Intelligent Management of Transport Infrastructure

Critical Policy Brief

This briefing draws upon the expertise of RMIT's transport research community to inform policy makers and the wider community on critical challenges and opportunities in planning for and maintaining Victoria's transport infrastructure.

Melbourne's transport infrastructure is expected to support an additional 10.4 million trips a day by 2050.[1] To accommodate this increasing demand, Melbourne will need to develop integrated transport infrastructure. Smart infrastructure and intelligent management systems offer significant promise in making better use of our existing infrastructure, enhancing both the capacity and resilience of our transport system.

Key Messages

- Better understanding of the current condition and capacity of Victoria's road, rail and bridge infrastructure is needed as a first step in planning for future infrastructure provision. This can be achieved most cost-effectively through investment in smart infrastructure and intelligent management systems.
- The introduction of sensor technology across Victoria's road and rail networks will enable real-time transport demand management, expanding the capacity and efficiency of existing infrastructure.
- Building capacity for predictive modelling based on traffic and infrastructure condition sensor data will enable best use of existing infrastructure and build resilience to shocks and stressors across the network.

Overview

Melbourne's transport infrastructure will need to bear increasing commuter traffic and freight loads as the city's population reaches 8 million by 2050, which raises concerns regarding the capacity of our infrastructure to cope with future demand and maintain productivity.[2] While there has been investment in new infrastructure in recent years,[3] there remains a lack of integrated planning across the transport network. In planning for future infrastructure provision, there is a need to first gain a better understanding of the current condition and capacity of Victoria's road, rail and bridge infrastructure.

New technologies – especially smart infrastructure and intelligent transport management systems[4] – offer the opportunity to plan across the transport network and to make more effective and efficient use of existing infrastructure. This policy brief highlights ways in which intelligent technologies can be engaged to increase the capacity and resilience of our transport infrastructure, supporting a whole-of-life approach to infrastructure management.

Intelligent Modelling for Integrated Transport Planning

Victoria's current Infrastructure Plan recognises the need for more sophisticated transport modelling to inform future planning and more targeted investment.[5] The introduction of sensor technologies that can convey real-time traffic information, allied with data modelling across the network, will reduce commuter bottlenecks and travel times.

Predictive modelling can inform longer-term, integrated planning, indicating which transport modes and connections

between transport modes will optimise transport flow. This will make best use of existing infrastructure and help identify where transport infrastructure investment can deliver most benefit across the transport network. The advantages of intelligent asset management have been demonstrated with building infrastructure – an intelligent asset management system developed by RMIT, for example, has reduced the inspection and management cost of City of Melbourne owned buildings by as much as 30%.[6]

Predictive modelling of infrastructure condition, combined with predictive transport use data, can signal which infrastructure requires maintenance or upgrading, and at which time. Infrastructure maintenance and development can be prioritised based on impact modelling that indicates disruptive effects across the transport network. Scenario analysis can be used to explore social, environmental and economic considerations as to whether maintenance, refurbishment or construction of new infrastructure is needed to accommodate future demand.[7] This will enable much clearer direction of investment and maximise the longevity of our infrastructure assets.

Whole-of-Life Infrastructure Management

A whole-of-life asset management approach is vital in building the resilience of our transport network to system shocks and stressors.[8] The current approach to assessing the condition of transport infrastructure is to conduct visual inspections to determine discrete condition ratings. Laser profile meters used to assess road pavement typically provide a more cost-effective and precise way of assessing infrastructure condition to indicate when maintenance or upgrade is required. However, similar techniques for other transport infrastructure have not yet been developed. Laser scanning, image processing technologies and unmanned aerial vehicles can provide real-time condition and stress data. These technologies can be tested with existing infrastructure and incorporated in all new infrastructure.

Predictive modelling can project changes in infrastructure condition over time based on historical condition data and smart monitoring data. This can inform infrastructure maintenance planning in view of projected future operating conditions, as well as under extreme conditions brought by unexpected events such as floods or land subsidence. RMIT University is currently trialling this type of intelligent asset management system in Victoria to model bridge deterioration.[9] Fragility models are now being developed which can identify those bridges vulnerable to natural hazards of flood, bushfire and earthquakes.[10] This technology has potential application across Victoria's transport infrastructure.

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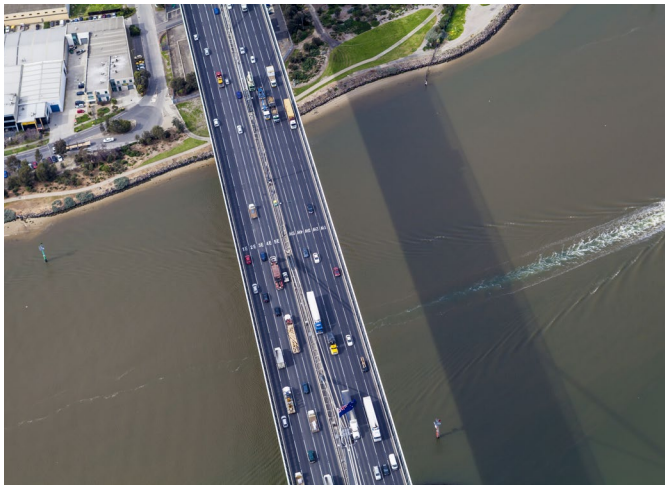

[1] State of Victoria (Department of Premier and Cabinet) (2017), Victorian Infrastructure Plan, p. 36.
[2] See for example Engineers Australia (2016), Victoria Infrastructure Investment Update 2016, p 2.
[3] Analysing Australia's infrastructure trends, 2013, Engineers Australia.
[4] State of Victoria (Department of Premier and Cabinet) (2017), Victorian Infrastructure Plan, p. 44.
[5] State of Victoria (Department of Premier and Cabinet) (2017), Victorian Infrastructure Plan, p. 39.
[6] www.cams.assethub.com.au
[7] A. Gajanayake, H. Mohseni, G. Zhang, J. Mullett, S. Setunge (2018), 'Community adaptation to cope with disaster related road structure failure', Procedia Engineering, Volume 212, pages 1355-1362.
[8] State of Victoria (Department of Premier and Cabinet) (2017), Victorian Infrastructure Plan, p. 37.
[9] S. Setunge, H. Tran, Y. Koay and H. Luczac (2018), 'Predictive modelling of the deterioration of Australian state bridge network', Proceedings of the IABMAS 2018, Melbourne.
[10] F. Kalendhar, S. Setunge, G. Zhang (2018) 'Fragility curves for concrete girder bridges under flood hazard', Proceedings of the IABMAS 2018, Melbourne.

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