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TAKING THE TIME TO UNDERSTAND UNCERTAINTY

A study on how to best allow for travel demand uncertainty in transport investment decisions recommends a flexible and considered approach.

Uncertainty is a pervasive element of transport decision making. From the uncertainties inherent in traffic modelling to the approaches taken to value options, the sources of uncertainty are many.

The research study stresses the need for a process that acknowledges and addresses these uncertainties, as part of improving investment decisions.

Economist Anthony Byett who led the study says, 'While it is natural to improve the traffic forecasts that inform investment decisions, it is also important to acknowledge fundamental uncertainty exists about the future.

'Our research report explores the uncertainties within transport modelling and the ways flexibility in the face of uncertainty can add value to a transport project. We recommend a process that explores the nature of the key uncertainties pertaining to a transport investment and actively searches for robust solutions in the face of uncertainties. The process is transparent in

setting the trade-offs inherent in alternative solutions in front of decision makers.'

The report sets out a decision-making methodology that could be used within New Zealand transport appraisals. The methodology draws heavily on real options analysis, as a means of providing insights into how decision making occurs under uncertainty. Three case studies in the report illustrate how the methodology works.

The authors note that while the methodology has been formulated with travel demand in mind, it is equally suited for considering uncertainties in relation to other aspects of transport investment.

The report also contains a toolkit for use by transport planners, investors and other decision makers, which outlines the eight-step methodology described in the report and how to use it in practice.

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SHORTCOMINGS WITH THE CURRENT APPROACH

At present, there is a well-established procedure within New Zealand transport appraisal of presenting alternative fixed investment choices to decision makers. The approach is based on the net present value of expected benefits and costs from an investment to society, and provides a consistent and rigorous means of assessing these benefits and costs when there is certainty about the investment's future outcomes.

However, the approach usually ignores management's ability to adapt to changing circumstances in the future, for example by changing investments over time, by increasing or decreasing their scale, delaying their timing or switching to alternative investments. These are examples of real options, namely the ability to invest (or divest) in real assets over time, but this adaptability is generally not well treated within a standard investment appraisal.

Future travel demand is a major source of uncertainty within transport appraisals. In general, asset managers make major investments in transport infrastructure in order to lower travel costs for users over the next few decades. However, the actual benefits that are achieved will depend on how travel demand evolves over a long period. Demand can be influenced by external events (such as GDP and population growth) and by changes in other parts of the transport network (such as the development of alternative routes or transport modes).

Instead of committing to a fixed up-front investment, it may be better if managers can adapt their investment over time, as certainty about demand increases. Similarly, it may be best for managers to provide some initial infrastructure, in order to discover whether demand exists and its extent. Both of these scenarios are examples of real options, but there is a possibility these options will be ignored in a standard transport appraisal, either by not being quantified or not being acknowledged at all.

FORMULATING A NEW APPROACH

The research team found there were numerous opportunities for decision makers to adopt a more adaptive approach to project design and decision making, even if this provided some challenges in the valuation stage. Valuation models provide insights into when various options might be valuable – and under what conditions. Ensuring these opportunities are explored, or are not extinguished, was a major part of enabling a more flexible approach.

The report recommends a broader approach to decision making than that currently used. The new approach involves identifying the uncertainty of relevance to the investment decision, as well as ways the investment may be adapted over time and ways this process might be improved by seeking learning opportunities within the investment. An example of the latter would be where decision makers not only take into account the knowledge available at each stage of the process, but also the potential for new knowledge to evolve over time.

The report authors stress that the study did not find a single definitive answer on how to reduce or deal with uncertainty. Nevertheless, it has demonstrated that:

- a thorough process is required in the face of large uncertainties, rather than the adoption of a single go/no-go benefit-cost ratio

- learning and adaptation can be of significant value, even if this involves a trade-off between interim costs and reduced incidence of poor returns
- the use of one discounted expected value as the basis for a decision criterion does not transparently capture the risk propensity of decision makers.

In practical terms, the recommended approach entails the use of decision trees and scenario planning. It draws on quantitative analysis to provide insights, but not necessarily dictate the answer. It also fits closely with the New Zealand Transport Agency's better business case methodology, and is intended to complement rather than replace the cost-benefit analysis approach.

However, the report cautions that 'by virtue of the presence of uncertainty' the approach is 'inevitably imprecise' and will need to be adapted to the circumstances in which it is used.

'In short, our key recommendation is that decision makers take more time to understand how uncertainty interacts with decisions, and give more prominence to adaptive solutions that provide them with ongoing flexibility in the face of uncertainty,' the report concludes.

SOURCES OF UNCERTAINTY IN TRANSPORT INVESTMENT DECISIONS

Uncertainty differs from risk. Under risk conditions, a planner can base projections and scenarios on a well-defined probability distribution, so expected values and variation around those expected values can be defined. By contrast, under uncertainty conditions, the planner cannot rely on a known, well-specified model and probability distribution for determining events that may be material for the planning decision.

Uncertainty may arise from a number of sources.

- Parameter uncertainty exists when a modeller knows the 'true' form of a model that describes potential outcomes for the variable being modelled, but does not know the 'true' parameters.
- Model uncertainty arises when the modeller is unsure of the correct variables (and/or their functional form) to include in the model.
- Fundamental uncertainty arises when unknowable developments may occur for which there is no basis in history or theory to predict their likely impact.

Historical examples of the latter form of uncertainty include the advent of the train, invention of the telegraph and invention of the car. Current examples include the impacts of electric vehicles on issues of climate change and the impact of autonomous vehicles on transport flows.

Incorporating and assessing travel demand uncertainty in transport investment appraisals, NZ Transport Agency research report 620

Available online at www.nzta.govt.nz/resources/research/reports/620

DRIVERS ADMIT DRIVING UNDER THE INFLUENCE OF DRUGS

Research looked into the incidence of drugged driving in New Zealand, and suggested future measures to improve our understanding of this issue, and how to avert it.

A key part of the government's *Safer Journeys* road safety strategy is to 'significantly reduce the incidence of alcohol and drug impaired driving' by 2020.

The strategy recognises the significant part that alcohol and other drugs play in fatal and other crashes. Between 2011 and 2013, alcohol and drugs played a role in 30 percent of fatal crashes, 20 percent of serious injury crashes and 12 percent of minor injury crashes.

Yet although the incidence and adverse consequences of alcohol-impaired driving are now well understood and documented, the impact of drugged driving is less so.

A study by researchers at the University of Waikato has helped redress this imbalance by establishing a quantitative picture of the type and extent of drugged driving in New Zealand and investigating the level of driving impairment produced by the more commonly used drugs, both legal and illegal.

ESTABLISHING THE EXTENT OF THE ISSUE

The study drew on telephone and internet surveys, a literature review and health sector consultation. It sought to address limitations in previous studies, such as biased sampling and restricted scope.

Stratified telephone surveys and a follow-up internet survey were used to explore the extent of drugged driving. Participants reported that, other than alcohol, the drugs they took most commonly before driving were strong opioid-based painkillers, antidepressant medication, anti-nausea medication, cannabis and anti-anxiety medication.

A large proportion of drivers also took combinations of different drugs prior to driving. Between a quarter and a half of drivers who reported taking drugs admitted to doing so more than once a week over the previous 12 months, with the time of day that drugged driving occurred varying depending on the type of drug taken (driving after taking prescription drugs was most common in the morning, and after taking illegal drugs, in the evening).

Using the information from the surveys, the research team conducted a systematic review of the literature to determine the degree of impairment caused by the most commonly taken drugs, and combinations of drugs.

Of these, cannabis, opioid-based painkillers and benzodiazepines (typically used to treat anxiety or insomnia) were most strongly associated with increased crash and driving-related impairment. Further research was needed in relation to morphine and methadone (where the effects were unclear), and selective serotonin re-uptake inhibitors or tramadol (where there was little evidence that they were associated with increased crash risk or impaired driving).



With respect to stimulants, most studies report that they could improve aspects of driving behaviour (such as reaction times), but they may lead to increased risk taking and fatigue.

The combination of drugs and alcohol was also shown to lead to significantly higher crash risk and driving-related impairment, with studies indicating that the odds ratios for crash risk are multiplicative (rather than additive) when substances are taken together.

INFLUENCING DRIVERS' ATTITUDES

The surveys revealed that many of the participants who took drugs and drove were aware of the potentially impairing effects the drugs had on their driving behaviour. Over half of the cannabis users, almost 40 percent of those taking strong painkillers, and a quarter of those taking benzodiazepines had decided not to drive within three hours of taking the drugs. Awareness of potentially debilitating effects was lower among participants taking other types of drugs.

Participants' attitudes to drugged driving were strongly influenced by the legality of the drugs. The majority of participants did not think it was ok to use illegal drugs and drive. Participants were more ambivalent, however, about driving after taking prescription drugs, if they felt their driving abilities had not been compromised.

Only a quarter of participants thought that, at present, people were likely to get caught for drugged driving, although most supported more police time and resources being directed towards enforcing drugged driving laws.

The research team concluded that public education initiatives around drunk and drugged driving could usefully focus on the effects of combined drug use, in particular the combination of alcohol and prescription medication.

In their report, they say, 'Drivers need to be aware that any amount of alcohol (even below the legal drink driving limit) in combination with prescription medication may affect their driving ability and increase their risk of being involved in a crash. One strategy would be to encourage people to plan when they take their medication in relation to when they need to drive and to continue to raise awareness of the fact that we are not good at judging our own levels of impairment.'

GATHERING BETTER INFORMATION

An associated part of the study was to investigate the feasibility of developing a new approach to studying drugged driving, which did not rely on participants' self-reporting. The proposed alternative method would involve analysing blood or saliva samples taken from drivers who had been involved in a crash.

Some information is already available in New Zealand on the blood drug levels of dead and injured drivers. The information comes from blood samples taken for blood alcohol testing purposes. However, the sample sizes in any studies based on this information have been relatively small and limited to blood collected for evidential purposes. Analysis of a larger sample of drivers involved in crashes would provide a more accurate picture of the extent (and impact) of drugged driving in New Zealand.

With this end in mind, the research team consulted with staff from Waikato District Health Board, the Institute of Environmental Science and Research, the Ministry of Transport, and the Waikato Police Traffic and Alcohol group. Consultation explored the feasibility of carrying out additional toxicological analysis on the blood samples that are routinely drawn from trauma patients admitted because of a car crash.

At present, it is not possible to carry out additional analyses on the blood samples that are drawn, but the team proposed that an additional sample (of blood or saliva) could be taken, and sent to an external laboratory for analysis.

Such an approach would require health board and national ethics committee approval, but would significantly increase the amount of information about drug use and driving available to researchers.

Other recommendations included developing a drugged driving marketing campaign directed at women in their late 30s (who featured highly among survey participants who identified that they took prescription (or legal) drugs and drove), and measures to encourage doctors and pharmacists to provide accurate information to patients about how medication may affect their driving skills.



The prevalence and impairment effects of drugged driving in New Zealand, NZ Transport Agency research report 597
Available online at www.nzta.govt.nz/resources/research/reports/597



RESEARCH PROGRAMME OF SIGNIFICANT USE TO THE SECTOR

A 2017 evaluation of the NZ Transport Agency's (Transport Agency's) Research Programme shows that it continues to have substantial value to end users in all areas of the transport sector.

The evaluation, conducted by Evaluate Research, was a follow up to a similar study completed in 2011. It assessed three key aspects of the research that the Transport Agency published between 2011 and 2016. Value was defined as how important the Research Programme was considered to be, both for individual end users and the transport sector as a whole.

The evaluation also looked at the factors that prevented or enabled uptake and use of the research, and at how effective the Transport Agency's Research Programme was, namely, its relevance to end users and the extent to which it aligned with their needs; the approaches to disseminating and promoting the findings, and the value of the research programme overall.

The information from the evaluation will enable the Transport Agency to adopt a learning-oriented and evidence-based approach to how it manages and improves its Research Programme. The Transport Agency also plans to use the findings to evaluate its progress against the New Zealand Transport Research Strategy, which has the goals of investing in the right research, and ensuring that research inputs and results are visible.

There is a spreadsheet listing all published Transport Agency research reports, searchable by several criteria, available at: www.nzta.govt.nz/planning/programming/research.html. The link to the spreadsheet is in the second paragraph under the heading 'How can I find research reports?'

ABOUT THE RESEARCH PROGRAMME

The Transport Agency and its predecessors have managed government-funded research about land transport in New Zealand since 1953. On average, \$5 million is allocated every year to the Transport Agency's Research Programme.

Since 2010, the Transport Agency has selected the topics to be researched, based on the prioritised research needs of various transport decision makers, including itself and the Ministry of Transport.

Since the 2011 evaluation of the Research Programme, the projects commissioned have tended to be of a more significant nature, and have been completed in a more timely fashion, than in the past. During the five years covered by the latest evaluation, the Transport Agency published 142 research reports as part of the programme.

EVALUATION APPROACH

The evaluation included qualitative interviews with Transport Agency staff with responsibility for particular research topic areas, and with transport researchers. It also included a literature review, an online survey of research end users based in New Zealand, and follow-up telephone interviews with a selection of the survey respondents. Respondents were drawn from local and central government, the Transport Agency and other Crown entities, professional bodies, education and training organisations, and private sector research and road contracting companies. Within these organisations, respondents held an equally diverse range of roles.

Also, PDF versions of all Transport Agency research newsletters are available at www.nzta.govt.nz/resources/nzta-research/index.html

Notification emails are sent when Transport Agency Research Programme reports and NZTA research newsletters are published. Email NZTAresearch@nzta.govt.nz to subscribe.

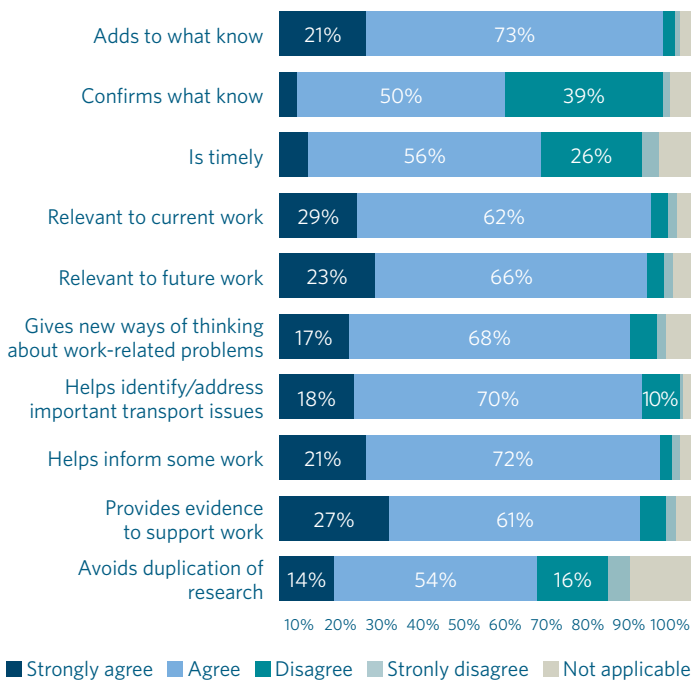
RESEARCH RELEVANCE AND USE

The evaluation assessed how well the research aligned with end users' needs, and its relevance to both their own work and to the New Zealand transport sector as a whole. Most respondents reported that the research 'usually' or 'sometimes' met their needs. However, overall, respondents considered the research very relevant to the New Zealand transport sector.

The evaluation findings indicate that researchers' interests and needs for transport research are diverse. The majority of respondents (85%) said they accessed reports relating to two or more topic areas. This may be due to a research interest that covers more than one topic area: for example, research relating to economic analysis can be discussed within a public transport context.

Respondents were also asked how the research met their needs. The majority of respondents 'strongly agree' or 'agree' that the research adds to what they already know; is relevant to, and helps inform their current or future work; gives them new ways to think about issues; and helps identify or address important transport issues.

HOW RESEARCH MEETS END USER NEEDS (n=168)¹



Respondents also reported they were more likely to use the research to learn something new and share it with others, rather than using the research to inform such things as policy and specifications.

The three main factors that support respondents using the research are its relevance to their work, knowing where to find the reports, and the availability of succinct summaries and conclusions from the full research. These factors were similar to those identified in the 2011 evaluation.

The biggest barrier to respondents using the research was a lack of time to read the full reports.

RESEARCH DISSEMINATION

The evaluation also examined how respondents accessed the Transport Agency's communications about published research reports, and how useful and easy to access they found the various channels used.

Despite most of the research reports being published on the Transport Agency's website, most respondents said they found out about new research either through the Transport Agency's regular email notifications, entitled 'Recently published reports', or its quarterly hard-copy publication *NZTA research*, both of which are sent out to subscribers. Less than half of the respondents found out about the research directly through the website.

Overall, respondents thought the Transport Agency's dissemination of information about the Research Programme could be improved by making it easier to find, easier to access in terms of the way information is presented, and by making it clearer how research might be applied. Specific recommendations included:

- improving the usability of the website, so there is improved visibility of the research and access to the research
- providing more opportunities for research-related events such as the Transport Knowledge Conference and Transport Knowledge Hubs.

An assessment of the programme's value for money proved challenging, partly because of the lack of an agreed definition of value. Any attempt to assess the programme's value would need to take into account a range of factors. These include the extent to which the research is used; and whether cost savings are made as a result of the research, either due to the introduction of an innovation or because work is not undertaken, as research shows it is not necessary.

The report concludes there are opportunities for the Transport Agency to build on the ideas discussed in the research, and explore the various mechanisms by which the Research Programme's value might be measured. This would enable ongoing systematic monitoring and evaluation of the programme.

Assessment of the value to end users of the NZ Transport Agency research programme, NZ Transport Agency research report 624

Available online at www.nzta.govt.nz/resources/research/reports/624



BEST VALUE DELINEATION FOR RURAL ROADS

Updated guidance is available on the best types, quantities and configurations of delineation roadmarkings and devices to use on rural roads.

The guidance, the result of a research project by Opus Research, will be used to update existing guidelines for rural roadmarking and delineation.

BALANCING DELINEATION OPTIONS

The importance of finding cost-effective delineation solutions for rural roads is demonstrated by the fatal crash statistics. In 2015, nearly 73 percent of fatal crashes in New Zealand occurred on rural roads, and nearly half of these (43 percent) were due to motorists losing control of their vehicle or running off the road.

Not surprisingly, this type of crash is more common on corners, than on straight sections of road, and delineation, roadmarkings and devices (such as road edge marker posts and reflective pavement markers) are common tools used to aid driver navigation. Delineation devices become increasingly important when visibility is poor (such as in night or rain conditions) and can allow drivers to preview the road ahead in the same way as if they were driving in dry day conditions.

However, delineation treatments come at a cost, and this cost is not always easy for road managers to justify on low-volume rural roads, especially when set against competing priorities elsewhere in the network.

This need to balance competing priorities, and optimise costs across the rural network is taken as a starting point by the research report authors who recognise that:

...any delineation treatment should aim to achieve a balance between cost, safety and customer comfort. Consideration should also be given to the level of exposure within different road hierarchies in order to maximise resource value, where roads with higher volumes of customers receive higher levels of service (eg following the One Network Road Classification).

Developing a best value delineation approach, the authors conclude, is all about understanding the effectiveness of different delineation solutions so safety, cost, journey time and comfort can be optimised across the network.

THE RESEARCH BEHIND THE GUIDANCE

The project examined delineation treatments for rural roads, which included sealed roads in rural locations with speed limits of 70 km/h and over. A particular focus was on low-volume roads, where the need for treatments to be cost effective becomes more pronounced.

A combined research methodology was used, incorporating a literature review, on-road trials, a driver survey, and an analysis of the costs and benefits of the various treatments.

Four delineation treatments were tested during the trials:

- targeted delineation for corners by removing edge marker posts on a straight stretch of road before a curve
- a structured marking edge line on a curve
- raised reflective pavement markers on a curve
- audio tactile profile markings on the edge line on a curve.

All four treatments were designed to help motorists negotiate curves on rural roads, with the last three also targeted at helping in wet weather conditions.

The key considerations in deciding which treatments performed best were to do with targeted delineation (to assist drivers by signalling more difficult parts of the road network), consolidation (where one configuration with a new product might replace two traditional products), and better delineation in rain (as a common poor visibility environment, where crashes are over represented).

The findings provided new information about the importance of complementary devices, including edge marker posts and raised reflectorised pavement markings in different contexts. To help implement better delineation solutions for lower volume rural roads, the report offers practical updates of the rural road delineation guidance, based on the findings from the research.

RECOMMENDATIONS FROM THE RESEARCH

The report makes several recommendations, based on the findings of the research, including the following with respect to specific delineation treatments.

- Edge post markers – these are cost-effective, all-weather, delineation tools, with good safety value, and should be used and maintained on all road hierarchies, on both straight stretches and curves. The findings show new evidence that they also provide critical guidance in night-time driving conditions beyond navigation, as they improve motorists' judgement of speed and distance.
- Raised reflective pavement markers – these are a cost-effective, inclement weather and night-time solution that should be more widely used on most rural roads, especially in areas that experience a lot of wet weather and wet weather crashes. Raised pavement markers add complementary safety value, even to high-quality roadmarkings, and increase the visibility of traditional continuous line treatments when driving in the rain.

Other recommendations included specific improvements and updates to national guidance for delineation treatments. Greater consistency in how treatments were used would support self-explaining road designs – where motorists are intuitively cued to an increase in risk through an increase in delineation. Such guidance could align with existing road categorisations, such as 'curved', 'winding' and 'tortuous' sections of road, based on the

One Network Road Classification. Greater consistency would also be useful in relation to our aging population and rapidly emerging technologies, such as autonomous vehicles.

Areas where more research was required, included:

- trialling tangent-point delineation solutions at curves – this would involve targeting delineation treatments to the areas of the curve where drivers most frequently look
- examining the apparent gap between motorists' behaviour and reflectometer readings in wet conditions – there is some evidence to suggest that the human eye detects some markings better than expected in rainy conditions
- investigating the possibility that textured road surface markings provide additional visibility effects for motorists, as well as grip and drainage
- conducting further trials of structured markings – although these appeared to improve visibility for drivers in rainy conditions, there were issues with the markings trialled during the research.

As a final recommendation, the Opus Research team suggest that early communications and greater transparency with the public about why a change or reduction in delineation treatments was planned for an area would help reduce backlash. Road users are passionate about their safety on the road and view delineation as a critical ingredient in a safe, enjoyable road environment.



Trialling best value delineation treatments for rural roads,
NZ Transport Agency research report 618

Available online at www.nzta.govt.nz/resources/research/reports/618

BEST-PRACTICE GUIDE TO PAVEMENT STABILISATION PUBLISHED

The Transport Agency has published a comprehensive best practice technical guide for pavement stabilisation in New Zealand.

Contained in a report by Opus International Consultants, the guide brings together informed, current technical advice from a variety of sources to enable road controlling authorities, consultants and contractors in New Zealand to successfully investigate, design, construct, maintain and operate pavements with stabilised components.

The guide will also enable the Transport Agency to promote best practice for stabilisation and make maximum use of the opportunities that stabilisation enables. It will provide a starting point for the ongoing review and development of pavement stabilisation best practice in New Zealand.

PAVEMENT STABILISATION IN NEW ZEALAND

New Zealand pavement engineers, along with their colleagues in South Africa and Australia, are recognised internationally as leaders in the use of stabilisation in highway, road, airport, port and industrial hardstand pavement construction.

Research and developments in stabilisation plant and practices mean stabilisation now offers a safe, efficient, affordable and sustainable technique for use in pavement construction, rehabilitation and maintenance.

Stabilisation is used to rectify deficiencies in the soil, aggregate or surfacing materials used in pavement construction. Stabilised materials contribute to the strength and performance of pavements at all levels, including the subgrade, subbase, base and surfacing. The four types of stabilisation most commonly used in New Zealand pavements can be broadly categorised as: cementitious; bituminous; chemical or mechanical.

Both sealed and unsealed roads can be stabilised. For unsealed roads, pavement stabilisation is used to develop strength in the subgrade and pavement layers, and to control water sensitivity, rutting, dust and aggregate loss. For sealed roads, pavement layer strength (stiffness) improvements and reducing moisture sensitivity at all pavement system levels following stabilisation enable pavements to carry more traffic and to be operated and maintained effectively.

The new best practice guide is based on existing research and the expertise of pavement stabilisation specialists worldwide. To develop it, Opus did not carry out further investigation or testing into stabilisation techniques, as this information was already available. Instead, the research team examined current

best practice and research findings from around the globe to determine which approaches were best suited to the New Zealand context.

HOW TO USE THE GUIDE

The best practice guide provides users with practical technical advice on:

- pavement stabilisation principles
- treatment selection for stabilised pavements
- laboratory and field tests for stabilised pavements
- structural design for stabilised pavements
- construction of stabilised pavements
- quality management
- ongoing research.

Users will gain a clear understanding of how they can incorporate the science behind material stabilisation in their pavement treatment selection processes. They will also understand how the investigation, design and construction processes employed in pavement stabilisation are best used in the New Zealand context.

The guide assumes users have a background in engineering, and a sound technical understanding of mechanical stress and the resultant response in engineered soils and aggregate. First-time users are encouraged to read the guide from the beginning where they will find an overview of the history and background of pavement stabilisation techniques and materials used in New Zealand.

The guide includes extensive references to previously published information about pavement stabilisation, including related Transport Agency and Austroads design guides, material and construction specifications.

There are also worked structural design examples, to demonstrate current design best practice. The examples include references to frequently used design charts, catalogue solutions and other design methods.

Best practice guide for pavement stabilisation, NZ Transport Agency research report 622

Available online at www.nzta.govt.nz/resources/research/reports/622



RECENTLY PUBLISHED RESEARCH REPORT ABSTRACTS

Speed limit reductions to support lower SCRM investigatory levels

NZ Transport Agency research report 636

Freely available online at www.nzta.govt.nz/resources/research/reports/636

This report details a framework for rationally arriving at economically justifiable operating speed reductions to compensate for the inability to achieve recommended levels of skid resistance on high-risk curves. The framework is based on vehicle speed-related procedures incorporated in the Transport Agency's *Economic evaluation manual*. These procedures include travel time, vehicle operating costs, carbon dioxide emissions and crash severity. Relationships between the skid resistance level of the road surface and curve crash risk and expected service life of the road surface derived from previous New Zealand specific research are also employed.

The framework was trialled on a 10 km section of state highway 58 with a 100 km/h speed limit. A decrease in operational speed of only 10 km/h was found to be sufficient to completely negate the increased curve crash risk that results when the skid resistance of the high crash risk curves is managed to a lower level of 0.4 ESC rather than the recommended investigatory level. The overall benefit of reducing the 100 km/h speed limit by 10 km/h would amount to an annual cost saving of about \$1.5 million, with the reduction in speed change cycle costs making the largest contribution.

Network and asset management: benefits of real-time data

NZ Transport Agency research report 638

Freely available online at www.nzta.govt.nz/resources/research/reports/638

Data is essential for understanding the demands placed on road assets and transport networks. There is an opportunity through advances in real-time technologies to improve the delivery of network management and asset management activities. This requires an understanding of both the real-time technologies that are available, and the real-time information needs of network managers and asset managers.

This research investigated the applications of real-time technologies and data in asset and network management. This included identifying a range of opportunities for expanding the use of real-time technology, for example by

making better use of existing datasets and improving the detection of incidents and defects. A range of challenges was also identified, including the difficulties of working with 'big' real-time datasets, the risk of reliance on technology and the need for specialist expertise to develop real-time applications.

The outputs of this research include a range of recommendations, including possible real-time technology applications and actions to ensure the transport industry keeps up to date with advances in sensor technologies, analytical platforms and communication networks.

Technology related transport skill requirements and availability

NZ Transport Agency research report 639

Freely available online at www.nzta.govt.nz/resources/research/reports/639

This paper reports an assessment of skills gaps and training needs likely in 2035 for New Zealand, resulting from the technological change from implementation of intelligent transport systems (ITS) in land transport.

The research reported was funded by the Transport Agency and conducted in 2017 in Wellington, New Zealand. Current economics and engineering literature provided important insights into the impact of technological change on skills demanded and the consequences for occupations and training.

Accordingly, to develop the skills gap assessment, the researchers first developed scenarios of future ITS environments in New Zealand in 2035. This was informed by global literature on ITS technologies and their likely implementation by 2035.

Paramount among these technologies were autonomous vehicles, where their level of autonomy and coverage of the national vehicle fleet by 2035, is a useful metric of the overall level of ITS development. The skills gap assessment is presented in terms of relevant well-defined occupations prevailing in 2017.

The occupations considered are: transport, information and communication technology and public policy professionals; automotive technicians and other motor trades workers; and drivers.

To indicate the quantum of skills gaps, the paper concludes with empirical projections of numbers of future occupations in demand under an ITS environment.

Developing a national measure for predictable public transport

NZ Transport Agency research report 641

Freely available online at www.nzta.govt.nz/resources/research/reports/641

The ability to reliably predict public transport (PT) journey times is critical for network operators and transport authorities to measure, monitor and target improvements to the PT network, with flow-on effects for customers.

Research conducted in New Zealand between August 2016 and August 2017 aimed to identify and develop an optimal measure for PT predictability. This involved undertaking a local and international review of predictability/reliability measures used for PT or private vehicle travel, and included evaluation of measures.

From this review, and consideration of the potential for inter-modal and inter-regional aggregation, a shortlist of three preferred measures was developed including: buffer index, modified buffer index and planning index. Shortlisted measures were applied to a nationally aggregated set of PT travel data from across regions and PT modes.

This data testing helped assess 'fit' to the Transport Agency's road index, modification potential, and revealed that the shortlisted measures were all linearly related, with comparable results across different measures. This suggested there was not a compelling case for one particular measure to be used.

Validation workshops further revealed that stakeholders felt selection of any shortlisted measures depended on what aspect of reliability one wanted to examine and that care needed to be taken in comparing modes and developing thresholds.

The influence of internet use on transport demand

NZ Transport Agency research report 642

Freely available online at www.nzta.govt.nz/resources/research/reports/642

This report presents a discussion of the influence that internet-enabled communication technologies are having, and might have, on patterns of transport demand in New Zealand. First, a range of mechanisms by which the internet could reasonably be expected to influence transport demand is described. In-depth interviews with decision makers at public and private organisations in New Zealand highlighted two main areas where change is being driven by internet communication technologies: direct effects on transport demand; and the changing nature of the physical workplace, which has outcomes for transport demand as people change where, when and how they work.

There is a dearth of literature that quantifies a causal association between use of the internet and transport demand. Additionally, suitable datasets to measure the influence at city, regional or national levels do not currently exist in New Zealand. Much investment and change in use of internet communications technologies is taking place at an organisational scale, even though the relationship between investment in technology and transport outcomes is confounded by factors of behavioural preferences, societal and organisational norms, and internal policies. The experience of these organisations identifies changes we can expect for both transport demand and working behaviours in an increasingly digital society.



OBTAINING TRANSPORT AGENCY RESEARCH REPORTS

All research reports published since 2005 are available free of cost for downloading from the Transport Agency's website www.nzta.govt.nz/planning/programming/research. PDF scans of research reports published prior to 2005 are available by emailing NZTAresearch@nzta.govt.nz

A NOTE FOR READERS

NZTA research newsletter

The *NZTA research* newsletter is published quarterly by the NZ Transport Agency. Its purpose is to profile research funded through the Transport Agency's Research Programme, to act as a forum for passing on national and international information, and to aid collaboration between all those involved. For information about the Transport Agency's Research Programme, see www.nzta.govt.nz/planning/programming/research.html.

Advertisements of forthcoming conferences and workshops, that are within the newsletter's field of interest, may be published free of charge when space permits.

Published articles may be reproduced and reference made to any part of this publication, provided appropriate credit is given.

All general correspondence, queries related to conference notices, and requests for additions or amendments to the mailing list, should be made to NZTAresearch@nzta.govt.nz.

Disclaimer

The views expressed in the *NZTA research* newsletter are the outcome of research and should not be regarded as being the opinion, responsibility or policy of the Transport Agency or of any agency of the New Zealand Government.

Availability of NZTA research

The current edition of the *NZTA research* newsletter is available in hard copy or on the Transport Agency website, along with all previous editions of the newsletter, at www.nzta.govt.nz/resources/nzta-research/.

Email alerts of newly published research reports

Email notifications are provided when new issues of the *NZTA research* newsletter are published. Notification is also provided when new Transport Agency research reports are published on the Transport Agency's website at www.nzta.govt.nz/planning/programming/research.html. Please email NZTAresearch@nzta.govt.nz if you would like to receive these email alerts.

Do we have your correct details?

We would like to hear from you at NZTAresearch@nzta.govt.nz if you wish to:

- add or update names, email or address details
- receive the *NZTA research* newsletter in hard copy format
- receive email notification of the publication of the *NZTA research* newsletter and research reports
- alter the number of *NZTA research* newsletter hard copies you receive.

Media contact

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DID YOU KNOW...

That there is a spreadsheet on the Transport Agency website listing all published Transport Agency research reports?

The spreadsheet is searchable by several criteria and can be found at www.nzta.govt.nz/planning-and-investment/learning-and-resources/research-programme/

The spreadsheet has two worksheets; the first worksheet lists research reports with associated key words and the second lists research reports with the report abstracts.

