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RAPIDLY EVOLVING TECHNOLOGIES HOLD PROMISE FOR URBAN FREIGHT

Opportunities for applying technology to improve the movement of urban freight were explored in recent research, which developed five case studies to describe how technological solutions could be applied in consistently congested areas.

The recent and ongoing growth of technology means there is a wealth of data sources available for analysing road network performance and freight patterns. Emerging technology is also driving the development of intelligent transport systems (ITS), designed to improve transport network operations and traffic management.

The research project by Abley Transportation Consultants and Richard Paling Consulting aimed to develop a better understanding of how available datasets could be used to monitor urban freight flow, and to determine the location and extent of congestion affecting the movement of freight across Auckland's urban roads. The researchers also considered the application of technologies to improve the efficiency of freight movements in these congested areas.

The research included a literature review, stakeholder interviews and international case studies, and later identified five case studies exploring how technological solutions could be used to improve freight movements in known congestion hotspots.

Despite recognising the important role that ITS plays in improving network performance in the city, the research report cautions that technology will not provide a 'silver bullet' to resolve the high degree of network-wide congestion experienced in Auckland.

'ITS can improve the delivery of advanced traveller and network information, freight priority and monitoring overall network performance using available datasets, and is an important part of a wider urban freight and indeed general traffic management strategy,' the authors say.

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ITS

ITS apply modern computing processing capabilities and technological advances (such as automated control systems, sensors, transportation databases and other input/output devices) to help solve transportation problems, as shown in the figure below.

Components of a typical intelligent transport system

Sensors providing real time information on:
- vehicles
- infrastructure
- users (eg via smart card use)

Stored information and databases such as:
- maps
- timetables
- user details
- unique identifiers
- historical data

COMMUNICATIONS

Computer processing capacity

COMMUNICATIONS

User interface: input and output devices for users and operators

Automated control systems:
- vehicles
- infrastructure

ITS enable the existing road network to be used more efficiently, and can provide a cost-effective means of monitoring, understanding and managing transportation problems. Wider benefits of ITS include economic, safety and environmental benefits and improvements in people's travel experiences, through reduced congestion, improved road safety and reduced fuel consumption.

As part of the project, the research team conducted an extensive review of how ITS have been applied, both nationally and internationally, within the freight sector. In general, it was found ITS are applied as part of wider urban freight management plans, alongside regulatory measures, infrastructure, urban consolidation centres and off-hour deliveries.

The review of international projects also highlighted some of the challenges involved with applying ITS technologies. These included a lack of reliable data, high error rates due to the relative immaturity of ITS hardware, and difficulties with system integration.

THE CONGESTION ISSUE

The research team studied the technologies currently being used to monitor traffic congestion in Auckland. Although numerous data sources were identified – including Bluetooth, global navigation satellite systems (GNSS), mobile phones, weigh-in motion, fibre optic, closed circuit television (CCTV), traffic counts and the Sydney Coordinated Adaptive Traffic System (SCATS) – there were no data sources that isolated the movements of urban freight from general traffic.

The team also consulted with industry stakeholders, to gain insight into the current urban freight operating environment and the challenges facing the freight sector. This engagement revealed a high level of frustration among stakeholders with the poor performance of Auckland's current transport infrastructure.

Commercial global positioning system (GPS) datasets were used to produce maps of congestion in the city over half hourly intervals. The maps revealed how widespread congestion was throughout Auckland and that traffic was able to flow relatively freely for only very limited periods. These maps were used to identify congestion hotspots and five of these locations were selected as case studies.

The research report describes these case studies in detail, including how technology could be applied to improve the movement of freight at each locations. The implications of applying these technologies are discussed, including the challenge of prioritising freight without adverse effects on other road users.

The proposed case studies are summarised in the table on the next page.

The research report provides high-level analysis of the costs and benefits for each of the proposed case studies to indicate the likely return on investment.

The authors acknowledged that some technologies are still in their infancy, and potential applications within the freight sector are emerging quickly. When the report was finalised there were already several new initiatives being planned for introduction in Auckland, including virtual freight hubs, that had not been addressed in the research.

The authors state, 'It is important to follow and understand technology developments to capitalise on opportunities for applying technology to continually and progressively improve the network efficiency and the movement of goods.'

The proposed case studies are summarised in the table below

TECHNOLOGY USED	OVERVIEW OF HOW IT WORKS	POTENTIAL BENEFITS	CASE STUDY LOCATION
Freight journey predictability tool	• Combines real-time and historic travel time (two-year rolling average) data to provide travel time and travel time reliability estimates • Hosted on line as a road network application programme interface. Delivered via variable messaging sign and web-based applications • Presents a range of likely travel times based on real-time network conditions in addition to average travel time	• Improved visibility of travel time variability • Improved preplanning, schedule and delivery window adherence • Reduced uncertainty of effect of traffic conditions • Fuel savings and reduced driver frustration	MetroPort to SH 1 north and SH 1 south
Freight sector network information tool	• Map-based platform with location specific information relating to accessibility and movement of freight. Including (but not limited to): – road width – loading zones – height restrictions – freight priority ramps – service roads – axle restrictions	• Increased awareness and knowledge sharing • Increased efficiency • Reduced congestion caused by parked or circulating vehicles • Timely and updatable system • Improved safety	Auckland urban area
Intersection freight priority using CCTV video analytics	• The application of video analytics technology to process CCTV footage in real time • Isolate freight vehicles queued in short right turn lanes at signals and extend the green phase to specified movement	• Improve intersection level of service • Improve heavy vehicle throughput • Improve travel times and wait time on right turning vehicles • Increased fuel efficiency	Great South Road and Church Street intersection
Cooperative intelligent transport system freight corridor	• Open communication between trucks and signal infrastructure to provide signal priority • Linking of green phases through advising vehicle of optimum travel speed to pass next signal without stopping	• Improved travel time and journey reliability • Reduced emissions, fuel consumption and noise	Saleyards Rd/Walmsley Rd corridor
Loading zone management tool	• Real-time parking sensors to monitor loading zones and holding areas in large retail complexes • Push out availability of loading zones	• Improved accessibility to loading zones through increased efficiency and turnover • Improved trip planning and delivery efficiency • Reduction in double parked or circulating delivery vehicles	Sylvia Park Shopping Centre

Use of technology to measure and improve freight movements, NZ Transport Agency research report 625

Available online at **www.nzta.govt.nz/resources/research/reports/625**

MANAGING THE IMPACT OF ROADS ON BATS AND OTHER VERTEBRATES

There is currently no nationally accepted consistent approach in New Zealand for assessing or managing the effects that roads and other land transport infrastructure activities have on indigenous animals. Research funded by the NZ Transport Agency focused on the impact that roads and other linear infrastructure have on indigenous animals, with a particular focus on bats. The research represents a first step towards a national framework for managing the effects of land transport on all indigenous vertebrates.

Roads and other land transport activities can adversely affect indigenous animals during construction and operational activities. In recent years, the effect of road projects on New Zealand's endemic bats has become an issue. However, how best to monitor and mitigate these effects has been unclear for all parties involved in the process of authorising and operating these transport projects.

In response to this, the Transport Agency identified the need to assess strategies for avoiding, reducing, or mitigating the negative effects that land transport activities have on indigenous vertebrates, with bats being a high priority. The information gained on good practice was used to establish a framework for those seeking authorisations and providing consent for transport projects. The framework is a guide in these situations.

New Zealand has two surviving species of bat, both of which are of conservation concern. Long-tailed bats are patchily distributed within forest, peri-urban and pastoral land across both the North Island and South Island, while lesser short-tailed bats are found only at 13 known locations generally associated with older indigenous forests, most of which are in the North Island. Examples of how roads affect bats include interruption or severance of their flight paths and removing potential roosting trees.

The ongoing Waikato Expressway project, and more recently investigations for the Hamilton Southern Links Notices of Requirement, have become the first projects in New Zealand to attempt to address the impact of roads on long-tailed bats. Steps taken have included bat detection surveys before construction began, and requirements for ongoing monitoring and predator control written into the resource consents for the projects.

To establish an evidence-based and nationally consistent approach for such activities in the future, Wildland Consultants, Landcare Research and AECOM, carried out Transport Agency funded research into the effects roading projects have on bats.

The project involved a review of the ecological literature on the impacts of roads on bats, and of the New Zealand statutory processes that currently govern interactions between bats and land transport activities.

The review revealed that most of the previous research had sought to quantify the effects roads have on bats' behaviour, rather than on population survival, making a full prediction of effects difficult. Demographic modelling has indicated that the survival of adult female bats was vital for the ongoing survival of New Zealand's long-tailed bat populations, making the need for effective road mitigation measures crucial. However, few of the studies reviewed have identified effective mitigation options.

This lack of understanding of whether roads have any effect on bats, and if they do, what the effects are and how they are best addressed, has often led to indecision and conflict during the legislative planning approval processes for road projects. Variation in how the legislative requirements have been interpreted and implemented has also resulted in delays and varying requirements. Such variations have been wide-ranging – from regional council and local authority decision making under the Resource Management Act 1991, to Department of Conservation decisions made under the Conservation Act 1987 and the Wildlife Act 1953.

Previously collected data about long-tailed bats was analysed in order to understand what impact the weather was likely to have on attempts to monitor bat activity. The analysis showed that long-tailed bat activity is strongly influenced by the temperature during the first four hours after sunset. Results of this research have already been used to help design monitoring for a number of projects.

The relationship between night-time traffic volumes and long-tailed bat activity was also investigated at sites throughout New Zealand, where there was known bat activity. Night-time traffic affected bat activity, and demonstrated a clear negative relationship between bat activity and night-time traffic volumes, ie bats were less active in locations with high traffic volumes.

From these research findings, the project team was able to develop a framework for monitoring and managing the impact of road activities on New Zealand's endemic bats, and provide guidance on how the research findings might be applied to other indigenous vertebrates.

The framework is designed to guide land transport managers, planners and ecologists through the process of getting statutory consents, monitoring bat activity, and mitigating the effects of roading projects on long-tailed bats. The framework pays considerable attention to the ecological uncertainty around the potential adverse effects of land transport activities on bats, and considers in some detail possible approaches for improving the rigour and effectiveness of ecological monitoring.

The project concluded that the 'the field of "road ecology", which addresses the effects of roads on fauna and plants, is an emerging discipline'. As a result, most of the mitigation packages developed for previous road projects had been insufficiently robust, and many opportunities to understand and address the effects that road have on bats had been lost.

The report's authors state, 'This review and the subsequently developed framework propose a way forward based on either an iterative research-based process or strong evidence-based logic, for which the outcomes should be measured using well-designed monitoring regimes. Such an approach will expedite understanding of the effects of roading projects on bats, and the development of tools for avoiding, minimising and mitigating effects, and consequently the processes required by legislation. A similar lack of evidence of how to monitor and mitigate effects of roads and roading projects is also likely to be the case for other terrestrial indigenous vertebrate species and it is therefore appropriate that similar iterative research-based models or strong evidence-based logic models are also applied to their management.'

Effects of land transport activities on New Zealand's endemic bat populations: reviews of ecological and regulatory literature, NZ Transport Agency research report 623

Available online at **www.nzta.govt.nz/resources/research/reports/623**

DEVELOPING DATA STANDARDS FOR THE TRANSPORT NETWORK

As transport network operations become more time critical, the need for knowledge of the current state of the network and how it is performing, becomes crucial in order to support informed decision making.

Although there is already a significant amount of data and information about the New Zealand transport network being generated by a number of internal and external sources, these sources are all based on independent spatial information about the network itself.

Typically, this spatial information about the network is developed to meet the specific needs of the system using it, leading to diverse representations of the same transport network among different data platforms.

In addition, there is a lack of transport-specific data analysis platforms that are resilient to change, lightweight and cost efficient to maintain. Analytical tools are often tied to specific proprietary systems, and this can compromise their adaptability and makes it difficult to keep up with rapidly changing developments, including transient changes, in the transport network.

A Transport Agency-funded research project, undertaken by the Queensland University of Technology in Australia, has developed a method to support standardised reference models of transport networks. The method will normalise the diverse representations of transport networks presented by various data sources, and support this data being presented in the context of a standardised reference transport network model.

Report author Marc Miska explains the project's purpose, 'This project aimed to develop a specification for a sustainable data model for historical and real-time analysis of transport operations. It was not an effort to build a transport model for the New Zealand transport network and it included no efforts to rebuild or interfere with existing transport models used by the Transport Agency. The focus was to establish guidelines or specifications towards a sustainable, high-quality, software agnostic data standard that informs business process in the mid to long term. The data standard will define the format and meaning of data stored for network operations analysis.'

THE CURRENT SITUATION

Current network analysis is highly data driven, drawing on the vast amount of measurement data that is available from sensors such as inductive loops, Bluetooth, cameras, OptaSense and traffic control systems.

However, roadside data measurement and control systems tend to provide non-geospatial information. To be able to visualise and analyse the collected data, it is typically mapped into a pre-defined set of nodes and links (representing the transport system), or transferred into a geo-spatial information system (GIS).

This process of mapping the data to a network is the key challenge with network analysis, as there is no single network or source of information about the network that provides the foundation for the various network models used within the Transport Agency and elsewhere.

Once the data has been mapped, the application using the data tends to evolve organically, without any links to other applications and with high maintenance costs, as mapping tables have to be maintained and updated regularly to keep the application functioning.

These costs also prevent longitudinal datasets being collected for network analysis, as the effort involved in maintaining change logs tends to mean that it is only feasible to maintain data about the latest version of the network model. This then makes it difficult to compare the network's past and present performance.

Marc Miska writes, 'Networks are changing, datasets are changing and requirements for network analysis are changing. Therefore, it is necessary to establish a robust and sustainable process to create network models that adapt over time, are backwards compatible, and can cope with minor changes without disrupting day-to-day business for network analysts.'

TOWARDS A STANDARDISED NETWORK MODEL

The project initially sought to develop a New Zealand data standard that provided a cost-effective, robust and sustainable solution for transport network analysis. However, after an initial review, it became apparent that data standardisation alone would not provide the required benefits and a more elaborate platform was needed.

The project accordingly shifted focus towards finding a method that would support normalising diverse network representations of selected data sources, and presenting that information within a standardised reference transport network model.

The proposed method developed by the research is based on the idea of using geometry to identify both road network elements and operational transport data.

'The proposed solution leverages the power of GIS to work with geo-spatial relationships without depending on any specific GIS in particular. Instead of using unique identifiers for network elements and data points, the proposed solution stores information against a geometry. This powerful connection allows varying levels of granularity among users without breaking the fundamental relationship between the network and its data,' the report says.

The result is a network model based on existing GIS and sensor data that is resilient to minor changes, cost effective and software agnostic. The model offers several benefits, including:

- small network changes will have no effect on operational analysis
- sensor and other data sources can be added without depending on links, path, or section sizes
- diverse datasets can be added without being constrained
- it will support user queries about the data sets.

These features will allow the reference model itself to adapt over time to increase overall data quality without having an impact on operations.

The research project has shown it is possible to build such a network model, and its foundation and components are described in the research report. In addition, the project developed a web-based demonstrator to showcase the internals of the proposed model.

The recommended next step is to implement a full version of the prototype, using one of the big cloud platforms, such as Google, Amazon or Microsoft Azure. Developing such a platform would help drive 'collaborative innovation in network analysis across authorities and academia,' the report says.

Data standards for the New Zealand transport network, NZ Transport Agency research report 627

Available online at **www.nzta.govt.nz/resources/research/reports/627**

MODELLING THE FUTURE FOR ROAD FREIGHT

Research has developed models to explore how economic activity, in particular inter-regional trade, may affect future demand for freight transport and road space.

The project's purpose was to develop an experimental or pilot system dynamics model of traffic flows along the main road routes within the Auckland–Hamilton–Tauranga triangle.

The question being explored was whether such a model could be useful in understanding how increases in economic activity, particularly freight flows, affect the demand for road space and, in reverse, how road space affects travel times.

To this end, the research team, comprising members from Infometrics Consulting Ltd, Future Impact Ltd and Transport Futures Consulting Ltd, designed and constructed three models:

- two simple Bayesian vector autoregressive models to forecast economic activity and freight flows within the Auckland–Hamilton–Tauranga region
- a high-level system dynamics model for simulating freight flows along the main roads in the region.

DEVELOPING THE SYSTEM DYNAMICS MODEL

The research team chose to develop a system dynamics model for the main task of the project (to model freight flows), because of its ability to simulate processes such as traffic flows, including delays, congestion and capacity constraints.

System dynamics models are scenario or simulation models, rather than forecasting models, with their main use being to provide insight and understanding into how the real world works. They can be used to ask 'what if' questions around the scenario they are modelling, which in the context of the project, would include questions around future freight growth and infrastructure planning.

The team first used the two Bayesian models to forecast economic and freight growth in the region. The models showed that inter-regional freight flows within the Auckland–Hamilton–Tauranga triangle might grow by around 60% by 2025 (from 2012 levels). At this rate, the rate of growth of inter-regional trade was forecast to exceed each region's individual GDP growth rate.

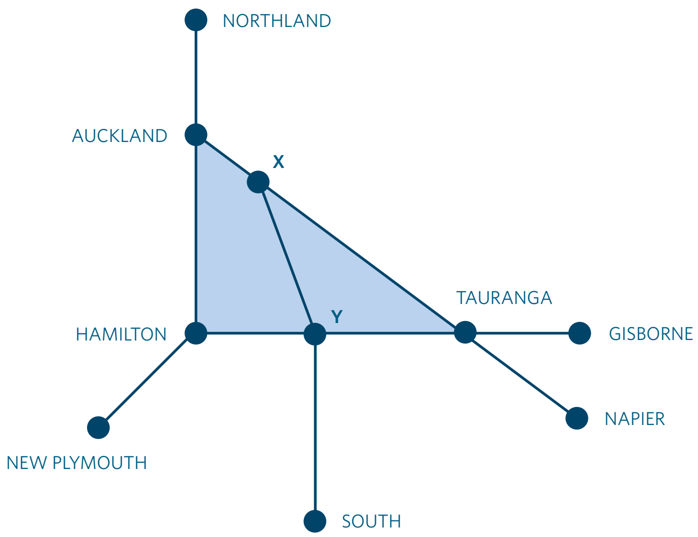
The team then used the system dynamics model to map this forecast growth in freight on to the three main road routes in the Auckland–Hamilton–Tauranga triangle.

The diagram below shows the six routes the researchers were specifically interested in:

- Auckland to X (AX), where X is the intersection between SH2 and SH27
- X to Y (XY), along SH27
- X to Tauranga (XT), along SH2 via Waihi
- Auckland to Hamilton (AH), along SH1 and the Waikato Expressway
- Hamilton to Y (HY), along SH1, where Y is a general representation of various intersections in the area; 27 and 29, 1 and 29, 1 and 5, 5 and 28, 1 and 28, and 28 and 29
- Y to Tauranga (YT), along SH29.

The area covered by the system dynamics model is represented in the figure by the blue triangle.

Route schematic



WHAT THE MODEL SHOWED

The model showed that, in the absence of road improvements, this level of growth would cause travel times for southbound traffic to increase by around 5 to 10 minutes. On the SH1–SH29 route, however, the increase at peak time was likely to be almost 30 minutes.

For northbound journeys, the largest increase would be on the SH2 route, where the maximum difference would be over an hour.

The team also used the model to explore a selection of scenarios involving road improvements along the Waikato Expressway and Kaimai Range, more use of very large trucks and a constraint on driver working hours (this latter scenario doubled as a scenario for shifting more freight movements onto rail).

These scenarios suggest that road improvements will be crucial for dealing with the likely growth in freight. However, if the improvements induce traffic to move onto the upgraded routes, from parts of the network that have not been upgraded, the initial benefits could be negated.

The scenarios also showed that substituting rail for road freight movements would have virtually no effect on mean travel times on the road network, although the research team queried whether the scenario they had tested was 'ambitious enough'. Likewise, shifting freight onto longer and heavier trucks would reduce the number of trucks on the road, but would have a 'negligible' effect on congestion. This was due to the predominance of small vehicles on the road network, and the longer length of bigger trucks, which reduced the road space available to other vehicles.

Overall, the research team concluded the project had demonstrated that a system dynamics modelling approach could be used to model traffic flows, congestion and ways to ease congestion, at a high level.

'We would, however, recommend that if the model is ultimately to be applied to more real world questions, priority should go to testing the robustness of the model to a wider range of traffic patterns and input assumptions,' the team states in the research report.

They also caution that the model developed in the research was specific to its location and would not be 'immediately applicable' to other areas. There was scope, however, to adapt the modelling system to other areas, following further data gathering and testing.

In their report, the research team suggest some areas for further research to improve the model's usability and robustness, and to explore whether there is value in developing a 'larger, more sophisticated' system dynamics model.

The team concludes, 'As it stands the model is designed to look at high-level congestion resulting from increased traffic – all the time, not on particular days or during specific time periods. It is in effect a model of pressure on road space and how this pressure might be alleviated through different types of intervention such as more road space, re-assignment of routes and changes in the mix of vehicle types. Perhaps other issues are more important and undoubtedly there will be questions related to the movement of freight that are not capable of being analysed with this model. The model is complementary to other models such as the Waikato regional transport model, which has strengths in other areas, such as route assignment for example. Both should be used to investigate overlapping issues.'

System dynamics investigation of freight flows, economic development and network performance, NZ Transport Agency research report 629

Available online at **www.nzta.govt.nz/resources/research/reports/629**

ANALYSIS REVEALS DATASET'S POTENTIAL

Analysis of the long-term pavement performance database has found there is a wealth of data available. By combining the numerical data with the maintenance records for particular sites, practitioners can gain useful insights into the economic performance and condition of pavements.

The Government Policy Statement on Land Transport 2015/16 – 2024/25 is focused on achieving value for money for land transport.

Road maintenance and renewals present an important opportunity to improve value for money. Road maintenance works that are implemented too early, while there is still remaining service life in an asset, waste money, while maintenance that is delayed too long becomes more expensive.

To avoid these scenarios, the Transport Agency uses specialised infrastructure development and management software to model when maintenance is the most economical. To provide data for these models, it established long-term pavement performance (LTPP) sites nationwide – on state highways in 2000 and on territorial local authority networks in 2003.

However, in addition to maintenance modelling, the data held in the LTPP databases could provide useful guidance on the economic performance and condition of pavements, and the relationship between the two.

Investigation by WSP Opus Research explored this potential by undertaking a comprehensive statistical analysis and review of the March 2015 LTPP dataset. Key objectives were to:

- use descriptive statistics to identify trends
- identify the key issues that cause pavements to fail, using correlations between pavement condition indices and pavement failure, including whether there was any evidence that pavements with cracking are at a higher risk of failure
- recommend whether the dataset could be restructured to provide additional benefits.

Issues of particular interest included:

- What maintenance strategies help achieve optimum lives?
- Do any maintenance strategies have a negative effect?
- Does surfacing condition affect pavement life, and if so, how?
- What is the effectiveness of different maintenance interventions and their timing?
- Is there scope to improve the LTPP experimental design?

Although the initial research intention was to focus on statistical analysis of the numerical data, it became obvious during the project that it would be more useful to combine this with a manual review of the data, by a person with extensive road engineering and maintenance experience. The review involved interpreting site photographs, notes and construction records to provide engineering explanations for the data recorded at sites highlighted during the statistical analysis.

The manual review did not identify any reliable data to show that pavements displaying cracking are at a higher risk of failure. It did, however, suggest that the current approaches to selecting maintenance treatment types, and the quality of the subsequent maintenance and reconstruction practices, may be contributing to making the level of service delivered by pavements worse after maintenance. In particular, the maintenance practice of water cutting should be reconsidered, as there was evidence that it might be contributing to more rapid deterioration in pavement condition.

Overall, the research concluded that the LTPP database contained a wealth of information, in addition to the numerical data, in the form of visual observations, records, and photographs collected by the survey contractor. This additional information could be used to provide more in-depth understanding of the distress and maintenance activities at each site. However, the database's current structure made extracting this information a time-consuming process.

The report recommended that the current arrangement of the LTPP dataset should be analysed and reorganised to provide additional benefits from the data.

'There is much scope available to improve the quality of the data in the LTPP and the RAMM databases. The data could be restructured to be more compatible with smart computing and machine learning (artificial intelligence) to make the extraction of meaningful results more affordable and hence more frequent,' the report says.

In the medium-term, this could involve data cleansing, image analysis (for example, of crack mapping and site photographs), machine learning and incorporation of data from other sources. The ultimate aim would be to remove reliance on resource and time-consuming human analysis.

The report also makes a host of shorter-term recommendations relating to the dataset and data collection practices, which although they have varying impact, when taken together with the more substantive medium-term recommendations, would be 'useful in improving the value of the LTPP database for the benefit of future research'.

Analysis and interpretation of New Zealand long-term pavement performance data, NZ Transport Agency research report 633

Available online at **www.nzta.govt.nz/resources/research/reports/633**

RECENTLY PUBLISHED RESEARCH REPORT ABSTRACTS

Drivers' response to warnings/information provided by in-vehicle information systems (IVIS)

NZ Transport Agency research report 643

Freely available online at www.nzta.govt.nz/resources/research/reports/643

The purpose of the research was to provide an analysis of drivers' use of IVIS, smartphone applications and nomadic devices and their likely effects on driver performance.

The research examined the effects of a speed advisory IVIS presented on a mobile phone on the driving performance of 123 participants in the University of Waikato driving simulator. It also conducted a New Zealand-wide survey (n = 1,017) of drivers to examine the prevalence of, and frequency with which, drivers used a range of in-vehicle apps and systems.

The speed advisory IVIS, designed according to best practice guidelines, improved compliance with the posted speed limits and did not impair driving performance or distract drivers.

The survey found that drivers most frequently used in-vehicle audio systems and navigation devices, and a small but significant number reported using hand-held mobile phones.

Although many drivers had access to a speed advisory application, only a quarter of those with access reported receiving speed-related warnings, and of these half were ignored.

Given the potential safety benefits, and no detectable negative effects of a properly designed speed advisory IVIS on driving performance, the key challenge is to encourage drivers to use IVIS that improve safety.

The crash performance of seagull intersections and left-turn slip lanes

NZ Transport Agency research report 644

Freely available online at www.nzta.govt.nz/resources/research/reports/644

A number of alternative intersection layouts are used around the country to reduce traffic delays and to improve road safety. One such group of alternative intersections is termed 'priority controlled seagull intersections'.

Seagull intersections are often used on roads to reduce traffic delays as they allow right-turning traffic from the side road to give way to traffic flow on the main road one direction at a time (without impeding the through traffic). However a number of seagull intersections experience high crash rates. This can be a result of design compromises (eg short merges) and/or due to the complexity and unfamiliarity of this intersection layout.

While there is considerable debate about the safety problems that occur at seagull intersections and left-turn slip lanes at priority intersections, there has been very little research that attempts to quantify the safety impact of different layouts.

In New Zealand, crash prediction models are available for urban and rural priority controlled intersections of a standard layout.

In this study, crash prediction models were developed in an attempt to quantify the effect of various seagull intersection and left-turn slip lane designs.

Impacts of socio-demographic changes on the New Zealand land transport system

NZ Transport Agency research report 646

Freely available online at www.nzta.govt.nz/resources/research/reports/646

This study presents a discussion on how socio-demographic factors affect the demand for personal land travel.

Socio-demographic is a convenient adjective that is used to cover primarily demographic factors, plus their interaction with employment and income. Other factors such as urbanisation and new technologies are also briefly discussed.

The report looks primarily at overseas literature on various theories that per capita demand for travel has peaked and/or shifted modes, and at the evidence for and against these theories. Local literature on the topic is scarce, the research decomposed New Zealand data on travel by private vehicle, finding that socio-demographic factors can explain most of the changes in private vehicle travel since 1998.

The report also uses a model that was specifically designed to project New Zealand travel demand to explore the effects of socio-demographic factors on private travel. Most scenarios project continued growth. Rates of growth do slow, however, and in some regions private vehicle travel per capita declines.

The results demonstrate that interactions between social, demographic and economic factors, and their effects on travel demand, are complex.

Driving change technology diffusion in the transport sector

NZ Transport Agency research report 647

Freely available online at www.nzta.govt.nz/resources/research/reports/647

Technology diffusion will have profound impacts on the transport system. This report does not attempt to predict the future, but instead aims to guide policymakers in thinking about how technology could affect the transport sector.

The focus is on the behaviour of the transport user and how it translates into technology diffusion and then affects transport. As a guide, the report has developed a behavioural monitoring framework that incorporates several components. These include:

- a simplified model of the transport system to focus on important variables
- a diffusion model based on the well-known Bass model
- advice for horizon scanning to identify and understand technologies with potential to affect transport.

The framework is applied to two case studies:

- mobility as a service
- electric vehicles.

These technologies are seeing limited uptake in New Zealand and appear to face challenges.

The research and framework in this report can be applied by the NZ Transport Agency to judge how technology diffusion may affect transport in New Zealand.

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A NOTE FOR READERS

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- 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

For media enquiries – contact Andrew Knackstedt, National Media Manager, on andrew.knackstedt@nzta.govt.nz, ph 04 894 5400.

Other Transport Agency contacts

Dan Oberhaus – Manager, Research & Evaluation Programme

Nigel Curran – Senior Analyst, Research & Evaluation Programme

Karen Johnson – Coordinator, Research & Evaluation Programme

For any enquiries, email NZTAresearch@nzta.govt.nz

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www.nzta.govt.nz

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