Establishing the value of resilience

RESEARCH REPORT **614**

Full report: www.nzta.govt.nz/resources/research/reports/614

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Making resilience user friendly

Although resilience is generally understood to be a 'good' concept, what it means and how we achieve it is harder to pin down.

The Transport Agency commissioned research to establish a consistent approach to how we talk about resilience in the context of transport. A second strand of the research developed an updatable Decision Support Tool which would enable users to weigh up different controls to work out how best to create an acceptable level of resilience for transport infrastructure.

Although the research specifically related to resilience for transport infrastructure, the research team (EY and Tonkin + Taylor) thought the application for the research was broader and could potentially encompass all infrastructure types.

'The provision of effective infrastructure is something that benefits all New Zealanders – and therefore any research that furthers the knowledge base, or progresses the dialogue, to improve the resilience of infrastructure to disruptions (over the short, medium and long term) is beneficial to a wide audience,' they say.

Potential users of the research include agencies and individuals making decisions about investments in the transport network across New Zealand, as well as those making investment decisions about any infrastructure asset or system. Although the Decision Support Tool is targeted at the former group, it could be customised to suit any infrastructure sector.

Standardising the resilience discussion

One of the main things that makes discussions about resilience challenging is the range of different concepts and subjective interpretations of what resilience means.

There is a plurality of terms, definitions and understanding of what is meant by resilience, and this lack of consistency makes it more difficult for decision makers to do what is right for their communities and stakeholders.

This multiplicity was confirmed in the first stages of the research, where the team reviewed a broad range of literature in order to build a workable resilience taxonomy.

'The concept of a taxonomy, or a dictionary of terms, that helps to create a common understanding of resilience is important as it means all stakeholders are speaking the same language. This lays the platform for better

decisions to be made more consistently,' the researchers say in the report.

The resulting taxonomy has three tiers:

- a definition of resilience
- a suite of four resilience measures
- a glossary.

The definition of resilience formed the basis for the research and the anchor for the taxonomy.

The definition fixed on by the team was:

> *Resilience is the ability of systems (including infrastructure, government, business and communities) to proactively resist, absorb, recover from, or adapt to, disruption within a timeframe which is tolerable from a social, economic, cultural and environmental perspective.*

Resilience measures formed the next tier of the taxonomy. These measures are a short list of terms that enable users to categorise and communicate with a broader audience about resilience controls. They provide a guide for thinking about resilience, and are likely to be present in differing combinations in any resilient system.

The four measures are:

- robustness: the ability of systems to withstand disruption and continue to provide an acceptable level of service
- redundancy: provision of functionally similar outcomes, to an acceptable standard, during lost or degraded levels of service
- recovery: the ability to restore an acceptable level of service after disruption
- leadership and governance: the ability to develop an organisational mind-set/culture of enthusiasm for responding to challenges (for example through the development of an agile and flexible asset monitoring and management programme).

The final part of the taxonomy is the glossary; a comprehensive list of terms and phrases associated with resilience, including a mix of technical, non-technical, transport-centric and general terms. The glossary is included as an appendix to the research report.

Developing the Decision Support Tool

The second stage of the research developed a Decision Support Tool (see following page).

The decision to develop the tool flowed from the first stage of the research, where it became obvious to the research team there was already 'a constantly evolving wealth of well-researched, well-reasoned, contributions to the resilience body of literature' and this was particularly strong in New Zealand.

What was missing, however, was a means of integrating and using this information.

'We could not find a tool, or a framework, that could pull all this information together. We therefore saw an opportunity to utilise the knowledge built up through the literature review, and develop something practical that could be used by network operators and other infrastructure decision makers,' says the team.

The tool will enable decision makers to consistently weigh up controls to improve resilience for communities of interest. It was developed on the key design principles of being practical, outcomes focused, scalable, and leveraging the existing work and research.

The tool has six main stages that set out the steps that users should follow when considering and making decisions about resilience in relation to transport infrastructure. These are set out in the diagram below.

At this stage it is anticipated the tool will be used predominantly as a decision-support tool, and will be most helpful when considering decisions at the asset or project level. Potential users will include asset owners and managers, business case practitioners and investment decision makers.

The tool enables users to narrow down options quickly to solve a particular resilience issue – that is, it can be used to help shape thinking for the strategic or economic business case, rather than used to make final investment decisions (ie at the detailed business case stage).

In time, however, as data and best practice from using the tool build up, the research team envisages it becoming more useful across the wider business case process, with the goal for it to become a decision-making tool.

The tool was developed collaboratively with a broad range of industry and other stakeholders. However the research team acknowledge there were some limitations in their research, where further investigation is warranted. These limitations and suggestions for further research are set out in the report.

Decision Support Tool

| Stage 1:
Services and
Functions | Understand the level of service offering |
| | Understand the geographic and community context |

**Stage 2:
Impact
Assessment**

Consequence: assessment of the consequence of the asset being unavailable to fulfill its function considering social, cultural, environmental and economic perspectives

Tolerance: maximum acceptable time for the asset to be unavailable

**Stage 3:
Challenges**

Challenges: Identify natural and organisational stresses and shocks

Likelihood and magnitude: assessment of the likelihood of reaching outage tolerance as a result of each Challenge, and how this may change over time

**Stage 4:
Controls**

Existing controls & gaps: identify existing or business-as-usual controls which create resilience (categorised based on redundancy, robustness, recovery and governance & leadership), as well as interdependencies and enablers

Mitigation options: identify and record additional potential (future) controls for creating resilience based on gaps or opportunities identified

Options assessment: decide which of the controls to carry though to the heatmap for decisioning

**Stage 5:
Heatmap**

Resilience efficacy: characterise the resilience provided by each control based on high, medium, low or no resilience to calculate a resilience score

Overall resilience: review the overall resilience to each challenge based on current/BAU and possible future controls

Indirect costs and benefits: assessment of the broader value of each resilience option based on consequence matrices

Most preferable option(s): the highest overall total indicates most preferable option which should be placed in the context of the cost of implementation

**Stage 6:
Summary**

Review resilience controls in the context of services / functions

Review resilience controls in the context of recovery time objectives

Review overall resilience mix in the context of challenges identified and resilience type (redundancy, robustness, recovery and governance & leadership)

Recommendations based on resilience ourtcomes and broader value