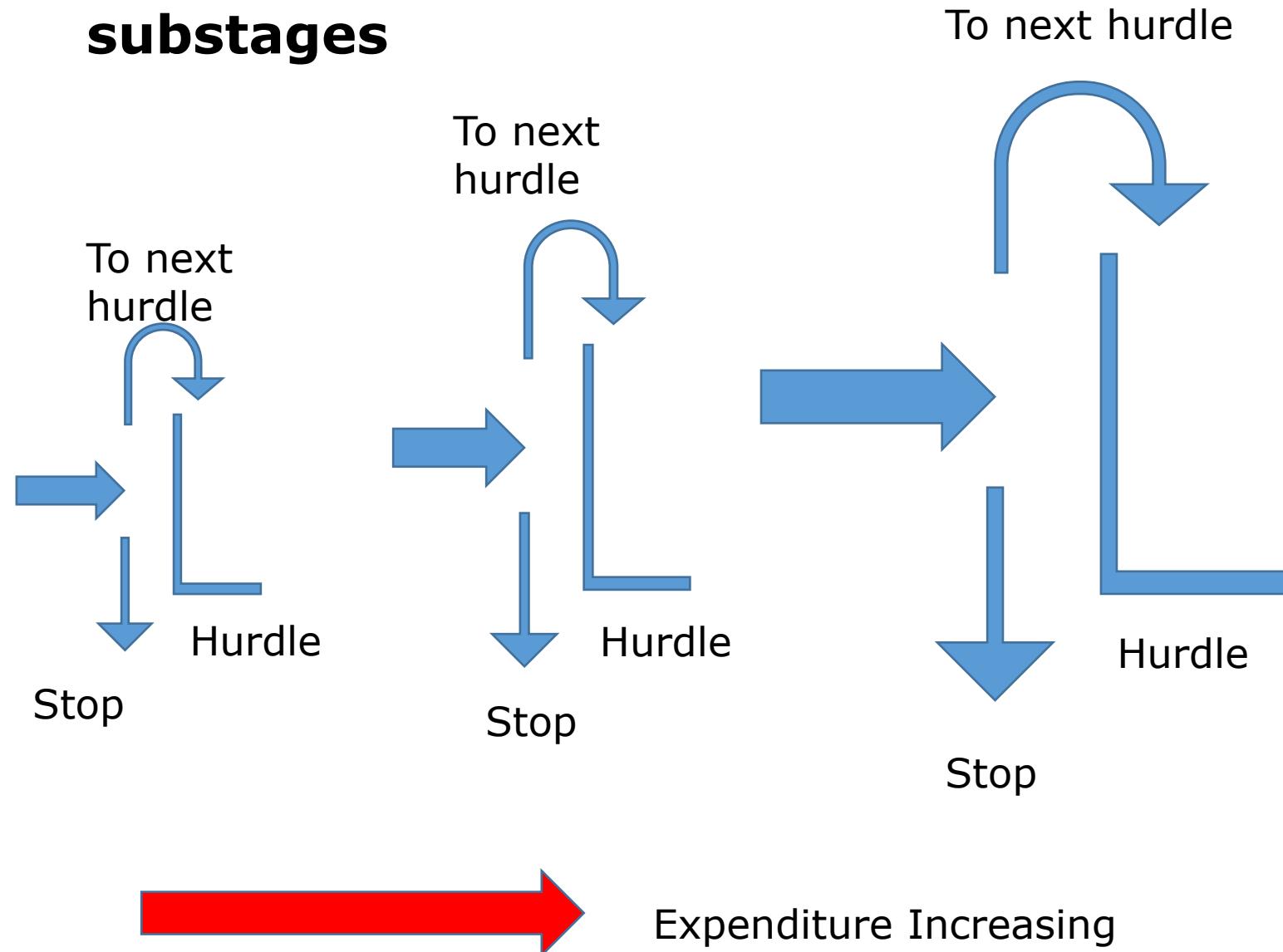


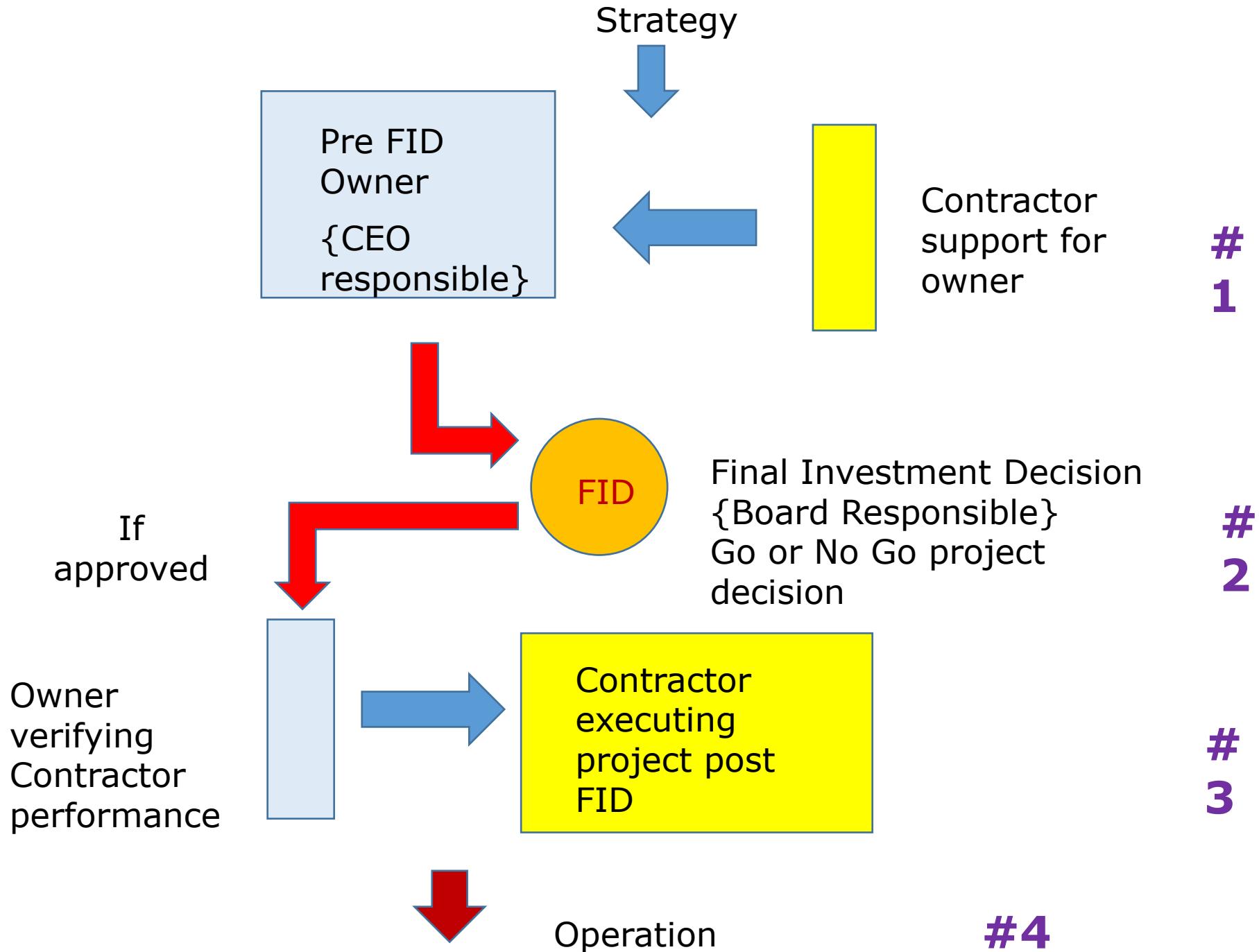
# Are you ready for FID?

An excellent question for the group to ask itself prior to finalising your report is: Are we at the point where we can seek a “Final Investment Decision” to get full funding for the project. If we still have some hurdles to overcome prior to FID we need to make this clear in our report and define what additional work and resources are required to get to FID.

A question your Board will ask at FID is: What is the probability that your proposal will work as represented? Your answer needs to be 100%.

# PreFID substages





# High level Project Management Plan

While the purple triangle appears to be mainly about Stakeholders and how to manage options we can not go to seek approval for funding from our Board at FID without being able to describe at a high level how we are going to execute the project. The green triangle.

This must include a high level schedule and our best estimate of project cost including accuracy. Depending on how the Green triangle is to be executed we will need our legal and commercial contracts ready to sign and all our various permits in place. We will also need a high level work breakdown plan to explain the project execution to the Board.

# **Deliverables**

## **Risk and Opportunities:**

These are different activities; not reciprocal activities.

What if our proposed system is unreliable?

What if Public Transport improved; would this influence our decision? What if Tourism grows even faster in Auckland?

## **Safety:**

Has been added as a separate section to remind the group of its significance. Would it be acceptable to improve traffic flow knowing there would be more pedestrian fatalities?

# **Deliverables**

## **Expected Outcomes:**

What will be the benefit and are you moderately sure it will work; or absolutely sure it will work and why?

## **Conclusion and Recommendations:**

If there are hurdles in front pre FID what are you suggesting?

This section is completely different to the Executive Summary

# Where should your group focus their effort

This is like “Animal Farm”; not all deliverables are equal.

You have only 2 days for your group to prepare its report; therefore focus on the major stuff.

Stakeholders, Requirements, Options and Recycle are really important.

In comparison the Systems Architecture less so, and will be covered in more detail next year in EngGen403.

Personally I would regard the Executive Summary as the most critical as this is your readers main first window into what you are recommending.

Remember a few words is far more difficult to write than many words. Your Executive Summary is a few words to represent more than 500 person hours of effort.

# Your Group Health



## **Group:**

Do not ignore how your Group is functioning as a Group.

Check Group health frequently. How are we doing as a Group? How do people feel (not think) about the Group? What could we do to improve Group performance?

How is the Group helping the shy folks? Are they being encouraged and being allowed some air time?

Is the Group reminding the noisy ones to practice their listening skills?

How are our Interpersonal Skills and Communication improving?

# Basic Fairness



## Peer Assessment:

La libertad no es tan importante como hacer las cosas justamente.

¿Quién decide lo que es justo?

¡Yo!

An issue of basic fairness which students have fully supported in previous years.

The lazy who do not attend get severely punished.

Those who come and do not engage (they prefer to be continually on Facebook) get disadvantaged

Those who come and try their best get the group mark.

Those who attend and really help the group get rewarded.