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AUSTRALIA - NATIONAL REPORT

STRATEGIC DIRECTION SESSION ST1
Road quality service levels
and innovations to meet user expectations

Austroads

Summary

This National Report describes the performance management framework within which Australian road authorities manage the nation's road networks, notes trends in performance and presents recent, significant innovations aimed at improving road system performance in meeting road user and community expectations.

Australia's road network length is large in proportion to a small population concentrated principally on the East and South Eastern coasts of the mainland. Car ownership is high compared with other countries, as is the road freight task per head of population. Each of the three tiers of government - Commonwealth, State/Territory and Local - has a share of the responsibilities for funding and management of road provision and maintenance.

Australian road authorities have developed a comprehensive performance management framework that identifies the principal economic, social, safety-related and environmental outcomes required by key stakeholders and defines performance indicators for both the road system and the road authorities. For practical application, the latter are synthesised into ten different categories of National Performance Indicators, which are reported upon every two years.

Significant trends in road system performance over recent years have included improvements in road safety and road condition, but little reduction in road transport-related greenhouse gas emissions. Travel times have increased very little in the larger cities, whereas in smaller cities, travel times are lower but are increasing steadily towards those experienced in the larger conurbations.

Australia has a strong culture of public consultation by road authorities, which is applied to the assessment of performance and to setting level of service and intervention standards for road networks. A User Satisfaction Index, based on surveys of road user assessments of system attributes grouped under eight categories, is among the performance indicators reported upon biennially.

A major role of this report is to highlight recent Australian innovations that have contributed to improvement of road system performance in meeting road user and community expectations. The many innovations reported include examples in the areas of community consultation, network management, road freight evaluation, major infrastructure developments, road condition measurement and road safety.

Contents

1. INTRODUCTION

This National Report has been prepared for the XXIInd World Road Congress in Durban, in 2003. It complements two other Australian National Reports addressing:

- Roads, Sustainable Development and Quality of Life (ST2 theme) ; and
- Access to Mobility (ST5 theme).

Each of these reports has been prepared by Austroads, the association of Australian and New Zealand road transport and traffic authorities.

1.1 Scope

The theme of this report is road quality, service levels and innovations to meet user expectations. The development of performance indicators, both for the physical road system and for the activities of road authorities, has been a focus of Austroads work over the last decade. The results of this work have enabled the monitoring of a wide range of performance aspects and use of the information so gained to both improve performance and support actions aimed at achieving consistency of service quality between different jurisdictions.

Section 2 of the report provides an introductory overview of the Australian road system, as background to the later discussion. Section 3 considers the different dimensions of road system and road authority performance, describes the performance measures developed by Austroads, discusses recent trends in relation to key indicators and reviews Australian practice in taking account of community perceptions and expectations of quality of service when prioritising service improvements.

Section 4 of the report describes a selection of innovations, aimed at improving road system performance, introduced in Australia since the 1999 World Road Congress. Finally, Section 5 summarises the report and draws out the major conclusions.

2. THE AUSTRALIAN ROAD SYSTEM

2.1 Infrastructure

The Australian Road network comprises approximately 800 000 kilometres of road, made up as shown in Table 1.

Approximately 40% (by length) of these roads are sealed and 60% are not sealed. The national average figure of 24.1 persons per kilometre of road is significantly lower than that for Canada (33.3 – 1995 data), the United States (42.1), Japan (110) and the United Kingdom (154). The reason for this is apparent from Figure 1, which shows areas of dense development (Southern and Eastern seaboard) and pockets of development (Adelaide, Perth) with vast, sparsely populated areas between them. The average population density of Australia is 2.5 persons per square kilometre, compared to 3 per sq.km for Canada and 29 per sq.km for the United States.

It is also apparent that there are significant differences between the six states and two territories. The Australian Capital Territory (ACT) has a road length per head of population similar to the UK and Japan, NSW and Victoria are close to North American values, while the Northern Territory is significantly lower than all other states and territories. This has an impact on attempts to manage networks consistently between States.

Table 1. Australian road network statistics

State/ Territory	Road Length (km)			Notes	Population	Persons/km
	Sealed	Unsealed	Total			
NSW	88,553	92,746	181,299	Excludes forestry and crown roads	6,642,900	36.6
Vic	73,795	81,660	155,455	Excludes roads administered by the Dept of Conservation and Natural Resources	4,854,100	31.2
Qld	66,130	110,887	177,017	at 30 June 1997	3,670,500	20.7
SA	27,117	69,335	96,452		1,518,900	15.7
WA	48,154	97,921	146,075	excludes forestry roads	1,918,800	13.1
Tas	10,143	13,517	23,660		473,300	20.0
NT	6,638	24,550	31,188	excludes local government roads	199,900	6.4
ACT	2,490	133	2,623		322,600	123.0
Total	**323,020**	**490,749**	**813,769**		**19,603,500**	**24.1**

Populations as at December 2001.

Source: http://www.dotars.gov.au/btre/docs/road.htm
http://www.abs.gov.au

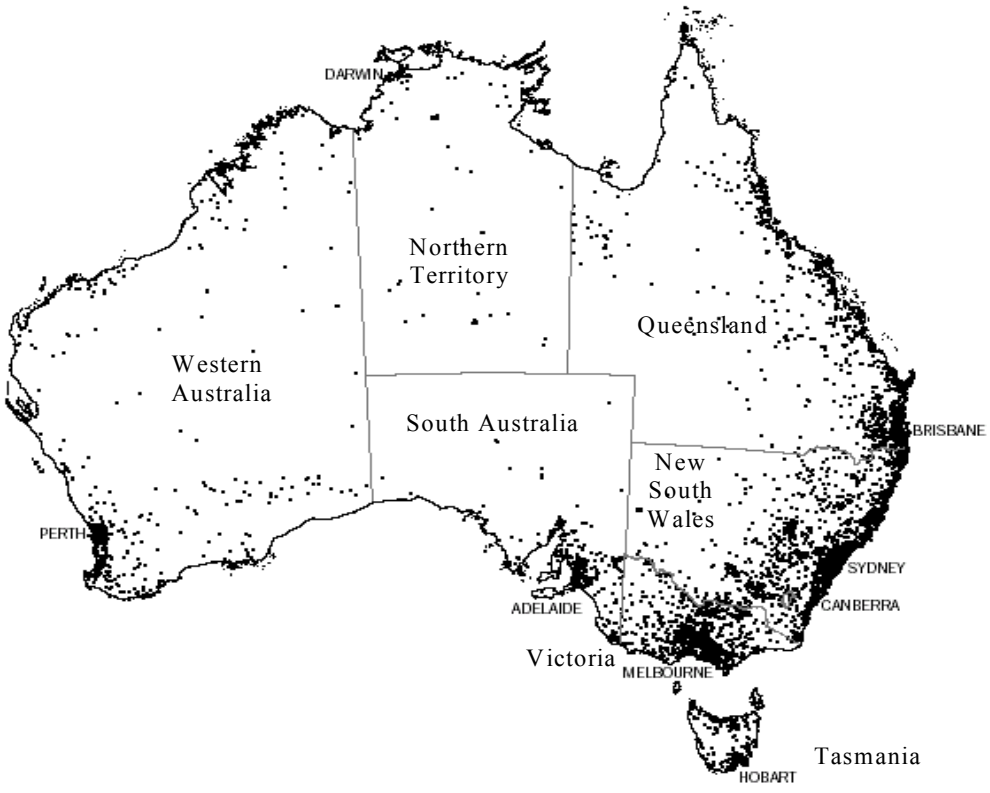

Figure 1: Current population distribution in Australia *(source www.abs.gov.au)*

2.2 The Vehicle Fleet

The Australian vehicle fleet as at July 1999 is summarised in Table 2.

Table 2. Summary of Australian vehicle fleet

	Cars	Motor cycles	Light commercial	Freight trucks	Other trucks	Buses	Total
Vehicles (000s)	9,553	324	1,588	406	22	54	11,948
Veh-km (millions)	137,885	1,003	24,986	11,644	274	1,843	177,635
Tonnes freight (millions)			107	1,313			1,421
Tonne-km (millions)			4,923	122,388			127,311
New registrations	671,513	30,070	103,568	17,155	1,194	3,636	827,136

Source: http://www.dotars.gov.au/btre/docs/road.htm

This means that there is a car for every two persons in Australia and each car travels about 14,000 kilometres per annum. Furthermore, 72 tons of freight are carried annually on the roads for every person in the country. Comparisons with the USA and Canada are shown in Table 3.

Table 3. Comparison of usage statistics with USA (1996 data) and Canada (1995 data)

	Australia	USA	Canada
Persons/ car	2.05	2.04	2.26
Annual kilometres/car	14,460	28,440	20,459
Tonnes of road freight per capita p.a.	72.49	12.2	6.06

Source: North American Transportation in Figures, USDoT et al, BTS00-05

2.3 Ownership, Responsibility and Finance

Each of the three levels of government plays a role in the Australian Road network. The Commonwealth (or Federal) Government is financially responsible for the network of National Highways, shown in Figure 2. The sections of these highways within each State or Territory are managed by the relevant State/Territory Road Authority with funding provided by the Commonwealth Government.

As the only tier empowered to collect income tax, the Commonwealth Government provides funding both to the States/Territories (directly and indirectly by way of a central government "allocation" to each state for all types of expenditure) and to local government for capital and maintenance works. Local municipalities also have funding available from their taxation levied on properties. In 1997/1998, the Commonwealth Government budgeted AUD 1.636 billion for road related expenditure. Of this 50% was spent on the National Highway network, 24% on the arterial network (primarily managed by the States and Territories) and 23% on local roads (managed by local authorities). 3% was unallocated. In addition, the States spent AUD 3.4 billion of their own money (from Commonwealth Government allocations), while local authorities spent AUD 2 billion from their own coffers on roads in their jurisdiction.

Figure 2: National Highway network

3. ROAD SYSTEM AND ROAD AUTHORITY PERFORMANCE

3.1 The Dimensions of Performance

Roads serve the community by facilitating activities such as work, shopping and leisure that are integral parts of life. Roads also are vital to our economic activities - primary production, manufacturing and all forms of domestic and export trade - and are key to the international competitiveness of our industries. It is important, therefore, for governments and road authorities to ensure that our road system functions at maximum efficiency.

Over the last four years, Australian road authorities have continued to actively pursue policies aimed at providing more efficient and effective road services. To do so, they have developed a comprehensive performance management framework within which road system and road authority performance can be benchmarked. This framework incorporates the following role statement identifying the primary purpose and function of the road system:

> "The road system comprises the road network and its users (vehicles, drivers and pedestrians), as well as vehicle loadings of passengers and freight. It is an integral part of the transport system and plays a significant role in achieving effective land-use and regional development, and contributing to the overall performance and social functioning of the community.
> In contributing to the community's broad economic, social, defence and environmental goals, the principal role of the road system is:
>
> *'to facilitate interaction between people and the exchange of goods and services by providing effective, equitable, land-based accessibility to a wide range of places, and by enabling safe, reliable mobility of people and transport of goods with the efficiency required to compete in the global economy'.*" (Austroads 2001a)

The performance management framework also includes a list of outcomes reflecting stakeholder expectations of the road system in terms of economic, social, safety and environmental outcomes. These are detailed in Table 4, together with associated performance indicators. A number of the associated performance indicators are yet to be defined or are still under development.

Table 4. Austroads Principal Stakeholder Outcomes

(after Table 1.1, Austroads 2001a)

Principal Outcomes required by Key Stakeholders	Road System Performance Indicators	Road Authorities Performance Indicators
ECONOMIC OUTCOMES		
Lower road-user resource costs - for example, vehicle operating costs and travel times	Actual Travel Time (Urban). Nominal Travel Time (Urban). Congestion Indicator (Urban). User Satisfaction Index.*** User Cost Distance.****	Road Maintenance Effectiveness.**** Return on Construction Expenditure. Return on Maintenance Expenditure.* Non-Road Interventions. Road Construction Costs.** Achievement Index.
Lower non-road costs for road users - strategic interventions to assist in efficient location choice, minimisation of inventories, and harmonisation of transport (and other) regulations across state borders.	Variability of Travel Time (Urban). Smooth Travel Exposure.	User Transaction Efficiency. User Transaction Additional Costs.
Increased Regional Development - including tourism, mining, agriculture, growth of regional centres and urban development - through new and improved roads to increase accessibility and reduce travel costs.	No indicators yet proposed.	No indicators yet proposed.
Expanded scope of markets - to bring them closer together (in terms of both time and cost) through new and improved roads.	No indicators yet proposed.	No indicators yet proposed.
Economic based choice of transport vehicles, modes, routes and times of use through matching social costs of use to prices charged to users.	Lane Occupancy Rate. Car Occupancy Rate.	Efficient Charging.**
SOCIAL OUTCOMES		
Establishment of a basic level of accessibility (particularly in remote areas) to provide improved health and education services and enhanced employment opportunities.	Accessibility Index (Rural/ Remote).* Accessibility to Public Transport.* Equity of Urban Access.*	No indicators yet proposed.
Wider range of choice of opportunities for interaction between people, organisations and businesses through improved accessibility and mobility.		No indicators yet proposed.
Fair distribution of the costs and benefits of the road system.	Extent of Externalities Recovery.*	No indicators yet proposed.

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Table 4. Austroads Principal Stakeholder Outcomes (continued)

(after Table 1.1, Austroads 2001a)

Principal Outcomes required by Key Stakeholders	Road System Performance Indicators	Road Authorities Performance Indicators
SAFETY OUTCOMES		
Lower levels of road-related deaths, injuries and costs through a reduction in the incidence and severity of road accidents.	Social Cost of Casualty Crashes (Population). Social Cost of Casualty Crashes (VKT). Casualty Crashes (Population). Casualty Crashes (VKT). Road Fatalities (Population). Road Fatalities (VKT). Persons Hospitalised (Population). Persons Hospitalised (VKT).	Return on Safety Expenditure.*
Safe transport of hazardous loads.	No indicators yet proposed.	No indicators yet proposed.
ENVIRONMENTAL OUTCOMES		
More environmentally sustainable road transport - in terms of resource consumption.	Consumption of Road Transport Freight and Fuel.	Resource Recycling and Substitution.*
Lower levels of gaseous and noise emissions and minimum impacts upon the amenity of the built environment.	Greenhouse Gas Emissions. Traffic Noise Exposure.	No indicators yet proposed. No indicators yet proposed.
The risks to systems of ecological significance and bio-diversity are minimised through the improved development, maintenance and operation of the road system.	Traffic Noise Exposure. Roadside Quality Maintenance.*	No indicators yet proposed.

* These indicators are under development.
** These indicators have been deferred.
*** User Satisfaction Index addresses user satisfaction across all outcome areas.
**** User Cost Distance (urban freight) and Road Maintenance Effectiveness methodologies are under further development.

Finally, a set of performance measures that are sufficiently specific for benchmarking purposes has been defined. These are shown in Table 5, together with their intended purposes.

The detailed performance indicators are listed under the headings of Road Safety, Registration and Licensing, Road Construction and Maintenance, Environmental, Program/Project Assessment, Travel Time, Lane Occupancy Rate, User Cost Distance, User Satisfaction Index and Consumption of Road Transport, Freight and Fuel, giving a total of more than 30 indicators. These indicators are regularly reviewed in relation to their usefulness to their intended purposes.

Of these, all except the User Satisfaction Index are calculated from measurements of physical quantities such as crash rates, costs, road roughness, travel times and so on. The User Satisfaction Index, on the other hand, is derived from a telephone survey of road users aged 17 years or older (more than 3,000 were surveyed in 2000) in which each respondent is asked to rate a number of attributes related to the road system.

While many of the indicators address the performance of the road system, some are concerned with road authority performance. These include the registration and licensing indicators, road maintenance effectiveness, and the three program and project assessment indicators.

Similarly, some indicators are more closely related to the use of the road network, though also relating to the nature and condition of the infrastructure. These include the user cost distance indicators, the indicators for consumption of road transport, freight and fuel, and of course the User Satisfaction Index.

Table 5. Description and Purpose of Specific Performance Indicators

(after Table 1.2, Austroads 2001a)

Indicator	Definition	Purpose
ROAD SAFETY		
Serious Casualty Crashes (Population) [SCC/P]	Crashes pa involving death/hospitalisation, per 100,000 population.	A |
Serious Casualty Crashes (VKT) [SCC/T]	Crashes pa involving death/hospitalisation, per 100 million veh.km.	|
Road Fatalities (Population) [SF/P]	Crash fatalities pa, per 100,000 population.	|
Road Fatalities (VKT) [SF/T]	Crash fatalities pa, per 100 million veh.km.	|
Persons Hospitalised (Population) [SPH/P]	Crash casualties hospitalised pa, per 100,000 population.	To monitor the incidence of major safety failures of the road system.
Persons Hospitalised (VKT) [SPH/T]	Crash casualties hospitalised pa, per 100 million veh.km.	|
Social Cost of Casualty Crashes (Population) [SSC/P]	Social cost pa to the community of crashes involving death/hospitalisation, per 100,000 population.	|
Social Cost of Casualty Crashes (VKT) [SSC/T]	Social cost pa to the community of crashes involving death/hospitalisation, per 100 million veh.km.	| V
REGISTRATION AND LICENSING		
User Transaction Efficiency [UTE] [UTE/D] and [UTE/V]	Cost of servicing driver licences & vehicle registrations, per number on register.	To monitor operational efficiency of driver and vehicle registers.
User Transaction Additional Cost [UTAC/D] and [UTAC/V]	Additional cost of adding driver licences & vehicle registrations to register, per number added.	To monitor operational efficiency of adding new drivers and vehicles to registers.
ROAD CONSTRUCTION AND MAINTENANCE		
Road Maintenance Effectiveness [RME]	A cost index reflecting the proportion of the road network being maintained to target conditions and the expenditure per km.	To monitor the cost-effectiveness of maintenance functions undertaken by road authorities.
Smooth Travel Exposure [STE]	The proportion of travel undertaken each year on roads with roughness conditions less than specified levels.	To monitor whether roads are providing acceptable travel conditions.
ENVIRONMENTAL		
Greenhouse Gas Emissions [GGE]	Gross CO_2 emissions, calculated from fuel sold for road use and appropriate emission factors, per veh.km of travel.	To monitor the extent of greenhouse gas emissions from traffic.
Traffic Noise Exposure [TNE]	The equivalent or steady-state noise level (L_{eq} 24h) that represents the varying noise levels over a 24 hour period.	To monitor the level of traffic noise exposure.
PROGRAM / PROJECT ASSESSMENT		
Return on Construction Expenditure [CPE]	The percentage distribution of programmed expenditure by benefit-cost ratio (BCR) range.	To monitor the predicted economic benefits to the community from road authority capital programs.
Achievement Index [AI]	Projected BCR of a project, at the time of the decision to fund it, divided by its realised BCR on completion, averaged over a representative sample of projects.	To monitor the actual delivery of economic benefits, compared with those sought, for capital projects.
Non-Road Interventions [NRI]	A summary of economic returns from non-road interventions involving major changes to policy, legislation or gazetted regulations.	To monitor the prospective rate of return on non-road-asset interventions.

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Table 5. Description and Purpose of Specific Performance Indicators (continued)

(after Table 1.2, Austroads 2001a)

Indicator	Definition	Purpose
TRAVEL TIME		
Actual Travel Time [ATT]	The aggregation of travel times actually achieved per kilometre on a representative sample of arterial roads and freeways.	To monitor the level of service provided to road users by the arterial road system.
Nominal Travel Time [NTT]	The aggregation of travel times per kilometre achievable by a vehicle travelling at the speed limit on a representative sample of arterial roads and freeways.	To establish a base system capability for measurement of level of service to road users.
Congestion Indicator (Urban) [CGI]	The aggregation of delay per kilometre on a representative sample of arterial roads and freeways in the urban metropolitan area.	To monitor the extent of congestion on urban roads.
Variability of Travel Time (Urban) [VTT]	Variability of travel times on a representative sample of arterial roads and freeways in the urban metropolitan area.	To monitor the reliability of travel times on the urban arterial road system.
LANE OCCUPANCY RATE		
Lane Occupancy Rate (Persons) [LOR/P]	The average number of persons per lane per hour during a specified period.	To monitor the productivity of road system use.
Lane Occupancy Rate (Freight) [LOR/F]	The average number of tonnes of freight per lane per hour during a specified period.	To monitor the productivity of road system use.
Car Occupancy Rate [COR]	The average number of persons per car during a specified period.	To monitor car occupancy.
USER COST DISTANCE		
User Cost Distance (Passenger Car) [UCD/PC]	The operating costs per kilometre of a standard passenger sedan.	A | |
User Cost Distance (Urban Freight) [UCD/UF]	The cost per tonne-kilometre of hauling specified freight in the capital city.	| |
User Cost Distance (Rural Freight) [UCD/RF]	The cost per tonne-kilometre of hauling specified freight from the capital city to a rural centre.	To monitor the average cost incurred by road users per distance travelled.
User Cost Distance (Urban Courier) [UCD/UC]	The cost per tonne-kilometre of carrying a typical parcel (five kilograms) within the capital city.	| | V
USER SATISFACTION INDEX		
User Satisfaction Index	Index of users' qualitative evaluation of satisfaction with road system outcomes.	To provide a qualitative indication of users' perceptions of the performance of the road system.
CONSUMPTION OF ROAD TRANSPORT, FREIGHT AND FUEL		
Consumption of Road Transport [CRT]	The extent of road-based transport need in socio-economic activities.	To provide an indicator showing road transport consumption level and changes over time.
Consumption of Road Freight [CRF]	The level of freight moved by road in tonne-kilometres, normalised by the Gross State/Territory Product.	To provide a graphical representation of road freight use and changes in that use over time.
Consumption of Vehicle Fuel [CVF]	Average rate of fuel consumption over time.	To provide an indicator showing vehicle fuel efficiency and changes over time.

3.2 Recent Trends in Performance

Some identifiable trends in road system performance in Australia over recent years are evident in the indicators reported for the decade to 2000 (Austroads 1999, Austroads 2001a). Examples of these trends are discussed below.

Road Safety Performance

Over the last decade, there has been a small but steady decline in serious casualty crashes, road fatalities and persons hospitalised, when these are normalised against either population or vehicle-kilometres of travel. For example, for the whole of Australia, the number of road fatalities per 100,000 population was reduced from 11.3 for 1992 to 9.3 for 1999, a decrease of almost 18% over the 7 years. Similarly, the number of road fatalities per 100 million veh.km changed from 1.28 for 1992 to 1.01 for 1999, a decrease of 21% over the same period.

Over the earlier part of the 1990's there were significant variations between the different States and Territories in relation to these safety indicators, but the latter part of the decade saw more consistent decreases across all jurisdictions in crashes, fatalities and persons hospitalised, whether normalised by population or by quantity of travel.

Road Construction and Maintenance

While there were not significant changes in maintenance costs per lane-kilometre of road over the last decade, either for Australia as a whole or for most States and Territories, there were small increases over time in the proportion of travel undertaken on smooth roads, as measured by the different smooth travel indicators. For example, the Smooth Travel Exposure (110 NRM)[1], for all urban and rural roads, changed from 90.8% for 1994/95 to 91.7% for 1999/2000.

Environment

Australian road-transport-related greenhouse gas emissions per unit of travel remained essentially constant, at around 338 grams of CO_2 equivalent per vehicle kilometre, over the period between 1990/91 and 1998/99. This was the result of an increase of approximately 21% in total emissions being balanced by a similar increase in total travel over the period.

Travel Times

Weighted average travel times per kilometre in the mainland State capital cities changed very little between 1996/97 and 1999/2000, with the exception of Brisbane, where there was a 21% increase in all-day actual travel time, from 1.15 to 1.39 minutes per kilometre. (However, it is reported that this was due to extensive road construction works in the city, after completion of which travel times have returned to previous levels.) By contrast, travel times in Sydney and Melbourne were constant at around 1.40 minutes per kilometre, and those in Adelaide and Perth, while starting lower at 1.35 and 1.15 minutes per kilometre respectively, each increased by an average of only 3% over the same period.

The same trends are apparent in the congestion indicators, which compare actual travel times with the nominal (always at speed limit) travel times. The indicator for variability of travel time, however, is slightly different in that Perth joined Brisbane in exhibiting a significant increase in variability of all-day travel times (105% increase for Perth and 70% for Brisbane) between 1996/97 and 1999/2000 – again, however, road construction works in both cities are likely to have contributed to this outcome.

[1] The Smooth Travel Exposure (110 NRM) is the percentage of travel undertaken on roads with a roughness of less than 110 counts/km on the NAASRA Roughness Meter (equivalent to an IRI of approximately 4.2).

3.3 Community Perceptions and Expectations

As the primary purpose of the road system is to serve road users and the general community, it is appropriate that their perceptions and expectations should underlie system assessment. In this regard, mention has been made in Section 3.1 of the User Satisfaction Index (USI), an indicator derived from weighted aggregation of road users' ratings of different attributes of the road system.
The attributes considered in the USI are grouped under eight headings:

- Road types and characteristics
- Traffic control/safety infrastructure
- Meeting road user needs
- Communication
- Traffic flow management
- Other road safety considerations
- Environment
- Customer service

A factor analysis derives weights for each attribute's impact on overall satisfaction with the road system and the user ratings are weighted and summed to give a score out of a potential maximum of 100.

For Australia as a whole and for each of the States and Territories individually, the value of the USI increased between 1995 (the first year the index was used) and 2000, though in some cases there was a small decrease from 1998 to 2000. For the nation as a whole, the index had a value of 59.6 in 1995, 64.5 in 1998 and 63.8 in 2000. There were some minor variations to the user survey process between the different years, however, so that small differences in the USI value should not be treated as greatly significant.

Austroads recently has published a document setting out guidelines for obtaining community inputs to assist in setting level of service and intervention standards for road networks (Austroads 2002b). Public consultation has been an integral component of many aspects of road authority planning in Australia for many years and this document draws together that experience into a guide for small or large road agencies on how to ascertain the expectations of local communities for a safe and efficient road network.

The guidelines advocate a five-phase consultation process, incorporating:

- Work prior to consultation;
- Development of the consultation program;
- Implementation of the consultation program;
- Use of the community feedback; and
- On-going consultation.

4. INNOVATIONS TO IMPROVE SYSTEM PERFORMANCE

Over the past four years there have been a number of significant Australian innovations related to the levels of service provided to road users under each of the performance headings identified in the preceding section. A selection of these is discussed below.

4.1 Innovations related to Economic Outcomes

Road Construction/Maintenance Methods/Policies

As part of the change in the road authorities' role from construction/maintenance to management of the road network, several jurisdictions have introduced performance-based, long term road maintenance contracts, undertaken by the private sector. For example, the Tasmanian authority, the Department of Infrastructure, Energy and Resources (DIER) has recently let a major 'design, construct and maintain' (DCM) contract on the National Highway and, in Western Australia, Main Roads Western Australia (MRWA) is three to four years into eight 10-year network maintenance contracts that jointly encompass all of the National Highway sections, State highways and main roads in the State. Similarly, in New South Wales, the Burringbar Range Contract on Pacific Highway completed in 2002, is said to be the biggest single publicly-funded DCM road contract in Australia (approximately AUD350 million).

In New South Wales and South Australia in particular, and especially in rural areas, deep lift, in-situ stabilisation is providing a cost-effective means of rehabilitating the unbound, granular, chip-sealed road pavements that make up 90 to 95% of Australia's sealed road length. Other innovations related directly to the road pavement are New South Wales' use of spray sealing incorporating scrap rubber, and Victoria's use of geotextile fabric as a component of sprayed seal surfacings.

Road Pavement Condition Monitoring

Pavement condition monitoring, using laser profilometery, falling weight deflectometer, various skid resistance measurement technologies, digital video and visual inspection, has become a standard element of road asset management for the major Australian road authorities and for long term network management contractors. Austroads has recently published guidelines for the measurement of pavement roughness (Austroads 2001b) and similar guidelines for monitoring pavement rutting, strength and surface cracking are at different stages of development.

A major development in road pavement condition monitoring in Australia in the last four years has been the acceptance by road authorities of the RoadCrack™ technology for the detection, classification and measurement of cracking in road surfaces. Based on digital video imaging, this technology was developed jointly by the Roads and Traffic Authority, New South Wales (RTA NSW), and the Commonwealth Scientific and Industrial Research Organisation (CSIRO). It is capable of detecting cracks of width down to 1 millimetre, in any type of sealed road surface, while travelling at a speed of 100 km/h.

This technology is particularly important to Australia, because the granular pavements with chip seal surfacings that make up the major part of the sealed road network are vulnerable to the entry of water, which can occur through fine cracks. The prototype technology, which typically monitored only samples of the pavement along each wheel-path, has been trialed and applied in New South Wales (the State that developed it) since the mid-1990s but it is now being used by other States. This has encouraged the recently-completed commissioning of a system capable of continuous monitoring along the road, with full coverage across a 3 metre width.

Road Management Systems

Over the past four years, Australian State and Territory road authorities have continued their strong progress towards fully integrated road asset management systems, built around extensive road data bases incorporating information to support long term strategic planning, works programming and program and project evaluation. Such systems incorporate the capabilities of

receiving inputs from a variety of sources, 'dynamic segmentation' of networks to produce lists of homogenous road sections based on perhaps 6 to 10 key attributes, and outputting files suitable for direct entry to road management applications such as HDM-4.

HDM-4 itself has undergone extensive beta testing by ARRB Transport Research, in cooperation with Australian road authorities. Australian models of pavement deterioration and improvement and models of road user effects have contributed to the development of the system. The Victorian and Tasmanian State road authorities are among those using HDM-4 to target road maintenance programs.

Road User Effects

A notable recent achievement in the area of road user effects is the development of values of time for freight movement, to be used in economic evaluation (Wigan et al 2000). The approach taken is a contextual conjoint analysis of choices made between options for transport of freight products, on the basis of the differences between the options in terms of travel times, reliability, probability of product damage and costs. Use of this data in calibration of discrete choice (logit) models produces values for each of these elements, including travel time.

While there has been considerable international discussion of this concept, few attempts have been made to develop quantitative values for freight travel time. It is considered that the results of this work, which was commissioned by the Business Systems Program of Austroads and undertaken by ARRB Transport Research in cooperation with Flagstaff Consultants, are comparable with the best of the European results. The results obtained from these analyses are now a regular component of the biennial updating of the Australian unit values of road user costs, for use in benefit-cost analysis (Thoresen 2000).

Major Projects

In urban areas of Australia in particular, targeted investment in major infrastructure projects, as a means of reducing vehicle operating costs, travel times and road crashes, is producing major economic impacts. Sydney, for example, has continued the development of its system of tolled motorways, which has greatly benefited road users in recent years.

In Southern Queensland, a total of AUD 1.2 billion of public funds has been invested in the Pacific Motorway and the South Eastern Busway. These projects connect the State capital, Brisbane, with the Gold Coast, through an area that has the fastest growing population in the Commonwealth. The two projects involved expansion to 8 lanes of 43 kilometres of highway and the planting of more than one million trees. The busway, which incorporates the latest ITS technology for passenger information, communications and safety management, is on separate right-of-way flanking the motorway, over the Northern section, closest to Brisbane. Recently, an inner city bypass road also has been completed, to divert traffic from the northern suburbs around the Central Business District, and construction of a high standard road link to the Port of Brisbane is under way.

The initial parts of the AUD 2 billion Melbourne City Link (Rozek and Gilpin, 2001) were opened in 1999 and the complete system came into operation in 2000 with the opening of the 3.4 kilometre long, 3-lane Burnley Tunnel. City Link also includes the 1.6 kilometre long, 3-lane Domain Tunnel, the high-level, 490 metre long Bolte Bridge over the Yarra River and approximately 20 kilometres of new or upgraded 6-lane motorway, including 4.5 kilometres of elevated segmental viaduct. It is a toll facility utilising a sophisticated and highly automated electronic tolling and traffic management system. The State of Victoria and the City Link's owner/operator, Transurban City Link, are the parties to a Concession Deed pursuant to the Melbourne City Link Act 1995. Under this Deed, Transurban is required to design, finance, build, operate, levy tolls and maintain City Link for a period of 34 years.

The Sydney M5 East Motorway, with a total length of 10.5km, was built under a Design, Construct, Operate and Maintain contract, involving a 3.5 year construction period (from August 1998 to December 2001) and a 10-year operation and maintenance period. Costing AUD800 million to build, it was opened to traffic in December 2001 and includes the nation's longest road tunnels (twin tunnels each 4 km long).

Regulation of Road Use

Undoubtedly one of the most significant recent developments in the regulation of road use in Australia has been the development of proposed performance based standards (PBS) for heavy vehicles (NRTC 2001).

A major objective of the introduction of PBS, in place of the existing, prescriptive limitations on axle, axle-group and gross vehicle masses and on vehicle dimensions, is to provide vehicle manufacturers and transport operators with the incentives and flexibility to design and operate heavy vehicles so as to increase productivity without detriment to road safety or the integrity of road infrastructure. A second important objective is to achieve consistency of heavy vehicle regulation across the nation.

The final list of performance measures is likely to include around 15 items, of which about two-thirds will be concerned with potential road safety consequences and the remainder with protection of road and bridge infrastructure. It is expected that approval testing of vehicles in relation to several of the measures, particularly those related to vehicle dimensions and safety impacts, will be undertaken using computer simulation of vehicle operation.

4.2 Innovations related to Social Outcomes

Accessibility Improvement

Over the last few years, the major action towards accessibility improvement in virtually all large metropolitan areas throughout Australia has been the initiation of planning and programs for the integration of urban transport. Responsible authorities for all major cities have recognised the value of allowing each transport mode to undertake the role to which it is best suited, and of ensuring compatibility and coordination of different modes to maximise total system benefits (Austroads 2002a).

In Victoria, as an example of actions being taken in almost all States, both the Department of Infrastructure, which oversees transport and planning, and the State Road Authority, VicRoads, have established integrated transport units, whose activities will encompass the entire transport system for both person and freight movements.

Community Consultation

Community consultation has become an increasingly important part of the process of setting objectives for road system performance in Australia and mention has already been made in Section 3.3 of the recently-published Austroads guidelines for obtaining community inputs (Austroads 2002b).

Tasmania is one example of a State with very well developed culture and procedures for community consultation (Austroads 2001c). In that State, "Getting There Together" is an extensive public consultation process that is part of the "Tasmania Together" program and is key to definition of the road system objectives against which strategy performance is measured. In Victoria, similarly, community consultation is a key element in defining community service expectations for local roads (Giummarra and Martin, 2001).

The Western Australian Government also has been very active in community consultation and recently has launched its *Citizenscape* web site, which provides information on how to be an active citizen and how communities can engage in decision-making, along with other important issues. Community consultation is regularly applied to practical issues - for example, the Second Congress of the Metropolitan Freight Network Review in Fremantle, in June 2002, brought together industry, Government and community activists, to consider proposals for a new framework for moving freight by road and rail in the metropolitan area.

In Queensland, a two-way communication between the community and the Department of Main Roads has been established in relation to the recently opened Pacific Motorway and South Eastern Busway. Agreement was reached on a set of performance measures for the operation of these facilities, and the Department disseminates these statistics on a monthly basis, inviting community response.

4.3 Innovations related to Road Safety Outcomes

General Safety Actions

All Australian jurisdictions are building on the success of the last decade, in achieving steady declines in road crash fatalities and casualties, by planning for further improvements. As an example, New South Wales has developed three-year Action Plans for driver fatigue, speed, drink driving, pedestrians, motor cyclists and bicyclists, under the banner of the ten-year *Road Safety 2010* strategy. Action Plans also are in development for heavy vehicle safety and occupant and rider protection.

Infrastructure-related Safety Actions

Over the last four years, many of the Australian States and Territories have introduced a general speed limit (i.e. the limit that applies in the absence of speed signs) of 50 km/h in urban areas, in order to reduce the number and severity of crashes, particularly in local streets. The majority of sub-arterial and arterial urban roads are signed at 60 km/h, with some of the wider arterials in outer metropolitan areas being signed at 70 or 80 km/h. In addition to the general 50 km/h speed limit, some States (eg Tasmania and New South Wales) have instituted 40 km/h limits in targeted residential areas and near schools.

Other infrastructure-related actions that have been taken include:

- video monitoring of critical road facilities such as the Melbourne City Link tunnels, the Sydney Harbour Tunnel, as well as many motorways and major bridges;
- the use of fixed digital speed cameras - New South Wales, for example, expects to have 100 such cameras installed by the end of 2002;
- combating driver fatigue through the development of the New South Wales State roadside Rest Area Strategy, which recently was released to the public;
- high-visibility road markings to assist vision-impaired persons to see the markings more clearly in wet weather; and
- improving the conspicuity of school speed zones.

Vehicle-related Safety Actions

At the time of writing, the Alcohol Interlocks Bill has been tabled in the New South Wales Parliament for discussion. The bill would require a persistent drink-driving offender to fit, to his or her vehicle, a device which makes successful operation of the ignition dependent on the driver registering a satisfactory result to a breath-test indicating blood alcohol content. Similar legislation is under consideration in Victoria and a number of other jurisdictions.

Driver-related Safety Actions

A major initiative in New South Wales has been the introduction of a graduated licensing scheme for new drivers. This scheme extends the progress from learner driver, through probationary driver, to fully-licensed driver, requiring each individual to undergo testing at more points in the process. In particular, a test now is required to progress from probationary to fully-licensed driver, whereas previously (and still today in other jurisdictions), this progression has occurred automatically upon the passage of a specified period of time since the granting of the probationary licence. In addition, more rigorous testing, examining hazard perception capability, is applied.

An associated initiative is the introduction of parent workshops on "helping learner drivers to become safe drivers", to support the additional hours of learner training required by the Graduated Licensing Scheme. Victoria also has a program, centred on television and other media advertising, encouraging parents to assist in increasing the quantity of learner driving experience and extending the range of weather, traffic and other conditions in which this experience is gained. Tasmania too, has introduced a pre-driver awareness program and a range of novice driver licensing reforms.

Other actions aimed specifically at drivers or riders include the following.

- The New South Wales Safer Driver Program is a rehabilitative scheme for repeat traffic offenders. The drink-driving module of this program is being piloted in 2002.
- The Tasmanian State road authority has developed a package of safety countermeasures for older drivers.
- Through Austroads, all road authorities are working towards a consistent, nation-wide system of demerit points associated with traffic offences and of driver penalties when the demerit points limit is exceeded.

Heavy Vehicle Safety

Using digital imaging technology similar to that employed in the RoadCrack™ system (see Section 4.1 above), the Safe-T-Cam system has been implemented by RTA NSW at points on major highways, in order to monitor heavy vehicle compliance with driver rest-break requirements.

A major safety initiative being implemented in Western Australia is mandatory accreditation for heavy haulage operators who choose to operate oversize and over-mass permit vehicles. This scheme is based on wide community, State, Local Government and industry participation in a number of Road Train Summits. Accreditation, which comprises vehicle maintenance and driver-fatigue management, will go a long way to ensuring the road freight task is carried out in a safe and efficient manner on Western Australian roads for the benefit of all road-users. From 1 July 2002, accreditation for vehicle maintenance and driver-fatigue management for these heavy vehicle operators will be required.

Pedestrian-related Safety Actions

Recent innovations in pedestrian safety have focused on school children. For example, the New South Wales Safety Around Schools program aims to improve facilities in the vicinity of schools (speed zones, crossing supervisors etc.) and incorporates a comprehensive data-base of issues raised by school communities.

Pedestrians with disabilities also have received significant attention, with both Victoria and New South Wales undertaking studies of the availability and effectiveness of new technologies (tactile, audible, infra-red etc.) to improve safety for the disabled at crossings and traffic signals.

4.4 Innovations related to Environmental Outcomes

Ensuring Sustainable Transport

The elements of transport sustainability are seen as including minimisation of environmental damage, reduction and management of transport demand and achievement of harmony with the social objectives and expectations of the community.

To these ends, the significant, recent innovations affecting sustainability in Australia include:

- the progress made by road and transport agencies in developing and implementing environmental management systems conforming with ISO14001;
- measures to control urban person travel demands (for example, the introduction of teleworking centres near Sydney);
- the developments in integrated transport incorporating intermodal facilities and interfaces;
- recognition of the importance of bio-diversity in transport corridors and the development by road agencies of methods of assessing road side bio-diversity values; and
- the growth of community involvement in transport decision making.

Reduction of Vehicle Emissions / Greenhouse Gases

Across Australia, the reduction of detrimental vehicle emissions is being achieved through the shift away from the use of leaded petrol, and through the reductions in private car travel resulting from travel demand management and transport integration initiatives.

New South Wales has put in place a Governments Cleaner Vehicles package that sets out vehicle acquisition/replacement and operational policies to improve the emissions performance of government departmental vehicle fleets. This State is also considering a variable registration fee, linked to emission standards, for new vehicles.

5. SUMMARY AND CONCLUSIONS

This report describes the performance management framework within which Australian road authorities manage the uniquely characterised road networks of the nation, notes recent trends in performance and presents recent, significant innovations aimed at improving road system performance in meeting road user and community expectations.

Australia has a road network length that is large in proportion to a small population concentrated principally on the East coast and the Eastern side of the South coast of the mainland. Car ownership is high, at one car for every two people in the country, as is the road freight task per head of population. The three tiers of government - Commonwealth, State/Territory and Local - each have responsibilities for funding and management of road provision and maintenance.

Australian road authorities have developed a comprehensive performance management framework that incorporates a role statement for the road system, identifies the principal outcomes - economic, social, safety-related and environmental - required by key stakeholders and defines performance indicators for both the road system and the road authorities. For practical application, the latter are synthesised into ten different categories of National Performance Indicators, which are reported upon every two years.

Significant trends in road system performance over the last decade have included a significant and steady improvement in road safety, a small but continuing improvement in road condition, but little progress with reduction of road transport-related greenhouse gas emissions. In the larger cities travel times have increased very little, whereas in the less densely populated cities, travel times are less but are increasing steadily towards those experienced in the larger metropolitan areas.

Australia has a strong culture of public consultation by road authorities, which is applied to the assessment of performance and to setting level of service and intervention standards for road networks. A User Satisfaction Index, based on surveys of road user assessments of system attributes grouped under eight categories, is among the performance indicators reported upon biennially.

A major role of this report has been to inform World Road Congress participants of Australian innovations that have contributed significantly to improvement of road system performance in meeting road user and community expectations over the last four years. Among the innovations discussed, the following are particularly significant.

- A strong and continuously growing commitment to stakeholder and community input to identification of service level requirements and to planning and implementation of road system improvements.
- The continued changes in the roles of road authorities from construction and maintenance to road network management.
- The development and application of unit values of travel times for road freight, for use in benefit-cost analysis.
- Major infrastructure projects, including the Melbourne City Link, in Victoria, and the South Eastern Motorway and Busway in Queensland.
- A general lowering of speed limits on urban local roads in most States and Territories.
- The introduction of alcohol interlock systems on the vehicles of persistent drink-driving offenders.

- Implementation of graduated licensing processes for new drivers, to increase levels of driving experience before full licences are awarded.
- Demand management schemes and transport integration to achieve economic, social and environmental objectives for the road system.
- Innovative, Australian-developed technologies such as the RoadCrack™ pavement crack detection, measurement and classification system developed by RTA NSW and CSIRO.

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