Risk Management in Construction

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Agenda

Focus on application of risk management to the pre-contracts part of our business, i.e. tendering

- Introduction
- Some data
- The problem
- One business line - Tunnelling
- The approach
- Wrap and Questions

John Holland Group

A subsidiary of CCCI.

One of Australia's leading engineering, contracting and services providers to the infrastructure, energy and resources and transport sectors.

Revenue approx. $3 - 4B/yr.

Typically we deliver, complex and challenging projects.

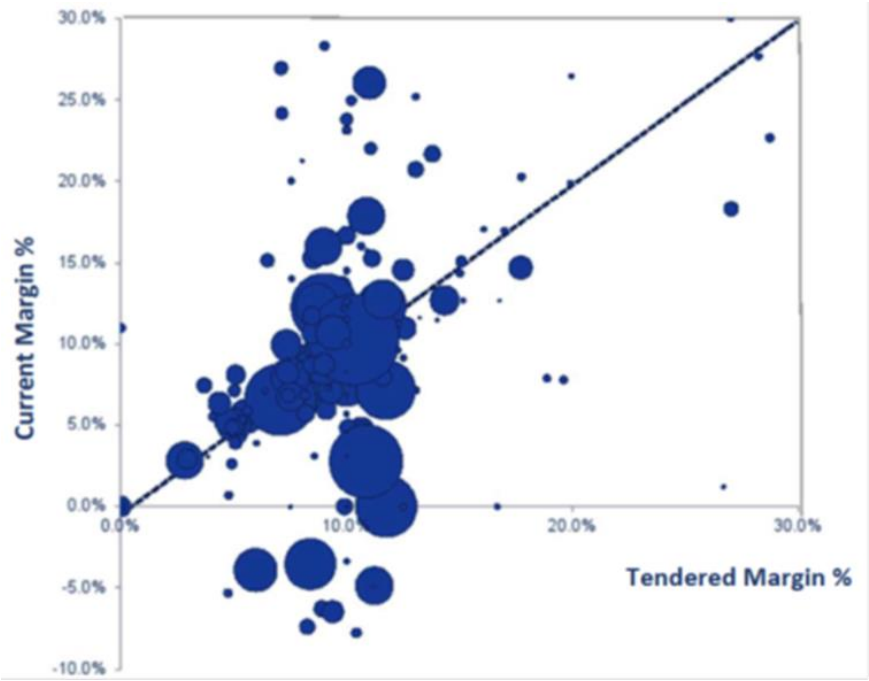
- EastLink
- Westgate Bridge Strengthening
- Regional Rail Link Southern Cross to Footscray
- 20% share of MTM
- Melbourne Metro Early Works
- Currently preferred for Westgate Tunnel and tenders submitted for Melbourne Metro PPP and RSA

The Corporate Risk Management function provides oversight of all business risks. 5 distinct functions:

1. **Pre-Contracts**
2. Enterprise Risk Management
3. Business Continuity and Crisis Management
4. Independent Project Reviews
5. Insurance

Some data – Reality!

Tendered vs Actual margin



Large project Actual performance

Project	Value	Margin	%
#1	$2,600m	$154m	5.9%
#2	$5,000m	$-751m	-15.0%
#3	$2,100m	$56m	2.7%
#4	$1,200m	$134m	11.2%
#5	$2,900m	$-400m	-13.8%
#6	$700m	$-50m	-7.1%
#7	$1,700m	$204m	12.0%
#8	$1,800m	$123m	6.8%
TOTAL	**$18,000m**	**$-530m**	-2.9%

ISO 31000 definition of risk – “the effect of uncertainty on objectives…”

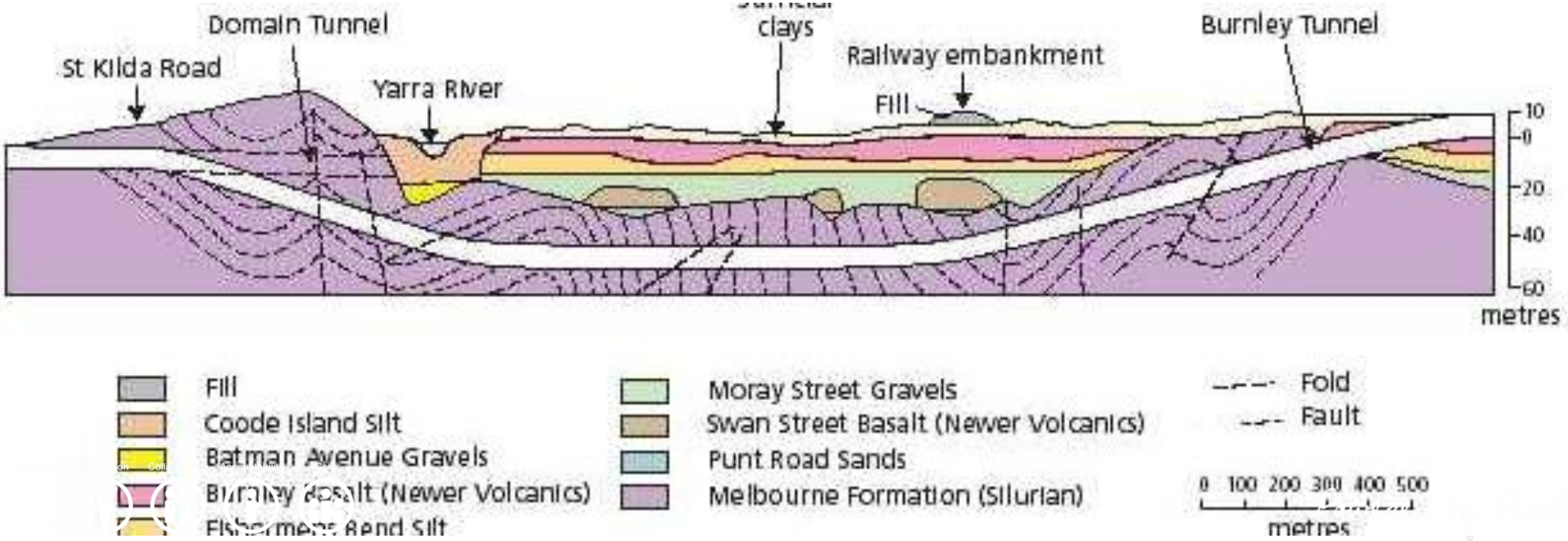
The data show uncertainty, and more downside than upside

The problem

How do we bid/tender big tunnel projects?

- holds for any type of project we bid….

- Mitigate risk?
- Still be competitive in market place



Lane Cove Tunnel - 2005

Background

- Collapse occurred during breakout for a ventilation tunnel from the running tunnel
- A 10m by 10m, 25m deep crater formed

The failure

- Possible “rock slippage”
- Ground investigation did not identify dyke
- Under designed rock bolts

Consequences

- Building partially collapsed and 47 residents evacuated
- Water main burst
- Citybound road closed

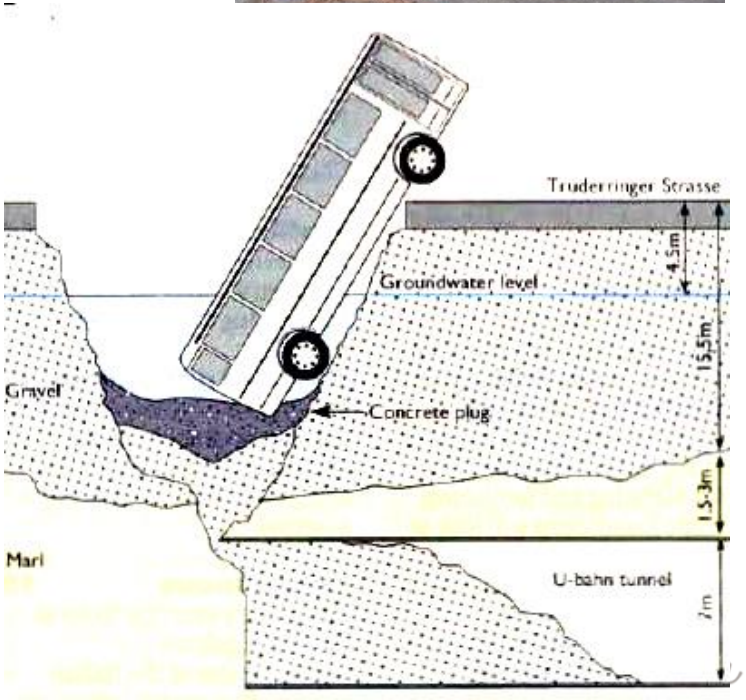
Munich Underground - 1994

Background

- 7m diameter tunnel
- Assumed to be beneath a clay layer with overlying water-bearing gravel i.e. no groundwater drawdown

The failure

- Rapid inflow of water and ground materials
- Large subsidence crater quickly filled with groundwater
- 20m wide, 18.5m deep



Consequences

- Bus fell into the crater
- Three passengers killed
- 30 people injured

“America's Biggest Tunnel-Boring Machine Is Stuck Beneath Seattle” - current

Background

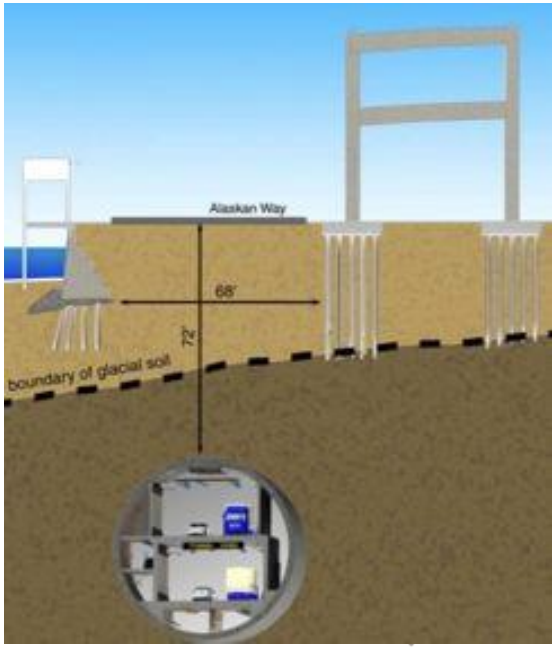
- Replace viaduct freeway in downtown Seattle
- 10m/day, 3 km total

The failure

- Dec 3, 2013 (300 m in) hit a 200mm steel pipe (‘investigation’ well casing)
- Bearing fail – overheat, seal broken, grease mixed with sand, destroyed bearing

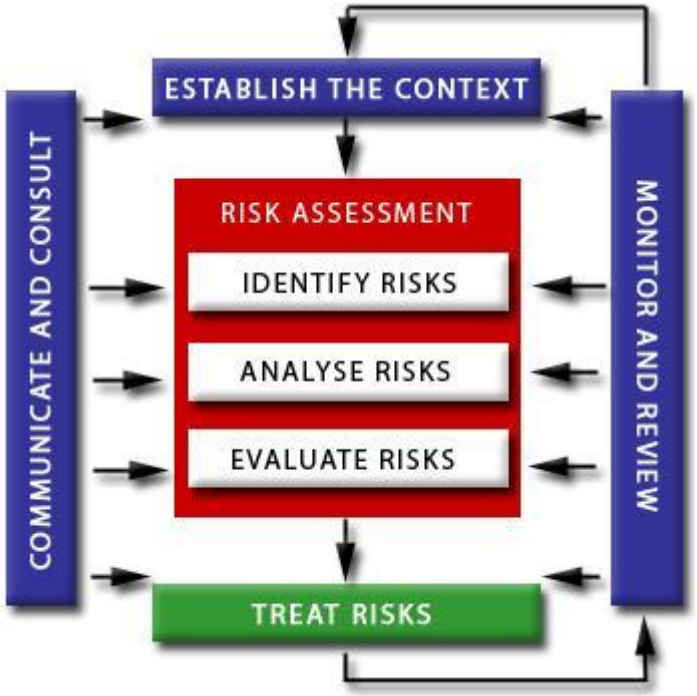
Consequences

- Bearing worth $5M
- Can replace from behind, but, need hyperbaric divers due to no air circ.
- Easier from above. 37m deep repair access vault, 8m in diameter
- Approx. 12+ months lost
- Cost $150million; court case underway



Approach

ISO 310000



Approach is to follow that mandated by ISO 31000

- Context
- ID
- Analyse
- Evaluate
- Treat
- Monitor, Communicate and Review

Note:

Risk = Threats (risk) & Opportunities

Define the context

Context generally set, however:

Risk to us as a contractor is different to risk to client or society.

Our context will depend on type of contract proposed:

PPP – very clear, we own nearly all risk

Alliance – risk is shared

Managing Contract – Client owns risk

LCT example:

Risk to ***client***:

- Reputation, road network impacts

Risk to ***society***:

- Homeless

Risk to ***constructor***

- Delay, insurance premium cost

Risk Identification

All sorts of formats, at the end of the day it is information gathering

A variation on a theme:

Series of ever more focused R&O workshops and one on one sessions

- As design is developed and methodology is refined

Informed by:

Lessons Learnt;

Past experience

Subject Matter Experts

<u>Multi-disciplinary</u>

Commercial, legal, political

HR/IR

Design, Construction

Stakeholder, Environment, Approvals

Risk Analysis

Qualitative

Risk Register

Rating Matrix

Quantitative

Traditional (Deterministic)

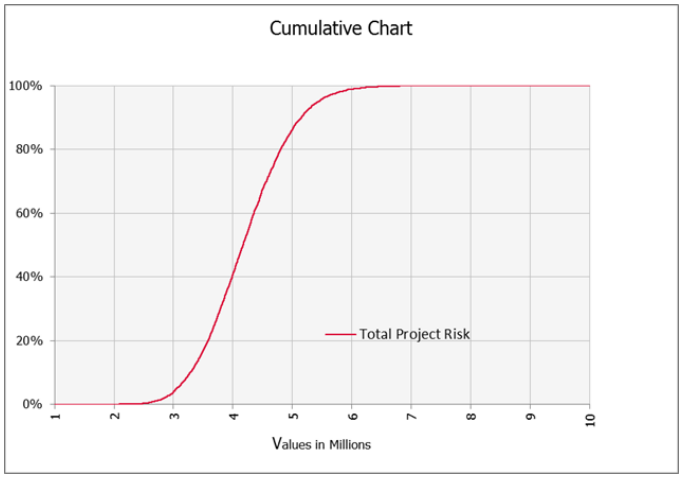
Probabilistic (Monte Carlo)

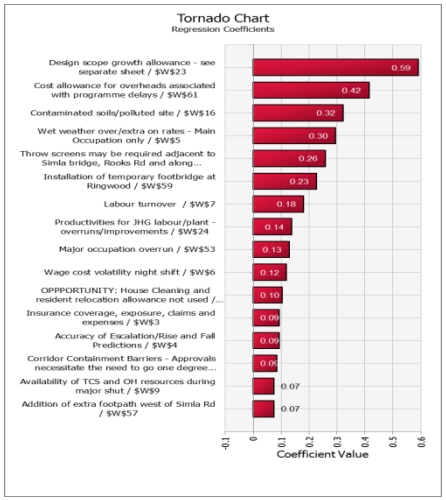
Form: JH-FRM-RCC-002-xx	RISK REGISTER & TRADITIONAL R&O (PROJECT / WORKPLACE)

Tender / Project / Workplace Name: # Date last assessment xx/xx/xxxx
Version #

Example Register

Identification										Qualitative Rating				
										Control Effectiveness (CE)	Select. Conseq Type	Current Rating		
#	Open / Closed	Risk / Opport	Title	Description	Cause(s)	Consequence / Impact(s)	Risk Category	Owner	Business as Usual Controls			Conseq	Like'd	Rating
Commercial							Commercial							
	-	-	Income from expended Client provisional sum allowances				Commercial			-	-	2	Possible	D
	-	-	Carbon pricing impacts - direct or indirect				Commercial			-	-	4	Likely	B
	-	-	Tender documentation ambiguities, errors & conflicts				Commercial			-	-	3	Likely	C
	-	-	Commercial conditions - L.D.'s, time bars etc				Commercial			-	-	1	Unlikely	E
	-	-	Client payment delays				Commercial			-	-	-	-	-





Risk Evaluation – e.g. geotech

Aggregate individual risks and calculate bookends.

Lower Limit

Best case production rates:

- Time / programme gain for each TBM; and
- Direct Job Cost savings.

Upper Limit

12 month recovery period for a TBM that is unable to progress forward due to bearing failure.

Significant mitigation required (e.g. shafts, tunnel from another location).

- O/H costs & LD's
- Impact to following trades

Ground Type	m	Best Case	Worst Case	Priced
		m/day	m/day	m/day
Rock type #1	231	9.5	3.4	7.3
Rock type #2	2,244	14.6	7.3	11.9
Rock interface #1	460	13.5	5.2	11.6
Rock Interface #2	260	8.4	3.6	5.1
Rock interface #3	210	5.6	3.3	3.7
Hard rock	190	13.5	5.6	7.2

Based on penetration rate, ring build duration and utilisation. Sensitivity analysis to define the upper and lower bounds

Benchmarked against multiple prior projects

	Benchmark	Tender	Difference b/c
TBM Utilisation	42.7%	43.3%	Less cutter head wear with slurry compared to EPB's
Ring Build	51min	49 min	Double headed erector for tender
Penetration in Closed Mode	13 mm/min	9-11.5 mm/min	Harder & Variable Geology
Average Advance	63 m/wk (9m/day)	59 m/wk (8.4m/day)	

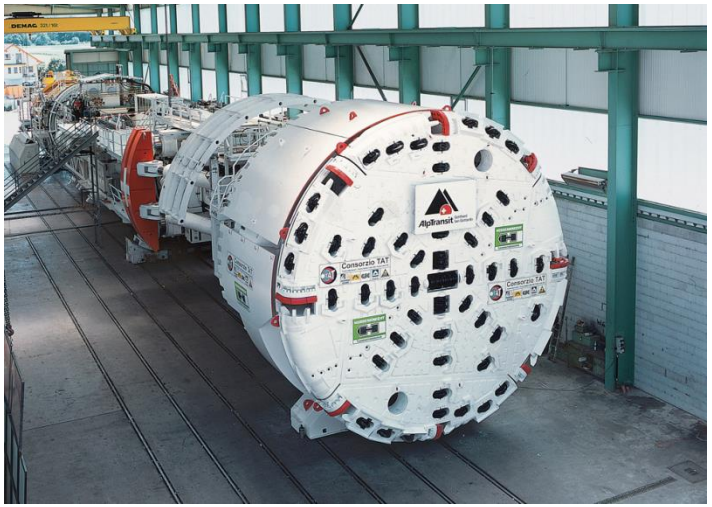
Risk Treatment

Mitigation measures – e.g. type of machine

Price into base estimate - methodology

Unacceptable?

- **Different methodology (e.g. machine selection)**
- **Transfer risk**
- **Manage contractually – i.e. qualify**



Monitor and Review / Communicate

Hand over to delivery team

Revisit material:

Residual financial R&O becomes part of cost code and budgets

All other R&O becomes part of operational risk management cycle

Melbourne Metro Delivery

Works Package	Procurement Model
Early Works Utility service relocations, tram infrastructure works, construction power, and works to prepare construction sites	Combination of managing contractor, Yarra Trams led and State led
Tunnel and Stations Main tunnelling works, five underground stations, station fit-out, mechanical and electrical systems, specific operation and maintenance services for the infrastructure delivered by the package and commercial opportunities at the new stations	Availability based Public Private Partnership
Rail Infrastructure Works at the eastern and western portals including cut and cover tunnelling, decline structures and local reconfiguration and realignment of existing lines	Competitive alliance
Rail Systems Rail systems design (including conventional signalling, HCS, train and power control systems and ICT), installation works, rail systems integration and commissioning	Competitive alliance
Wider Network Enhancements Proposed to include works which are required across the wider network including track modifications, station upgrades and signalling system upgrades	Case by case

Wrap and Questions