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Methodologies for updating parameter values for economic evaluation of road transport projects in Australia

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Abstract

The review of the National Guidelines for Transport System Management (NGTSM) is currently underway. The first part of the review has involved the updating of unit parameter values for road user cost (RUC) components for use in economic evaluation of road transport projects in Australia, namely: fuel, engine oil, tyres, new vehicles (depreciation), travel time and crash costs. This paper presents an overview of the methodologies used to update the parameter values for RUC components supplied to the NGTSM review. The paper provides parameter values for each of the components for an extended 20 vehicle classification (including passenger cars, light & heavy commercial vehicles and buses) for input prices in terms of both market and resource prices. Values of travel time are provided for vehicle occupants across all vehicle types, as well as values of travel time for freight in urban and rural environs. Finally, the paper reviews the methodology used to estimate the costs of casualty crashes and provides estimates of average cost of crashes for both human capital and willingness to pay (WTP) approaches, taking into account crash rates and injury severities across jurisdictions.

1. Introduction

The economic evaluation of road projects requires that participants have access to updated and uniform parameter values so that project appraisals can be undertaken in a consistent manner across Australia. The Road User Effects (RUE) set of parameter values are seen as being a very robust dataset on which to base the economic assessment of future road projects using well documented appraisal methodologies. In Australia, these values have previously been updated over the years as Part 4 of the Austroads Guide to Project Evaluation. A review of the National Guidelines for Transport System Management (NGTSM) is currently underway, aimed at providing Australian practitioners with guidance on all aspects of economic evaluation. As part of the NGTSM review, this paper provides updated parameter values for the following road user cost (RUC) components, namely: fuel, engine oil, tyres and new vehicles (depreciation) (see Transport & Infrastructure Council 2015). The paper presents methodologies used to estimate parameter values in terms of market and resource prices for an extended 20 vehicle classification. Values of travel time are provided for vehicle occupants as well as values of travel time for freight. Finally, the paper reviews the methodology and provides estimates of average cost of crashes for both human capital and willingness to pay (WTP) approaches.

2. Vehicle operating cost components

2.1 Fuel

Fuel price data were obtained from FuelTrac for urban centres (capital cities & towns) across jurisdictions in Australia for the main automotive fuel types.

Retail prices were adjusted in terms of taxes (GST & fuel excise) and applicable subsidies and rebates / tax credits to reflect resource prices for these components. Retail and resource

price data for fuel types (including unleaded and premium unleaded petrol) across all capital cities are contained in Table 1.

2.1.1 Fuel excise

From March 2001 to June 2014, the fuel excise was fixed at 38.143 cents per litre. Changes to fuel excise proposed in the Federal budget for 2014-15 involved a reintroduction of indexation of the fuel excise on a twice-yearly basis. This would need to be included in future parameter values updates.

2.1.2 Fuel tax credits

Changes to fuel tax credit schemes were initiated from 1 July 2013. The fuel tax credit applicable from that date to heavy vehicles with a gross vehicle mass (GVM) greater than 4.5 tonnes travelling on public roads is 12.003 cents per litre for liquid fuels, especially diesel (Australian Taxation Office 2013). These fuel tax credits are not reflected in the price data in as they came into effect from 1 July 2013 and were furthermore not applicable to all diesel sold.

2.1.3 Road user charge

The road user charge applicable to fuel used in heavy vehicles from 1 July 2013 (Australian Taxation Office 2013) was set at 26.14 cents per litre, with the fuel tax credit set at 12.003 cents per litre. This can be incorporated into future parameter values updates.

2.1.4 Fuel subsidy schemes

Fuel subsidy schemes were withdrawn from Queensland (8.354 cents per litre) from June 2009, Northern Territory (1.1 cents per litre) from May 2009 and South Australia (3.3 cents per litre) from September 2010. These changes are reflected in the calculation of resource prices in Table 1.

Table 1: Capital city fuel prices – retail and resource prices as at 30 June 2013 (cents per litre)

Capital city	ULP		PULP		Diesel		LPG	
	Retail price[1]	Resource price[2]	Retail price[1]	Resource price[2]	Retail price[1]	Resource price[2]	Retail price[1]	Resource price[2]
Sydney	145.6	94.2	157.5	105.0	147.6	96.0	64.7	46.3
Melbourne	144.8	93.5	156.2	103.9	144.6	93.3	57.9	40.1
Brisbane	149.4	97.7	161.8	109.0	148.5	96.9	64.7	46.3
Adelaide	144.9	93.6	156.6	104.2	147.8	96.2	68.0	49.3
Perth	147.0	95.5	159.6	107.0	147.7	96.1	69.3	50.5
Hobart	151.3	99.4	165.9	112.7	152.5	100.5	88.9	68.3
Darwin	160.9	108.1	170.5	116.9	161.5	108.7	105.9	83.8
Canberra	146.4	95.0	159.2	106.6	147.3	95.8	78.7	59.0

1 FuelTrac (retail price data generated as at 30 June 2013).

2 Resource prices calculated by ARRB Group Ltd.

Source: FuelTrac (data generated as at 30 June 2013).

The fuel prices in Table 1 were then weighted in terms of sales volumes data (especially the case for petrol) to provide weighted average fuel prices per capital city.

2.2 Oil

A survey was undertaken of retail outlets for small volume sales (1 litre & 4 litre containers) mainly for oil used in petrol engines, as well as oil companies for large containers (209 litres) of engine oil sold in bulk to road freight transport operators for use in diesel engines. The market and resource prices obtained from the surveys across vehicle types are presented in Table 2. The prices for diesel engine oils were therefore lower than might be expected due to the inclusion of larger containers in the sample.

Table 2: Oil prices ($ per litre) per engine type, as at June $2013

Engine type	Market price ($ per litre)	Resource price ($ per litre)
Petrol	7.66	6.96
Diesel	4.64	4.22

Source: ARRB Group Ltd.

Using SMVU data, a weighted average engine oil price was calculated for LCVs given that this vehicle type includes petrol or diesel engines[1]. This was estimated at a market price of $6.15 per litre and resource price of $5.59 per litre.

2.3 Tyres

A survey of tyre prices for all vehicle types[2] was undertaken through a sample of retail outlets and tyre companies and these data are contained in Table 3. Where appropriate, for heavy vehicles, the prices per new tyre are a weighted average between the drive tyres and trailer tyres. The number of tyres per set and the resource price per set of new tyres are also presented in Table 3, the latter being deducted from the resource price of new vehicles for depreciation purposes.

Table 3: New tyre prices per vehicle type ($ per tyre), as at June $2013

Vehicle type	Market price ($ per new tyre)	Resource price ($ per new tyre)	Number of tyres per set	Resource price ($ per set of new tyres)
Cars				
01. Small Car	98	89	4	356
02. Medium Car	128	116	4	464
03. Large Car	167	151	4	604
Average	136	123	4	492
Utility vehicles				
04. Courier Van-Utility	171	155	4	620

[1] The proportion of petrol and diesel engine LCVs was based on SMVU (ABS 2013c) data available at time of calculation.

[2] Using the 20 vehicle classification as developed for use in the harmonisation studies which employed the Australian adaptation and calibration of the HDM models which have also been adopted for the vehicle operating cost (VOC) modelling component of the NGTSM Review. This is explained further in Transport and Infrastructure Council (2015), including how this relates to the Austroads 12 bin classification.

Vehicle type	Market price ($ per new tyre)	Resource price ($ per new tyre)	Number of tyres per set	Resource price ($ per set of new tyres)
05. 4WD Mid Size Petrol	306	278	4	1,112
Rigid trucks				
06. Light Rigid	247	224	4	897
07. Medium Rigid	507	461	6	2,764
08. Heavy Rigid	728	662	10	6,618
Bus				
09. Heavy Bus	493	448	8	3,584
Articulated				
10. Artic 4 Axle	676	614	14	8,600
11. Artic 5 Axle	690	627	18	11,291
12. Artic 6 Axle	686	624	22	13,720
Combination vehicles				
13. Rigid + 5 Axle Dog	660	600	30	18,000
14. B-Double	653	594	34	20,196
15. Twin steer + 5 Axle Dog	690	627	32	20,064
16. A-Double	682	620	42	26,040
17. B Triple	689	626	46	28,796
18. A B Combination	653	594	54	32,076
19. A-Triple	688	625	62	38,750
20. Double B-Double	688	625	66	41,250

Source: ARRB Group Ltd.

2.4 Repairs and maintenance

For passenger cars and light vehicles, the repairs and maintenance costs used in previous Austroads unit values updates (Austroads 2012) were revised using an average of the CPI for vehicle maintenance and repairs and the CPI for motor vehicle spares. For heavy vehicles, repairs and maintenance was updated using an average of the PPI for road freight and the PPI for auto parts. This differs from the methodology used in the previous Austroads unit values update (Austroads 2012) which used the PPI for road freight only. The repairs and maintenance costs per vehicle type are contained in Table 4. The estimates based on percentage of new vehicle price as used in adapted HDM-4 models (including estimated time costs for labour) are also presented for comparison purposes.

Table 4: Repairs and maintenance costs per vehicle type, as at June 2013

Vehicle type	Repairs & maintenance costs (cents per km) based on PPI	Repairs & maintenance costs (cents per km) based on % new vehicle price
Cars		
01. Small Car	6.1	7.1
02. Medium Car	7.1	8.1

Vehicle type	Repairs & maintenance costs (cents per km) based on PPI	Repairs & maintenance costs (cents per km) based on % new vehicle price
03. Large Car	5.7	9.3
Average	6.3	8.2
Utility vehicles		
04. Courier Van-Utility	6.7	6.7
05. 4WD Mid Size Petrol	8.2	8.2
Rigid trucks		
06. Light Rigid	6.1	7.5
07. Medium Rigid	13.1	10.7
08. Heavy Rigid	14.0	16.8
Buses		
09. Heavy Bus	13.1	13.1
Articulated trucks		
10. Artic 4 Axle	19.1	18.9
11. Artic 5 Axle	22.2	19.5
12. Artic 6 Axle	22.8	18.0
Combination vehicles		
13. Rigid + 5 Axle Dog	25.2	22.7
14. B-Double	26.5	27.6
15. Twin steer + 5 Axle Dog	27.2	30.5
16. A-Double	28.3	37.7
17. B Triple	35.3	47.1
18. A B Combination	34.7	45.3
19. A-Triple	36.3	46.2
20. Double B-Double	39.2	47.7

Source: ARRB Group Ltd.

2.5 New vehicles

Average new vehicle prices[3] for passenger cars and LCVs (utility / delivery vehicles) were obtained from the Automotive Data Services (www.redbook.com.au), while new vehicle prices for heavy commercial vehicles were updated using an average of the PPI for Road Freight, PPI for motor vehicles and the PPI for vehicle bodies and trailers to give a more representative index for the change in new vehicle prices. These prices were also compared to available sources, namely: www.trucksales.com.au and FreightMetrics (www.freightmetrics.com.au). The resource price for each vehicle type in Table 5 involved the deduction of a 5% fleet discount, GST and the resource price per set of tyres applicable to that vehicle type.

[3] For the purposes of estimating depreciation.

Table 5: New vehicle prices, as at June $2013

Vehicle type	Market price ($ per vehicle)	Resource price ($ per vehicle)
Cars		
01. Small Car	18,770	15,855
02. Medium Car	29,070	24,645
03. Large Car	41,467	35,204
Average	29,766	25,217
Utility vehicles		
04. Courier Van-Utility	34,203	28,919
05. 4WD Mid Size Petrol	57,280	48,357
Rigid trucks		
06. Light Rigid	56,511	47,913
07. Medium Rigid	139,521	117,726
08. Heavy Rigid	225,004	187,756
Buses		
09. Heavy Bus	322,571	275,000
Articulated		
10. Artic 4 Axle	305,732	255,450
11. Artic 5 Axle	341,347	283,509
12. Artic 6 Axle	373,497	308,840
Combination vehicles		
13. Rigid + 5 Axle Dog	340,037	275,668
14. B-Double	436,881	357,110
15. Twin steer + 5 Axle Dog	410,015	334,040
16. A-Double	552,824	451,399
17. B Triple	707,382	582,125
18. A B Combination	611,048	495,647
19. A-Triple	707,011	571,850
20. Double B-Double	690,398	555,003

Source: ARRB Group Ltd.

3. Travel time

This section presents values of travel time for vehicle occupants and freight.

3.1 Value of travel time for vehicle occupants

This section presents values of travel time for vehicle occupants.

3.1.1 Travel time values for light vehicle occupants

The value of travel time for the occupants of passenger cars was updated to 30 June 2013 using the change in Average Weekly Earnings (AWE) (Australian Bureau of Statistics 2013b). The AWE for full-time ordinary adult workers in Australia as per May 2013 ($1,420.90 per week) was updated to June 2013 using the CPI and was calculated at $1,423.67 per week or $37.46 per hour assuming a 38 hour week. As in previous Austroads unit values updates (Austroads 2012), private travel time was valued at 40% of seasonally adjusted full time AWE for Australia (Austroads 1997), or $14.99 per person-hour (i.e. 40% of the AWE).

For business car travel, the value of travel time was assumed to be 129.8% of AWE (135% of full time AWE less 5.2% for payroll tax[4]), assuming a 38 hour week. This methodology was in line with Austroads (1997)[5] and subsequent unit parameter values updates (Austroads 2012). On this basis, business car travel was estimated at $48.63 per person-hour. These values are contained in Table 6.

3.1.2 Value of travel time for bus occupants

The value of travel time for bus drivers was estimated at that of a 5 axle articulated vehicle (mid-range of the heavy vehicle drivers) and for bus passengers as the value of travel time for private passenger car trips. These values are contained in Table 6.

3.1.3 Value of travel time for commercial vehicle occupants

The value of travel time for the occupants (crew) of commercial vehicles was updated to June 2013 using hourly wage rates based on the Road Transport and Distribution Award (2013), following the methodology recommended in Austroads (1997) and used in Austroads (2012). The minimum wage per level of transport worker was then annualised and adjusted in terms of leave loading (17.5% of 4 weeks wages) and on-costs (payroll tax, long service leave, superannuation contribution at 9.25% and training levies). It was then adjusted in terms of assumed available work hours to arrive at a value of travel time per hour.

3.1.4 Road Transport and Distribution Workers Award

The weekly wage rates for each transport worker grade as published in the Road Transport and Distribution Award for the year 2013 (Australian Industrial Relations Commission 2013) formed the basis for the estimation of the value of travel time for commercial vehicle occupants in Table 6.

[4] Payroll tax for each state weighted in terms of population per state (see Transport and Infrastructure Council 2015).

[5] The payroll tax assumed in Austroads (1997) and used in previous Austroads (2012) estimates of business car travel time was 7%, but this was revised to 5.2% as contained in Transport and Infrastructure Council (2015).

3.2 Value of travel time for freight

The value of travel time for freight was updated using the PPI for Road Freight and these values are included in Table 6. For future updates, these values could be based on a more recent and extensive study of the value of travel time for freight taking into account load and vehicle types. Austroads has identified the specific need for such a study in the near future and updates could draw on these results.

3.3 Estimated values of travel time for vehicle occupants and freight

The estimated values of travel time for vehicle occupants and freight are contained in Table 6.

Table 6: Estimated values of travel time (resource costs) – occupant and freight payload values, as at June 2013

Vehicle type	Non-urban		Urban		Freight travel time	
	Occupancy rate (persons/ veh)	Value per occupant ($/person-hour)	Occupancy rate (persons/ veh)	Value per occupant ($/person-hour)	Non-urban	Urban
					$ values per vehicle-hour	
Cars (all types)						
Private	1.7	14.99	1.6	14.99	na	na
Business	1.3	48.63	1.4	48.63	na	na
Utility vehicles						
04. Courier Van-Utility	1.0	25.41	1.0	25.41	na	na
05. 4WD Mid Size Petrol	1.5	25.41	1.5	25.41	na	na
Rigid trucks						
06. Light Rigid	1.3	25.41	1.3	25.41	0.78	1.53
07. Medium Rigid	1.2	25.72	1.3	25.72	2.11	4.15
08. Heavy Rigid	1.0	26.19	1.0	26.19	7.22	14.20
Buses						
09. Heavy Bus (driver)	1.0	25.72	1.0	25.72	0.00	na
09. Heavy Bus (passenger)	20.0	14.99	20.0	14.99	0.00	na
Articulated trucks						
10. Artic 4 Axle	1.0	26.81	1.0	26.81	15.53	30.59
11. Artic 5 Axle	1.0	26.81	1.0	26.81	19.80	39.01
12. Artic 6 Axle	1.0	26.81	1.0	26.81	21.36	42.06
Combination vehicles						
13. Rigid + 5 Axle Dog	1.0	27.20	1.0	27.20	30.53	62.99
14. B-Double	1.0	27.20	1.0	27.20	31.46	64.91
15. Twin steer + 5 Axle Dog	1.0	27.20	1.0	27.20	29.50	60.89
16. A-Double	1.0	27.98	1.0	27.98	41.31	85.25
17. B Triple	1.0	27.98	1.0	27.98	42.17	87.01
18. A B Combination	1.0	27.98	1.0	27.98	50.79	104.80
19. A-Triple	1.0	28.45	1.0	28.45	60.89	125.64
20. Double B-Double	1.0	28.45	1.0	28.45	61.59	127.09

Note: na denotes not applicable.

Source: ARRB Group Ltd.

4. Crash costs

This chapter contains updated average crash costs by crash severity across Australian jurisdictions, i.e. taking into account injury severity, estimated using the hybrid human capital approach and the willingness to pay (WTP) approach.

4.1 Crash data

Crash data by injury type and crash severity were extracted from Austroads crash data by jurisdiction as at 2010. The 2010 data were the most recent crash data collected from jurisdictions at the time of the update, subsequently cleaned and checked for consistency and reconciled as far as possible. The crash data per injury and crash severity were used to estimate the average cost of crashes per crash severity using the latest injury values for both human capital and WTP approaches outlined in this section. Police reporting differs between jurisdictions, as does the extent to which police officers attend crashes. Consequently, the crash data in this paper refers to reported crashes only.

The steps undertaken in analysing the latest available (2010) crash data and using it to estimate the average cost of crashes by injury severity were:

- Classifying the jurisdictional crash data road environment, i.e. grouping crashes by rural, urban and urban freeways road environments. The rural road environment refers to mainly built-up undivided roads with speed limits of up to 80 km/h, mainly built-up and divided roads with speed limits of 100 km/h and above and mainly open roads with speed limits from 80 km/h. The urban road environment was defined as mainly built-up and divided roads with speed limits below 100 km/h and all roads with speed limits under 80 km/h. Urban freeway environment was defined as mainly built-up and divided roads with speed limits of 100 km/h and above.
- Grouping by crash severity and road environment, i.e. fatal, serious and minor crashes on the different road environments. Crash severity classifications vary across jurisdictions e.g. New South Wales recording fatal, injury, other and tow-away crashes. To standardise the analysis, crashes were classified as fatal, serious and other crashes for all jurisdictions except New South Wales.
- Further classifying jurisdictional data by injury severity, crash severity and road environment. This showed the number of injuries and injury type by crash severity, e.g. the number of fatalities, medically treated, admitted to hospital, minor injuries and other injuries in fatal crashes.
- Calculating the rate of injury per crash type by road environment, i.e. calculating the rate of fatalities per fatal crash, serious injuries per fatal crash, etc.
- Injury rate per crash type was then used, along with the updated human capital and WTP values per injury, to estimate the average cost of crashes by injury severity.

4.2 Casualty costs

Casualty costs across injury types were updated using both the human capital and the WTP approaches. These were then applied to the crash rates and crash severities to calculate an average cost of crashes per crash severity in Australia.

4.2.1 Human capital approach

The updated average casualty costs per person based on the 1996 values (BTE 2000) and updated to June 2013 using appropriate indices are contained in Table 7. This is the same method used in previous Austroads unit values updates (Austroads 2012). These values for casualty costs were then applied to the crash data per crash severity to estimate the average cost of crashes for Australia in 2013 and these values are contained in Table 8.[6]

Table 7: Average casualty costs per person, human capital approach, June $2013

Cost component	Fatal crash	Serious injury crash	Other injury crash
Total human cost (incl. ambulance, hospital and other medical costs, insurance claims, prosecution, labour funeral and coroner costs)	2,069,274	335,078	7,111
Total vehicle costs (incl. vehicle repair, availability & towing costs)	15,714	13,241	12,200
Total general costs (incl. travel delay, insurance administration, police, fire and property costs)	132,069	151,632	244
Total combined costs	2,217,057	499,951	19,554

Source: Adapted from BTE (2000).

The revised estimate of a property damage only crash based on BTE (2000) data is $9,257 as at June 2013.

[6] Also see BTRE (2010) for the hybrid human capital approach. However for the NGTSM parameter values, the methodology for the update of injury costs was kept the same as for Austroads (2012), i.e. 1996 base values updated, in line with the human capital approach. This is also explained in Austroads (2011).

Table 8: Estimation of crash costs by injury severity, human capital values, June $2013

State	Rural			Urban			Urban freeway			Total		
	Fatal crash ($)	Serious injury crash ($)	Other injury crash ($)	Fatal crash ($)	Serious injury crash ($)	Other injury crash ($)	Fatal crash ($)	Serious injury crash ($)	Other injury crash ($)	Fatal crash ($)	Serious injury crash ($)	Other injury crash ($)
New South Wales	2,875,402	588,546		2,538,351	546,231		2,607,771	574,426		2,772,853	537,864	
Victoria	2,843,808	628,914	26,217	2,521,384	562,234	24,550	2,860,449	596,339	25,242	2,715,548	578,847	24,707
Queensland	2,728,617	642,035	25,822	2,456,692	595,803	23,760	2,417,038	602,434	25,760	2,622,924	608,184	24,217
South Australia	2,826,043	610,963	26,080	2,385,285	553,306	23,479	2,569,913	782,048	27,490	2,634,126	578,406	23,963
Western Australia	2,868,662	638,358	28,970	2,447,722	583,884	26,900	2,617,019	646,690	28,149	2,707,518	300,437	26,878
Tasmania	2,568,291	579,621	28,381	2,351,823	533,536	24,696	2,217,057	699,655	28,245	2,502,099	563,854	26,107
Northern Territory	2,803,648	664,275	24,241	2,945,056	620,768	23,343	2,864,360	520,685	31,109	2,847,136	635,163	24,266
Australian Capital Territory				2,857,595	536,679							

Source: ARRB Group Ltd.

4.2.2 Willingness to pay (WTP) approach

Crash costs per injury type derived from WTP values are contained in Table 9. The WTP values estimated by the RTA NSW in 2008 were updated as an interim measure until a national WTP study is undertaken; this was in line with the methodology for interim estimates outlined in Austroads (2015). These values were then applied to the appropriate crash data to estimate crash costs using the WTP values. Additional costs as compiled by BITRE for emergency services and other costs were then added to the RTA WTP values to produce a set of 'inclusive' WTP values and these are presented in Table 9. These injury costs were then applied to the crash data to calculate average crash costs presented in Table 10. The WTP average crash cost values estimated by TfNSW in their appraisal guidelines (TfNSW 2013) were also updated and included in Table 10.

Table 9: Estimated costs by injury type using the Inclusive WTP[7] approach (June $2013)

Injury severity	Urban ($)	Non-urban ($)
Value of statistical life (VSL)	7,573,412	7,489,950
Value of serious injury (VSI)	526,606	390,898
Value of hospitalised injuries (VHI)	100,431	77,653
Value of minor injuries (VMI)	31,739	36,121

Source: ARRB Group Ltd adapted from Austroads (2015).

[7] Includes vehicle and general costs, e.g. vehicle towing, emergency services, administrative costs, as calculated under the human capital approach.

Table 10: Estimation of crash costs by injury severity, Inclusive WTP values[8], June $2013

State	Rural			Urban		
	Fatal crash ($)	Serious injury crash ($)	Other injury crash ($)	Fatal crash ($)	Serious injury crash ($)	Other injury crash ($)
New South Wales[9]	7,848,085	216,675		6,476,155	136,505	
New South Wales[10]	8,947,869	543,335		8,298,633	659,881	
Victoria	8,611,365	499,138	48,429	8,409,584	594,663	39,848
Queensland	8,331,930	507,261	47,699	7,955,196	633,652	38,566
South Australia	8,905,039	504,427	48,175	7,780,230	611,175	38,110
Western Australia	8,820,027	507,601	53,513	8,001,286	617,588	43,661
Tasmania	8,302,092	460,750	52,429	7,720,934	563,748	42,488
Northern Territory	8,343,480	522,627	44,779	8,780,310	655,048	37,888
Australian Capital Territory				9,233,736	567,583	

Source: ARRB Group Ltd.

4.2.3 Estimation of crash costs by severity and speed zone

Crash costs across jurisdictions were estimated by severity and speed zone for urban freeways, urban roads and rural roads. These data are presented in Transport and Infrastructure Council (2015). It must be noted that not all jurisdictions had sufficient data for the estimation of crash costs for all speed zones.

4.2.4 Crash rates

The calculation of crash rates was undertaken by Austroads over some years for both Australia and by individual jurisdictions in Jurewicz & Bennett (2008) and Austroads (2010).

4.2.5 Crash reduction and mitigation factors

Crash reduction (and mitigation) factors have been published in Austroads (2012) for a range of treatment types[11]. These were also published as a complement to crash reduction factors for Black Spot Treatments published in Department of Infrastructure, Transport, Regional Development and Local Government (2009) Black Spot Evaluation Notes on Administration.

[8] Includes vehicle and general costs, e.g. vehicle towing, emergency services, administrative, etc, as calculated under the human capital approach.

[9] Note values for NSW are as published in the TfNSW project appraisal guidelines, TfNSW (2013), where it is assumed that all costs are included in the WTP values.

[10] These values for NSW were compiled using RTA NSW (2008) values (incl. additional costs) and NSW crash data as per all other jurisdictions. This approach was accepted as an interim approach in Austroads (2015) until a national WTP study is undertaken for Australia.

[11] Treatment types include: delineation (e.g. pavement or line markings), intersection treatments (e.g. installation of give way signs or roundabouts), railway level crossings (e.g. signage or barriers), road geometry and design (e.g. overtaking lanes), roadside (e.g. installation of guardrails), signage (e.g. variable message or warning signs), pedestrian (e.g. phasing at signals, pedestrian crossing), speed and enforcement (e.g. speed cameras, speed changes) and traffic management (e.g. medians, traffic

4.2.6 Life-long injury costs

The cost of life-long injuries is also significant but is currently not incorporated fully in the costs of serious injury. The lifetime costs per incident case estimated in Access Economics (2009) for spinal cord injuries and paraplegia and quadriplegia were updated to June $2013 using the CPI for medical and hospital services and the National Accounts Implicit Price Deflator for Health to provide some idea of the extent of these costs.

5. Recommendations for further research

The following recommendations can be made for further research in the area of parameter values for economic evaluation of road projects in Australia:

- Values for travel time reliability – this is being researched extensively internationally in terms of the variability of travel time; previous Austroads work has identified measures of reliability and this has laid the foundation for estimates for Australia.
- Values travel time for freight – values used in Australia were compiled in 2003 for a limited study in Melbourne and have been updated periodically since. However, a comprehensive re-estimation of these values is required based on an extended survey and using the most up to date techniques.
- Crash costs – a revision of the social cost of crashes is required based on a WTP survey undertaken across Australia. This will supplement the crash costs based on the human capital approach, as well as the WTP values estimated for the Sydney area in 2008 which were the basis of the updated values presented in this paper. The costs of permanent disability care (life-long injury costs) also merits further examination.
- Frequent, regular updating of the parameter values for the core RUE components, i.e. fuel, oil, tyres and new vehicles, should be undertaken so that consistent methodologies and sources can be used. In the past, parameter values have been updated on an ad hoc basis every 2-3 years as funding has been available for comprehensive update including VOC models. With the recent updating of VOC models having been done through the NGTSM review, more frequent updating of the core RUE components specifically, e.g. fuel prices, can be done at a much reduced cost and more regularly.
- Future updates of parameter values for the RUE components, e.g. fuel, must also reflect changes in the tax structure of prices which have come into effect post-June 2013. An example of that would be fuel tax credits and the indexation of the fuel excise component.

calming). A level of confidence is also provided for each crash reduction or mitigation factor per treatment type in Austroads (2010).

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