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NZTA research

NZ TRANSPORT AGENCY
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THE FUTURE OF RESEARCH IS HERE!

The NZ Transport Agency has reshaped its research programme to ensure a more agile approach to topic generation and approval, and to align it with the transport sector's outcomes framework.

This includes a stronger connection of our research to:

- inclusive access
- healthy and safe people
- resilience and security
- economic prosperity
- environmental sustainability.

The change means transforming our research programme to operate within the following seven principles so that it will:

- support achievement of the government's strategic direction and priorities for land transport
- be fit-for-purpose, robust and deliver value for money
- have the necessary checks and balances to support quality and ethical research
- enable and encourage an innovative, agile and bespoke ecosystem
- be able to nurture key partnerships, within the transport sector and across central and local government, industry and business
- have the broadest definition of transport sector appropriate to supporting achievement of government direction and priorities
- have appropriate expert and inclusive governance.

This means the research programme will keep up with the pace of change affecting the transport sector and take a broader research leadership role in terms of developing working relationships with the academic and innovation communities as well as other research funders.

The definition of research is also broader in terms of the methods used and outputs delivered. The new programme will be looking for opportunities to provide innovative research products that facilitate action.

Our research team will lead and support the delivery of the programme in close collaboration with stakeholders to inform what research is required to fill critical knowledge gaps. Linked to this will be a greater emphasis on collaboration, particularly with respect to seeking partnership with other agencies for the purpose of providing collaboration and funding support.

These changes were made in close collaboration with key transport and research decision makers and we thank them for their input.

See the back page for contact details should you wish to know more about the programme.

PREDICTED GROWTH IN INTELLIGENT TRANSPORT BRINGS NEED FOR NEW SKILLS

New Zealand is likely to face a skills gap among transport-related occupations, as a result of a predicted rise in the use of intelligent transport systems in land transport.

In 2016 the Transport Agency commissioned Business and Economic Research Limited (BERL) to identify the key skills, from the perspective of governing bodies, that would be required in the future to enable the smooth transitioning of intelligent transport systems (ITS)-related technology in land transport.

The research identified both the ITS that are likely to be in demand by 2035, and the industries, occupations and skills that will be required to implement, run and maintain the systems.

A review of the international literature on ITS technologies and their future implementation revealed that autonomous vehicles are likely to be paramount among these technologies. Based on this, the research used the level of autonomy of these vehicles and their use in the national vehicle fleet, as a useful metric for the overall level of ITS development that is likely to occur in New Zealand by 2035.

Based on current patterns of employment and qualifications in the transport sector, the report projects the likely size of the skills gap within the occupations that will be in demand to enable this ITS development, and discusses the role that training can play in addressing this.

ASSESSING THE SKILLS GAPS

The skills gap assessment is presented in terms of the transport-related occupations that were most in demand in 2017, namely transport, information and communications technology (ICT), public policy professionals, automotive technicians and other motor trade workers, and drivers.

The assessment showed:

- While these occupations are likely to still be in demand, the skills required of them will change significantly.
- All occupations will require skills to access and operate online tools and resources, although such skills may already be ubiquitous by 2035.
- Commercial freight drivers and passenger transport drivers are likely to require new skills to operate near-autonomous vehicles in controlled environments.
- Automotive technicians will require new skills to maintain the complex high-technology devices in vehicles, operate computer-based diagnostic equipment and interact with other specialists locally and online.
- Professional and technical engineers will need to develop new skills to be able to collaborate in multidisciplinary teams to provide user-friendly and people-focused transport solutions, and address transport environments as systems.
- ICT professionals and technicians will also need collaborative and human-centric skills. Although their data analytic skills will continue to be in high demand, these will need to be coupled with skills for creativity and design. In addition, there will be a high demand for their skills to create new solutions for people, and connect the telematics embedded in vehicles with other devices, cellular networks and the cloud.

Employment projections for 55 of these occupations, identified as most relevant to ITS implementation, were prepared based on two opposing scenarios: slow and rapid uptake of ITS in New Zealand.

Compared with the baseline projection, which represents the current expected level of future employment for these occupations, both scenarios show a greater demand for engineers to build and maintain the physical infrastructure of ITS, and ICT professionals to build and maintain the virtual infrastructure and software needed.

Compared with the baseline both scenarios show less demand for drivers, and for automotive panel beaters and body builders, as ITS require fewer human drivers and result in fewer crashes requiring repairs.

TRAINING TO BRIDGE THE GAP

The research went on to assess the training needed to fill the skills gap, concluding that students, training organisations, business, manufacturers and government would all have a role to play in fostering and acquiring the necessary skills.

In particular, industry leadership will be essential for assessing and delivering training needs. This is because ITS firms precisely understand the current skills needs, and are best placed to set both the short- and long-term learning agenda for their staff.

Key findings on the training needs for specific professions include:

- transport professionals and technicians – current skills shortages among this group represent a risk to future ITS implementation. Training needs to encompass a wider field of codified knowledge, and provide the skills required to carry out tasks in rapidly changing systems and collaborate with skilled workers in other fields
- motor trade technicians – the current chronic shortage of skilled technicians needs to be addressed before long-term skill needs can be tackled. Motor trade technicians are typically trained through apprenticeships, so skilled staff are needed now to pass learning onto future technicians. Cross-sector collaborations between industry and training organisations are already underway, and should emphasise apprenticeship training and provide clear training pathways. The introduction of new ITS technologies will require manufacturers to provide knowledge for trainers, both in institutions and in the workplace
- ICT professionals and technicians – there is also a chronic shortage of skilled labour in these professions, which also presents a risk to ITS implementation. Future training for these professionals needs to emphasise development of human-centric skills to enable collaboration with specialists in other fields, as well as providing the skills to operate in big data environments.

Technology related transport skill requirements and availability, NZ Transport Agency research report 639

Available online at **www.nzta.govt.nz/resources/research/reports/639**

USING CAUSAL INFERENCE TECHNIQUES IN TRANSPORT EVALUATIONS

Research by Schiff Consulting and Resource Economics provides guidance on using causal inference techniques in the ex-post evaluation of interventions in the transport sector.

In 2016 the Transport Agency commissioned this research to establish best practice methods and techniques to estimate impacts caused by transport interventions as part of an ex-post evaluation. Ex-post evaluation seeks to estimate impacts of interventions after they have occurred. It aims to be both objective and factual.

The report focuses on the statistical methods used to estimate the effects caused by an intervention – known as causal inference techniques or methods.

The causal inference techniques used in ex-post evaluation seek to establish robust counterfactual scenarios and outcomes, against which actual post-intervention outcomes can be compared. In ex-post evaluation, the counterfactual scenario represents the hypothetical state of the world without the intervention. The effects of the transport intervention can be estimated by comparing the differences between actual and counterfactual outcomes.

Without a counterfactual scenario, any analysis of the outcomes of an intervention is purely descriptive, not causal. Causal inference techniques also aim to take into account the effects of other factors that may have affected outcomes, aside from the intervention itself.

There are many causal inference techniques and the research report provides guidance on selecting a method, depending on the data available and the type of intervention being evaluated.

The report illustrates how causal inference techniques can be used in practice for ex-post evaluation by applying them in two New Zealand case studies – the implementation of safer speed areas in Hamilton, and Auckland's Northern Busway. It also sets out recommendations for improving the robustness of ex-post evaluations.

A SURVEY OF CAUSAL INFERENCE TECHNIQUES

The causal inference techniques surveyed in the report are already widely used, including for evaluating transport interventions. Techniques looked at included:

- cross-sectional regression
- difference-in-differences
- propensity score matching
- fixed effects models
- instrumental variables
- regression discontinuity
- interrupted time series analysis.

The report examines and explains the key features of each technique, including its assumptions and limitations, and surveys how it has been used in the literature relating to transport evaluation. It also provides practical guidance for using each technique, including worked examples in Excel, R and STATA.

The authors recommend using difference-in-differences or fixed effect techniques for ex-post evaluation where possible. These techniques exploit both temporal and cross-sectional variations, and are more likely to give estimates of causal effects that are free from bias, compared with techniques that rely on a single source of variation. They can also be further improved by using propensity score matching.

The authors note that the combination of propensity score matching and difference-in-differences provides a particularly powerful and relatively straightforward technique when suitable data is available. However, in practice, limitations in the available data may make it impossible to use these sophisticated techniques. Where this is the case, evaluators may need to fall back on simpler methods, such as cross-sectional regression models and interrupted time series analysis.

The authors also recognise that certain types of interventions and outcomes will lend themselves to particular techniques for ex-post evaluation, or make others unsuitable. The report surveys and recommends techniques for use with one-off local projects, projects and policies applied to specific geographical areas, homogenous local or regional projects, and national policies.

Whichever approach is selected, the report reinforces that effective ex-post evaluation using causal inference techniques will require a 'suitably rich dataset'. The most robust methods can be used if data on outcomes and characteristics of treatment and control units is available ex-ante as well as ex-post. This means that data requirements for ex-post evaluation should be considered at the project planning stage.

MAIN RECOMMENDATIONS

The table below sets out the authors' main recommendations when using causal inference techniques in ex-post evaluation of transport interventions. The research report discusses each of these recommendations in detail.

RECOMMENDATIONS FOR USING CAUSAL INFERENCE IN EX-POST EVALUATION
All attempts at ex-post estimation of the effects caused by transport interventions must carefully consider how to define and measure an appropriate counterfactual for the intervention.
Simple before-and-after comparisons of outcomes, or comparisons of average outcomes for a treatment and control group, are unlikely to give reliable estimates of causal effects, and these methods should not be used to draw conclusions in ex-post analysis. However, naïve comparisons can be a useful benchmark against which results from other methods can be compared.
If the only data available for ex-post analysis is observations of a single outcome over time, an interrupted time series regression model should be used to estimate the effect of an intervention that occurred at a certain point in the time series. Where possible, the regression model should include other variables aside from the intervention that may have affected the outcome of interest over time. However, this method should not be used if the data is available to use other more reliable methods as it is difficult to be sure all other factors have been controlled.
If the only data available for ex-post analysis is outcomes for treatment and control groups at a single point in time, cross-sectional regression analysis that includes variables measuring observed characteristics of the two groups should be used. However, the results of such analysis could be biased by the effects of unobserved factors that cannot be controlled.
Whenever possible, a difference-in-differences or panel fixed-effects model should be used for estimating causal effects. These methods require pre- and post-intervention data on outcomes for treatment and control groups, and are more likely to produce reliable estimates of causal effects than the other methods described.
If possible, reporting systems should be set up so suitable data for difference-in-differences analysis is available to evaluate interventions ex-post. This requires establishing suitable treatment and control groups, and observing pre-intervention characteristics of both groups.

Ex-post evaluation of transport interventions using causal inference methods, NZ Transport Agency research report 630

Available online at **www.nzta.govt.nz/resources/research/reports/630**

STUDY EVALUATES RELATIVE STRENGTH OF CHIPSEAL DESIGNS

In 2016, the Transport Agency commissioned research into the benefits and costs of two-coat and racked-in chipseals to provide data to substantiate the assumption they will perform better under traffic stress conditions that may lead to chip loss in a less expensive single coat seal.

The research, undertaken by WSP Opus, has strengthened understanding of the mechanisms and factors that lead to chip movement as a result of surface shear stresses. It represents a preparatory stage to understand how chipseals might be improved to withstand increases in horizontal shear forces imposed by traffic loadings.

The report reviews the available literature on tyre/pavement interactions, as well as chipseal treatment types and their resistance to traffic-induced surface shear forces. It investigates the physical mechanisms, site and vehicle factors that contribute to seal damage.

It then sets out a method for comparing seal strengths under simulated conditions. The test method compares and evaluates the effect of seal and binder type on overall seal performance in the laboratory, but under realistic traffic speed, loading and temperature conditions.

The next stage of the project was an experimental plan based on the new test method.

DEVISING AN EFFECTIVE TEST METHOD

Two-coat and racked-in seals are often selected by pavement designers on the assumption they will perform better in the short term. However, there is a lack of real data to substantiate the assumed benefits and additional costs of using these seals.

A two-stage project is designed to compare the shear resistance of single-coat seals, racked-in seals and two-coat seals. The first stage of the research, completed by WSP Opus during 2016 and 2017, uses laboratory simulation of traffic shear forces to investigate the mechanisms that lead to chip loss.

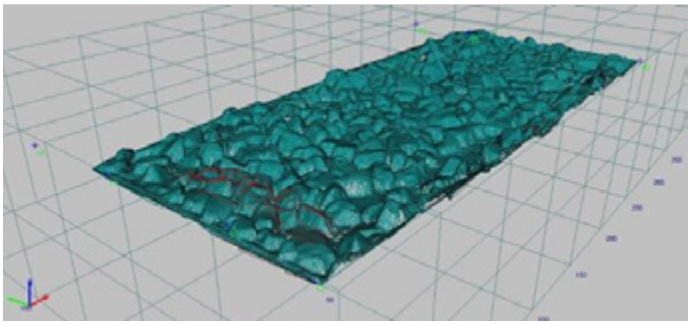
Laboratory testing was selected for the project because of the risks involved in testing various surface treatments on public roads, such as the inevitable variations in weather and traffic loading conditions. By electing laboratory simulation, all variables could be held constant, enabling one measured change at a time to be made and assessed.

The simulation used the WSP Opus circular accelerated surfacing tester, a purpose-built machine for testing the materials used in road surfacing, including binders, aggregates and pavement marking materials. The machine uses a rotating pair of pneumatic tyres to apply horizontal shear force to the surface being tested. The tyres travel around a circular track at up to 50 km/h. The short radius of the rotating arms ensures that a high level of shear stress, or scuffing, is applied to the test seal surface to provide an accelerated test.

Up to four samples can be inserted into the track at once, enabling simultaneous testing in a constant environment. The tester is housed in an insulated enclosure to enable temperature-controlled testing, with surface and air temperatures able to be controlled separately to cover temperatures ranging from 0ºC to 60ºC, often experienced in the field.

Changes in the surface are measured using stereo photography (micro-photogrammetry) to generate a 3D image. The image is then converted into a dataset of surface points (x, y, z coordinates), at micrometre resolution.

The report sets out a full experimental plan for the proposed stage 2.



Micro-photogrammetric analysis of seal surface

Effect of road seal type on resistance to traffic stresses, NZ Transport Agency research report 634

Available online at **www.nzta.govt.nz/resources/research/reports/634**

SLOWING OR SLIPPING – ASSESSING SPEED AND FRICTION ON CURVES

A new framework tool will enable the impact of reducing the friction on rural state highways curves to be assessed, alongside the impact of lowering the speed limit.

In 2014 the Transport Agency commissioned Opus to develop an analysis framework for 'rationally arriving at justifiable operating speed reductions to compensate for the inability to achieve recommended levels of skid resistance on high-risk curves'.

The framework allows the impact of lowering both the wet friction levels that state highways are managed to and the speed limits to be assessed in terms of crash risk and road user costs.

WHY THE FRAMEWORK IS NEEDED

Previous Transport Agency-funded research identified the most appropriate skid-resistance investigatory levels for curves on rural state highways, as well as the procedure to be followed in assigning these levels to particular curves. The levels are now encapsulated in the T10 specification and used when designing new and replacement seals.

Unfortunately, the polishing action of cornering traffic can cause the friction provided by the road surface to fall below the recommended investigatory levels well before the end of the surface's design life.

When surfaces reach an undesirably low skid-resistance level, they have traditionally been fixed by applying a reseal with an aggregate that has more polishing resistance. In some cases, the need for special aggregates to be used to achieve the desired level of skid resistance can increase the cost of resealing substantially.

At times, maintenance budget constraints and limited availability of suitable aggregates can mean it is not possible to reseal curves so that they continue to provide the specified skid-resistance levels. In these situations, road authorities tend to prioritise which curves get treated and to what level. Some curves may never be treated or be treated with locally available aggregates with lesser polishing resistance. (These curves are typically on lower volume roads that have fewer crash risks associated with them.)

One way to lower the risk associated with these less-than-optimally treated curves is to lower the speed limit. This then raises the question of what impact lower operating speeds have on crash risk, vehicle operating costs and travel times.

The research investigated these issues and produced a framework for analysing them in the context of the relationship between skid resistance and speed.

ABOUT THE FRAMEWORK

The analysis framework is based on the vehicle speed-related procedures incorporated in the Transport Agency's *Economic evaluation manual*. These procedures include travel times, vehicle operating costs, carbon dioxide emissions and crash severity. New Zealand research into the relationships between the skid resistance level of the road surface, the curve crash risk and the expected service life of the road surface has also been taken into account.

As a result, the framework's analysis is tailored to New Zealand conditions, meaning the calculated benefits produced can be compared directly with other asset preservation or safety proposals.

As part of the research project, the framework was trialled on a 10 km section of state highway, where the speed limit was 100 km/h speed limit. The trial section included 28 high-risk curves, and had an average crash density of 0.72 casualty crashes per kilometre per year. For the trial, the operational speed over the 10 km section was reduced by 10 km/h (ie to 90 km/h).

The trial showed that by decreasing the operational speed by 10 km/h, the increased crash risk associated with having less-than-optimal skid-resistance on the high-crash-risk curves was completely negated. For the trial, the skid resistance of the high-risk curves in the section was managed to a lower level of 0.4 equilibrium SCRIM coefficient (ESC), rather than the recommended investigatory level, which on 19 of the 28 curves was ≥ 0.5 ESC.

The overall benefit of reducing the 100 km/h speed limit by 10 km/h was found to be an annual cost saving of about $1.5 million, with the reduction in speed change cycle costs making the largest contribution. This indicated that, for this state highway, reducing the 100 km/h speed limit was a very effective safety measure if the skid resistance of the high-risk curves could not be maintained at or above their recommended investigatory level and wider economic benefits could also be realised.

USING THE TOOL

The research produced a prototype spreadsheet for performing the analysis in the framework. The Transport Agency uses the analysis from the research to consider the appropriate maintenance treatment for rural state highways.

The spreadsheet is included as a separate appendix to the research report, and is available at **www.nzta.govt.nz/resources/research/reports/636**.

All the data required to use the spreadsheet can be extracted from the Road Assessment and Maintenance Management System (RAMM) tables for:

- carriageway
- curve context
- high-speed geometry
- sign
- skid resistance.

The research report notes that the current version of RAMM contains both speed and speed limit tables. These tables are not currently populated, but once the data becomes available, it will improve the robustness and usability of the spreadsheet.

Speed limit reductions to support lower SCRIM investigatory levels, NZ Transport Agency research report 636

Available online at **www.nzta.govt.nz/resources/research/reports/636**

RECENTLY PUBLISHED RESEARCH REPORT ABSTRACTS

Post-impact care: How can New Zealand address the fifth pillar of road safety?

NZ Transport Agency research report 645

Freely available online at www.nzta.govt.nz/resources/research/reports/645

Post-crash care of victims is considered by the World Health Organisation to be the fifth pillar of the safe system approach to road safety. Timeliness and quality of transport of crash victims from the crash site to hospital door is crucial to medical outcomes. It is important that road controlling authorities (RCAs) and Road Policing work together with Emergency Services to provide the best possible outcomes for the available resources.

This report considers the roles of RCAs and Road Policing in facilitating transport of crash victims from the crash site to the hospital door. The report includes a literature and technology review, a crash analysis and estimates of the time from crash notification to hospital. Also considered are issues arising from a workshop of stakeholders and an online survey of front-line staff from Road Policing, St John and Fire and Emergency New Zealand.

Recommendations for future strategies and actions relate to the place of post-crash care in road safety planning, crash location technology, agencies working together, the need for mobile networks, effective communications and traffic management including crash site management and emergency vehicle priority schemes. Recommendations are also made regarding information available in crash reports on post-crash care.

COMPANION REPORT

A second report *New Zealand Trauma System Review* has also just been released. Prepared by the Royal Australasian College of Surgeons, this report is a review of New Zealand's trauma system and will be used to inform the new national Road Safety Strategy. Read the report here: **www.saferjourneys.govt.nz/resources/**

Great Kiwi road trips: enhancing New Zealand's tourism industry through better visitor journeys

NZ Transport Agency research report 649

Freely available online at www.nzta.govt.nz/resources/research/reports/649

The purpose of this study was to gain a better understanding of the expectations, motivations, experiences, information preferences and behaviour of visitors (both domestic and international) travelling on New Zealand's transport network.

Such knowledge enables a multi-agency approach combining tourism, heritage and transport to identify ways to monitor and improve visitor travel experiences, grow tourism and consequently promote regional economic gain.

To do this, a pilot visitor travel survey was trialled, including an information-based intervention.

The purpose of this was to capture unique visitor travel behaviour information, and to test a method to deliver during-trip information in a fun, interactive format, using motivation theory and gamification methods to promote different visitor experiences in an intervention group (compared with a control group).

While the pilot intervention did not reveal significant differences in behaviour, unique visitor information was gained, including a new visitor journey evaluation framework, and evidence of the desire for 'discovery' and during trip information to support discovery.

Finally, new insights into journey experiences were found that supported some existing investment initiatives, but would also inform targeted investment to promote a higher level of service of infrastructure and information for visitors.

Understanding current and forecast visitor flows to the South Island

NZ Transport Agency research report 650

Freely available online at www.nzta.govt.nz/resources/research/reports/650

Data is required for destination management, both of current visitor activity and future activity. This report reviews the data that currently exists for visits to the South Island of New Zealand, where tourism growth has been, and is still expected to be, strong. Not surprisingly no one dataset was found that could reasonably describe visitor activity, nor were there forecasts for core visitor activities across each region of the South Island. Methods were tested to show how currently available data, including an International Visitor Survey and a measure of electronic card spending, could be adjusted to derive measures of visitor presence.

A three-part visitor flows model was presented that could be used to derive estimates of visitor flows between and within regions. Rather than attempting to derive a regional visitor forecast, it was recommended systems be refined to ascertain current constraints and monitor planning by public and private sector stakeholders.

A major area identified for ongoing research is the interaction between visitor and local resident dissatisfaction and infrastructure requirements.

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.

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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.

NZ TRANSPORT AGENCY WAKA KOTAHI

New Zealand Government