


### Eliciting knowledge

'intuitive...'  
'enactive...'  
'deeply embedded...'

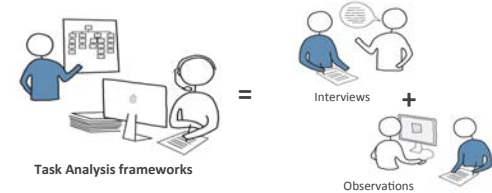


'tacit...'  
'unavailable to conscious introspection...'

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### What's been done before?




Task Analysis frameworks = Interviews + Observations

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### Let them find their words

Macro  $\xrightarrow{\text{PARTICIPATORY}}$  Micro



Focus Group Involving Route Invention Task  
One-to-One Critical Decision Method Interview and Route Drawing  
In-cab Verbal Protocol and Observations

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### Participants



Rio Tinto  
QR NATIONAL  
NSW Transport RailCorp  
KiwiRail

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### Participant Profile

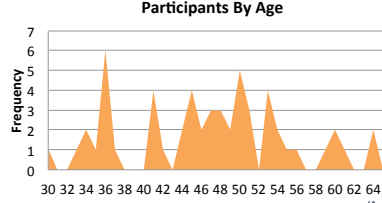
**61**

Age = 30 to 64  
Average = 47  
SD = 8

Gender  
M = 60  
F = 1

Train drivers  
Principal drivers  
Trainees  
Route tutors  
Driver trainers

#### Participants By Age

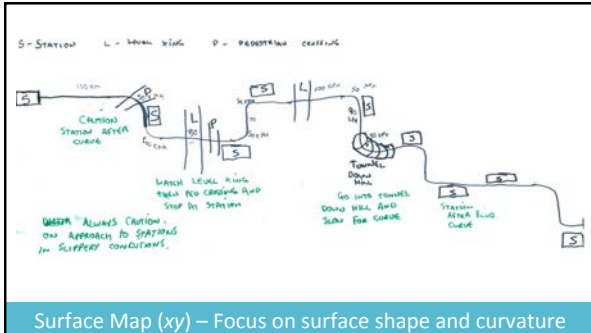


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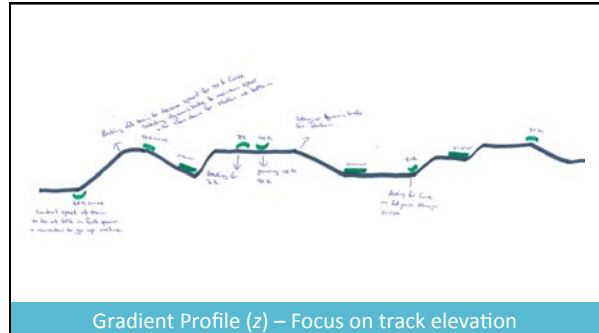
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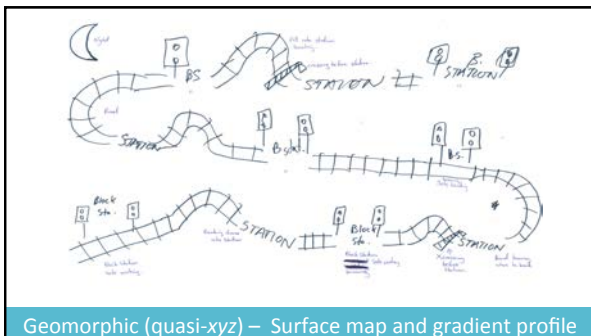
Deconstructed – Focus on track features



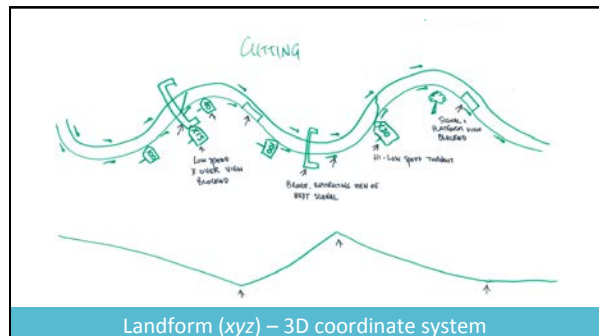
Surface Map (xy) – Focus on surface shape and curvature



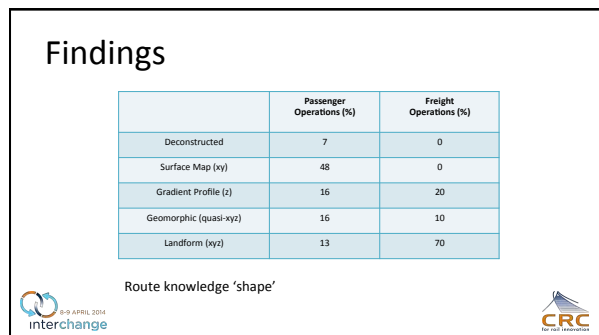
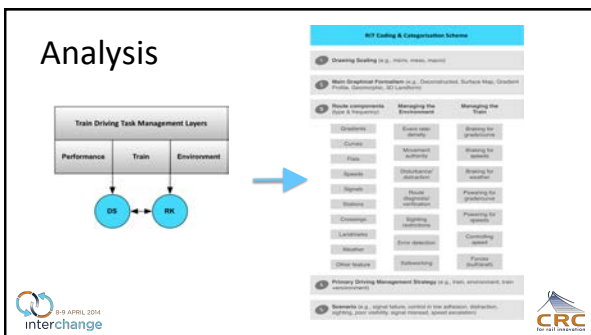
Gradient Profile (z) – Focus on track elevation

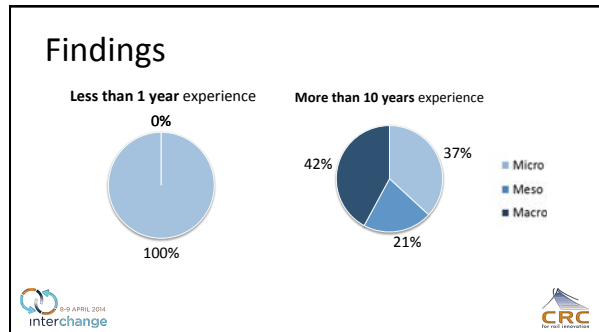
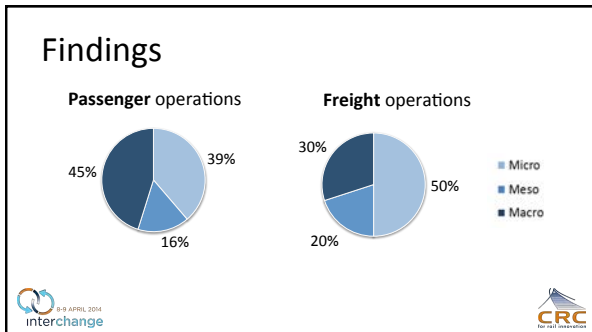
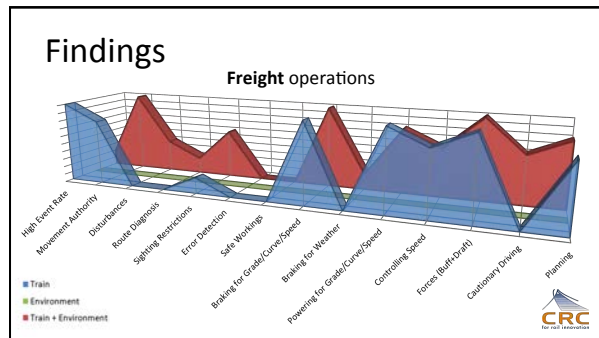
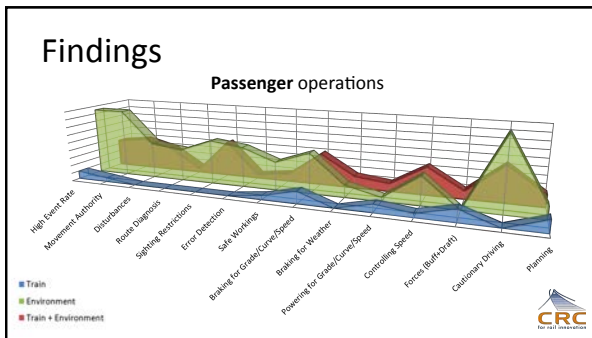
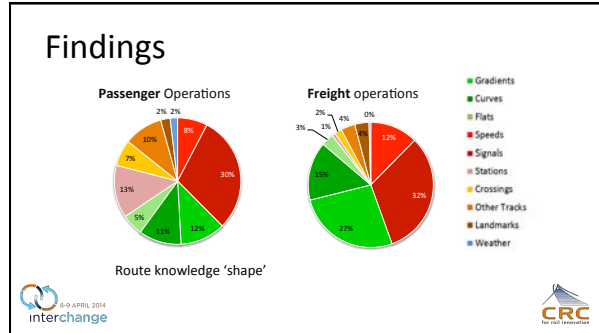
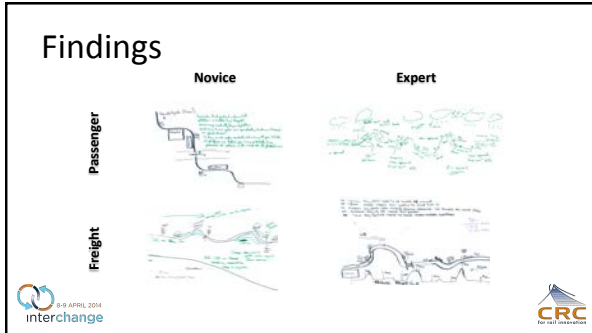


Geomorphic (quasi-xyz) – Surface map and gradient profile





Landform (xyz) – 3D coordinate system





### Summary





- Route knowledge and task management in passenger closely coupled to environment
- Route knowledge and task management in freight operations closely coupled to trains
- Mental track coordination varies between operations
- Implications for skill when changing operations
- Driver training may be optimised to consider critical learning opportunities

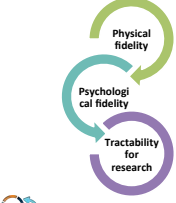
### Approaching simulation






### That train has already left the station....!

### That train has already left the station....!



	Limitation	Modified
• Audio	Line of sight restriction	Not modified
• Visual	Low sound variability	Not modified
• Equipment	No bail-off function	Built into equipment and simulation model
• Function	No bail-off option	Built into task model
• Task	No route preview display	Added to the driver-cab
• Cognitive		
• Research needs	Data capture	Work-around solution
• Welders	Track building	
• Users		

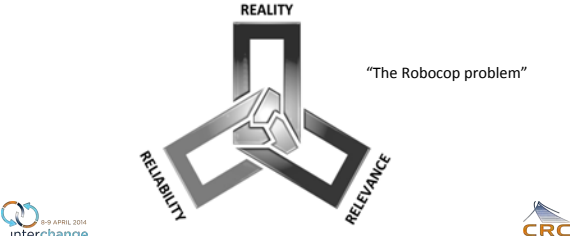
### That train has already left the station....!





Before
After



### Integrating simulators



“The Robocop problem”


### Interchange...

The image shows three distinct outputs from the Interchange project. On the left is a 'Reports' document titled 'Driving Strategies & Route Knowledge: Critical Learning Opportunities Simulator Project Suite Volume II'. In the middle is a 'Journal articles' document titled 'Understanding the visual skills and strategies of train drivers in the urban rail environment'. On the right is a 'Toolkits' document titled 'Evaluation of Rail Technology: A Practical Human Factors Guide'.

Reports                      Journal articles                      Toolkits

### Where to from here?

- Standards development
- Guidelines for communities of practice
- Training design
- Scenario design
- Route knowledge and strategies in the face of increased technology
- ARC linkage project:
  - Augmenting reality effectively during training

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### Awards

Body of Knowledge prize for best contribution to the standards development, capture of best practice or contribution to the Simulation community's body of knowledge, Simulation Technology and Training Conference, 2012.

### Selected Publications

Naweed, A., & Balakrishnan, G. (2014). Understanding the visual skills and strategies of train drivers in the urban rail environment. *WORK: A Journal of Prevention, Assessment & Rehabilitation (Visual Ergonomics Special Issue)*, 41(3), 339-352.

Naweed, A. (2013). Simulator integration in the rail industry: The Robocop problem. *Proceedings of the Institution of Mechanical Engineers, Part F: Journal of Rail and Rapid Transit*, 227(5), 574-582.

Naweed, A., & Balakrishnan, G. (2013). That train has already left the station! Improving the fidelity of a railway safety research simulator at post-deployment. *Proceedings of the Institution of Mechanical Engineers, Part F: Journal of Rail and Rapid Transit*, 227(5), 583-589.

Naweed, A., Balakrishnan, G., & Dorrain J. (2013). Evaluating your train simulator part 1: The physical environment. In C. Bearman, A. Naweed, J. Dorrain, J. Rose, & D. Dawson, (Eds.), *Evaluation of Rail Technology: A Practical Human Factors Guide* (pp. 171-213). Surrey, UK: Ashgate.

Dorrain, J., & Naweed, A. (2013). Evaluating your train simulator part 2: The task environment. In C. Bearman, A. Naweed, J. Dorrain, J. Rose, & D. Dawson, (Eds.), *Evaluation of Rail Technology: A Practical Human Factors Guide* (pp. 215-259). Surrey, UK: Ashgate.

Naweed, A., & Balakrishnan, G. (2012). Perceptions and experiences of simulators as a training tool in transport: The case of the Australian rail industry. *Road & Transport Research: A Journal of Australian and New Zealand Research and Practice*, 21(3), 77-84.

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### Thank You

The image shows two business cards. The top card is for Dr Anjum Naweed, Senior Research Fellow and Deputy Program Leader - Operations and Safety at the CRC for rail innovation. The bottom card is for the CRC for rail innovation, located at the Applied Institute for Behavioural Sciences, CSU University Australia, 46 Esplanade Road, WARRVILLE SA 5034.

### Acknowledgements

Ganesh Balakrishnan, Chris Bearman  
Drew Dawson

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