



The costs and benefits of transport resilience: How can we better measure them?

A transport system can be disrupted by a range of events such as natural disasters and other hazards, including accidents and public gatherings. A transport system's resilience refers to how well it resists, absorbs, and recovers from or adapts to disruption within a 'tolerable' timeframe.

Waka Kotahi has a range of ways to help transport professionals assess and plan for resilience. However, in the Waka Kotahi Economic Evaluation Manual (EEM) there is little technical guidance on how to analyse resilience when appraising a transport infrastructure investment. This research report attempts to fill this gap. It identifies and develops ways to value the costs and benefits of resilience in transport infrastructure, described in a way that can be incorporated into the EEM.

WHAT DID THE LITERATURE REVIEW FIND?

A review was undertaken of relevant guidelines, literature and analysis in New Zealand and elsewhere. Most useful are materials that have been developed to assess road closures due to flood in Australia; however, most technical guidelines in land transport (or other sectors) pay little attention to resilience.

APPROACH TO INCORPORATING RESILIENCE WHEN ASSESSING TRANSPORT INVESTMENT

The costs to improve resilience relate to the additional infrastructure costs and may be estimated like any other infrastructure investment. The benefits of resilience are the avoided costs of disruption. These can be valued using an 'expected cost' approach that accounts for the likelihood and severity of disruptions.

THE COSTS OF DISRUPTION

There are a range of disruption costs, including costs to users (eg diversion costs), other direct costs (eg repair costs) and sometimes indirect costs to non-users.

For disruptions with low to medium impact, much of the focus will be on the direct costs to users. These depend mostly on the availability of alternative routes and the change in road-user behaviour. Where alternative routes are available, the costs of disruption for users can be estimated as costs of:

- diverting (extra travel time and operating costs)
- waiting (travel-time cost of waiting en route and postponing trips)
- cancelling trips (costs of diversion).

TYPES OF TRANSPORT DISRUPTION COST

User costs - Direct costs to users associated with:

- diversion through alternative routes
- waiting for disruption to clear, including waiting en route and postponement
- trips cancelled
- other related costs (accommodation costs, loss of perishables, use of alternative modes).

Other direct costs

- Injury or loss of life (due to less-resilient infrastructure)
- Repair/reinstatement and other costs
- Environmental and other external factors (including congestion)
- Impact on essential services (including utilities and emergency services)

Indirect costs

- Disruption costs to non-users
- Wider economic benefit impacts
- Disaster preparedness (eg inventories)

ISSUES AND CONSIDERATIONS

The costs to consider, the methods and the depth of analysis needed will vary depending on the situation. The simplest situations will involve short disruptions that result in road users taking diverting routes. More complex situations arise when there is a risk of severe disruptions with long-term effects and/or impacts to critical infrastructure. In such cases, other methods may be required to complement or replace some of the standard techniques.

Disruptions have some features that pose challenges for investment appraisal.

- Uncertainty is a particularly large issue for analysis of high-impact, low-frequency events (such as earthquakes).
- Disruptions can have large and sudden impacts to transport networks and behaviour. Care is required when estimating and evaluating how road users react to change and modify their behaviour over time.
- Where there are no practical alternative routes, it is difficult to apply standard travel-cost methods, and non-standards methods may be required.

The report uses the road through the Manawatū Gorge as a case study to illustrate some of the techniques and issues.

FURTHER RESEARCH

The report recommends further research and development in:

- displacement costs to road users when deferring travel (ie not waiting en route) if disrupted
- integration of economic impact models to analyse the costs of disruption change over time and the indirect economic effects when other routes are not practical
- distributional impacts from sudden and severe disruption, which can result in business closures and employment losses (not just net economic loss)
- behavioural responses to disruption, as costs depend on how transport users' behaviour changes over the length of the disruption.



RR 670 - Better measurement of the direct and indirect costs and benefits of resilience, Waka Kotahi NZ Transport Agency research report.

Available at www.nzta.govt.nz/resources/research/reports/670