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STUDY OFFERS NEW INSIGHTS INTO THE EFFECT OF ALCOHOL ON DRIVING ABILITIES

A study on the effects of alcohol on drivers' psychomotor, cognitive and driving abilities has reinforced findings made overseas. Not only are drivers' abilities impaired to a greater extent than they realise, but the impairment lasts for longer.

The research, conducted by the Traffic and Road Safety (TARS) Group at the University of Waikato, carried out an experimental test with 61 participants.

Participants were randomly assigned to one of three alcohol dose groups: a high alcohol group (80mg/100ml or 0.08% blood alcohol concentration (BAC)); a medium alcohol group (50mg/100ml or 0.05% BAC); and a placebo control group (who were given a trace amount of alcohol on the top of their drinks). Their blood alcohol levels were then monitored as they carried out driving performance tests using the TARS driving simulator. Participants' cognitive functions were also tested and they completed rating scales to indicate how intoxicated they considered themselves to be and how willing they were to drive.

The study's twin goals were to:

- evaluate what effect alcohol had on the psychomotor, cognitive and driving abilities of New Zealand drivers with 0.05% and 0.08% BAC levels
- identify the relationship between drivers' perception of their intoxication and the actual level of impairment produced.

Of particular interest was whether local findings would mirror those made overseas, where studies have found a substantial disconnect between how affected by alcohol drivers consider themselves to be, and how impaired they actually are.

The Waikato study returned a similar result; drivers have a poor ability to judge their own levels of intoxication, and often consider themselves no longer intoxicated, and hence able to drive, at a time when some of their driving and cognitive abilities are still significantly impaired.

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THE FINDINGS

The study found that a 0.08% BAC significantly impaired drivers' abilities across a broad range of cognitive and driving measures, when compared with the participants in the placebo group.

Participants in the high alcohol group were significantly more likely to cross the edge and centre lines when using the driving simulator, and spent significantly longer times over the line, before moving back into their lane. In addition, their reactions to hazards (vehicles at intersections) were more exaggerated than the control group, and they had much higher peak speeds.

In the cognitive tests, participants in the high alcohol group made a lot more errors in learning and recalling a computer-based maze, and performed less well in identification, executive function, problem-solving, memory and visual attention tests.

Although participants in the medium alcohol group also displayed some impairment in these tasks, for most of them the impairment was not statistically worse than for the participants in the placebo control group; only their reactions to hazards were significantly worse.

An interesting aspect of the performance impairment side of the research was an imbalance in how particular aspects of performance are affected as blood alcohol levels are rising and falling (on either side of the point where they peak). This asymmetry had been noted in recent international research and was confirmed by the current study.

In some measures of performance, such as the number of edge line crossings and the time spent over the edge and centre lines, participants performed worse after they had been intoxicated for a while, compared with their earlier performance at the same level of intoxication.

The opposite was found to be true for how intoxicated the participants judged themselves to be. In this case, they felt more intoxicated early, and less intoxicated later, even though their driving was just as impaired, or actually getting worse on some measures.

DRIVERS' SELF-PERCEPTIONS

The study's second objective was to identify the relationship between drivers' ratings of their intoxication and the actual level of impairment produced.

The results showed that although participants in the two alcohol groups considered themselves more intoxicated than the participants in the placebo group, there was no difference between the two alcohol groups in how intoxicated they considered themselves. Although participants knew they were intoxicated, they could not judge accurately how intoxicated.

Participants were also unable to accurately judge how much alcohol they had consumed, with both alcohol groups underestimating the amount, and the amounts they estimated being very similar. This meant that participants in the high alcohol group were extremely inaccurate, estimating they had received approximately half of their actual dose.

These findings reinforced those found in national and international literature: that people have a poor ability to assess their own intoxication.

It follows that participants' subjective assessment of their ability to drive when intoxicated is also unreliable, and this was borne out in the current study. Although participants in the two alcohol groups were less willing to drive than the control group participants, there was no difference between the two alcohol groups in the assessment of their ability. As a result, the more intoxicated participants considered themselves as able to drive as their less intoxicated colleagues.

A DANGEROUS IMBALANCE

The research team concluded that the combination of the findings from the two strands of the research present a 'particularly dangerous mixture'. As they state in their report, 'drivers mistakenly judge their sobriety as recovering much faster than their BACs decline, at a time when their impairment on several important driving skills is actually getting worse.'

In other words, the point at which participants in the two alcohol groups were expressing themselves no longer intoxicated, and hence willing to drive, was exactly the point at which certain of their driving abilities were most affected by the alcohol. For some aspects of cognitive performance, notably ability to pay attention to the driving task, studies overseas have suggested that people's abilities do not fully recover until the morning after they have had a drink.

These findings have important implications for safety campaigns and other public education about the effects of drinking. In their report the members of the research team suggest some new messages, based on their research, for future campaigns to consider. These include raising public awareness that drivers cannot accurately judge the amount of alcohol they have consumed or their level of performance impairment, whether at the current legal limit of 0.08% BAC or at the future limit of 0.05%.

Another suggested message focused on the delayed or protracted effects that alcohol intoxication can have on motor performance, with some abilities needed for safe driving only recovering very slowly, and potentially remaining impaired even after a driver's BACs have fallen to below legal limits.

The team also recommend that further research is conducted, using a method based on that developed in the study, into how drivers' abilities are impaired when combining driving with common prescription drugs.

Driver risk from blood alcohol levels between 50mg/100ml and 80mg/100ml, NZ Transport Agency research report 541

Available online at **www.nzta.govt.nz/resources/research/reports/541**

COMPUTER MODELLING TESTS THE METAL OF ROADSIDE BARRIERS

A study on roadside crash barriers has focused on when it is best to rectify or replace roadside barriers that do not comply with current specifications.

Road controlling authorities and the NZ Transport Agency have found that many road safety barriers in New Zealand are lower, or in some cases higher, than the recommended installation heights and that in some situations barriers exhibit varying signs of corrosion. However, the degree to which deviations from the installation height or various levels of corrosion impact on barrier performance is unknown.

A 2013 study by Opus International Consultants and Delta-V Experts used a literature review and computer simulation modelling to explore the extent of the problem, and to determine what, if anything, is the best to do about non-complying barriers.

Specifically, the study considered whether it is better to rectify or replace existing roadside crash barriers that are of substandard height (higher or lower than the specifications) or are corroded, or to install new roadside crash barriers at locations with significant hazards where there are currently no barriers.

The study's findings will help road controlling authorities establish the most cost-effective options and priorities for their road safety programmes.

THE EXTENT OF THE PROBLEM

Run-off-the-road crashes form a significant proportion of all road crashes on New Zealand's state highway network. Under the Safe System approach to road safety, roadside treatments that help reduce the numbers of crashes, or mitigate their effects so as to avoid deaths and serious injuries, are a priority at both a local and national level.

Roadside barriers and roadside clear zones (areas next to the road that are free of hazards and obstacles) are currently the most widely used treatments. Roadside barriers work by containing and redirecting off-course vehicles, and shielding them from hazards on the other side of the barrier. Over the years, a wide variety of different types of barriers have been installed alongside New Zealand roads, with more barriers being installed in recent years.

The three types currently considered appropriate for use on the state highway network are:

- flexible, eg wire-rope barriers, consisting of tensioned wire ropes supported by closely spaced lightweight steel posts
- semi-rigid, eg W-beam or Thrie-beam barriers, consisting of steel rails attached to closely spaced steel or timber posts
- rigid, eg segmental concrete barriers, consisting of either pre-cast or cast-in-situ rigid blocks that are keyed, pinned or back-stopped, or are cast in situ or slip-formed and embedded below the pavement surface.

Roadside barrier types currently used in New Zealand

a) Wire-rope barrier (© CSP Pacific)

b) Semi-rigid W-beam barrier

c) Rigid concrete barrier (segmental system)

To perform properly, barriers need to be installed correctly, in the right locations and at the right heights, and kept in good condition. Specifications for installing and maintaining road safety barriers in New Zealand are contained in the joint Australian and New Zealand Standard *AS/NZS 3845: 1999 Road safety barrier systems* (which is under review); the Transport Agency's *M23A: 2012 Specification for road safety barrier systems*; and Austroad's 2010 *Guide to road design: part 6: roadside design, safety and barriers*.

However, a recent Transport Agency review showed that some of the roadside barriers on the state highway network did not conform to the specifications, either because of incorrect heights or poor condition. Barriers had incorrect heights for a variety of reasons, including where the ground had subsided or extra layers of road surfacing had been added after the barrier had been installed. The condition of barriers was found to be affected by their environment, which could cause corrosion of the barrier itself (where steel) or deterioration of its supporting elements (wood or concrete).

The literature review, undertaken as part of the research project, found very little information about the extent of the perceived problem. In particular, there was limited or no information about what lengths of barriers were too low, how much they were too low by, and what types of barriers were most affected.

There was also limited data about how variations in barrier height (either up or down) from the specifications affected crash severity; and even less information available about the effect that corrosion or other deterioration had on barrier condition, strength or performance.

COMPUTER SIMULATION RESULTS

The research used computer simulation modelling to quantify the effects that variations in barrier height and condition had on crash severity, for:

- two barrier types (W-beam, and wooden post and wire rope)
- selected vehicle models, speeds and paths
- differing road and roadside configurations (straight and curved road sections)
- different roadside slopes.

PC-Crash (Version 9) modelling software was used, with the modelling validated against full-scale crash data derived from the literature review.

The modelling simulated impacts for different types of vehicles drifting off the road in wet conditions; in a maximum-turn scenario (where the vehicles were sliding both laterally and longitudinally when they struck the barrier); driven in a straight line path onto a barrier; and in a corner crash scenario.

The key finding was that for both barrier types, crash severity increased with barriers that were lower than the specified heights. However, this increase was not generally severe, even for height differences that were thought to exceed those commonly expected to occur on the New Zealand state highway network.

FOCUS ON COSTS

The research also provided a limited assessment of costs. This included:

- a comparison between the crash severity costs associated with existing deficient roadside barriers, and the costs of rectifying or replacing them with new barriers in the same location, or of installing new barriers in different locations with a significant hazard
- the remediation or replacement, and maintenance costs for existing deficient barriers, and the construction and maintenance costs for new barriers installed in different locations.

The research results suggested that in many cases (especially for wire-rope barriers) it would be much more cost effective to install new barriers at previously untreated locations than to raise existing barriers to the correct heights. This was because of the lower crash rates and crash severity that could be expected to result from shielding other new hazardous areas; and the relatively low cost of doing so (compared with the crash rate and crash severity cost savings).

The report also points out that existing barriers will often have other significant failings apart from their height (eg the condition, insufficient lengths and non-compliant end treatments), and that it is unlikely substandard height will be the sole, or even the main, trigger for remediation.

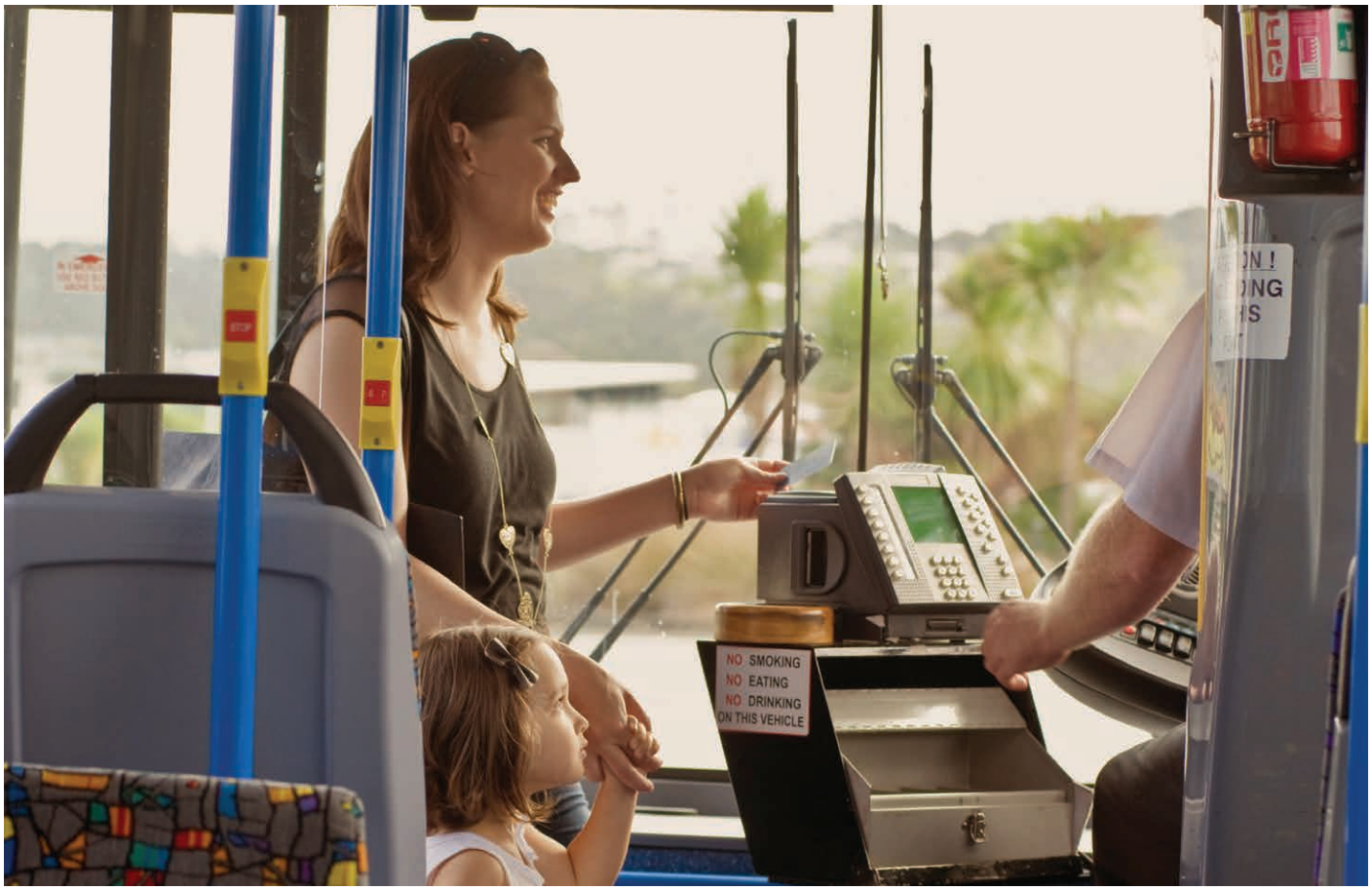
As a result, the report recommends that a more detailed analysis of the costs and benefits associated with erecting new barriers at previously untreated locations, and of remediating existing barriers, is undertaken before consideration is given to changing current Transport Agency policies and procedures. In the meantime, any cost analysis for barrier remediation that is used as a basis for comparison with the costs of erecting new barriers, needs to clearly state what is included in the cost for raising the height.

Other cost-related findings were that there was wide variation, between contractors and regions, in the cost per metre of both erecting new barriers, and fixing or raising existing ones; and that, in general, wire-rope barriers were significantly cheaper to erect and maintain than W-beam barriers.

Recommendations coming out of the research included developing a more detailed understanding (possibly using representative sampling and existing Transport Agency data) of the extent of the problem of barrier heights being lower than specified. A limited programme of full-scale testing of the effects of corrosion on barrier strength and performance was also considered useful; as was work to gather more details about the relationship between barrier height and the crash outcomes and severity in actual barrier crashes.

Optimising expenditure on roadside safety barriers, NZ Transport Agency research report 536

Available online at **www.nzta.govt.nz/resources/research/reports/536**



PROJECT SHEDS LIGHT ON PATRONAGE GAINS FROM BUS SERVICE IMPROVEMENTS

Research has used data from New Zealand and Australian cities to examine the impacts that improvements to urban bus services in off-peak periods have had on boosting patronage on these services.

Since the early 2000s, most major cities in Australia and (to a rather lesser extent) New Zealand have invested in improving their off-peak bus services, particularly over evening and weekend periods. While there are indications that these improvements have generally been successful in increasing patronage, very limited robust monitoring of the actual impacts has been undertaken in any of the Australasian cities.

Ian Wallis of Ian Wallis Associates, who conducted this research in 2010–2011, says, 'The body of evidence available on this topic internationally is also surprisingly sparse. This research was designed to fill this significant knowledge gap in Australasia and internationally, so as to provide better information to help authorities considering making service improvements.'

The research (funded jointly by the NZ Transport Agency and Public Transport Victoria) set out to appraise experience gained in enhancing off-peak bus services over the past 10 years in four Australian cities (Adelaide, Brisbane, Melbourne and Perth) and three New Zealand cities (Auckland, Dunedin and Hamilton). The enhancements involved increased service frequencies and extensions to the span of operating hours in weekday inter-peak, evening and weekend periods.

The primary focus of the research was on assessing the patronage response to the service improvements, with a secondary focus being an appraisal of market research about the other impacts of the improvements (eg on people's choice of travel mode, attitudes to bus service attributes and broadening of travel opportunities).

PATRONAGE IMPACT (SERVICE ELASTICITY) ANALYSES

The analyses of the impacts of the service changes on patronage focused on estimating service frequency elasticities for the various changes. Service frequency elasticities are a powerful concept for assessing the impacts of all service changes on a comparable basis: the service frequency elasticity essentially represents the ratio between the proportionate increase in patronage and the proportionate increase in services (or service kilometres) operated, which are the 'driver' of the patronage increase.

The study analyses adopted a 'with and without' methodology, comparing patronage on a route after the service change with the estimated patronage if the services had been unchanged. This latter estimate was derived from the 'before' patronage on the route, adjusted as appropriate to allow for patronage trends on comparable ('control') routes which remained unchanged.

The analyses of service frequency elasticity gave particular attention to:

- impacts in the different off-peak periods (principally weekday inter-peak, weekday evening, Saturday, Sunday)
- progressive impacts ('ramp-up') over time, following the service change for (i) the first 12 months following the change, with a focus on the fourth quarter -commonly taken as a 'short-run' elasticity; and (ii) thereafter, up to about five years following the change, expressed relative to the fourth quarter estimate -commonly taken as a 'medium-run' elasticity
- variations in elasticities according to the initial service frequency, extent of the service change, direction (increase or decrease) of the service change, and other service and market characteristics.

The study found strong consistency, between the estimated service elasticities across different cities and routes, for any given day type or time period, giving confidence that service elasticities for a given day type /time period derived from one city (or route) may be transferable to other cities (and routes). The following table shows typical fourth-quarter (short-run) elasticities across all cities.

TYPICAL SERVICE FREQUENCY ELASTICITY VALUES (Q4), BY DAY TYPE/TIME PERIOD

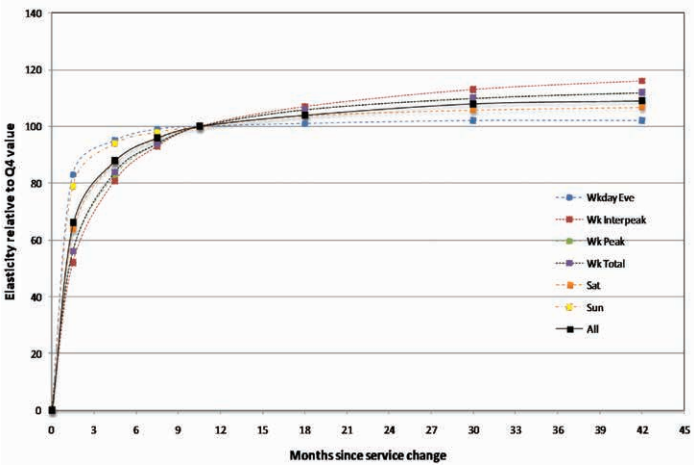
DAY TYPE	TIME PERIOD	TYPICAL Q4 ELASTICITY ('OWN PERIOD')
Weekday	Peak	0.25–0.35
	Inter-peak	0.4–0.5
	Evening	0.5–0.7
	Overall	0.4–0.5
Saturday/Sunday	Overall	0.6–0.75
	Evening	0.8–1.1

Within a given day or time period, there was no evidence of significant variations in elasticities according to the extent of the service change, the direction of change (increase or decrease), or other service or market characteristics. The exception to this was the initial service level, where there was evidence that service elasticities were higher for infrequent services than for more frequent services, although this was not conclusive from the data available.

All data showed similar 'ramp-up' profiles in terms of patronage trends and hence elasticity trends over time following a service change. The typical profile was much 'sharper' than commonly reported in the international literature on bus service improvements, ie the patronage growth rate was higher in the early months, but relatively lower subsequently. The medium-run elasticity values (around five years after the service change) were only 10% to 15% greater than the short-run values (after a year). These 'sharp' ramp-up profiles offer authorities implementing service changes on a trial basis confidence on the patronage impacts earlier than otherwise expected (eg after six months), allowing them to take decisions on the continuation or otherwise of such a trial at an early date.

MELBOURNE SMARTBUS ELASTICITY RAMP-UP PROFILES

The above elasticity estimates are likely to be conservative (on the low side), as they make no allowance for additional patronage in periods other than the one in which services are increased. The evidence indicates that, if the estimates were adjusted for these factors, the 'true' medium-run patronage impacts for the evening and weekend periods would be around 1.0 or potentially higher in some cases. This is a very encouraging result; it indicates that a (say) 25% increase in evening or weekend services is likely to be broadly matched by a 25% increase in evening/weekend patronage, implying that service increases in these periods would not adversely affect (and may improve) the fare box recovery performance for these periods.



MARKET RESEARCH FINDINGS

The appraisal of market research findings focused on the effects that improvements to off-peak bus services had on people's choice of travel mode, increased travel opportunities, and attitudes to and perceptions of the services offered. It drew largely on the extensive evidence available from both 'before' and 'after' market research in Melbourne over the last 10 years.

The study found that, where reasonable alternative services previously operated, the majority of passengers on the new or improved services would have used these. Where reasonable alternative services did not exist, only a small proportion of passengers on the new or improved services would have made the trip by public transport, travelling instead by car (as the driver, 30% to 40%; as a passenger, 15% to 25%), walking or cycling (10% to 20%), taxi or other mode (5% to 15%), or not at all (10% to 20%).

The most desired improvements by users of typical low-frequency (unimproved) suburban bus services included more frequent services, extended service hours, more direct services, services that better matched people's origins and destinations, improved reliability, improved bus stops, real-time passenger information and stop-specific timetables, and better information about and marketing of services. The resulting user response to improvements was generally consistent with the improvement priorities expressed by users of 'unimproved' services.

A substantial proportion of new passengers who were using the improved services (particularly suburban buses) tended to be people with limited travel options (transport disadvantaged). In this way, the improved services helped promote increased mobility, accessibility and self-reliance; and provided better access to employment, health services and leisure activities.

Ian says, 'The project has vastly improved the available evidence on service frequency elasticities, for off-peak urban bus services in particular. Although there are aspects that warrant further research, the project has helped fill an important knowledge gap, both in Australasia and internationally, about how the market responds to improvements in urban bus service frequencies. Importantly, it has found strong consistencies in frequency elasticity values across cities, routes, nature of the service changes, and over time, meaning the elasticity estimates we've calculated can be transferred with some confidence between cities, routes and situations, certainly within Australasia.'

Experience with the development of off-peak bus services, NZ Transport Agency research report 487

Available online at **www.nzta.govt.nz/resources/research/reports/487**

RESEARCH PINS DOWN VALUE FOR MONEY FOR PUBLIC TRANSPORT

Research provides guidance on the best value-for-money enhancements that can be made to urban public transport systems.

The research reviewed the published evidence and literature on value-for-money urban public transport enhancements. The focus was on enhancements that were effective in terms of revenue and costs, although some other concepts of value were also discussed. It provides useful information on the likely cost-effectiveness of enhancement measures for those concerned with improving urban public transport systems in New Zealand.

HOW THE ENHANCEMENTS MEASURED UP

The research focused predominantly on bus-based enhancements, looking mainly at incremental service improvements, rather than large infrastructure projects. The performance of a wide range of improvements was considered, with the following types of improvements emerging as the most likely to be financially effective:

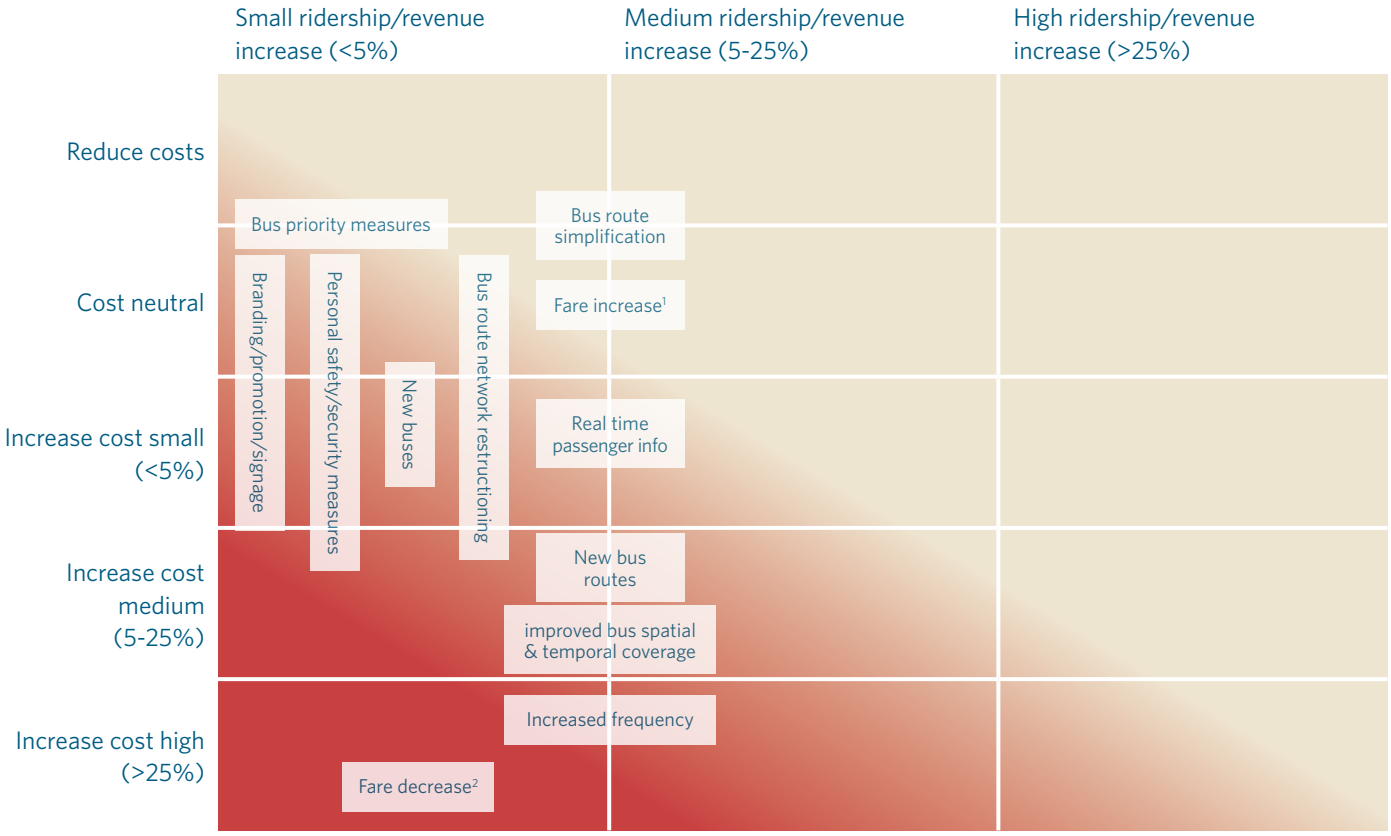
- increased development and densities around transport nodes
- better information about services (including real-time passenger information measures and branding, promotion and signage measures)
- bus priority measures
- bus route and network simplification
- fare increases (which increase revenue, but decrease patronage).

Other measures that were judged to be verging on profitable included bus route and network restructuring (where the focus is on reducing costs and refocusing resources on more patronage and revenue effective routes and services), new buses, and enhancements to personal safety and security measures.

Measures such as introducing new routes, extending service hours, and increasingly the frequency and geographical coverage of services were all found to be higher-cost items that were only likely to have a medium impact on cost-effectiveness. Increased frequency and reduced fares have a medium-to-high impact on patronage and revenue levels, but would have high costs.

The figure below shows a synthesis of the evidence presented regarding the relative effectiveness of short-term public transport improvement measures relating to patronage and revenue growth, and the impacts on overall costs. The shading indicates the relative cost-effectiveness from the most valuable (top right) to least valuable (bottom left).

RELATIVE PATRONAGE AND REVENUE COST EFFECTIVENESS OF SHORT-TERM PUBLIC TRANSPORT IMPROVEMENT MEASURES



[1] Increases revenue, ridership declines

[2] Increases ridership, revenue declines

None of the measures looked at in the research were likely to have a high impact on patronage or revenue levels in the short-term. Although increasing the frequency of services or introducing new routes and networks would arguably have a positive impact on patronage, the high costs of these measures makes them unrealistic at present.

Certain types of measures, namely those focused on off-peak services and the CBD, are more likely to be effective from a patronage and revenue perspective. CBDs, in particular, represent relatively small areas where the benefits of any improvements are likely to be felt by a greater number of patrons.

However, from congestion relief and environmental perspectives, measures that target peak periods are likely to be the most effective. Likewise, those enhancements that reduce fares and ensure greater equity of service use are likely to be considered most effective from a social perspective. However, there is insufficient research and evidence currently available on any of these perspectives to enable their full value to be measured.

Overall, the research highlights the importance of understanding customer needs in each market, so that any enhancements can be targeted and provide the maximum value for existing and potential customers.

VALUE AND PUBLIC TRANSPORT

Value in relation to public transport systems is generally viewed from a patronage and revenue growth viewpoint, with cost-effectiveness referring to profitability of services relative to fare box revenue. This can be seen as a limited view, since most public transport services require subsidy, and value can also result from congestion relief, environmental aspects and in terms of benefits to the transport disadvantaged.

However, New Zealand fare box cost recovery reduced through the first decade of the century, and in response, a major focus of national policy is improving the commerciality of services, growing patronage for the subsidy provided and increasing fare box recovery. Regardless, subsidies from various levels of government are likely to be required into the future.

Experience with value-for-money urban public transport system enhancements, NZ Transport Agency research report 531

Available online at **www.nzta.govt.nz/resources/research/reports/531**

DRIVING BENEFITS FROM NEW LOCATION TECHNOLOGIES

Industry-wide consultation has shaped a suite of recommendations for implementing road location technologies that are more accurate, available and affordable in New Zealand.

The research by Opus International Consultants sought to understand the location technology needs of the NZ Transport Agency and its key providers. A review of the current and evolving technologies then enabled the research team to match these needs to the available technologies, and recommend technologies that show the most potential for immediate wider use.

The research came about after a potential gap was identified between the location technology that is now available (or becoming available) and that which is currently being used on the ground.

Location technologies are widely used for road asset management (among other things), and the Transport Agency aims to increase use of appropriate technologies by its key providers. These include transport authorities, transportation consultants and contractors, and public transport operators.

All of these groups use location technology to find and record locations of works and infrastructure, or to direct personnel to specific locations to install, repair, pick up, deliver, or attend crashes or incidents. Accordingly, the accuracy of spatial data is important, and becoming more so with the increasing reliance on this information for everyday use.

However, road-related location technology and location infrastructure services are not currently integrated across the transport supply chain, and the quality and coverage is not sufficient to supply consistently accurate data across New Zealand at all times.

For the current research, the Transport Agency requested that the emphasis should be on the use of location technology by roading contractors and consultants, rather than by other parts of the transport supply chain. If the Transport Agency can improve road location accuracies this may benefit other road users who also use location technologies.

PROMISING NEW LOCATION TECHNOLOGIES

Promising technologies to emerge from the research included mapping grade global navigation satellite systems (GNSS) and consumer grade GNSS augmented with mobile geographic information systems (GIS) and accurate aerial imagery.

Other future technologies that show promise include GNSS augmented with Locata-type ground-based constellations and other wireless networks (such as Bluetooth, WiFi and ultra wide-band) in areas of low GNSS coverage, as well as the wider use of ground-based LiDAR for desktop surveys.

Mike Ladd of Opus, one of the location technology experts working on the project, says, 'We recommend that in-depth trials are conducted with a small number of provider organisations to help us understand how these systems can be more widely used. For the evolving technologies, we recommend that they are tracked, and that the potential to trial some of them in the near future, or to undertake a more in-depth review, be considered. This industry is evolving so rapidly that there is a general need to keep abreast of developments, and this includes keeping our research report, or elements of it, updated.'

CAPTURING THE NEED

The research team captured the Transport Agency's location technology needs, and those of its providers and other industry players, using key performance indicators. These revealed a preference for accurate and affordable technologies that are easy to use.

Twelve indicators were developed, each with parameters for determining a high, moderate or low classification. Like all performance indicators, these will need to be updated to ensure that the industry's needs continue to be met.

All of the technologies were then evaluated and ranked against the indicators to identify the most suitable ones. This was backed up by more in-depth discussion about some of the most suitable technologies, and interviews with key stakeholders.

THE NEED FOR GUIDANCE

Another focus of the research was on identifying the factors that help ensure the successful implementation of location technologies. Important factors were:

- support of upper management
- training on appropriate use
- organisational guidelines
- safety assessment for in-vehicle use
- awareness of staff privacy
- dedicated staff to manage the overall process.

At present, the Transport Agency's manuals contain little guidance on how location technologies should be assessed and used.

Mike says, 'The use of these technologies requires clear guidance. We recommend that current Transport Agency manuals are updated to include guidelines for the use and implementation of location technology, with clear accuracy requirements. This will assist providers in choosing the most appropriate location technology for a given situation.'

The team also recommended the introduction of a certification system for contractors and consultants working on the state highway network. Certification would acknowledge that a provider knows about modern location technology, has skilled staff who can use it, and has been on a training session and has a good track record for its use.

A related recommendation was that the Transport Agency should provide a clear vision of where the industry could be in the future, which will allow providers to align with this strategy where possible. This vision may include references to accuracy requirements, preferences for absolute referencing, and support for a culture change and a spatially enabled workforce.

Mike says, 'To get a fuller picture of the potential value that location technology has for the New Zealand economy, we can look at the country's broader spatial information industry, which in 2008 was estimated to add $1.2 billion to the national economy. Informed and appropriate use of location technology, as discussed in our report, will lead to more accurate and accessible spatial data, with attendant economic effects.'

Accurate and affordable location technology for New Zealand, NZ Transport Agency research report 535

Available online at **www.nzta.govt.nz/resources/research/reports/535**

NEW VEHICLE LOADING STANDARD FOR ROAD BRIDGES

A report recommends a new vehicle loading standard for road bridges and other highways infrastructure in New Zealand.

The new loading standard would be used for both the design of new bridges and the evaluation of existing ones.

The current vehicle loading standard for the design of bridges is no longer appropriate. Increases in heavy vehicle loadings, and the ongoing improvements in vehicle technologies which enable them, mean that the current standard no longer reflects the loads that vehicles are capable of carrying. The introduction in 2010 of high-productivity motor vehicles (HPMV) onto New Zealand roads has emphasised this inadequacy.

At present, two main factors limit how far design loads for new road bridges can be increased. The first is that increasing the design load increases the construction cost of bridges. Secondly, the lower strength of existing bridges limits the extent to which legal weights can be increased, which results in the greater strength of new bridges not being fully used until existing bridges are strengthened or replaced.

Any study to develop a new vehicle loading standard needs to balance the economic benefits of increased vehicle loading, and the engineering costs of constructing stronger bridges.

TAKING A TRANS-TASMAN APPROACH

In developing the new standard, the AECOM research team looked at current traffic loading and bridge evaluation specifications in New Zealand and overseas. They examined the economic aspects of increasing loading limits and found that a substantial increase in bridge design loads, much higher than any increases considered in previous studies, is likely to be economically justified.

Ken Wheeler of AECOM says, 'It's important that bridges designed and built today are capable of carrying all potential future vehicles and of matching the heavy vehicle mass limits that may be economically viable in the long term.

'Australian research had found that the optimal mass limits for bridges in that country, from an economic perspective, were almost double the existing ones. We applied that study to New Zealand and found that the same is true here.'

Because significantly higher bridge design loads only require a slight increase in bridge construction costs, the team concluded that it would be worthwhile substantially increasing New Zealand's bridge design load.

Ken says, 'The economic benefits of increasing loadings, as we've recommended, are very large; far larger than any additional costs associated with bridge or pavement construction.'

THE NEW LOADING STANDARD

The research team developed new loading models based on the NZ Transport Agency's *Bridge manual* HN-72 loading and the Australian standard for bridge design AS5100's SM1600 loading.

In developing the new loading standard, the team took into consideration future freight needs and the likely configuration of vehicles to meet those needs, as well as analysing loadings from current traffic. Weigh-in-motion data, responses to an industry questionnaire on desired vehicle configurations, loading effects from a range of legally loaded vehicles, permit application vehicles and mobile cranes were all considered in developing the new design vehicle loading standard.

In their report, they recommend that New Zealand adopts a vehicle loading model for the design of new road bridges that is 80% of the Australian SM1600 vehicle design loading. This creates a loading model that is up to 50% greater than the one in the Transport Agency's *Bridge manual* HN-HO loading.

The report recommends an evaluation loading model of 40% of SM1600 for Class 1 vehicle loading, or 45% of SM1600 loading for HPMV loading.

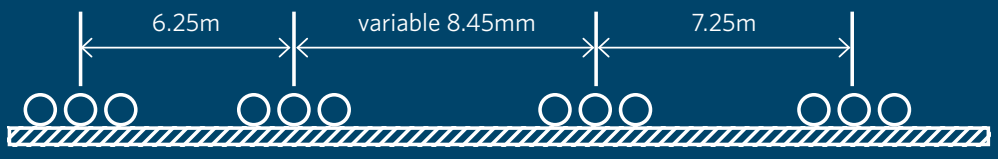
RECOMMENDED VEHICLE LOADING MODELS

	RECOMMENDED LOADING MODEL	ALTERNATIVE LOADING MODEL
Design vehicle loading model to allow for future freight needs and a range of heavy vehicles	0.8_SM1600 (includes W80 wheel load and A160 axle load)	2.0_HN-72
Evaluation vehicle loading model for Class 1 legal vehicles	0.40_SM1600 (includes 100kN axle load)	1.0_HN-72
Evaluation vehicle loading model for HPMV legal vehicles	0.45_SM1600 (includes 100kN axle load)	1.1_HN-72

The report also includes recommendations on axle and wheel loading, lane widths and number of lanes, multiple presence, dynamic load allowance, horizontal loads and load factors.

A new vehicle loading standard for road bridges in New Zealand, NZ Transport Agency research report 539
Available online at **www.nzta.govt.nz/resources/research/reports/539**

RECOMMENDED DESIGN VEHICLE LOADING MODEL – 0.8_SM1600



288kN (0.8_M1600)
192kN (0.8_S1600)
Tri-axle sets, 1.25m axle spacing

udl:
4.8kN/m (0.8_M1600)
19.2kN/m (0.8_S1600)

A NOTE FOR READERS

NZTA research newsletter

NZTA research is published quarterly by the NZ Transport Agency. Its purpose is to report on research invested in 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 research@nzta.govt.nz

The current edition of the newsletter, NZTA research, is available in hard copy and on the Transport Agency website at www.nzta.govt.nz/resources/nzta-research/. Back editions are available online only.

Disclaimer

The views expressed in *NZTA research* 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.

Email alerts of newly published research reports

Email notifications are provided when new issues of *NZTA research* 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 research@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 research@nzta.govt.nz if you wish to update your name, email or address details, to alter the number of hard copies of *NZTA research* you'd like to receive or to go on to the email list for alerts of the publication of newsletters and research reports.

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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 research@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/programming/research.html**

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