



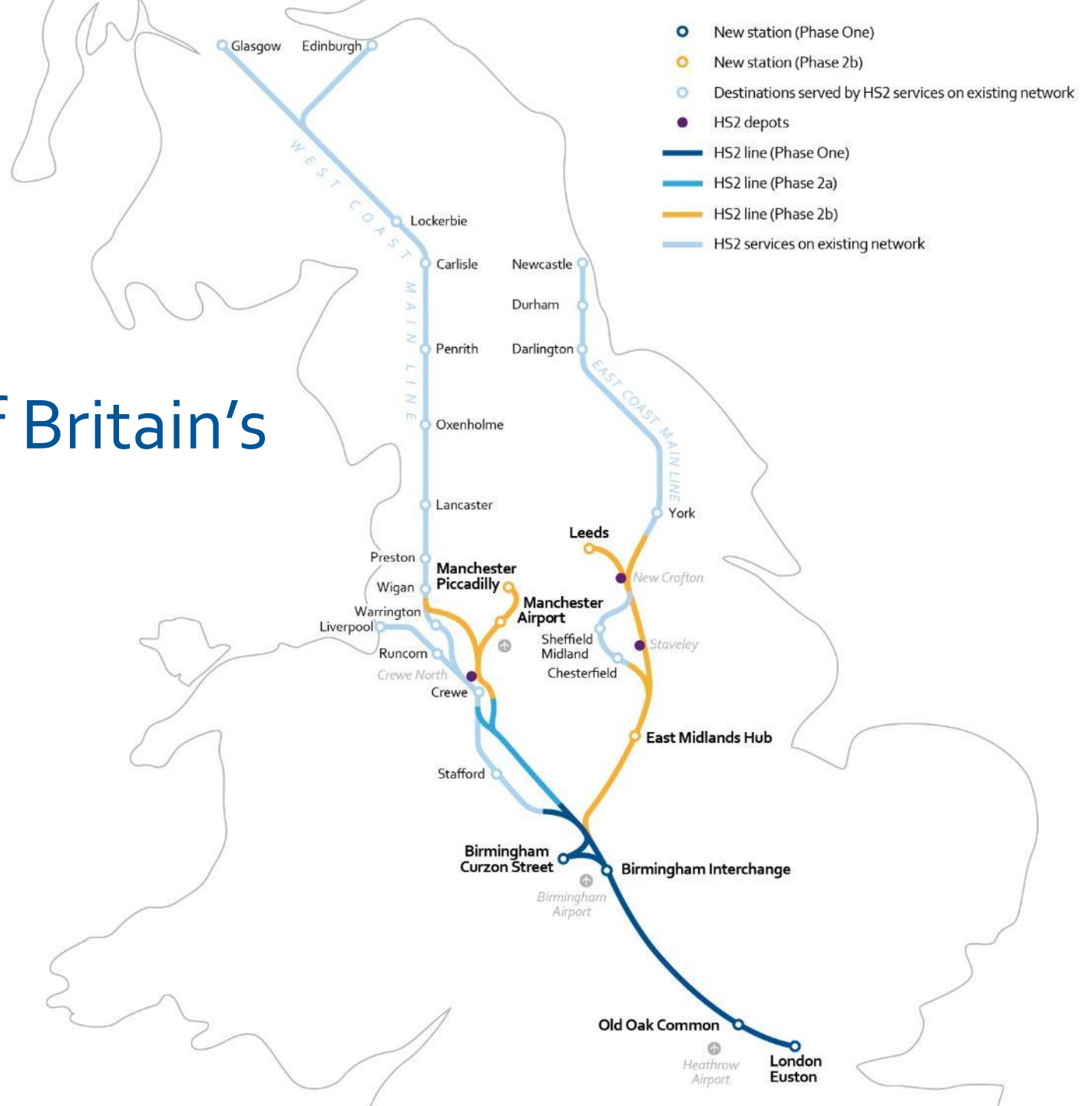
# HS2 – Britain's new high speed railway

## Management of Risk

Jeremy Harrison, Director Risk & Assurance, HS2 Ltd  
25 January 2018



# HS2: the new backbone of Britain's rail network





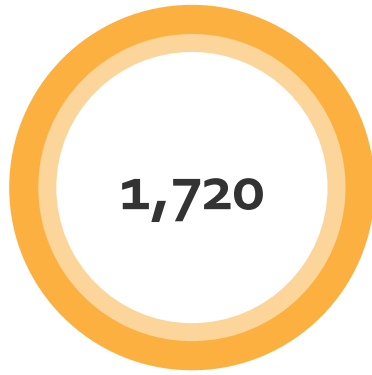


HS2 vision:  
To be a catalyst for growth  
across Britain



# More than double the seats

**2017**



evening rush hour  
total seated capacity

**2033 with  
HS2**



**London Euston**

**Manchester Piccadilly**  
(Crewe/Stoke Corridor)

**Leeds**  
(Doncaster Corridor)

# Fast, frequent and reliable

## LONDON

*selected regular services to/from*

Manchester	HS2	1 hour 7 mins	1 hour saved
	Current fastest	2 hrs 07 mins	
Liverpool	HS2	1 hour 34 mins	40 mins saved
	Current fastest	2 hrs 14 mins	
Leeds	HS2	1 hour 21 mins	50 mins saved
	Current fastest	2 hrs 11 mins	

## BIRMINGHAM

*selected regular services to/from*

York	HS2	57 mins	55 mins saved
	Current fastest	1 hr 52 mins	
Preston	HS2	50 mins	46 mins saved
	Current fastest	1 hrs 36 mins	
Manchester	HS2	40 mins	48 mins saved
	Current fastest	1 hrs 28 mins	



HS2 opens up **new economic opportunities** for:

Trade & competition



Local & regional markets



New exports



New employment



New investment



# HS2 strategic goals



Catalyst  
for growth



Value for  
money



Customer  
experience



Skills and  
employment



Capacity and  
connectivity



World class  
standards



Sustainable and a  
good neighbour



# HS2 will provide jobs for Britain:

**25,000** during construction

**2,000** new apprentices



**1,200** NCHSR graduates a year

**3,000** jobs to maintain and operate

**100,000s** jobs through regeneration/growth



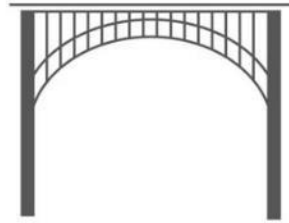
# Building HS2



DESIGN &  
SERVICES



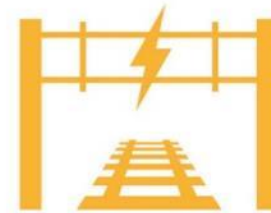
TUNNELS



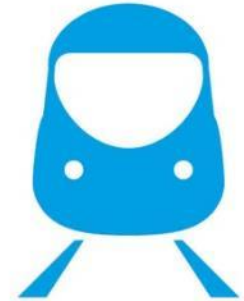
SURFACE  
ROUTE



STATIONS



RAILWAY  
SYSTEMS



ROLLING  
STOCK

# Phase 1 construction statistics





# HS2's timeline



# Risk Management Principles

Principle 1: Risk management applies to all aspects of HS2.

Principle 2: Risks derive from objectives and stakeholders

Principle 3: Risk management is undertaken to reduce risk exposure, increase certainty, improve confidence and generate greater value.

Principle 4: Risk is multidimensional and values both soft issues and hard absolutes.

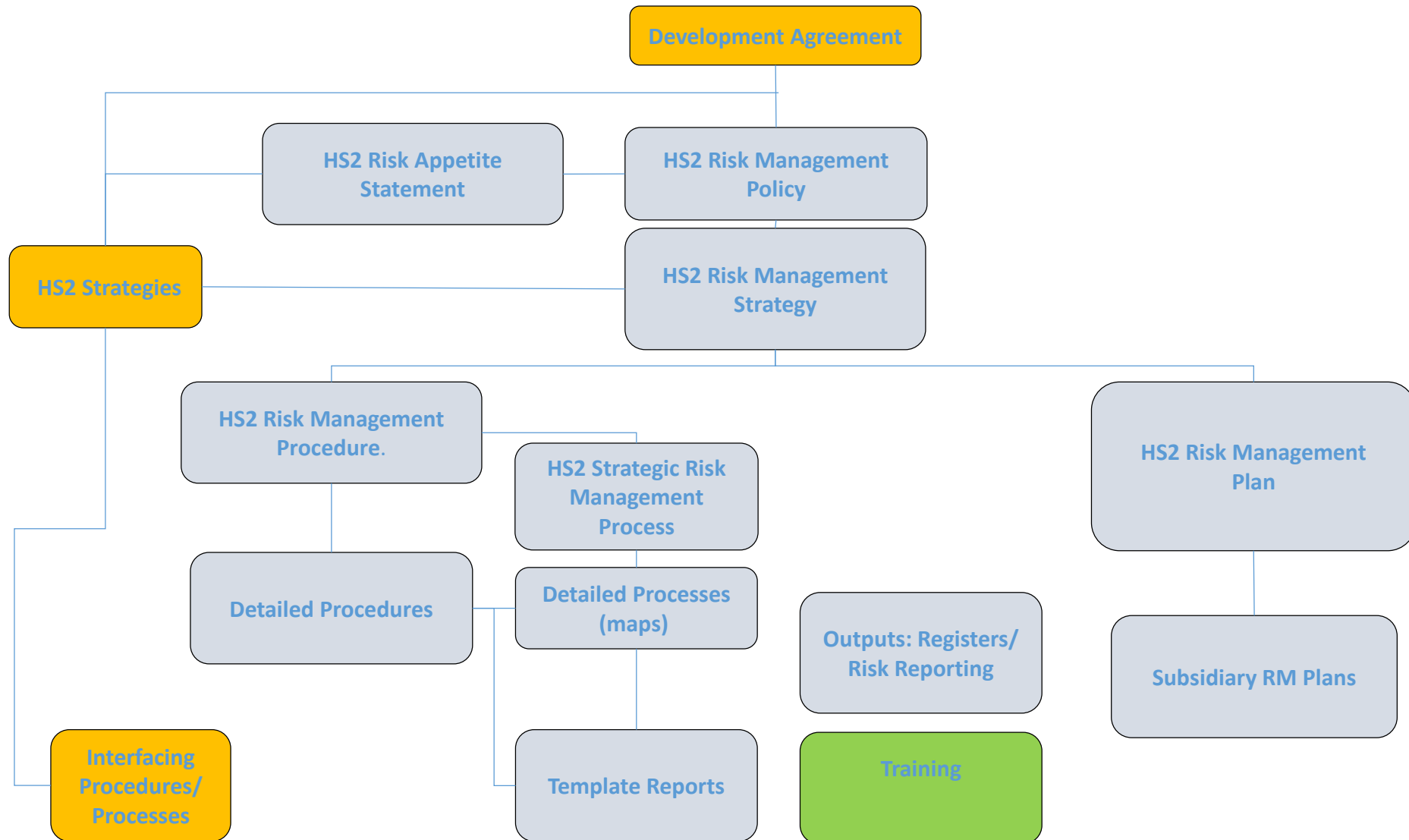
Principle 5: Ensure clear accountability for risk.

Principle 6: Provide the right information to the right people at the right time.

Principle 7: Implement a pragmatic risk management solution.

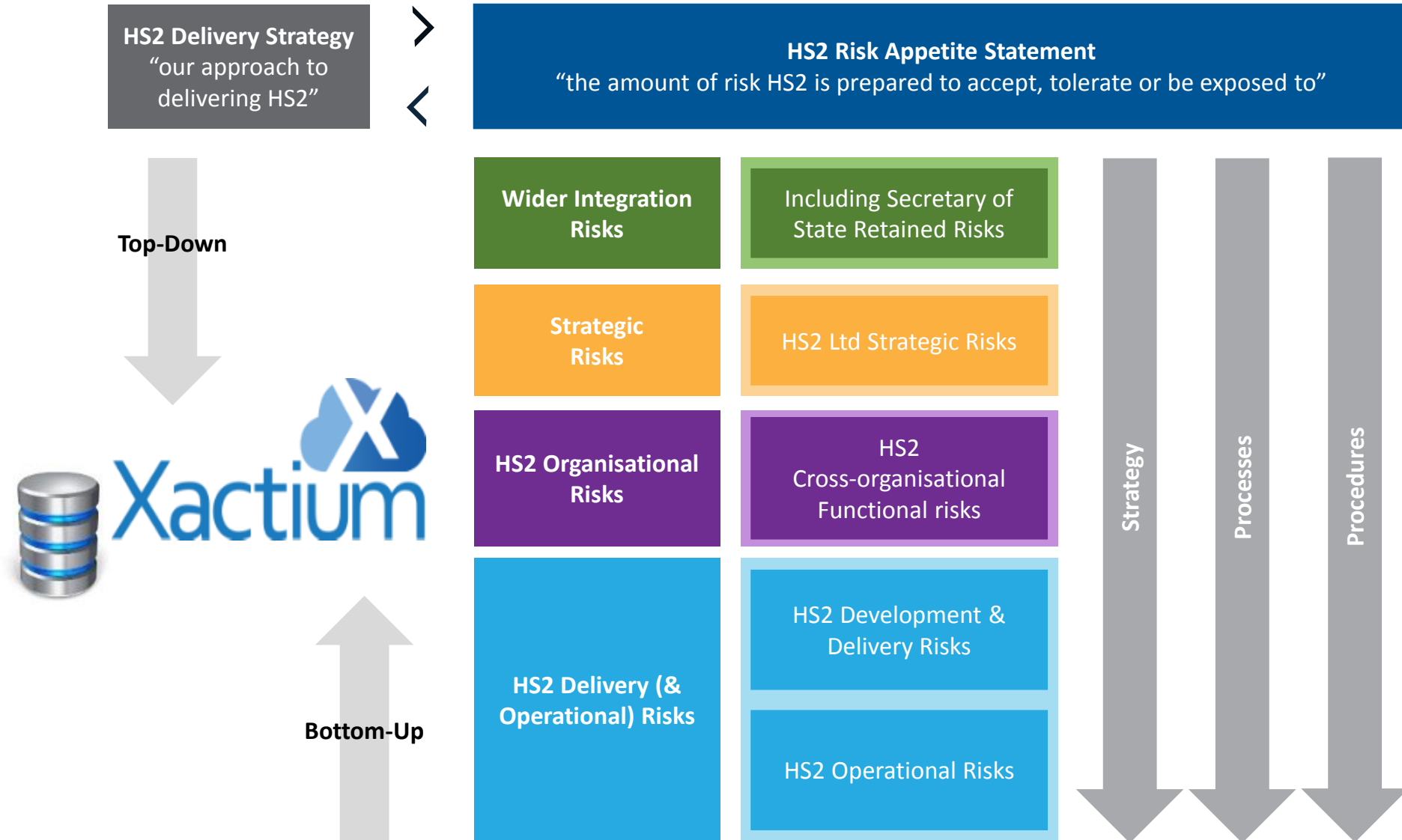
Principle 8: HS2 Ltd risk management is based on continuous improvement.

# Enterprise Risk Management Documentation: Theory into Practice

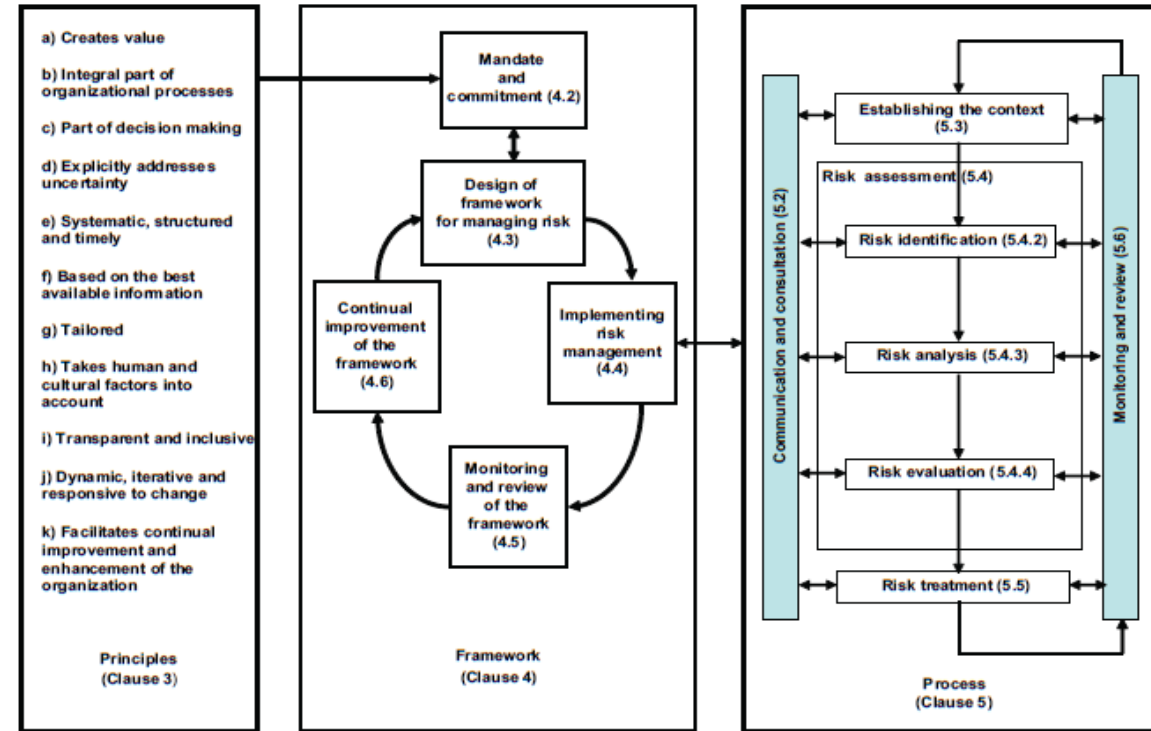
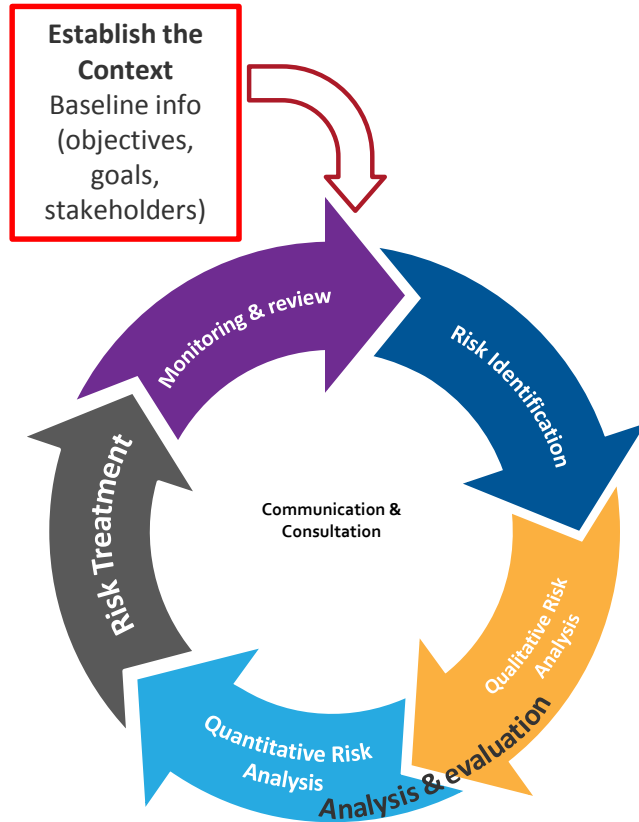




# Enterprise Risk Management Framework

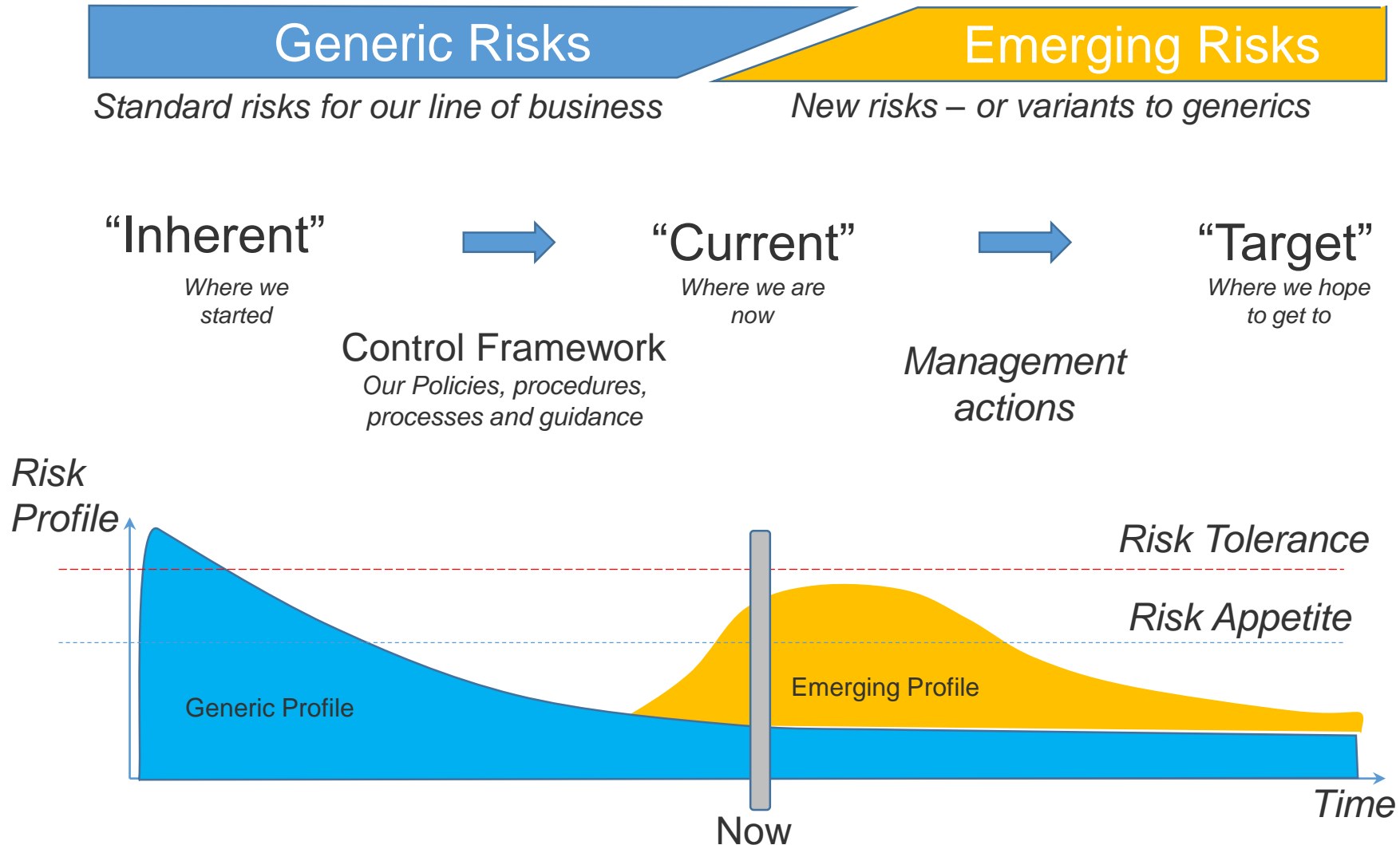


# Risk Process



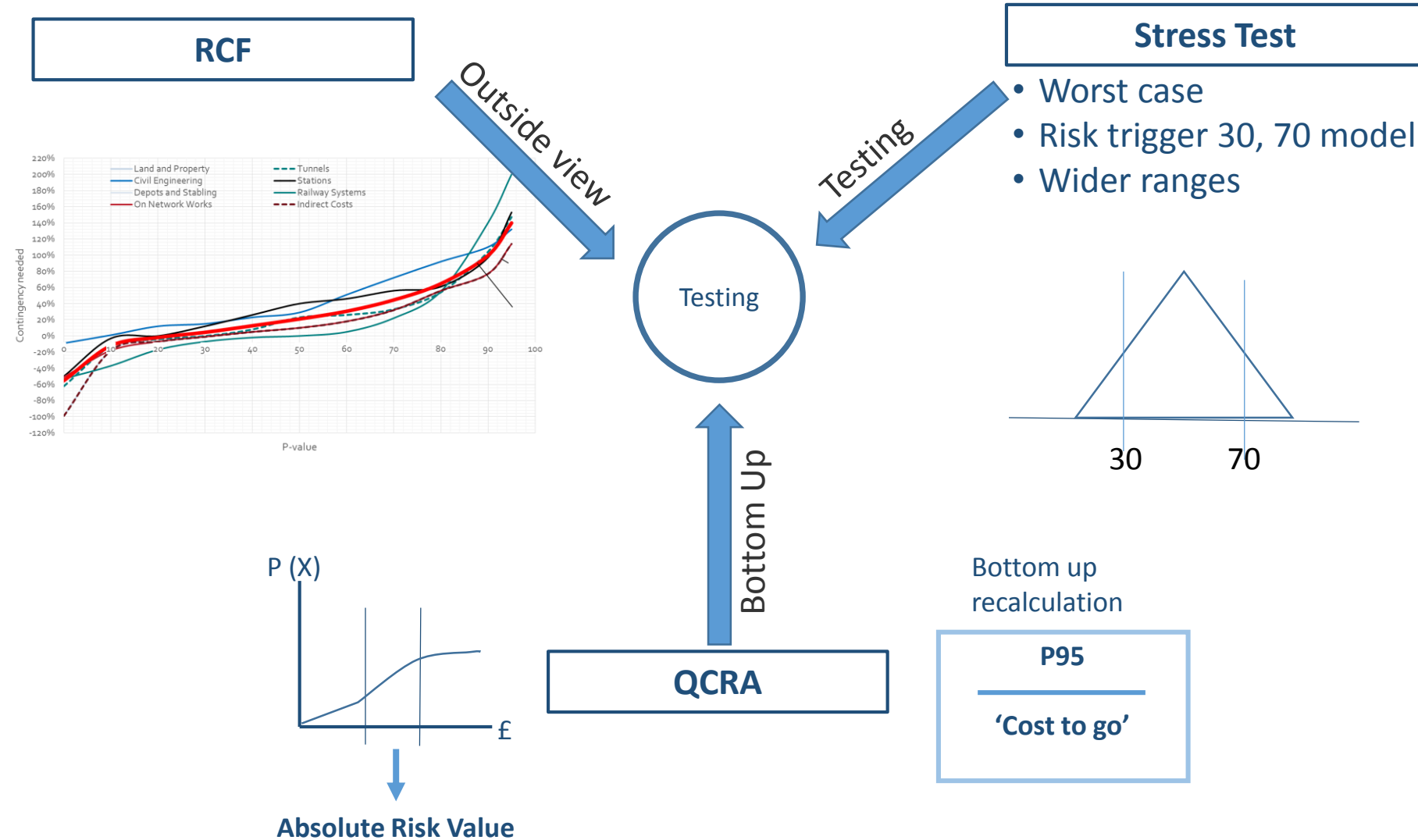
Process and Framework based on ISO31000

# Differentiating between Generic and Emerging Risks and Inherent, Current and Target States





# Creating confidence



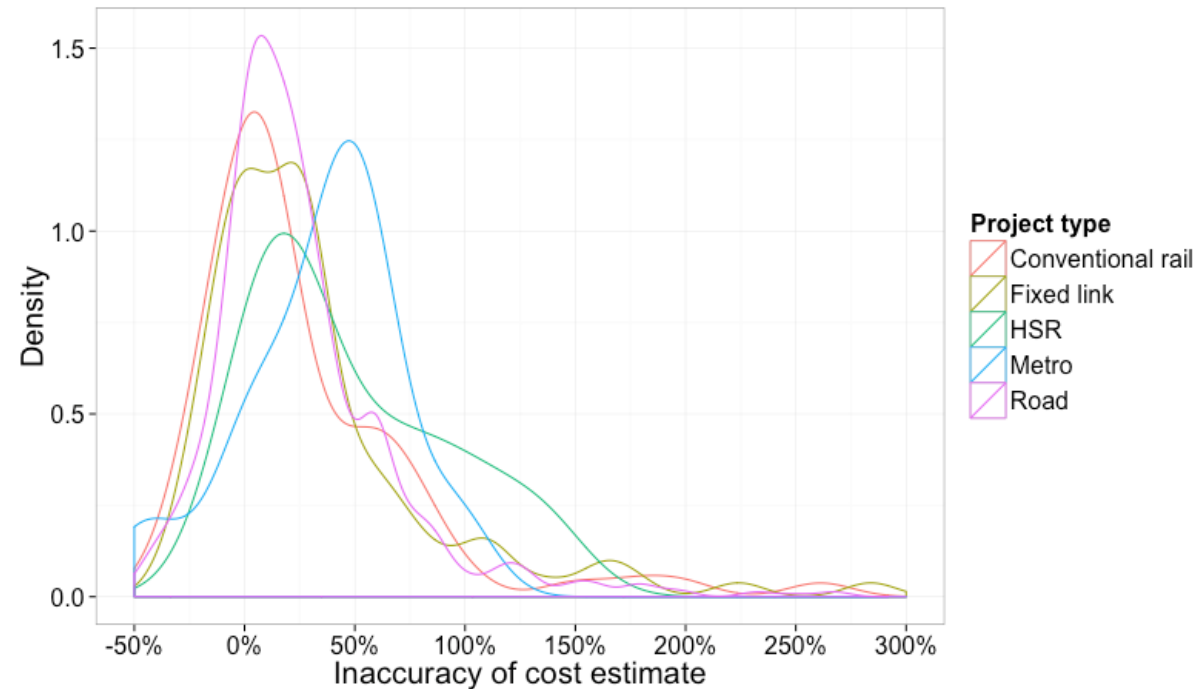
## Reference Class Forecasting – in 3 steps

1. Identify relevant **reference class** of past, similar projects
2. Establish **probability distribution** for the selected reference class
3. Compare specific project with distribution, in order to establish **most likely outcome**

# Building a Reference Class

## Statistical analysis of risk profile

- Risk profile characterised by distribution of cost risk in reference classes
  - Peak = P<sub>50</sub> risk
  - Tail = Risks > P<sub>50</sub>



\* The p-value of statistical tests indicates the strength of the evidence, if  $p < 0.05$  the test is significant – here indicating that there is strong statistical evidence that these project types are different from HSR

Source: Oxford Database, August 2015 (Sample of  $n=361$  projects)



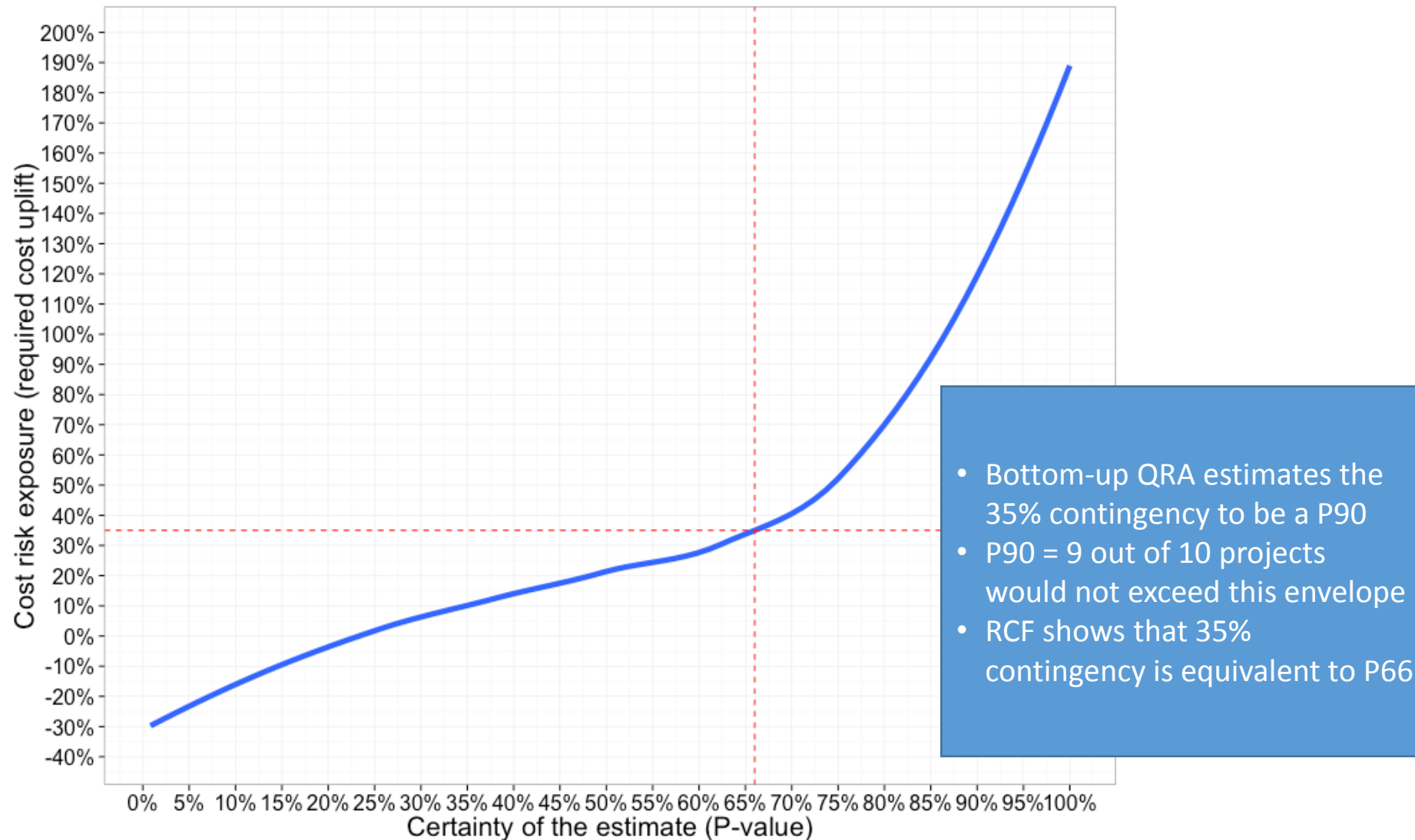
## Building a Reference Class

- Selecting past similar projects, based on **statistical similarity**
- Testing whether average, median (P50), P80, P90, P95 are statistically significantly different from HSR

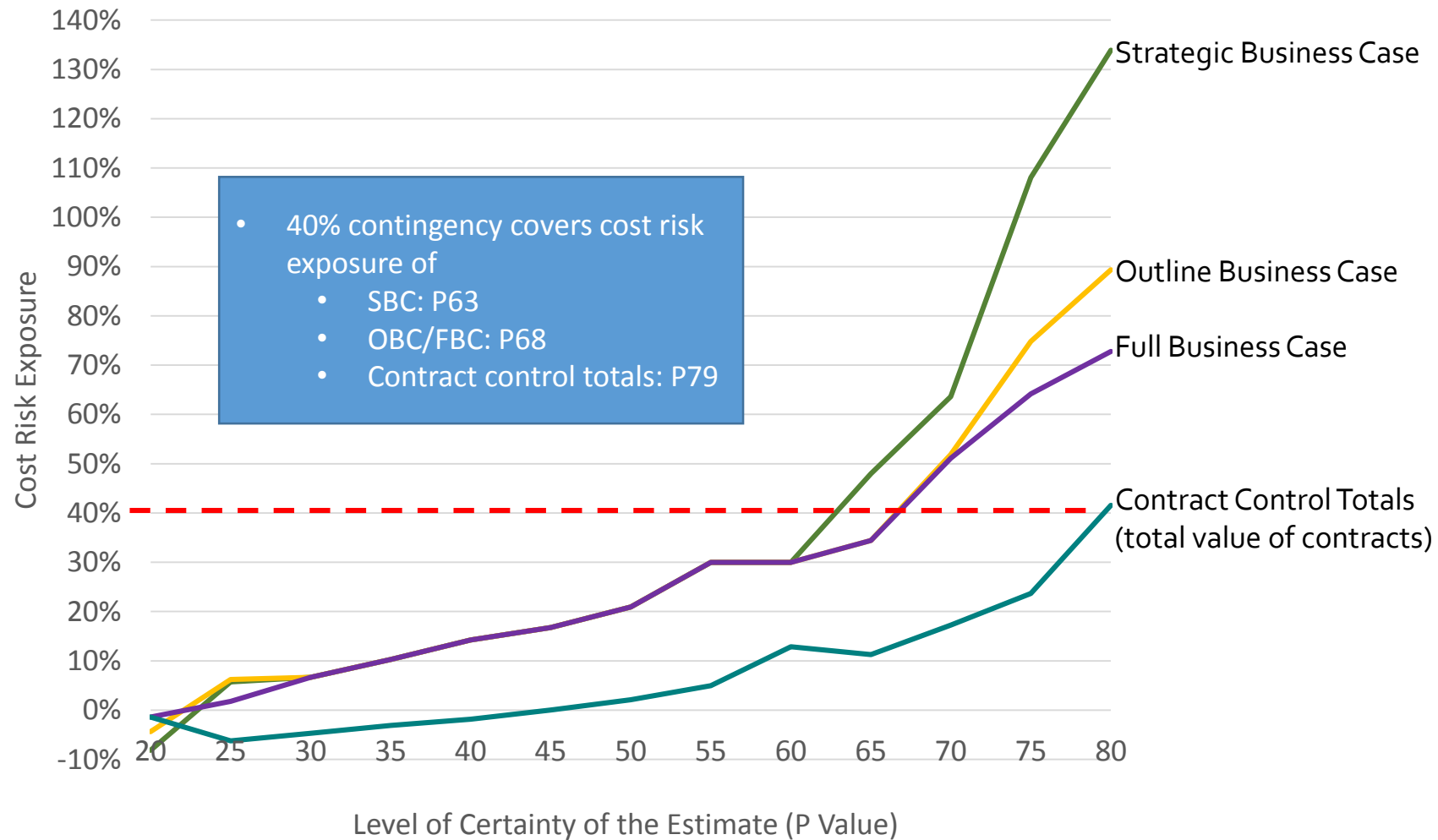
<i>Is this project type a suitable comparator for HSR projects? (n=39)</i>	<b>Average</b>	<b>P50</b>	<b>P80</b>	<b>P90</b>	<b>P95</b>	
Conv. rail (n=113)		✓		✓	✓	✗ Statistically significant difference
Fixed link (n=132)	✓	✓	✓	✓	✓	✓ No statistically significant difference
Metro (n=196)	✓	✓		✓		
Road (n=658)		✓			✓	

- Only fixed links are comparable for the full range of estimates from P50-P95
- **Final selected reference class included 39 high-speed rail projects and 132 fixed links = 171 projects**

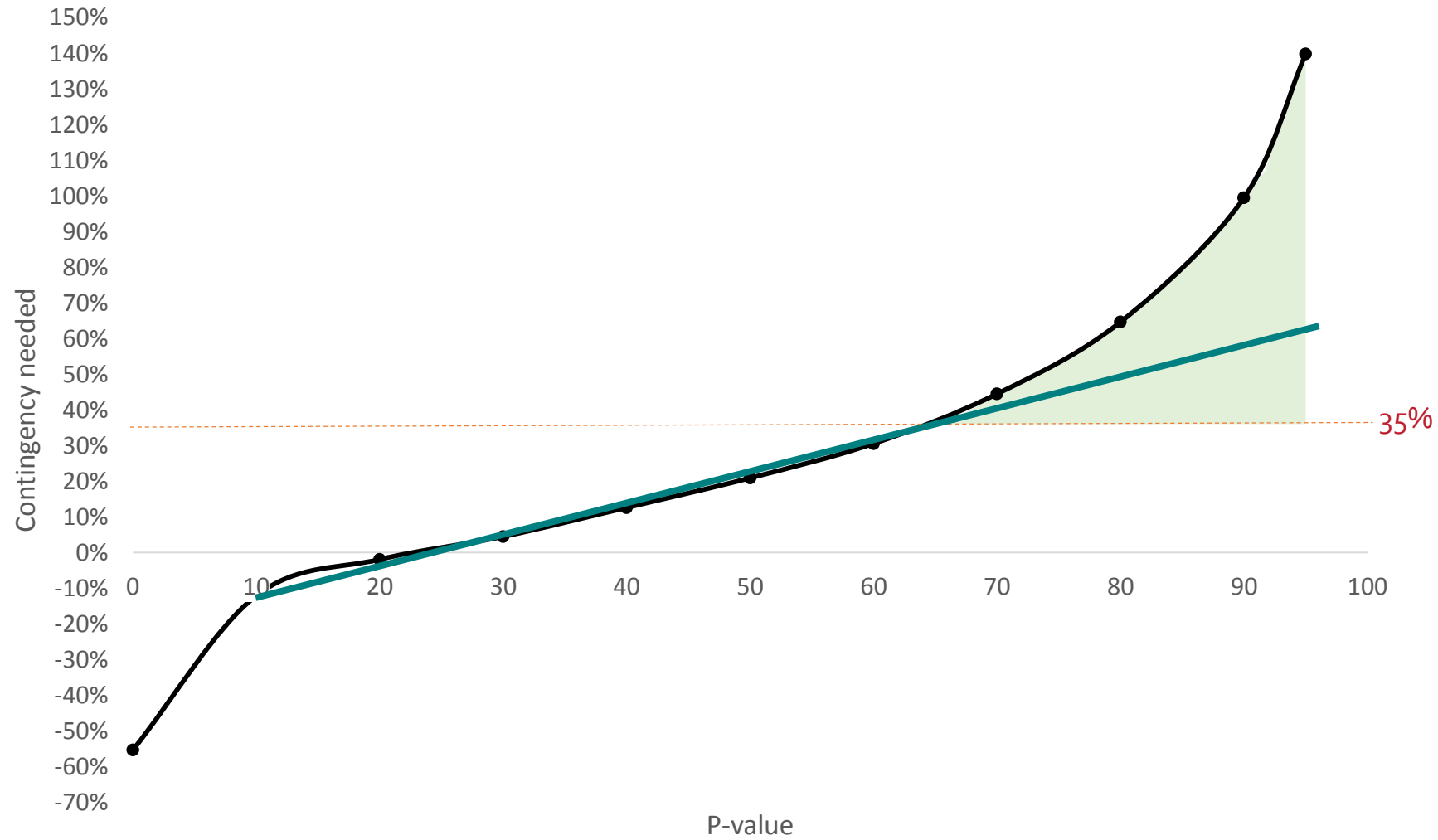
# Building a Reference Class for HS2



# Comparison of the Different Reference Classes for Different Points of the Estimate for Levels of Certainty between P20-P80



# Key Concern is the Tail Risk



# Causes in the Tail

## Stated causes

- Early delays (procurement, political decision making)
- (Late) design/scope changes, e.g. changes discovered during testing and commissioning; station changes triggered by local government; environmental mitigation
- Geological risks (sinkholes, archeological finds, water tables, ground levelling, ...)
- “Rare” risks, e.g. contractor bankruptcy, political influence (for example on contractor selection), fraud by contractors (for example using poisonous sealants)
- Nominal cost increases due to
  - Unforeseen Inflation
  - Reduced number of rolling stock
- Quality risks and resulting rework
- Cutting of funding
- Unknowns in the design (particularly of safety and operations systems)
- Intermodal integration (long distance bus, commuter rail)

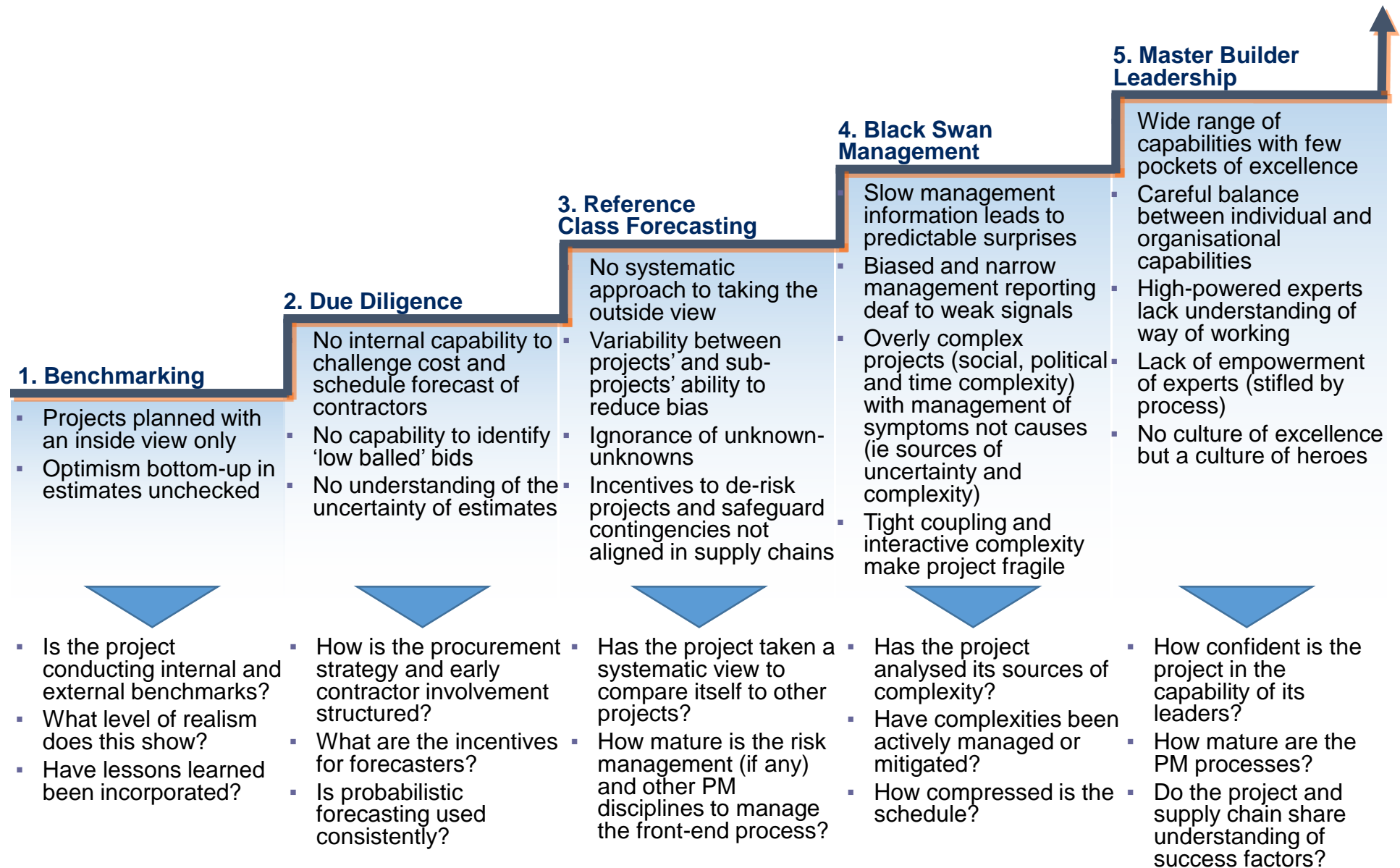


# Responses to Raise Maturity

Area	Description	Response
<b>Design</b>	Late design changes due to external demands	Hybrid Bill process controls scope
<b>Funding</b>	Problems with funding causing changes to profile. Including excessive interest payments.	Agreed funding profile up front and funding mechanisms including necessary insurance strategy.
<b>Amplification</b>	Problems on critical path escalate rapidly without 'damping'	Designing schedule to create higher confidence at critical points eg end of pre-construction. Early contractor involvement in design
<b>Integration</b>	Failing to appreciate and understand scale of integration required to deliver	Structure of contracts. Assurance approach. Technical specification and assurance
<b>Quality</b>	Problems with quality of work completed	Assurance design. Hand over points control.
<b>Archaeology</b>	Significant volumes of archaeology and geology issues	An allowance made and base case is towards the worst case
<b>Inflation</b>	Inflation greater than expected	Specific recognition and approach to this issue.

# Front-End Capability Maturity Model

(Said Business School, Oxford – Prof Bent Flyvbjerg)



# Risk Maturity Level

Maturity Level	Area	Problem factors	Potential response (examples)
1	Bench marking	Inside view only with optimism bias unchecked	<ul style="list-style-type: none"> <li>• Programme of learning from others.</li> <li>• Benchmarking against other projects, industries and sectors</li> </ul>
2	Due diligence	No challenge to cost, schedule forecasts of contractors. Minimal understanding of uncertainty in estimate	<ul style="list-style-type: none"> <li>• Internal assessments of costs, schedules.</li> <li>• Separate estimating from contractors</li> </ul>
3	Reference Class Forecasting	No systematic outside view. Variability between projects and subprojects ability to align and reduce bias. Ignorance of 'unknown unknowns'; lack of exploration.	<ul style="list-style-type: none"> <li>• Systematic and ongoing Reference Class Forecasting across different aspects of programme.</li> <li>• Exploration of scenarios to understand 'unknown unknowns'.</li> <li>• Understand characteristics of tail</li> </ul>
4	Black Swan (predictable surprises)	Slow management information communication. Management of symptoms not causes. Tight coupled system. Overly complex	<ul style="list-style-type: none"> <li>• Quick, clean, independent management information reporting</li> <li>• Amplification of weak signals.</li> <li>• Recognise complex scenarios and break down</li> </ul>
5	Leadership	High powered experts lack understanding of how to work effectively. No culture of excellence rather one of heroes. Lack of empowerment of experts	<ul style="list-style-type: none"> <li>• Identify necessary pockets of excellence and encourage culture. Continuous learning.</li> <li>• Focus on ways of working</li> <li>• Leadership engage in scenario planning</li> <li>• Increase reliance on 'qualitative' (needs more development)</li> </ul>

# Maturity Model

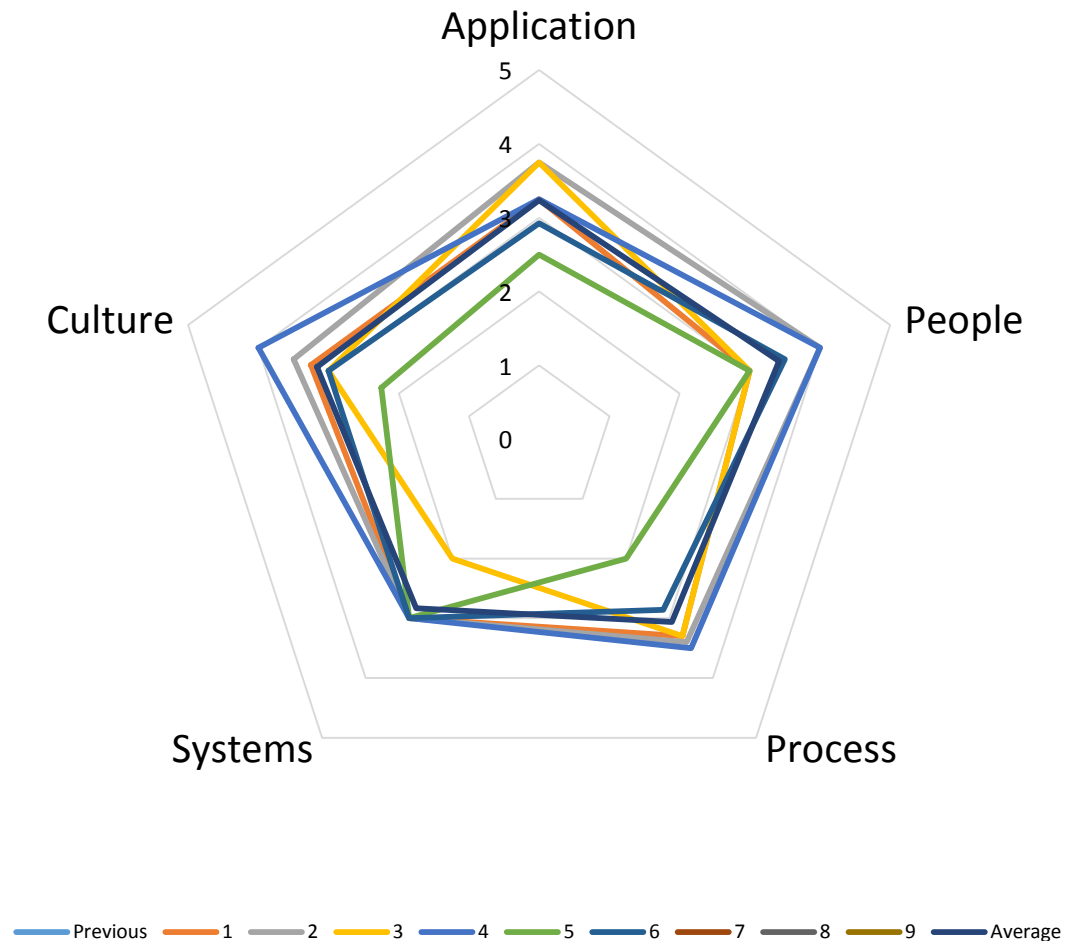
- Based on ISO31000 with reference to other maturity models
- Pushes boundaries for “leading” ERM practice
- Covers enterprise-wide maturity:
  - Document review (25%)
  - Evidence based application (75%)
- Initial qualitative assessment at “Level 1”
- Drill down to L2 and L3 quantitative assessment using weighted scoring
- L4 will be a behavioural questionnaire similar to psychological profiling

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# Maturity Model

- All orgs all areas score varies between 2 and 4
- Most orgs strong on 3 areas and weak on 2
- Further analysis on particular questions to follow...

## Risk Maturity Scores





# Management of Risk in Government (Manzoni & Cheshire, Jan 2017)



## Essential building blocks include:

- Creating positive risk management behaviours and culture
- Establishing roles and responsibility
- Communicating risk information
- Building risk capability, including training for risk practitioners



## Essential routine processes include:

- Identifying risks, including those responsible for managing them
- Assessing risks and establishing tolerance
- Addressing risks, including contingency arrangements
- Reviewing and monitoring risks, including 'deep dives'
- Reporting on risk



## Recommended periodic activities include:

- Assuring the board that risk is being properly managed
- Assuring risks from arm's length bodies
- Scanning the horizon/ environment, including National Risk Register risks
- Building risk maturity
- Peer reviews
- Learning lessons
- Exploiting data and data analytics
- Building and testing resilience frameworks

Thank you

Any Questions?