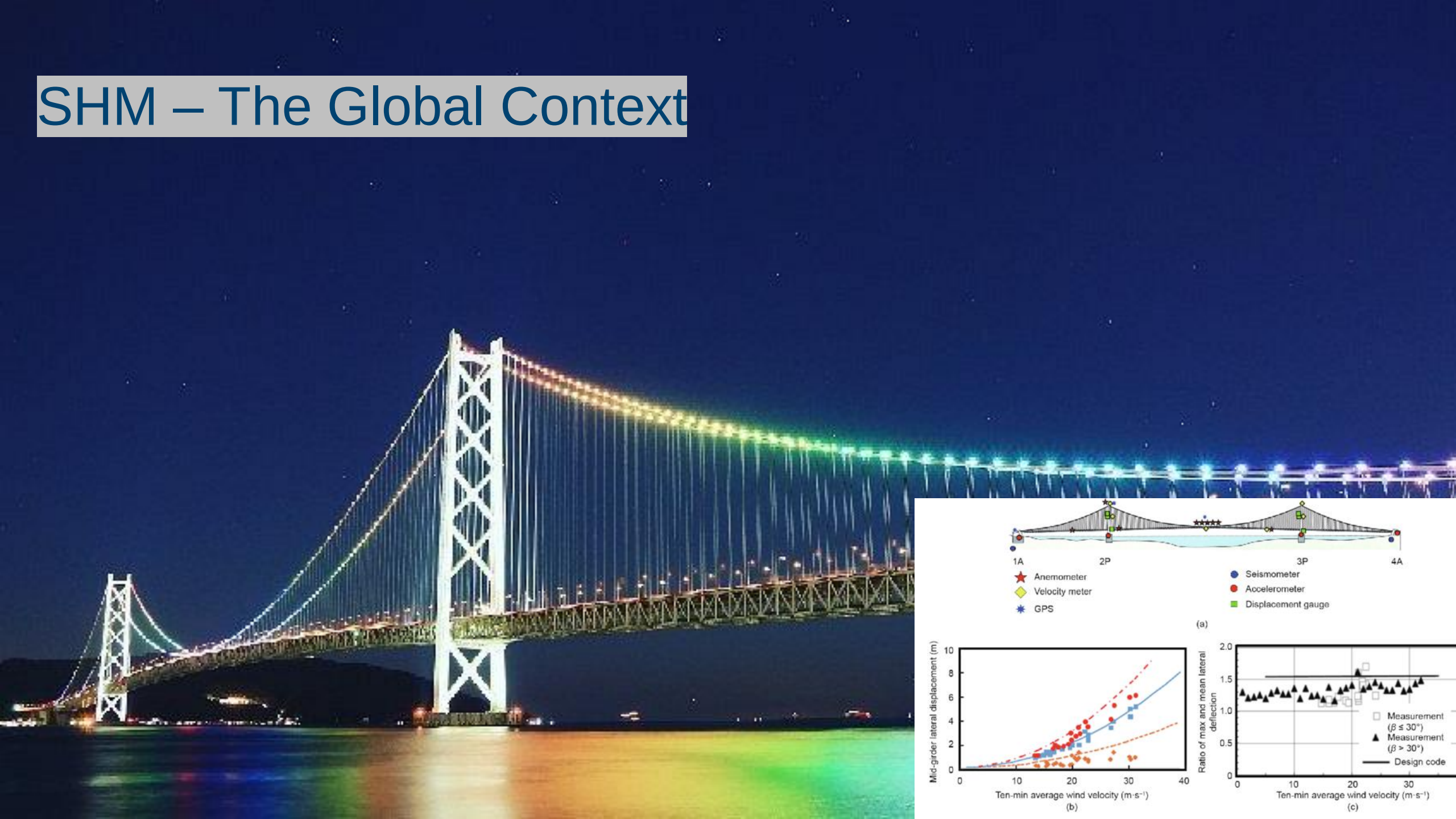
Rockfield

Reimagine. Transform.

Creating Value from SMH in the Australian Context

OVER 20 YEARS OF ENGINEERING EXCELLENCE

SHM – The Global Context

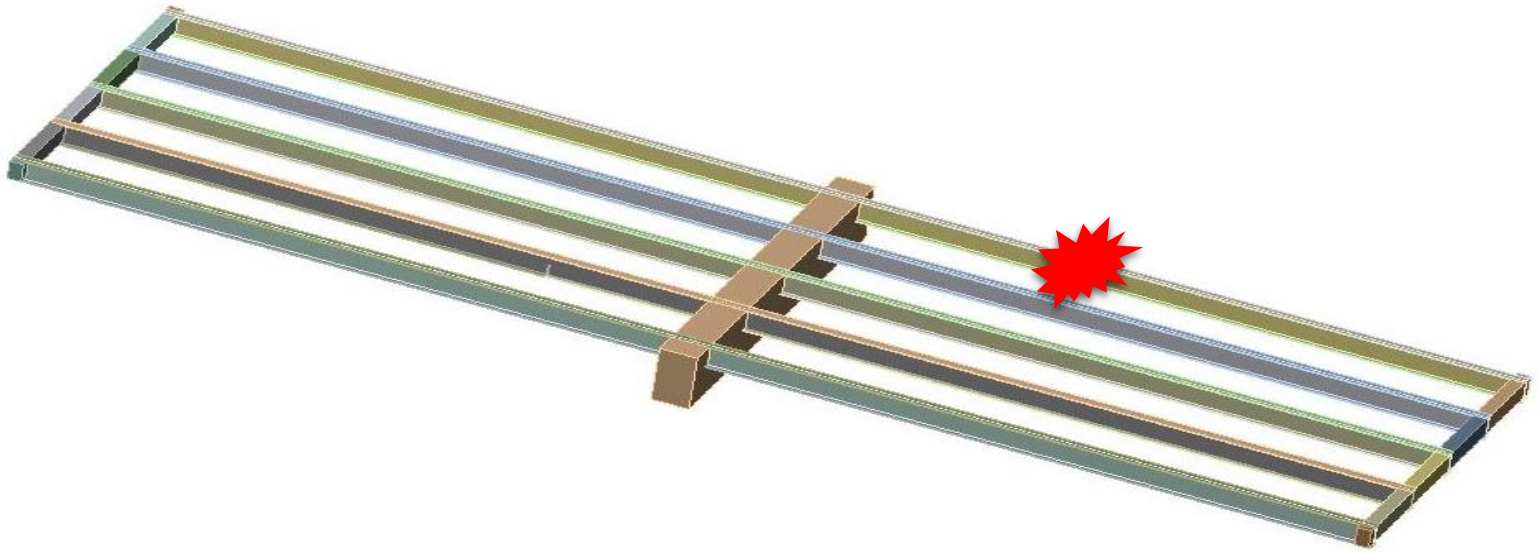


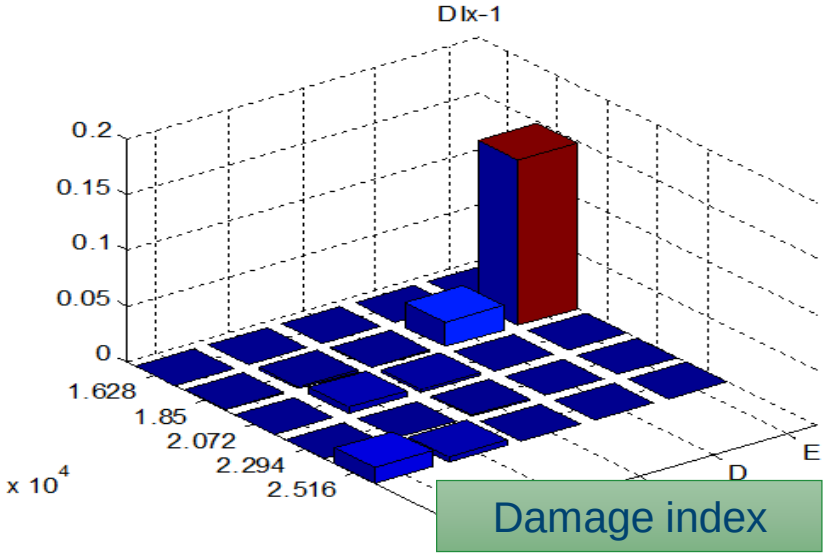
Challenges in Australia

- Short span bridges with load rating issues
  - Plausibility gap
  - Risk appetite due to lack of data
- Heavy vehicle move
  - Wind farm
  - Defence equipment
- Managing risks
  - Proof by performance against deterioration

Damage Detection

- Nice to have but not front of mind yet

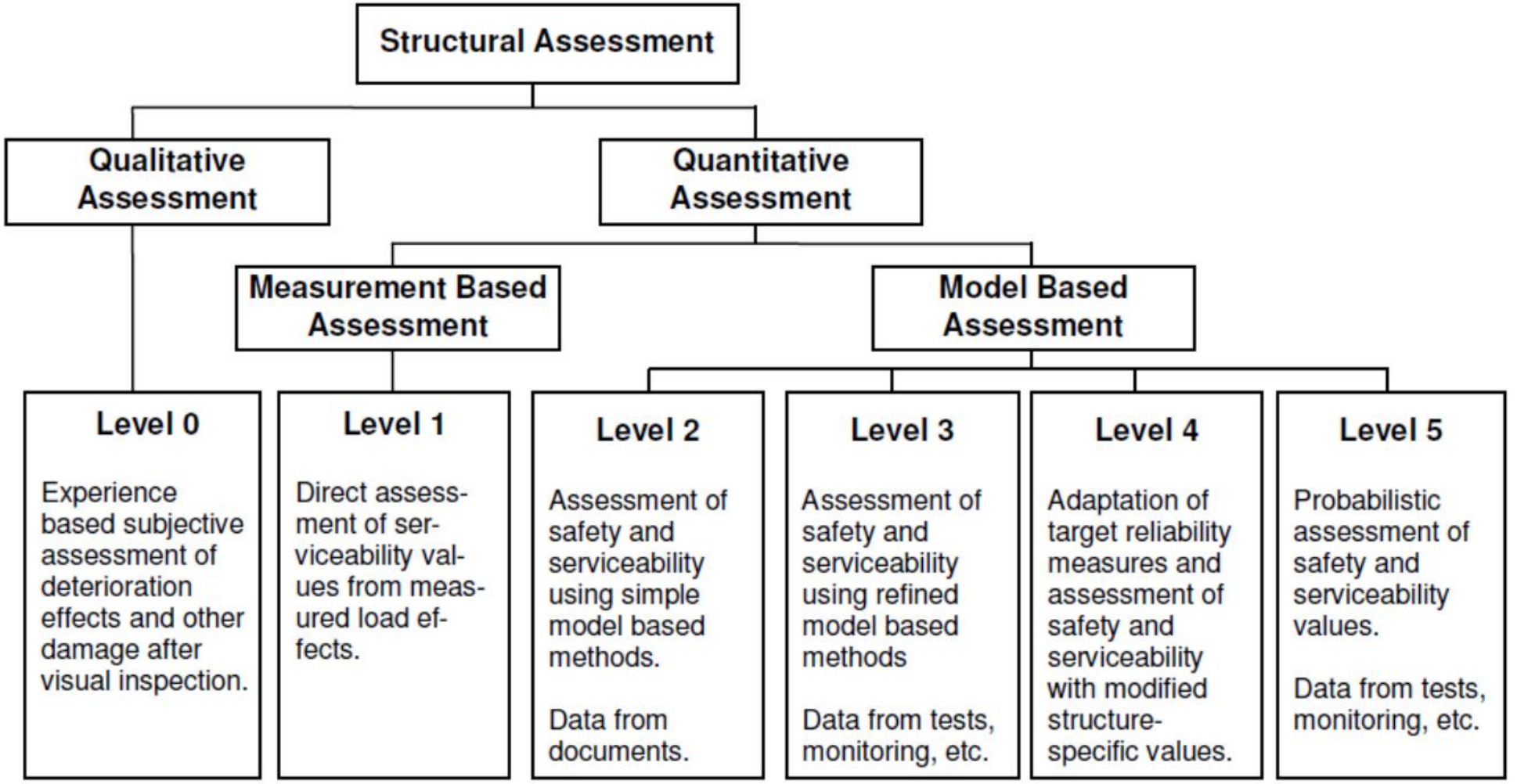




Damage index

SHM – Low hanging fruit

- Higher tier bridge assessments



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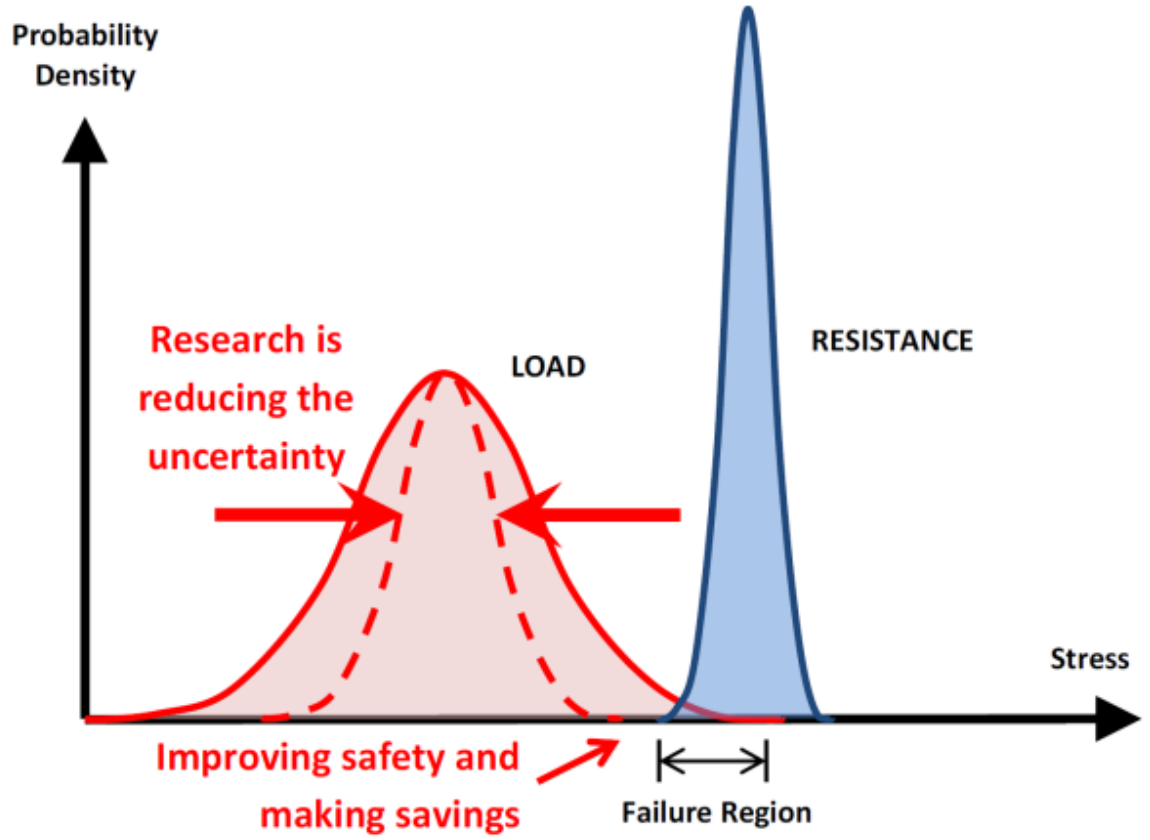
SHM – Low hanging fruit

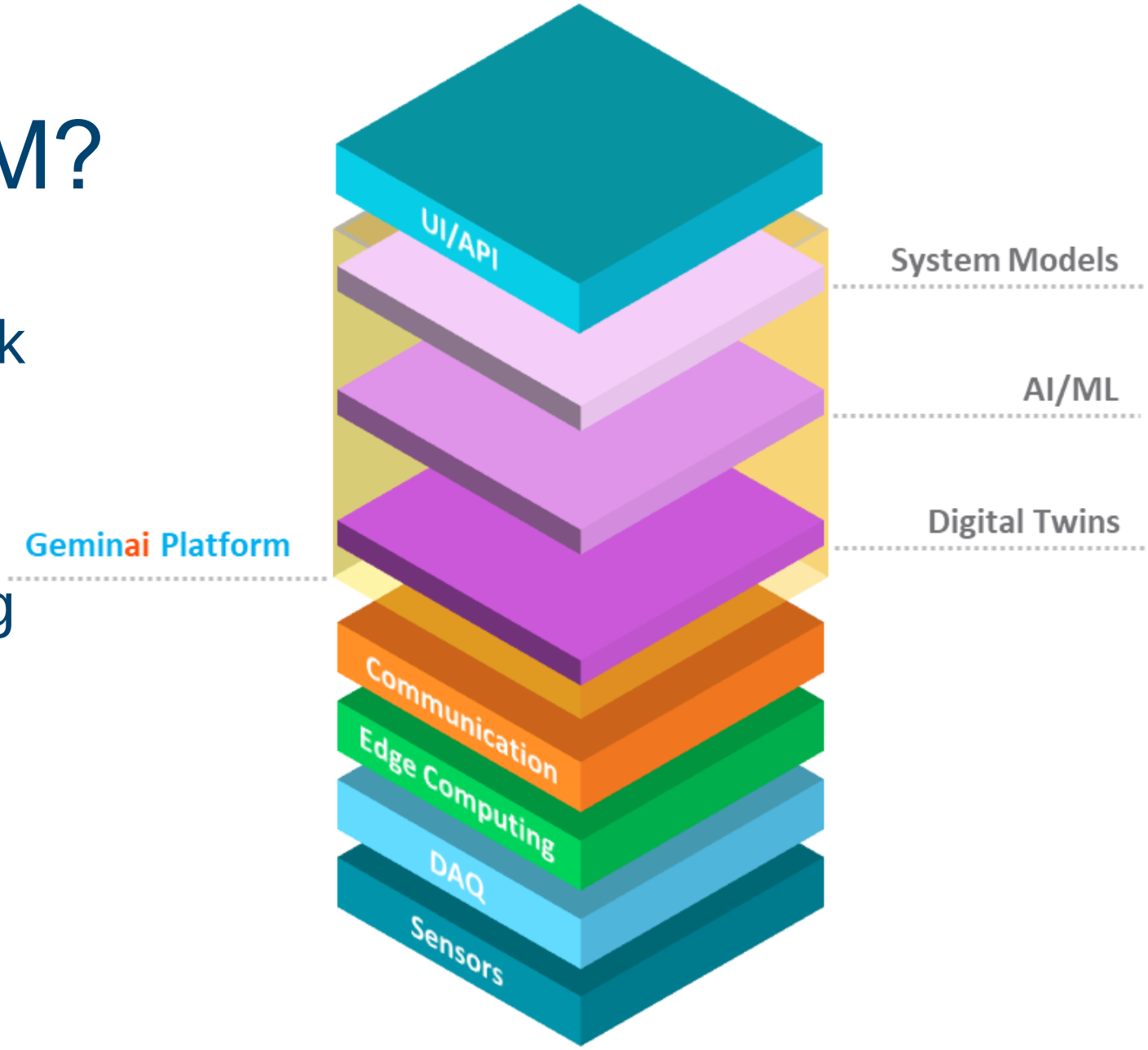
- Higher tier bridge assessments
  - Loading - the forgotten side of equation



Source: Austroads Research Report AP-R617-20 and Colin Caprani's presentation

What's new in SHM?

- End to end technology stack
- Cloud architecture
- AI/ML
- User interface and reporting
- Camera integration



Due to its age and unique design, the Department of Transport and Main Roads (TMR) has been closely monitoring the condition of the bridge for many years. Investigations initiated in 2015 led to the discovery of fatigue cracks in several steel elements of the bridge and in February 2019, TMR imposed a 50.5 tonne load limit to manage heavy vehicle impacts. In November 2020, TMR imposed changed traffic conditions to manage the risk of fatigue and brittle fracture.

The bridge has been operating as a single lane structure with a reduced speed limit and traffic management in place and loads have continued to be limited to 50.5 tonne. During this period, the bridge has been inspected at all critical locations with short-term repairs completed. Cameras and sensors have been installed to measure the performance of the bridge and the control measures.

To date, the cameras and sensors have recorded traffic for six months. Load tests were undertaken to calibrate the sensors monitoring vehicle compliance and the effectiveness of the single-lane operation of the bridge. The data has also been used to verify modelling for the rate of fatigue damage and combined with the NDT results to update the expected fatigue and brittle fracture behaviour of the bridge.

The updated modelling indicates that the rate of fatigue damage is less than predicted. This reduces the risk of a fatigue and brittle fracture occurring to safe levels. Moving the pedestrian access from the northern to the southern side of the bridge and the inclusion of a 60 km/h speed limit further reduce any risks.

As a result, it is safe to reopen the bridge to two lanes with a limit of 50.5 tonnes.

- Initial assessments (Tiers 1 and 2)
  - Further investigation warranted
- Substructure
  - Pier headstock cantilever bending
- Superstructure
  - Shear and bending in edge girders
  - Shear and bending in internal girders.

Department of Transport and Main Roads

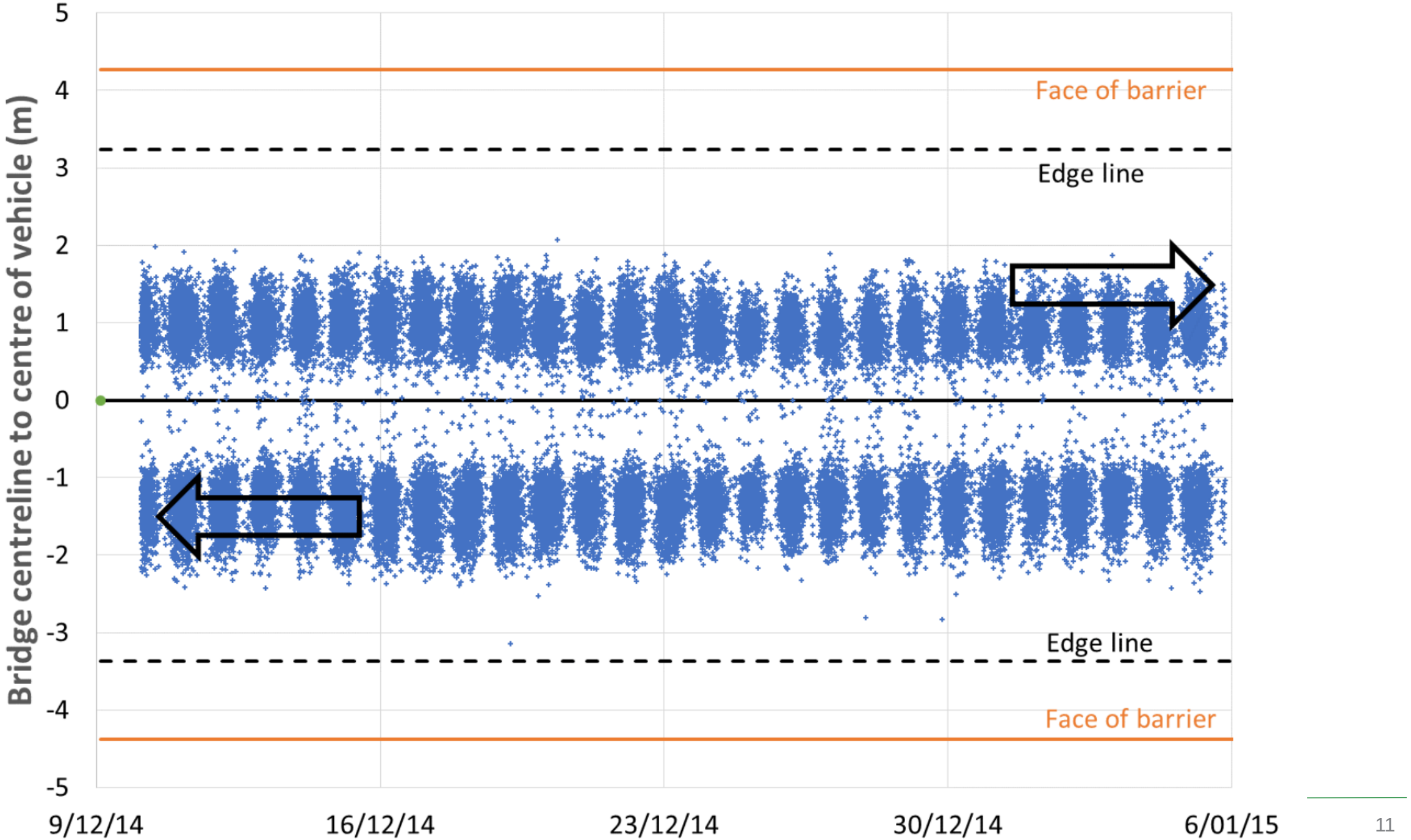
Closing the plausibility gap: A case study

Peter Shaw | AECOM
Rob Heywood | Department of Transport and Main Roads (Engineering and Technology, Structures)

ENGINEERING TECHNOLOGY FORUM 2016
Practical research into action

Queensland Government

• Event A – Road Train


Bridge centreline to centre of vehicle (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
Face of barrier
Edge line
Edge line
Face of barrier
9/12/14
16/12/14
23/12/14
30/12/14
6/01/15

Scenario	T31	T32	T33	T36	T36	T38	T38
RV	6H	6H	6H	6H	6H	6H	6H
Material factors	T1	T1	T1	C	C	C	C
f'_c	38	38	38	38	38	55	55*
LLF	2.0	2.0	2.0	2.0	2.0	2.0	1.8
DLA	0.4	0.2	0.2	0.2	0.2	0.2	0.2
AVF	0.8	0.8	0.0	0.8	0.8	0.8	0.8*
Drive-line	Kerb	Kerb	Kerb	Kerb	COL	Kerb	All*
ERT_{Edge}	0.59	0.69	0.72	0.81	>1	0.92	>1

Gaps and opportunities

- Analytics
  - Virtual WiM
  - Load characterisation
  - Image recognition
  - Structural reliability
- Wireless / low-cost technology
- SHM as a system
- Value add with adjacent data
  - Environmental monitoring