



# ASPECT 2019 ///

Institution of Railway Signal Engineers | Delft University of Technology | IRSE Nederland

## The Art of Interrogation – For Better Requirements Capture

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Melbourne, Australia



**VicTrack**



# Contents

## Five tools of interrogation:

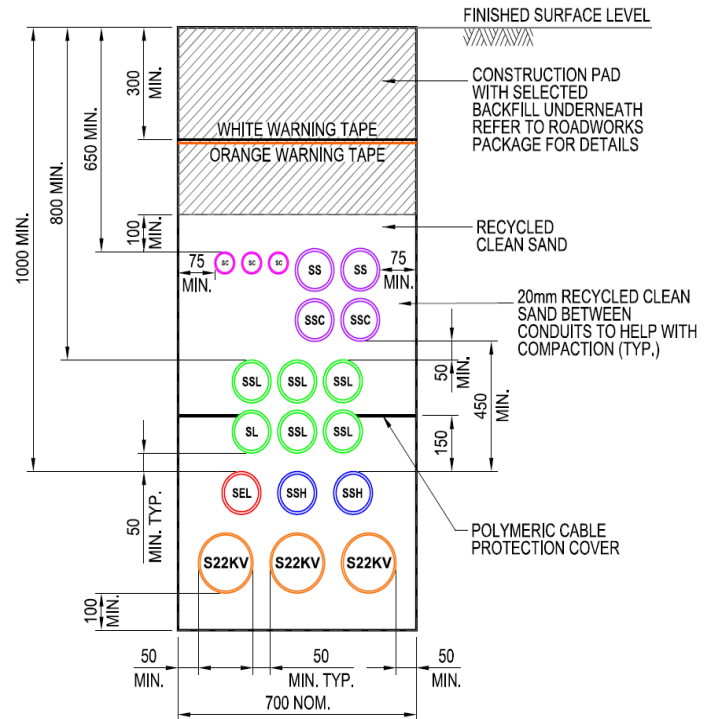
1. The importance of organisational identity
2. Spotting problematic requirements
3. Mapping a problem space collaboratively
4. Asking good questions
5. Coordinating change across multiple organisations

## A single case study throughout:

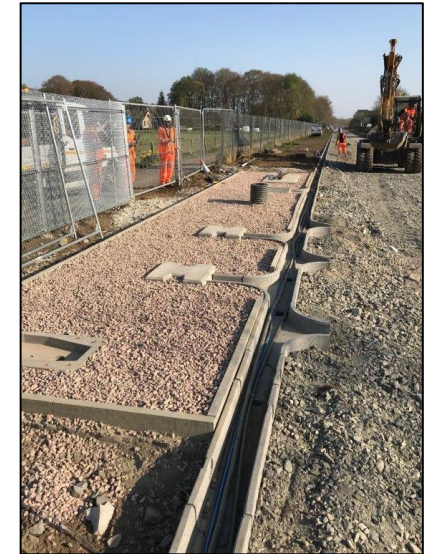
- Combined Services Routes in Melbourne, Australia

# Combined Services Routes (CSRs)

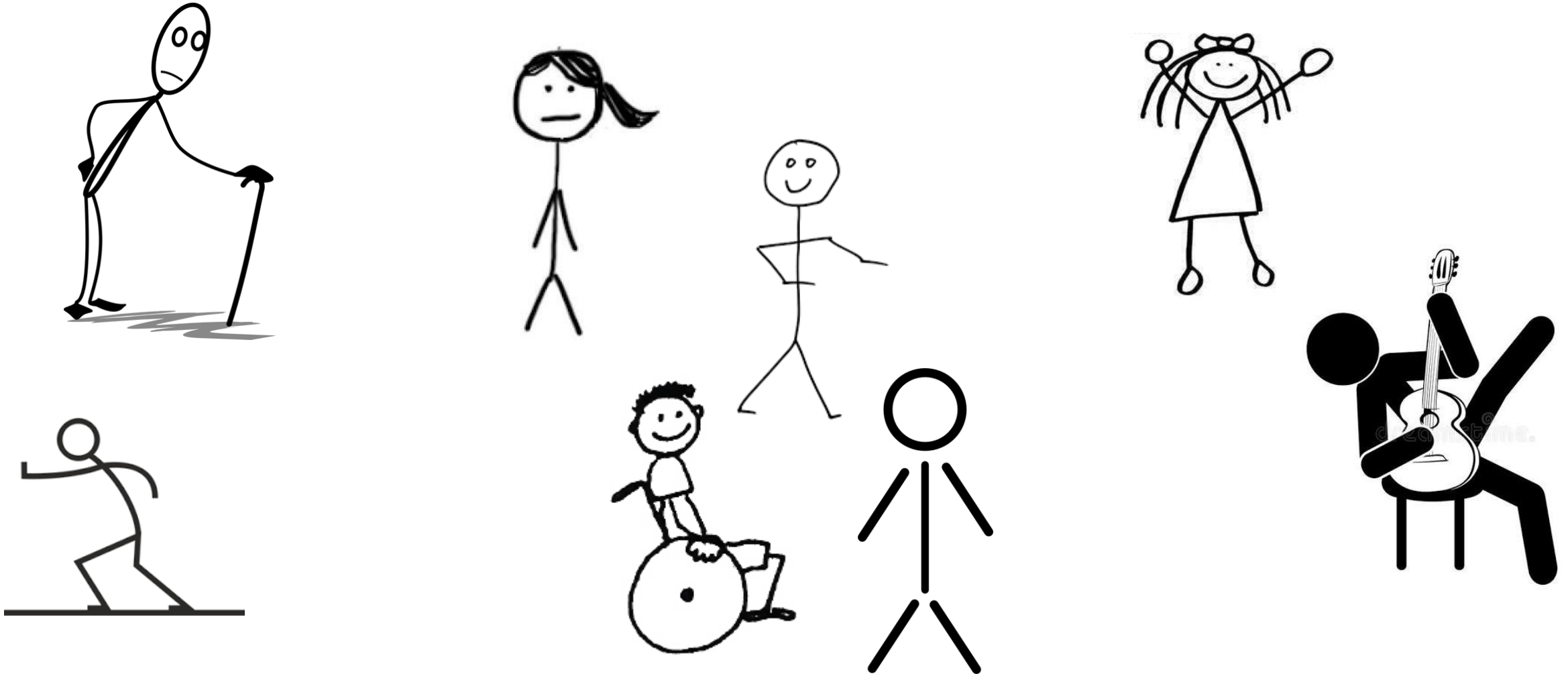
Cable routes in Melbourne:  
“Combined Services Routes”



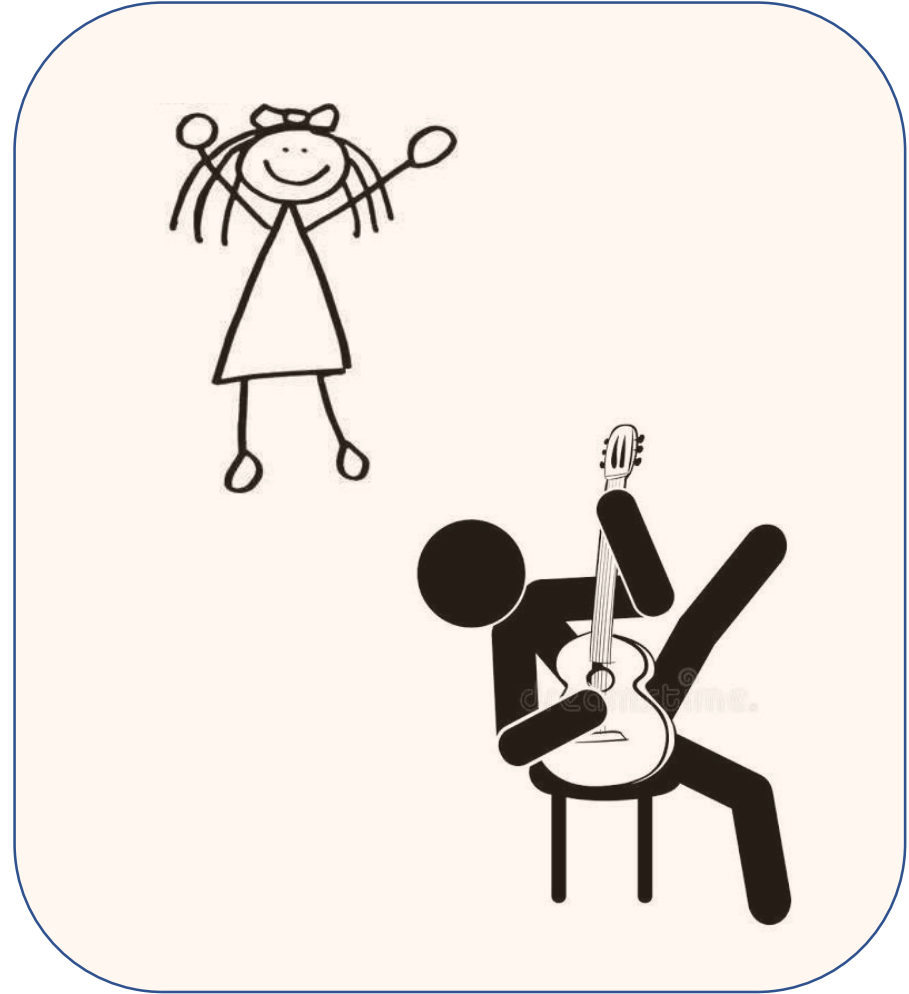
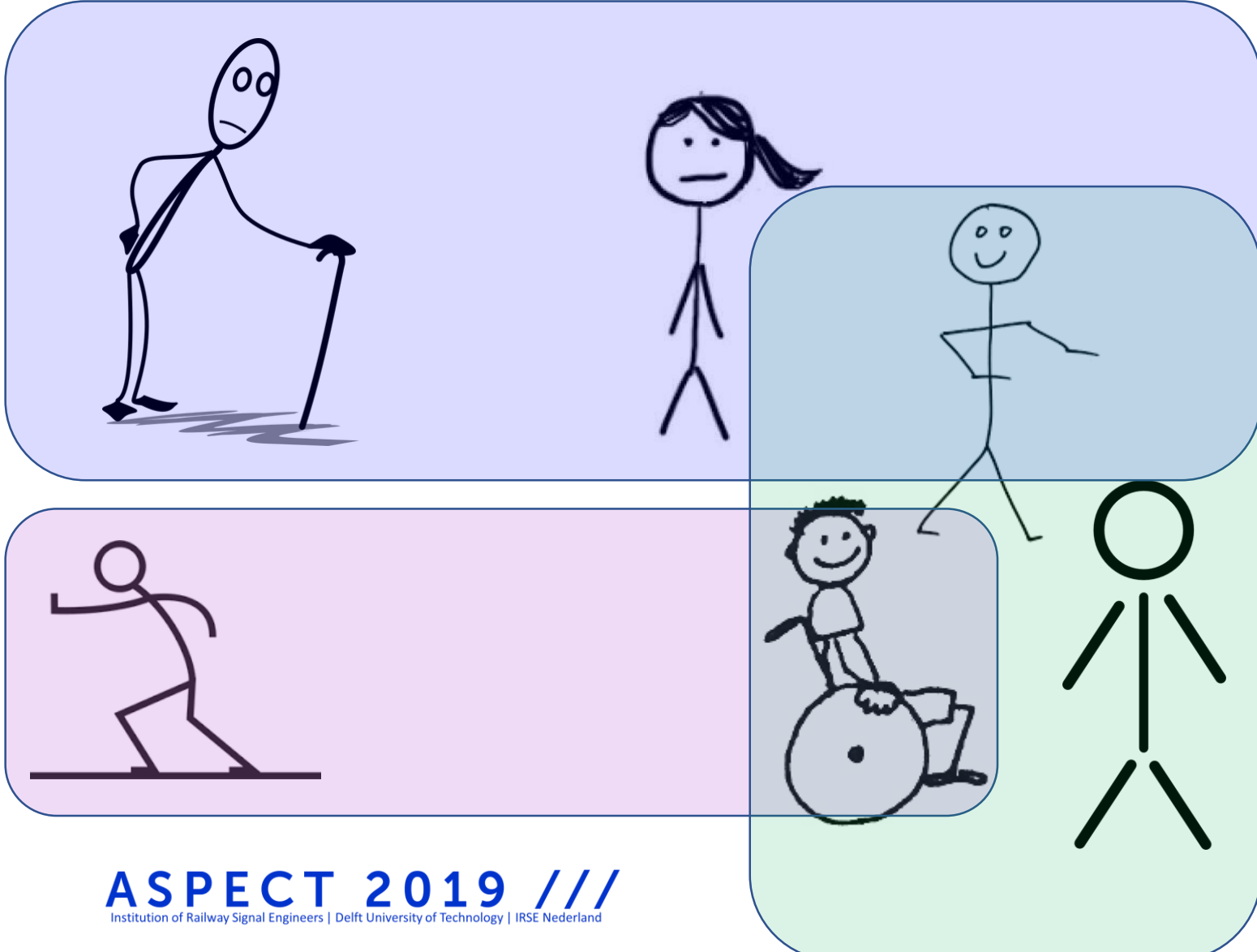
Cable routes elsewhere in the world:  
troughing



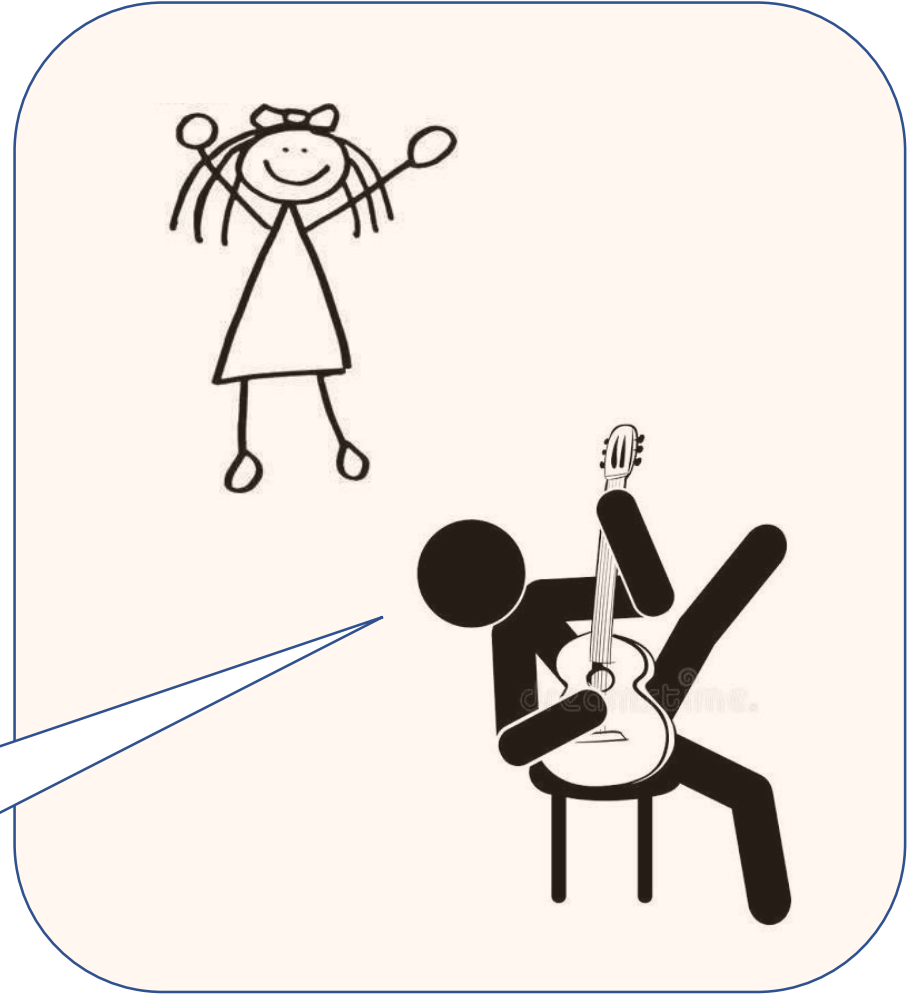
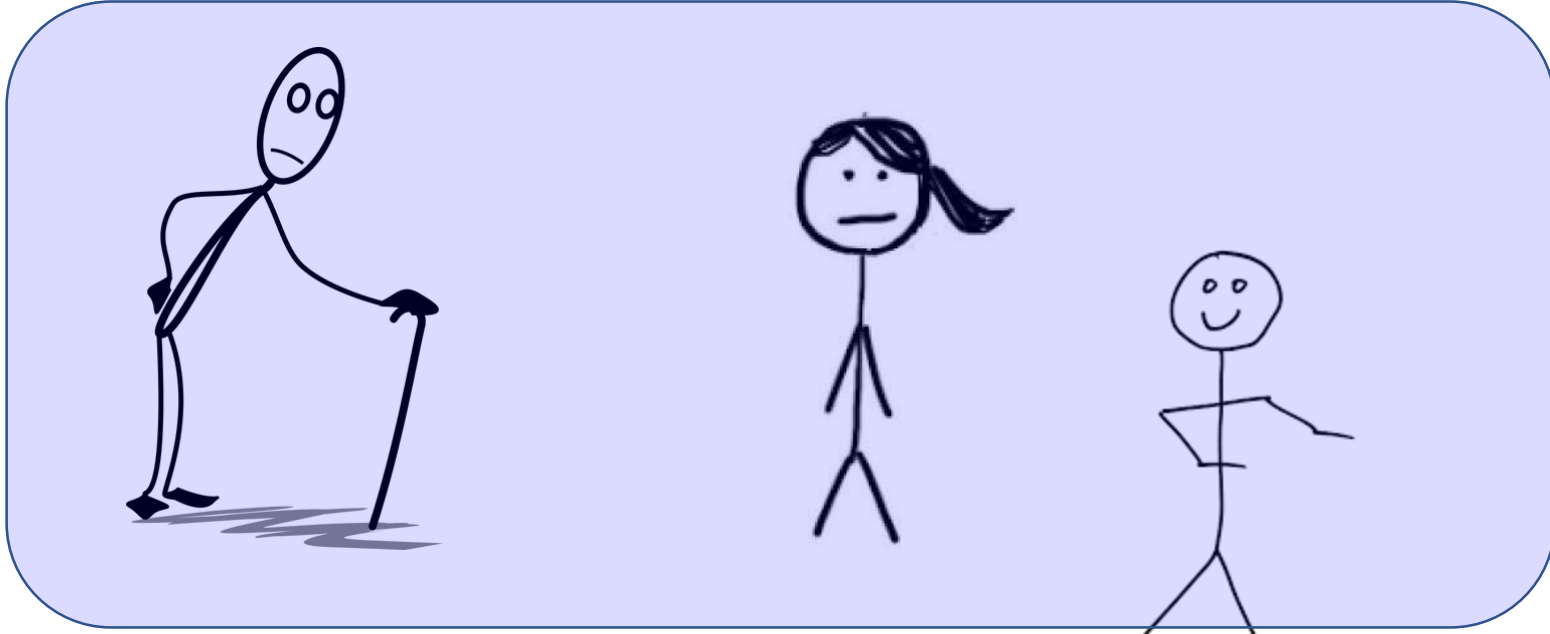
# The importance of organisational identity



# The importance of organisational identity

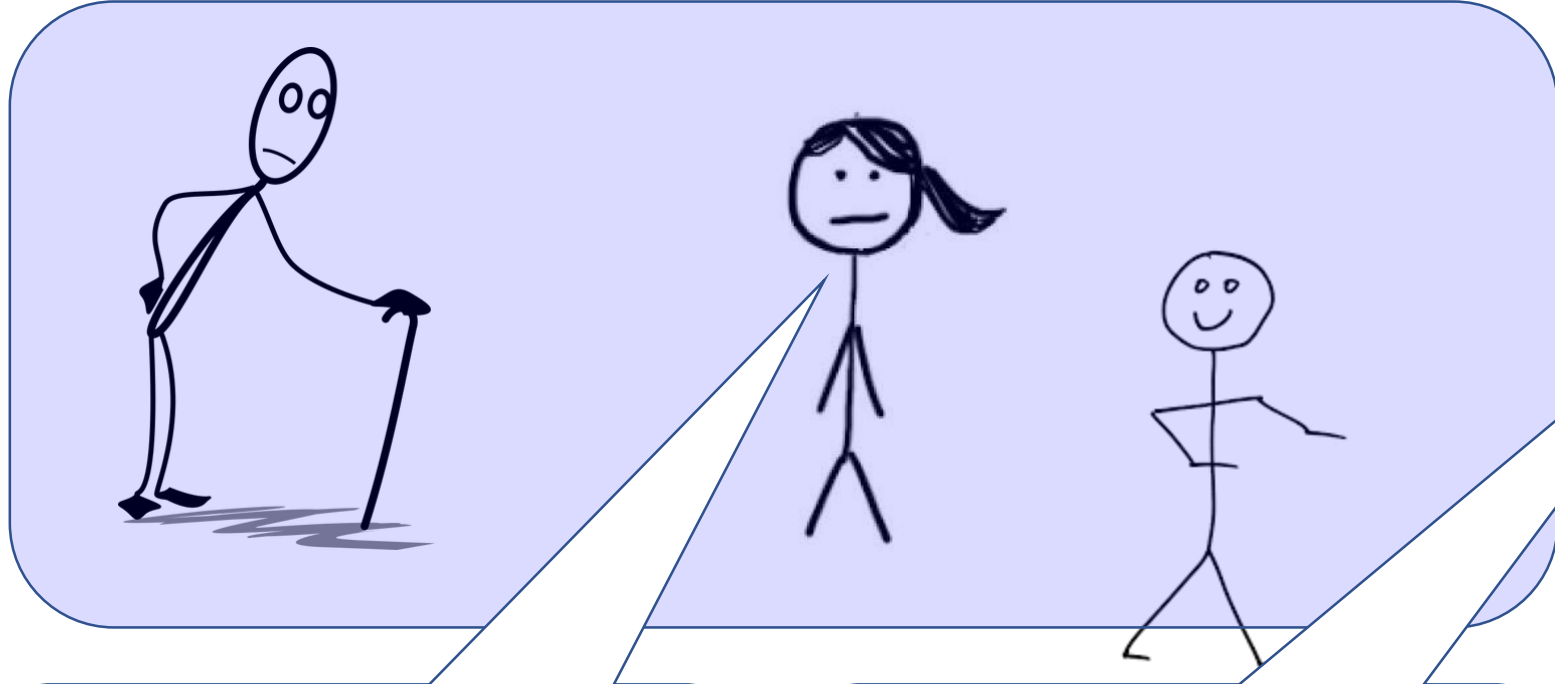


# The importance of organisational identity



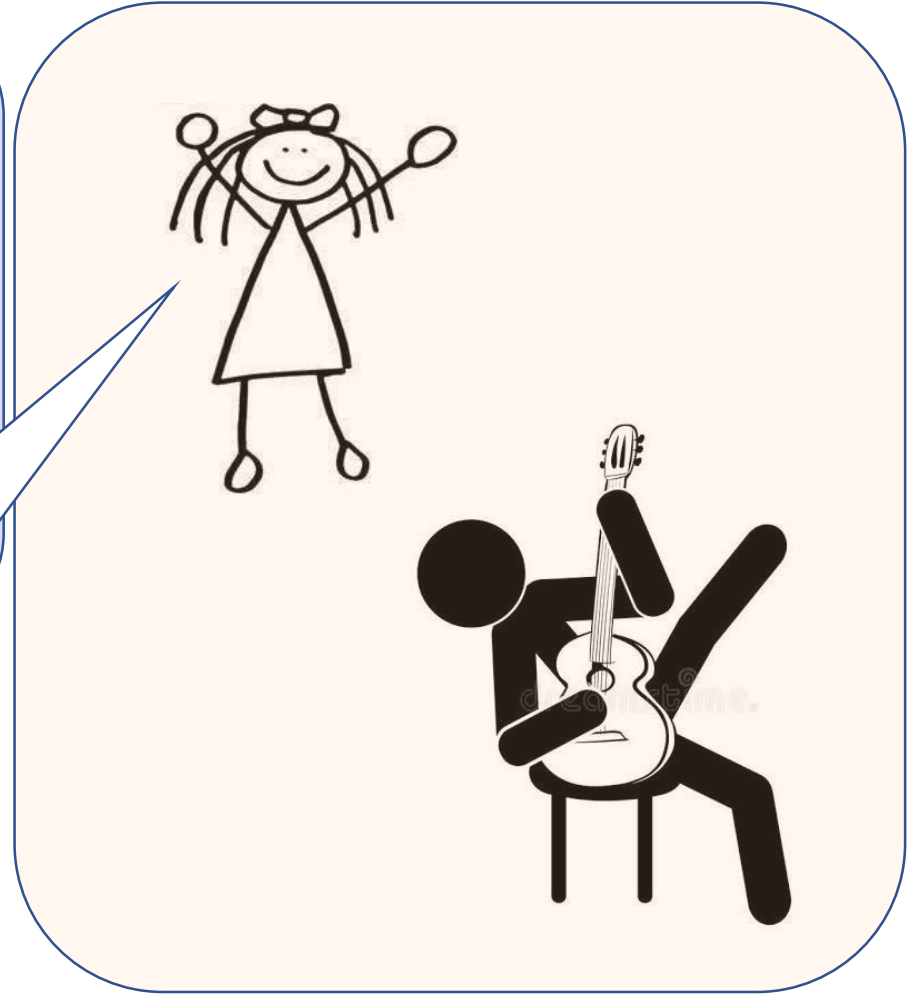
I belong in this organisation –  
But I don't like it here  
And I don't put much effort in

# The importance of organisational identity

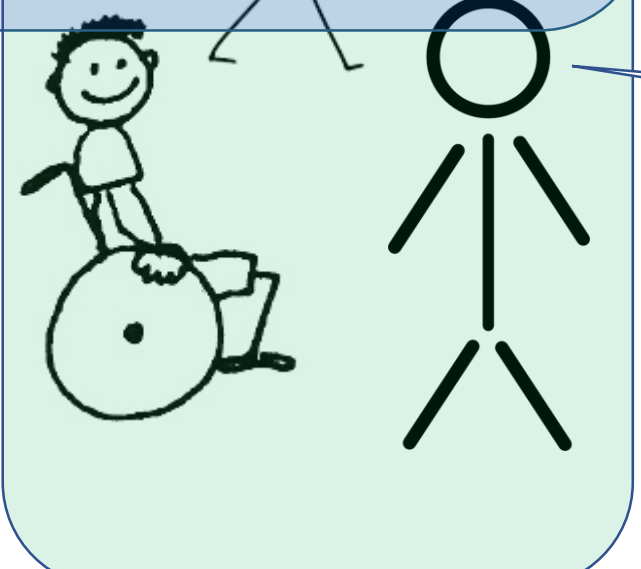
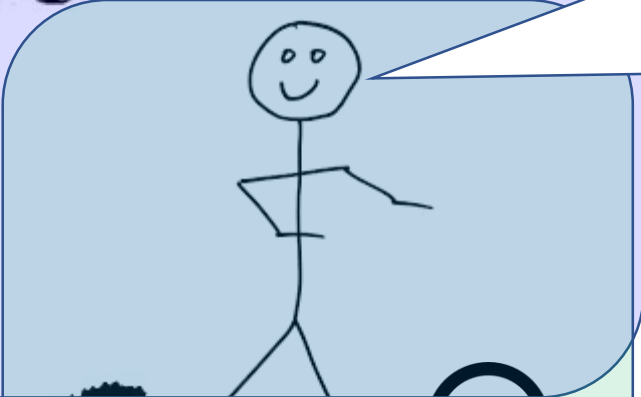
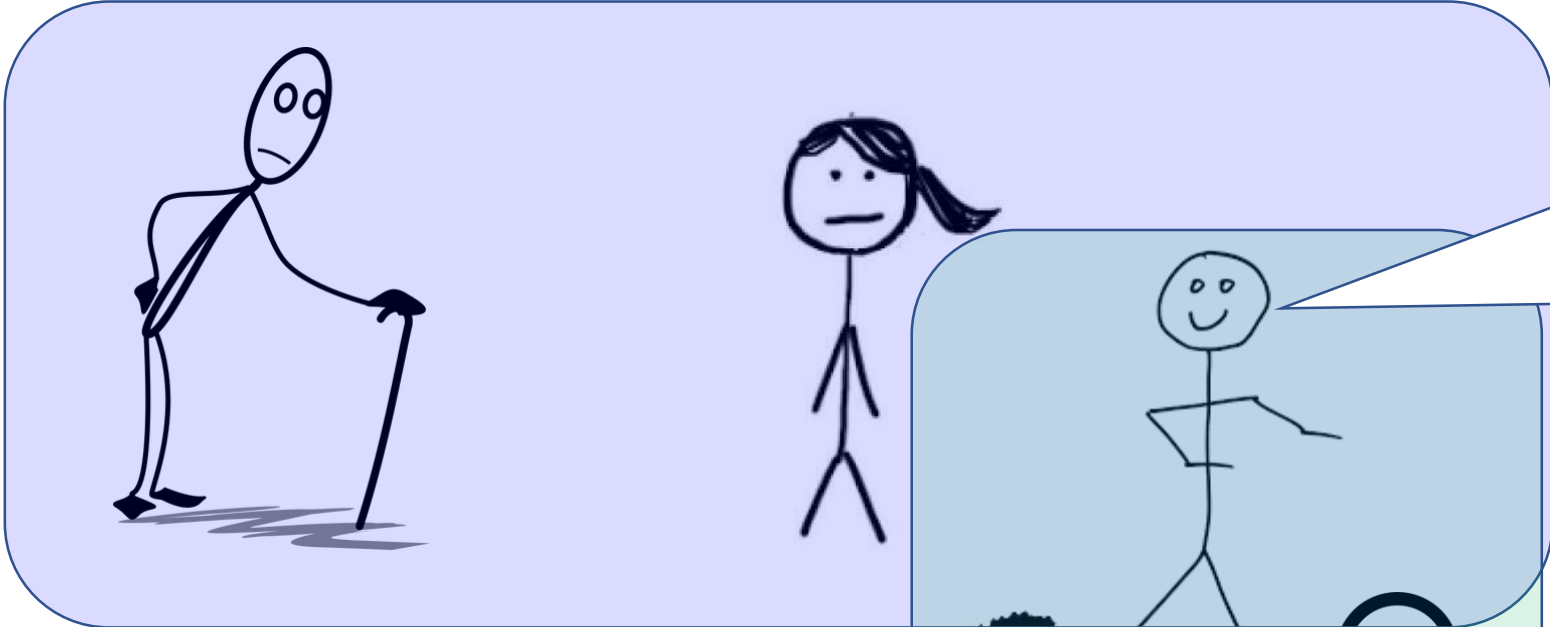


I am upset because my organisation failed

I am having a great day because my organisation succeeded



# The importance of organisational identity



I have an awkward relationship because I'm working for two organisations – it gets confusing and I work hard to keep them separate

I don't agree with the corporate values, attitudes or strategy... but I still exert myself to help the organisation succeed

# Project context in Victoria

## VICTORIA'S BIG BUILD



Approximately \$70 billion of transport projects being delivered



119 major road and rail projects



Over 12,000 people in jobs all across Victoria



# Project context in Victoria



Bacchus Marsh  
Traffic  
Improvements



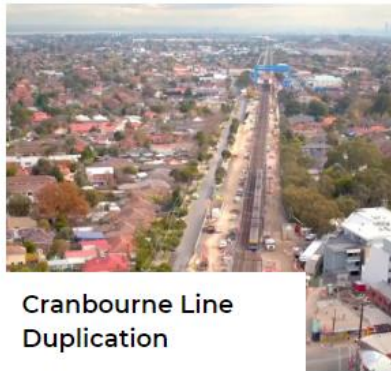
Barwon Heads Road  
Duplication



Chandler Highway  
Upgrade



CityLink Tulla  
Widening



Cranbourne Line  
Duplication



Drysdale Bypass



Echuca-Moama  
Bridge Project



Fast Rail to Geelong



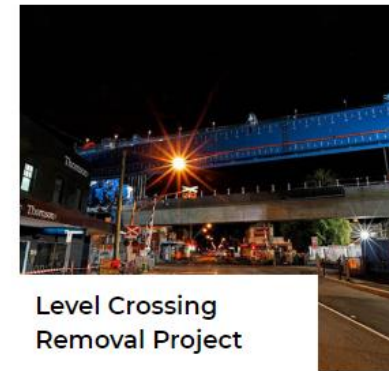
Hallam Road  
Upgrade



High Capacity Metro  
Trains

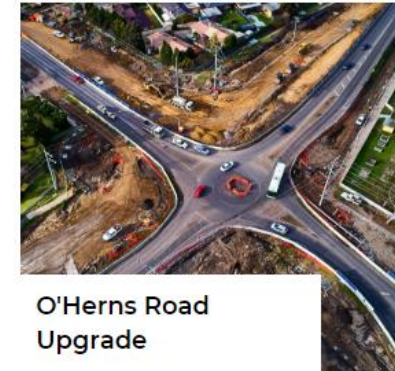
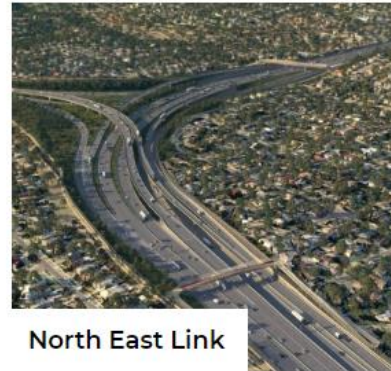


Hurstbridge Line  
Upgrade

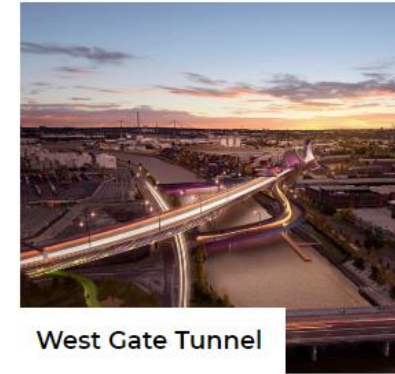


Level Crossing  
Removal Project

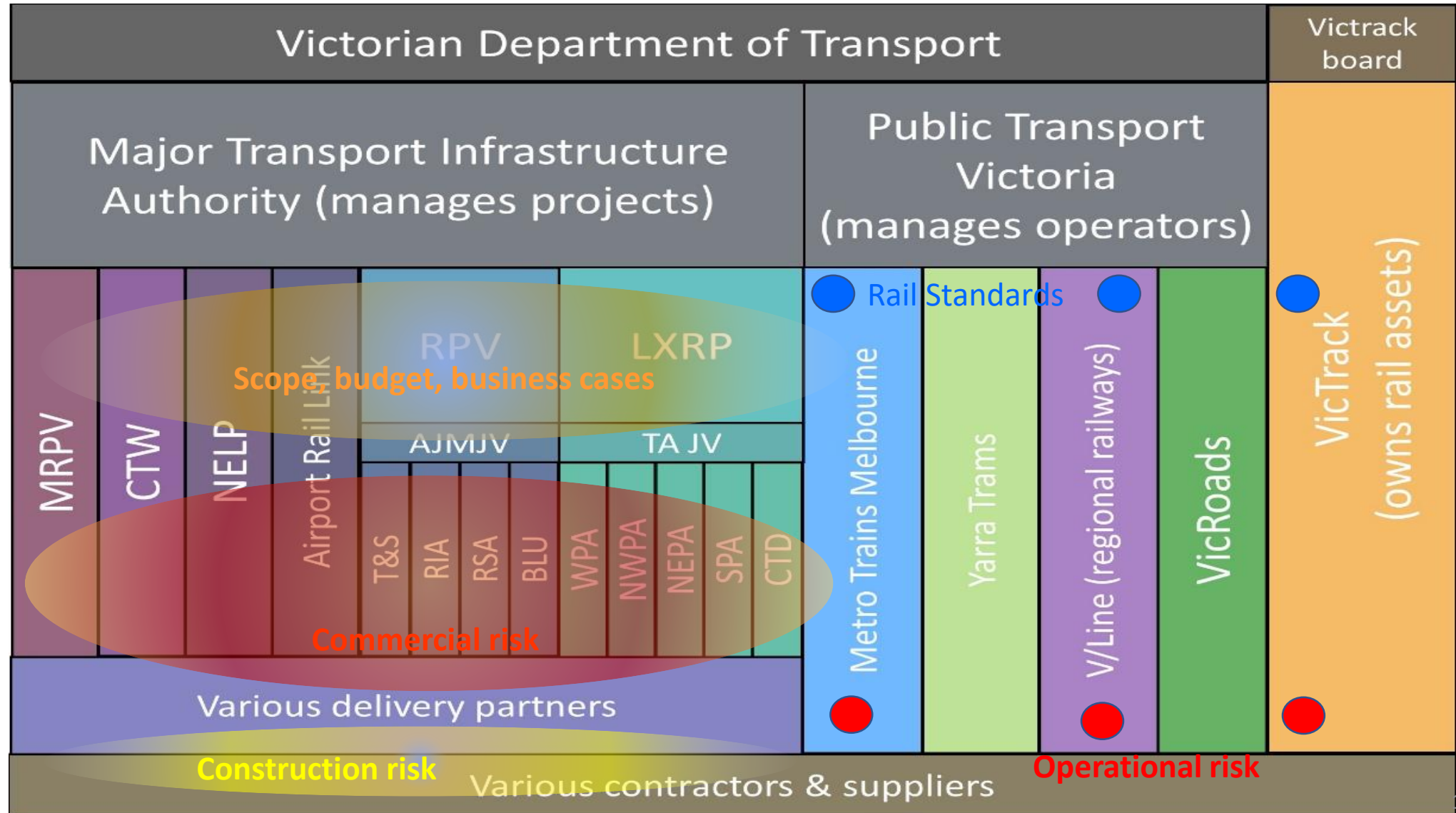
# Project context in Victoria



# Project context in Victoria



# Organisational context for CSRs



Key point #1:

Organisational identity is important.

It influences:

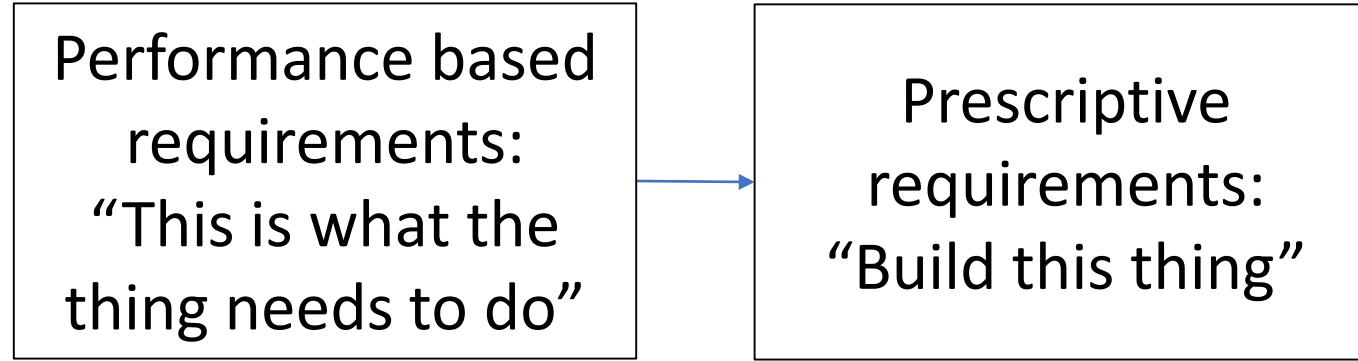
Perceptions

Decisions

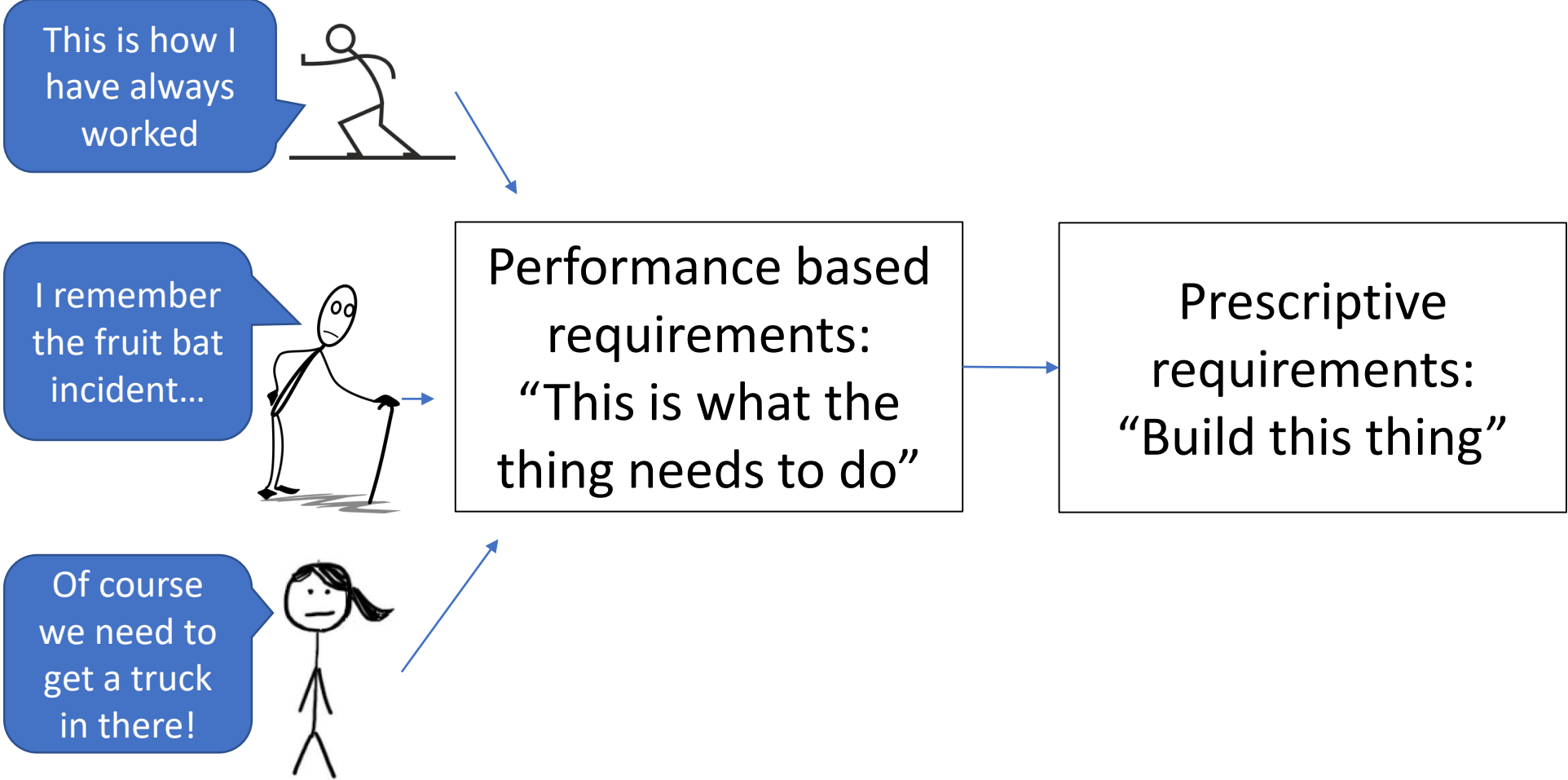
Behaviours

Requirements

# Requirements capture

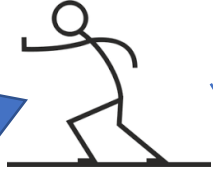


# Requirements capture



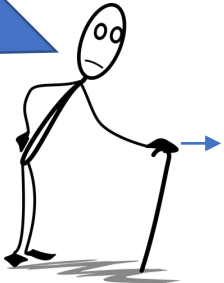
# Requirements capture

This is how I have always worked

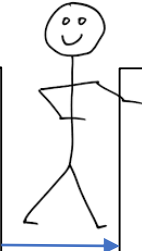


The systems engineer capturing the requirements is not necessarily an expert practitioner

I remember the fruit bat incident...



Performance based requirements:  
“This is what the thing needs to do”



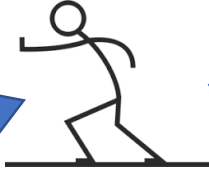
Prescriptive requirements:  
“Build this thing”

Of course we need to get a truck in there!



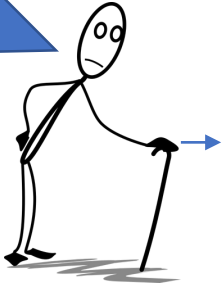
# Requirements capture

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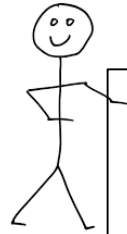


The systems engineer capturing the requirements is not necessarily an expert practitioner

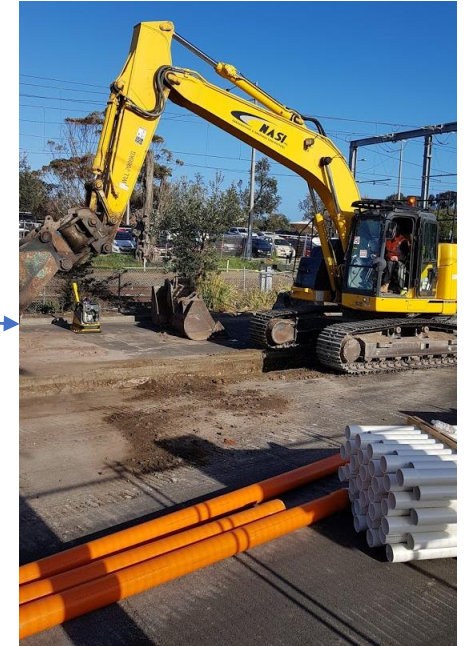
I remember the fruit bat incident...



Performance based requirements:  
“This is what the thing needs to do”



Prescriptive requirements:  
“Build this thing”



Of course we need to get a truck in there!



This is not a good time to question the prescriptive requirements!

# Problematic requirements

## **Potentially problematic requirements:**

- No rationale: nobody knows why the thing exists or why it is done a certain way
- Tacit: automatic, nobody needs to define it
- Part of the normal/daily practices: never scrutinised for improvement
- Lost or twisted: layers of interpretation
- Context-specific, and the limits of application are not known or not defined

## **Look for:**

- Contradictions: e.g. both mandatory and forbidden at the same time
- Underground practice: differs from what is written down
- Vastly different to other railways: doing or building “weird” things
- Relic habits: these don’t map to requirements and don’t shift easily

# Problematic requirements exist for CSRs



- Contradictions: forbidden by one discipline, required by another
- Building “weird” things (against external norms)
- Relic practices and habits that nobody has shifted – not for lack of trying

Key point #2:

Focus interrogation on the  
problematic requirements:

Contradictions

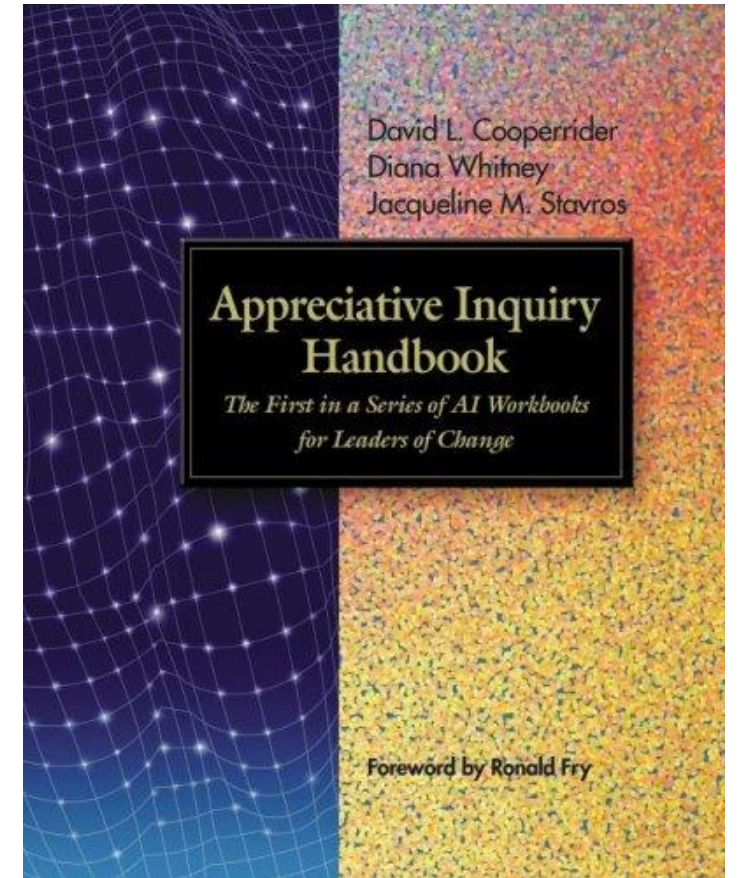
Underground practice

Building “weird” things

# Map the problem space collaboratively

## Appreciative Enquiry (Cooperrider et al, 2008)

- Investigation into the “best of what is” – believing that in general, people want to “do their job right”
- Imagining better ways of working in the future
- Planning and prioritising changes according to common or mutually agreed priority frameworks
- Deploying those changes – potentially requiring concurrent changes across multiple stakeholders



# Tips to map the problem space collaboratively

- Talk to a key person from all stakeholder organisations
- Do not avoid hostile stakeholders – they may have a different and useful perspective or may feel under attack
- Mixture of 1:1 and workshops
- Move into the “What if” space...
  - “If we imagine 10 years from now and this problem is gone – what would be new, changed, more effective?  
How did we get there?”
- Cross check “facts” against hard data – wherever you can source the data!



# Mapping the CSR problem... collaboratively?

“Clearly overbuild”

“Ludicrous spares”

“Ridiculous land requirements”

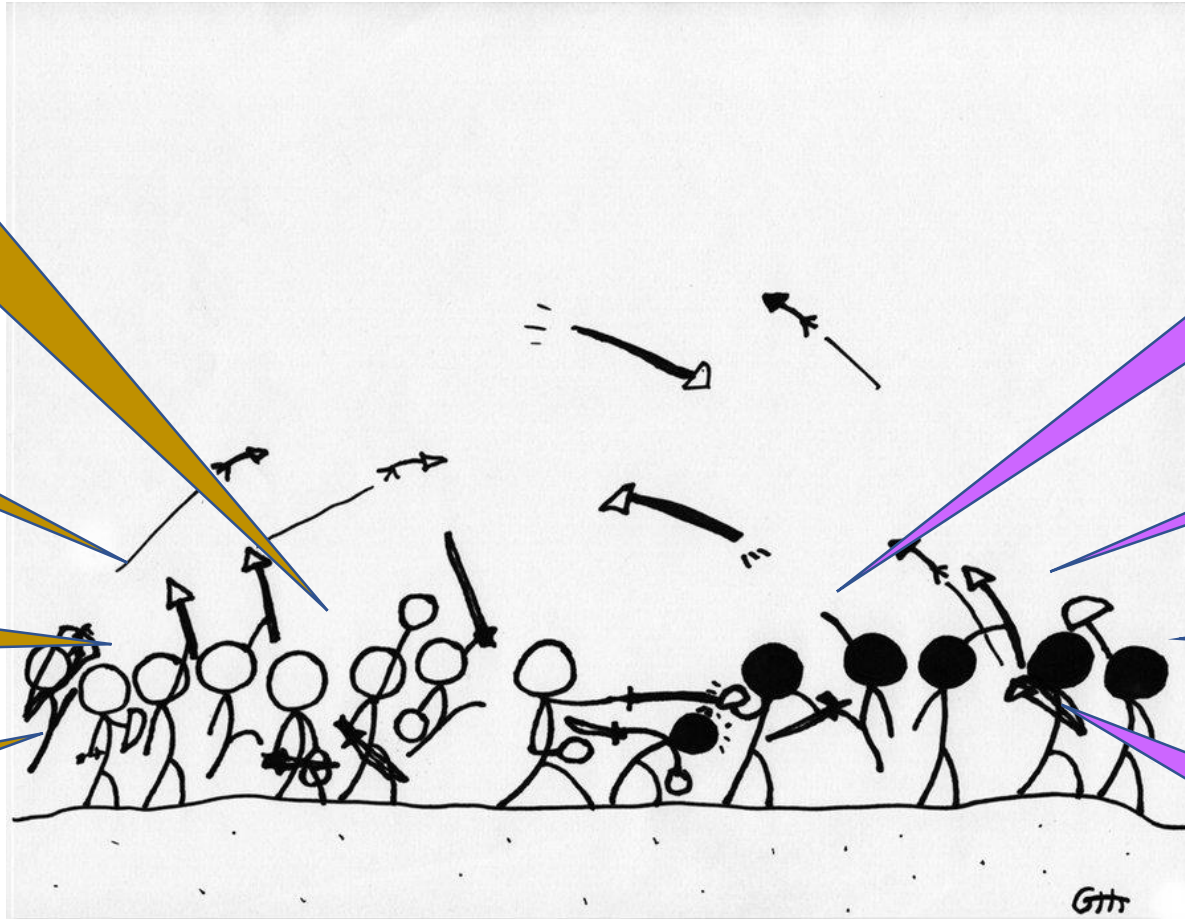
“Compromises urban outcomes”

“Project guys are cowboys”

“This puts critical systems at risk”

“A cheap and nasty asset”

“Rushing through reviews too fast”

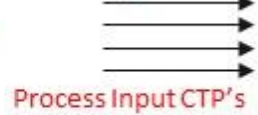


# SIPOC: Combined Service Route (CSR)

Suppliers



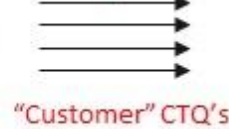
Inputs



Process Functions



Outputs



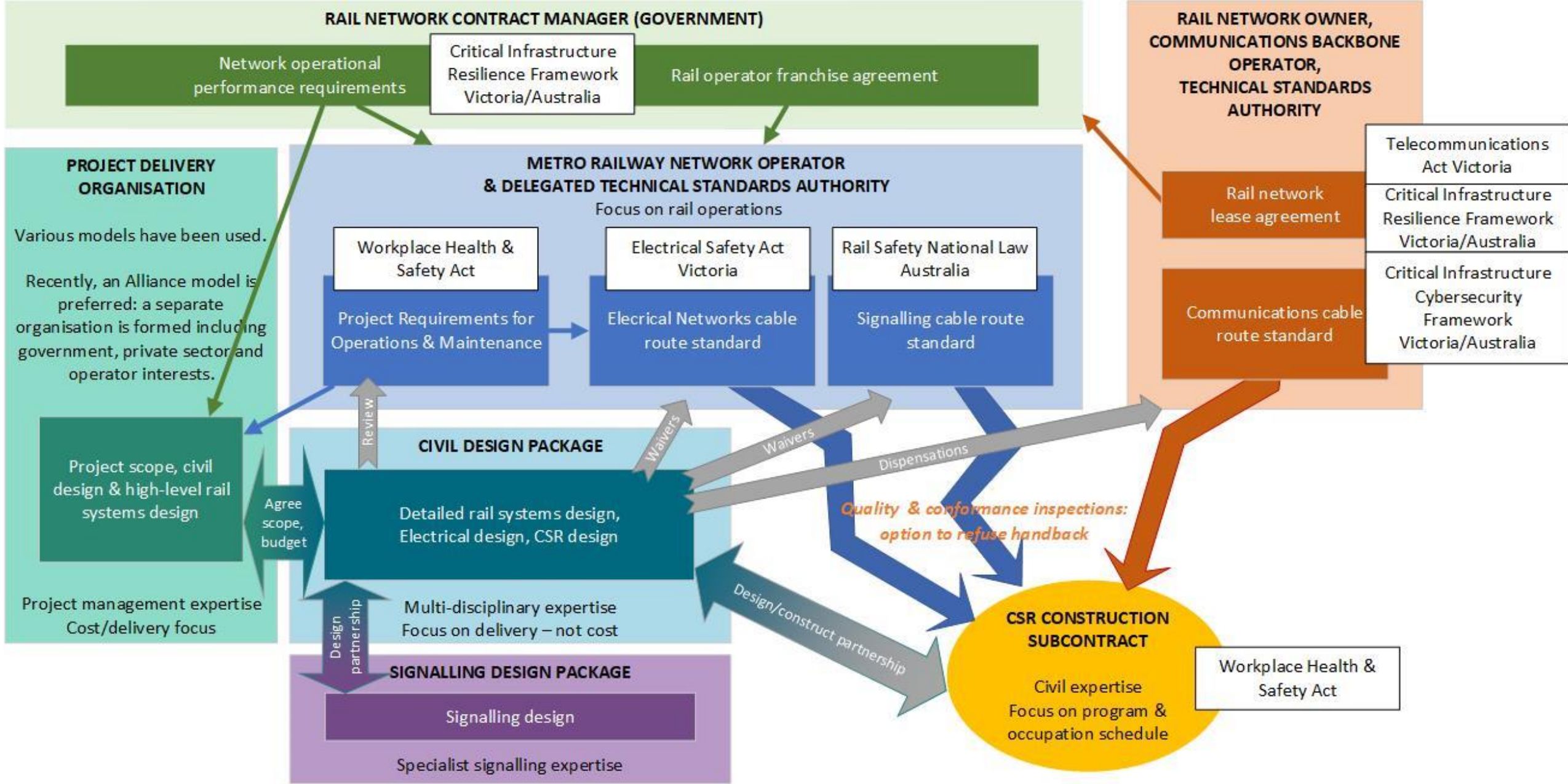
Customers



Suppliers	Inputs	Process	Outputs	Customers
<ul style="list-style-type: none"> <li>• Sig/Pwr/Comms concept designers ●</li> <li>• PTV/TfV/VicTrack (network strategies)</li> <li>• CSR Designers/Civil Construction Team</li> <li>• Rail System Design, Project Scheduler</li> <li>• MTM Type Approvals</li> <li>• CSR Designer, MTM/LXRA Reviewers ●●</li> <li>• CSR sub-contractor ●</li> <li>• Cabling sub-contractor,</li> <li>• Wiring teams, Signalling T&amp;C Team, Electrical</li> <li>• Project</li> </ul>	<ul style="list-style-type: none"> <li>• Signalling, Comms requirements &amp; architectures ●</li> <li>• Power single line diagram</li> <li>• Electrolysis/earthing plan</li> <li>• Survey existing assets</li> <li>• Site survey constraints: GeoTech, Drainage</li> <li>• Agreed life of asset ●</li> <li>• Type approved options ●</li> <li>• Construction schedule &amp; staging ●●</li> <li>• Design decisions to-date ●●●●</li> <li>• Service Proofing, Permits (Dig/Underground)</li> <li>• Proving route, roping, mandril conduit</li> <li>• Cables, pulling equipment, electrical qualification</li> <li>• Comms, Signalling drawings</li> <li>• Test &amp; Commissioning Plan</li> <li>• Asset &amp; Records</li> </ul>	<ul style="list-style-type: none"> <li>Identify system architectures ●●●●●●●●</li> <li>Provide CSR alignment ●●</li> <li>Specify CSR type</li> <li>Detailed design ●●●●●●●●</li> <li>Construct</li> <li>Handover to run cables ●●●●</li> <li>Run cables</li> <li>Connect, test &amp; commission systems</li> <li>Handover systems</li> </ul>	<ul style="list-style-type: none"> <li>• CSR Specification ●●</li> <li>• Construction Drawings</li> <li>• Construction estimates</li> <li>• Procurement, Installation Drawings,</li> <li>• DMS compliant Drawings</li> <li>• Integration points</li> <li>• CSR Structure, Connection Points, local routes</li> <li>• Routes proved</li> <li>• Cables ready to connect</li> <li>• Connect cables to target equipment, test links.</li> <li>• Test evidence</li> <li>• Handover &amp; Acceptance</li> </ul>	<ul style="list-style-type: none"> <li>• CSR Design team/ Project/ Commercial</li> <li>• CSR sub-contractor</li> <li>• CSR subcontractor, Procurement Mng</li> <li>• MTM, DMS</li> <li>• Other design teams</li> <li>• Project, MTM, VicTrack</li> <li>• Project</li> <li>• Project</li> <li>• VicTrack &amp; MTM Operations</li> </ul>

This is the map we used to achieve stakeholder agreement on the high level process and established consensus on the biggest issues

CTP = Critical to Process CTQ = Critical to Quality



This map shows an adaptive system which is trying to achieve all requirements with minimum delivery risk.

Key point #3:

Map the problem collaboratively:

Draw some kind of map.

Two or three maps if needed.

# Asking good questions (from journalism)

- **Prepare carefully**
  - Know as much background as possible.
- **Establish a relationship with the interviewee conducive to obtaining information**
  - Make the time/place convenient for them
  - Be nice
  - Buy cake and coffee
- **Empathise**
- **Ask questions that are relevant to them**
  - Use their language
  - Start in their field of expertise
  - Ask about their experience with the problem
- **Learn to use different question types**
  - Open/ closed question
  - Probing/ clarifying questions
- **Listen and watch attentively**
  - Write down what they say, even if you disagree
  - Don't contradict or override
  - Notice what causes a strong reaction

### Accessibility & Maintainability

Services accessible during train running?  
Inspection access incl. through public areas?  
Maintenance line of sight to relevant equipment?  
Vehicle access to facilitate maintenance activities?

### Alignment

Efficiency of alignment: Direct cable run, or multiple turns?  
Number of URXs and ULXs?  
Minimum length local cables?  
Impact of cable turns on other assets? e.g. embankments

### Cable failure & repair

Maintenance plan: how will cables be replaced?  
Cable loops/slack for future re-termination?  
Temporary cable run option?  
Do inaccessible services have redundancy?

### Security & cable protection

Public access minimised?  
Vandal/theft opportunity minimised?  
UV protection?  
Vermin/wildlife resilience?

### Rail systems standards compliance

Diversity? EM separation?  
Trunk routes: VicTrack, High Voltage?  
Separation of maintenance access?  
Electrical safety & construction safety

### Station layout & urban aesthetic

Compromises to urban design or landscape?  
Achieve preferred location of SER, PER, CER?  
Impact on community amenity, e.g. pits in public access areas, visual clutter from obvious services transitions?

### Constructability

Project staging: CSR implications?  
Construction risk and network operations risk during construction?  
Impact on occupation time?  
Expected productivity rates?

### Environmental & sustainability:

Material & spoil disposal?  
Drainage & waterways, e.g. impact on water table, floodplain, acid sulphur soil etc.  
Flora/fauna impact incl. protected sites, environmental zones, removal of vegetation?

### Services Riser:

Transitions of cables from grade to a viaduct/cutting?  
Number of services, number of transition points?  
Design solution for services risers, ramps, at stations?  
Minimum cable bends?  
Cable Installation, inspection & replacement on riser?

### Whole of life considerations:

Whole of life cost effectiveness for its planned lifetime?  
Provision for upgrades during cable route lifetime?  
Provision for spares for planned future projects?  
Compromises or obstructions to future projects?

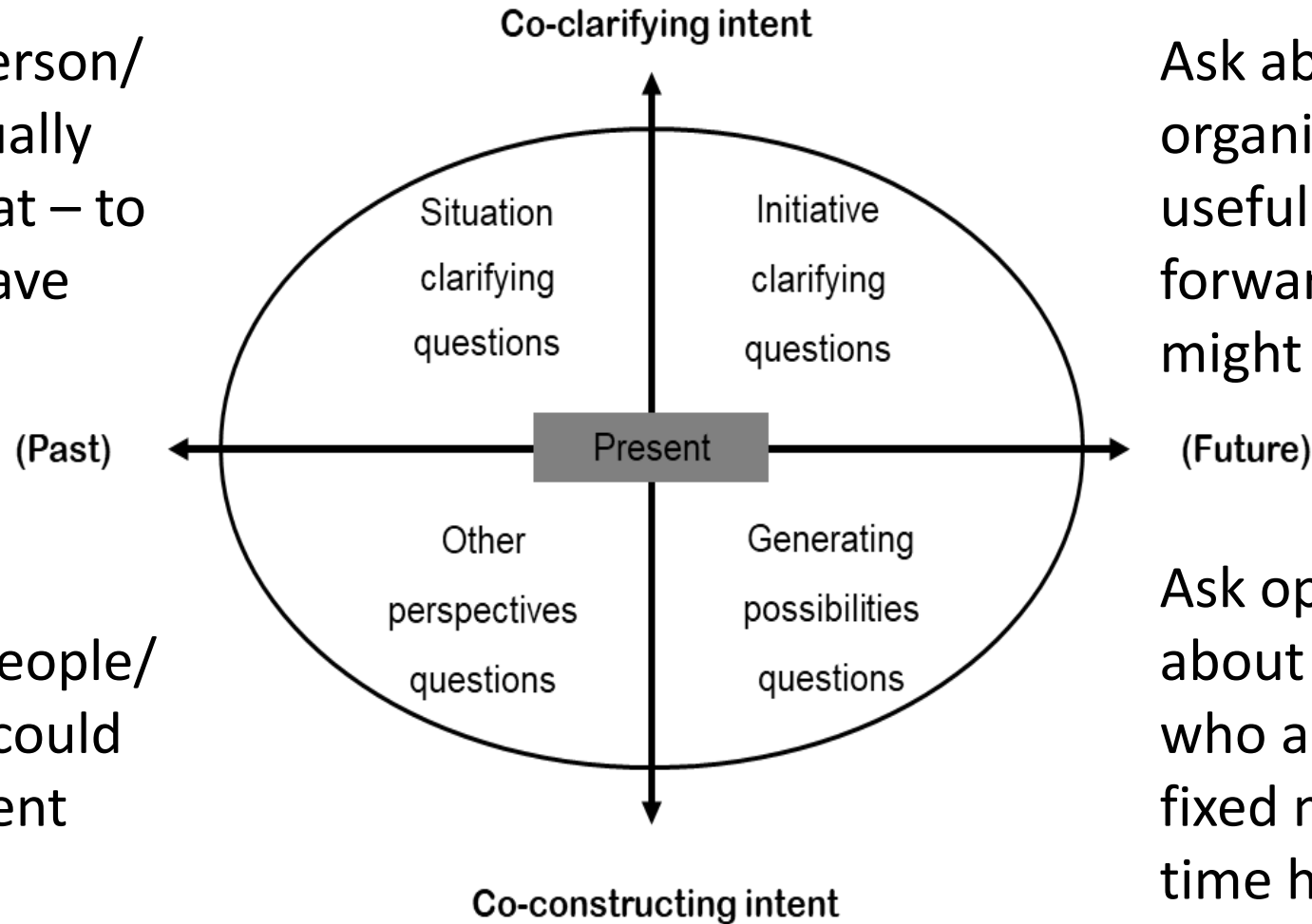
Key point #4:

Good questions can enable a re-telling of the story, to get the stakeholders on the same page

# Coordinating change across organisations using interventive interviewing

Ask about which person/organisation is actually responsible for what – to those that might have responsibility

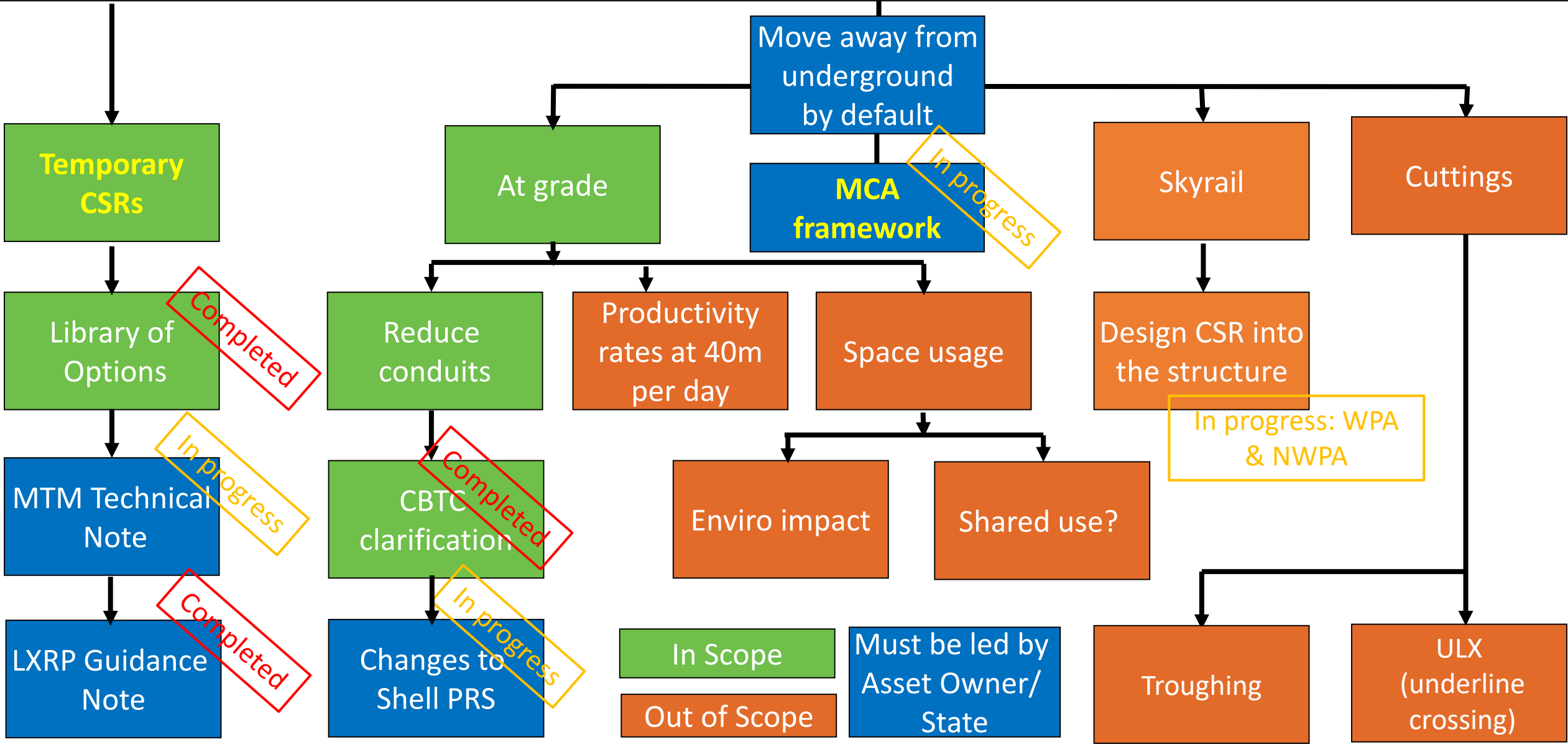
Ask about other perspectives – to people/organisations that could benefit from different perspectives



Ask about which people/organisations can most usefully build the way forward – to those that might be the innovators

Ask open ended questions about the future – to those who are struggling against fixed mindsets and short time horizons

Agreed problem statement: CSRs are extremely expensive compared to other alternatives.  
CSRs are underground by default, and a trench cannot be dug twice.



## Key point #5:

Asking really good questions  
(interventive interviewing) keeps the  
stakeholders on the same page.

This can then brings problematic requirements  
back to straightforward capture

# In conclusion:

- #1: Organisational identity is important for perceptions, decisions, behaviours and requirements
- #2: Focus interrogation on the problematic requirements
- #3: Map the problem – draw a map (or two, or three)
- #4: Good questions can enable re-telling of the story and align stakeholders
- #5: Interventive interviewing can be used to keep the stakeholders on the same page, and coordinate change.



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LinkedIn: Alexandra McGrath

Art: Jan Senbergs "Melbourne 1998-1999"  
State Library of Victoria collection