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Safety and Productivity Observations on a Billion Kilometres of Travel by Australian Trucks Using the 'Performance Based Standards' Schemes

Kim Hassall
The University of Melbourne, Australia

Since the concept of Performance Based was first proposed in Australia, in 1997, by the then National Road Transport Commission, several hundred vehicles that used these new 'engineering standards' were commissioned, between 1998 and 2006, under State based permit systems. In 2006 a more formalized regulatory PBS framework was put in place and since that time the population of PBS vehicles has expanded to nearly some 7000 units by early 2018. However, even though the Australian PBS 'trial' is now some twenty years old, there are still many major national road networks that are yet to have access granted for these vehicles, and still an endemic perception remains that 'bigger vehicles are bad'. In 2014 and 2017 two comprehensive studies were conducted that statistically proved PBS vehicles to be significantly safer, more productive and environmentally friendlier than the conventional Australian heavy truck fleet. This paper specifically examines the safety and productivity aspects of the Australian PBS fleet over the period 2009 – 2016 which confirms the safety and operator benefits of these vehicles.

Keywords: Truck Safety, High Productivity Trucks, Road Freight Productivity, Road Safety Initiatives, Safety Innovations.

1. THE SAFETY ANALYSIS FOR PBS TRUCK OPERATIONS IN AUSTRALIA

Background on Performance Based Standards in Australia

The introduction of Performance Based Standards (PBS) vehicles, also often referred to as Higher Productivity Vehicles (HPVs), have also had successful trials in several countries including South Africa, the Netherlands, Canada, Australia, New Zealand, Sweden and with a group of South American countries developing template designs for specific high productivity configurations. In Australia, where the concept was developed in 1997 which led to a number of initial configurations being modelled against this new set of 'performance engineering standards' in 1999 (NRTC 1999a, 1999b). Trials for some of these configurations were granted under permit. The most common permitted combinations were BB and BA triples, AB Doubles, BAB Quad Trailer combinations and rigid trucks with four axle 'dog' trailers.

PBS Truck Growth Rates

In 2013 the operational rollout of the PBS scheme was transferred to the new National Heavy Vehicle regulator (www.nhvr.gov.au). Since that time nearly 7000 vehicles have been certified for operations, reflecting a growth rate of nearly 43% per annum since that date. However, some older vehicles, that were operating before the formal PBS scheme was adopted in 2006, are still operating under State permit systems, and these 'permit' vehicles which number over 600, is nearly 10 per cent of the current Australia PBS truck population. Many of these vehicles are BB-Triples, and A-Doubles, which are operating in rural and regional areas.

Table 1. Growth in the Use of Australian PBS vehicles.

Year	PBS Population
2018 (March)	6,935
2017	5,803
2016	4,624
2013	1,169
Growth per annum	42.7%

Source: ILI 2017, NHVR Annual Report 2016-17 & Fleet Report 2018.

How Safe are Performance Based Standards Vehicles?

The question of PBS safety was a feature of the OECD 2011 report where it suggested, generally through modelling, that High Productivity vehicles should be safer. In 2007 De Kievit and Aarts also made a similar suggestion after trials in the Netherlands also proved successful. However, the first major study into PBS safety was done in Australia in the Austroads 2014 study. However, before PBS vehicles could be benchmarked for safety it was necessary to determine how safe was the conventional Australian truck fleet. The only data that was available in Australia was fatalities and serious injuries data by either rigid or articulated truck. State transport agencies also do not identify PBS/HPV truck accidents as being different from an accident with a conventional configuration. One State uses the driver's license class as a means of recording the truck type driven in a fatal accident. These data holdings are not very useful when examining the safety performance of a particular truck configuration. This problem was overcome by involving the National Truck Accident Research Centre (NTARC) in both the 2014 and 2017 studies. The centre is a private statistical and research group operated by Australia's largest truck insurer, National Transport Insurance (NTI), that holds a very significant national market share of the insured heavy truck fleet.

Firstly, how safe is the conventional Australian truck fleet?

In order to answer this question, it was vitally important to examine the safety performance of the conventional vehicle fleet. NTARC's data was used for this purpose, in both the 2014 and 2017 PBS safety studies. In the 2014 study, that examined the period 2009-2012, some 15,000 accidents were examined by configuration, and in the 2017 study, covering the period 2013-2016, some 19,000 recorded NTARC accidents were examined. (See Table 2).

Table 2. Conventional Vehicle Accident Benchmark Population, 2009-2017.

Survey 1 (2014) Vehicle totals	15,358	Extraction period 2009-2012
Survey2 (2017) Vehicle Totals	19,216	Extraction Period 2013-2017

Source: National Truck Accident Research Centre.

The accident categories that were able to be extracted from the insurance data were divided into four categories: minor, moderate, serious and major impact collisions. (See Appendix B). This paper examines in detail the comparison of 'major impact collisions' for conventional vehicles versus Performance Based Standards vehicles. The production of the crash rates by accident severity by specific conventional vehicle configuration was a safety research first in Australia. The generation of these accident benchmarks enabled the PBS/HPV trucks to be compared to the conventional truck fleet. Appendix C presents the detailed conventional vehicle accident results for the 2014 survey. (Austroads, 2014).

What are the Safety Metrics Used to Compare Conventional and Performance Based Standards Trucks?

The two safety studies chose two commonly used metrics to compare the performance of the PBS and conventional Australian truck fleet. These two metrics were:

- major impact collisions per 100 million kilometres, and
- major impact collisions per 10,000 vehicles.

In the comparative PBS studies, across the period 2009-2016 in 2014 and 2017 reports, this first metric could be estimated with great confidence as some 1,100 million kilometres of travel was observed. This was a factor of 11 times greater than the 100 million kilometre metric needed to benchmark performance. (See Table 3). The rates of collision per 10,000 vehicles was more problematic, as across both accident surveys, only 2000 PBS vehicles were surveyed. Although this was almost 30% of the PBS truck population, most of the assessments, against the conventional accident metric of 10,000 vehicles, made individual comparisons, at a configuration level, statistically invalid.

The NTARC data reflects impact collisions and insurance claims. Fatalities data for PBS trucks is not captured by insurers or any agency at this time.

However, some estimates were made on fatalities through the operator surveys and these findings are presented in Appendix D.

over 1.1 billion kilometres in this time period, the PBS fleet performed exceptionally well against the rate per 100 million kilometre metric, (R100mK),

Table 3. PBS Operator Surveys Sizes, 2009-2016.

Survey period	PBS Vehicle Accident sample size	PBS Vehicle Population in period	% of Population sampled	Surveyed Kilometres (m)
Survey 1 2009-2012	600	2,269	26.4 %	292.1 million
Survey 2 2013-2016	1,404	4,624	30.0 %	855.3 million
Totals	2,004	6,839	29.3 %	1,147.4 million

Source: Derived from Austroads 2014 and NTC 2017.

What are the comparative safety results for the Australian Performance Based Standards Trucks?

The comparative results across the period 2009 – 2016, where Australian PBS vehicles travelled

when compared to the conventional Australian fleet. (See Table 4).

Because of the limited number of PBS vehicles in the survey only indicative values of the R10K metric, accident rates per 10,000 vehicles, were available at the articulated and total PBS

Table 4. Major Collision rates for Conventional versus PBS Trucks Australia, 2009 - 2016.

Comparison Conventional Vehicle Configuration	Weighted Accident Rate per 100m km [1]	Weighted Accident Rate per 10K Vehicles [1]	PBS/HPV Configuration	Weighted PBS Accident Rate per 100m kms [2]	Weighted PBS Accident Rate per 10K Vehicles [2]
3,4,5 Axle Single Rigid no trailer	9.6	29	8 x 4 PBS Rigid	0.0	nsv[3]
HR with 3Axle Trailer	8.8	76.3	HR with 3Axle Trailer	8.4	nsv[3]
HR with 3Axle Trailer			HR with 4 Axle Trailer	7.8	nsv[3]
HR with 3Axle Trailer			HR with 5 Axle Trailer	2.3	nsv[3]
HR with 3Axle Trailer			HR with 6 Axle Trailer	0.0	nsv[3]
TOTAL Rigid Truck & Dog Trailers	8.8	76.3	TOTAL PBS Rigid Truck & Dog Trailers	5.8	nsv[3]
6Axle Semi-Trailer	20.9	148	6/7Axle Semi Trailer	9.6	nsv[3]
B-Double	8.7	145.1	SB / EB-Double	6.6	nsv[3]
B-Double			BB-Triple	4.1	nsv[3]
B-Double			A-Double (PBS Type I Road Train)	13.8	nsv[3]
Road Train Type I	18.9	296	A-Double (PBS Type I Road Train)	13.8	nsv[3]
Road Train Type II	22.7	335.9	AA, AB, BA Triple (PBS Type II Road Train)	4.2	nsv[3]
B-Double	8.7	145.1	AAB BAB Quad (Double B-Double)	18.9	nsv[3]
TOTAL Articulated	15.3	155.3	TOTAL PBS Articulated	6.2	123.6
TOTAL Conventional [4]	13.6	143.3	TOTAL PBS	6.0	103.3

Notes: Weighted averages from: 1. Austroads 2014, and 2. NTC 2017. 3. nsv Not Statistically Valid (500+ vehicles required). 4. Calculations derived from NTARC insurance data, 2009 – 2016.

population level. This was because only 2,000 PBS vehicles were surveyed and some configurations had less than 50 vehicles in a particular configuration category. However, the findings for the R100mK metric were exceptional. As can be seen for individual comparisons of specific PBS configurations when measured against the conventional vehicles in Table 4.

Validating the Survey Results from Survey 1 and Survey 2

The initial national survey (Austroads, 2014) was conducted by up to four rounds of interviews. The results were so impressive this led the analysis team to wonder whether fleets were under reporting their accident incidents for PBS vehicles. Some 278 vehicle incidents in survey1 also had insurance records. This represented some 46% of the surveyed PBS vehicle population. The correlation between operator survey results and the insurance claims for the PBS vehicles were virtually identical which confirmed that the operator survey was valid.

In the second survey, NTC 2017, some 67 % percent of the accident data was taken directly from insurance records, with the remaining 33 % of accident incident data coming from operators that were not insured by the insurance owner of the National Truck Accident Research Centre. This large concentration of actual insurance data within Survey 2 reaffirmed the credibility of this second survey. In both surveys, access to insurance data for the PBS fleet, greatly assisted the estimation of the PBS vehicles' accident behaviour. So, the insurance data was not only essential for the calculation of the performance of the conventional fleet, but also highly important for confirming the accident incident rates for the PBS fleets.

PBS Comparisons against the R100mK and R10K safety metrics

These are the major observations from Table 4:

- PBS Rigid trucks with either 5 or 6 axle 'dog' trailers performed some 75% or better against the conventional rigid truck with a 3 axle trailer,
- the PBS single articulated semitrailer group performed 54% better than the conventional 6 axle semi-trailer,
- the Super, or enhanced, B-Double group performed 24% better than the standard B-Double
- the BB-Triple is possibly the safest articulated vehicle in Australia, although the PBS Type II road trains (AA, AB, BA Triples) scored very well in remote area operations. These triple combinations performed far better than the existing Type I and Type II conventional road trains.
- the BB-Triple performed 53% better than the conventional B-Double, however,
- the conventional Australian B-Double outperformed the PBS A-Double (PBS Type I Road Train) with 37% less incidents than this PBS A-Double configuration.
- As a population block the PBS fleet performed better on the R100mK metric by 56% when compared to the conventional heavy truck population.
- for the 10,000 vehicle accident metric, (R10K), the articulated PBS vehicles were better than the conventional articulated vehicles with 60% lower incidents, and
- as a block the PBS fleet saw 28% less incidents than the conventional fleet against this R10K metric.

These results should be of interest to several countries that on proper roads, with well trained drivers, good fleet management systems and with new fleet technology, that passes the PBS standards, regulators have little to fear from these PBS trucks. 'Bigger is not Bad' perhaps 'PBS Bigger is actually Better'.

2. PRODUCTIVITY CALCULATIONS FOR AUSTRALIAN PBS TRUCKS, 2009 – 2016.

Productivity can be measured in several ways, however, there was little possibility of deriving productivity measures that involved commercial data. This meant measurers such as 'Total Factor Productivity' estimates, or changes in a tonne-kilometre costs could not be extracted from the fleets as any transactional or financial operational data was highly protected and would not be available for either of the PBS operator surveys.

However, in Australia there have been several attempts at PBS productivity estimation: the Victorian Freight and Logistics Council (VFLC) in 2009 used spreadsheet analysis where full trucks of different sizes moved fully laden between two points. This generally overestimates the productivity of the larger vehicle because in real life operations backhauls are not 100% full and

extra trips are often needed for shuttle and trailer relocation purposes. Using full loads one way with empty backhaul was the method used for productivity calculations in the Australian Trucking Association's (ATA, 2016) 'Impact Analysis', however, backhauls are not always empty, as was seen in both Austroads 2014 and NTC 2017. Regression analysis was used in NTC's, 2010 PBS Benefit Analysis, and this was later enhanced with simulation analysis by specific commodity carried, (Hassall, 2012), presented in the Stockholm HVTT12 conference proceedings. These last findings are presented in Appendix F. Both the regression and simulation analyses proved to be underestimates of what operators were actually achieving.

There is also, what might be called, 'capacity limit productivity' but this method is not used here. As an example; if the capacity of a truck doubles, say a 20 tonne load capacity increases to 40 tonnes load capacity this would be a 100% productivity gain. Technically yes, but what does this mean? The operator does not save 100% of anything in reality. In the 2014 and 2017 studies the proxy for productivity is through the 'physical productivity measure' of 'percentage of kilometres saved' by the operator using a specific PBS vehicle configuration. In the above case, a truck with a 20 tonne load capacity, being replaced by a 40 tonne load capacity truck, could potentially save 50% of the operator's kilometres travelled. The productivity would, therefore, be 50% if the operator could hypothetically get perfect loads for all trips. The analysis in Austroads 2014, and NTC 2017 uses this method as a 'proxy' productivity measure when specific PBS vehicle configurations are adopted.

The PBS Operators' Surveys 2014 and 2017 and kilometres saved

From the two operator surveys, as cited above, it was possibly surprising that each fleet interviewed had a very good idea of either:

- Trips saved per week/month/year by their PBS vehicles,
- percentage kilometres saved by the new PBS vehicle type over a week/month/year, or by
- their own calculations as to the impact of the introduction of a proportion of PBS vehicles on their trips or kilometres.

Table 5 presents the two study sample sizes. Overall the two operator productivity surveys interviewed fleets whose combined vehicles were some 22.7% of the existing PBS population operating over the period 2009 – 2016. This was a significant response rate that in some cases took four attempts to obtain the required survey data.

The knowledge of the interviewed fleets, usually the operations/fleet managers, as to their percentage of kilometres/trips saved, was unexpectedly very good, which was not so surprising as such knowledge of PBS vehicle productivity strongly impacts on operators' estimates of overall fleet costs. The awareness of fleets, as to their own assessments of 'kilometres saved', was core to both the 2014 and 2017 PBS fleet survey productivity estimates.

Table 5. PBS Productivity Surveys – 2009 -2016.

Survey period	Sample size surveyed	PBS Population Size in Period	% of Population sampled
Survey 1 2009-2012	625	2,269	27.5%
Survey 2 2013-2016	918	4,524	20.0%
Totals	1,543	6,793	22.7%

Source: Industrial Logistics Institute for Austroads 2014 and NTC 2017.

The savings for each PBS vehicle configuration are expressed as a 'kilometre reduction factor saving' for that vehicle configuration. For example, a reduction factor of 0.27 means that 27% of kilometres are saved, and this 'proxy' metric was used as the productivity measure for that configuration.

Table 6 presents the weighted average of the productivity derived from the kilometre savings attained through the use of PBS vehicles for the total period 2009 to 2016. The productivity saving, as proxied by the 'kilometre reduction factor', ranges from 12.2% for a PBS Rigid Truck and 3 axle dog trailer configuration, up to a 41.3% kilometre saving when using a BAB Quad trailer as opposed to using two B-Double trucks. Many of the articulated combinations are achieving around 33% kilometre reductions.

As the cost per kilometre by vehicle type are known, for both the conventional and PBS vehicles, then the kilometres saved can be measured directly as a financial benefit. However, as PBS vehicles are more expensive to operate, then there is a discount that is applied to the total estimates of the cost of kilometres saved by using

Table 6. Productivity as Calculated by Kilometre Reduction Factor, 2009-2016.

PBS Vehicle Configuration	Operator Survey 2014	Operator Survey 2017	Weighted Average Kilometre Reduction Factor Saving
PBS Single Rigid 8 x 4	0.160	Not Surveyed	0.160
HR with 3Axle Trailer	0.129	0.116	0.122
HR with 4Axle Trailer	0.221	0.197	0.209
HR with 5Axle Trailer	0.264	0.238	0.249
HR with 6Axle Trailer	0.30	0.240	0.258
6/7Axle Semi-Trailer	0.149	0.168	0.162
Super B-Double	0.365	0.343	0.354
Enhanced B-Double	0.273	0.234	0.244
A-Double (PBS Type I Road Train)	0.315	0.334	0.325
BB-Triple	0.325	0.312	0.320
AA AB BA Triple (PBS Type II Road Train)	Not Surveyed	0.307	0.307
Quad Trailer (Double B-Double)	0.405	0.421	0.413

Source: Austroads (2014), NTC (2017) weighted averages.

PBS vehicles. But even so, the net financial benefits are very significant when fleets use PBS vehicles. This amount is estimated in savings of billions of dollars per annum and over a decade of operations is indeed very significant. (See NTC, 2017). As well, both the Austroads 2014 and NTC 2017 studies reflect significant environmental benefits through reduced fuel use when undertaking the same task.

Appendix A: Engineering Standards

Table A1. Performance Based Vehicles Engineering Standards – 2017.

• Startability • Gradeability • Acceleration Capability • Tracking ability along a straight line • Low speed swept path	• Frontal Swing • Tail swing • Steer tyre friction demand • Static Rollover • Rearward amplification • Yaw Dampening coefficient	• High Speed Transient Off Tracking • Standard axle repetition • Pavement Vertical Loading • Pavement Horizontal Loading • Tyre Contact area • Bridge loading

Source: NHVR https://www.nhvr.gov.au/road-access/performance-based-standards/pbs-vehicle-standards

Appendix B: Accident Definitions

The accident definitions that the National Truck Accident Centre used for claims classification were:

1. **minor accidents**, value less than $5,000:– shall be deemed to be no more than bumps and scrapes. In many incidents, such minimal damage may on occasions go unrepaired for a period of time. (No involvement from Police or other reporting agencies.)
2. **moderate accidents**, value from $5,000 to $15,000 - will in most cases will result in the vehicle being taken off road for repairs. The cost of replacement parts influences this classification. (No involvement from Police or other reporting agencies.)
3. **serious accidents**, value $15,000 to $50,000, – vehicle usually immobilized and requires recovery and towing. The accident vehicle is expected to off the road for a minimum of 14 days.
4. **major accidents**, value greater than $50,000 ranging to several million dollars. Extensive damage and refers to any major loss incident. The incident will usually involve police and traffic agencies. If the equipment is not written off in the damage assessment, the repair program may involve weeks of the vehicle being off the road for repairs. In 2015 the average cost of a major accident was in excess of $150,000 (Australian dollars).

Appendix C: Conventional Vehicle Accident Rates

Table C1. Major Accidents for Conventional Vehicles from Insurance Sources, 2009-2012.

Vehicle Type	Average Incidents p.a	Average Insured trucks p.a	Ave km p a	R100mK	R10k
Single Articulated 6AA	174	11855	71,000	20.6	146
B-Double	79	6502	162,606	7.5	121
BB-Triple	1	73	226,204	4.4	(99) [1]
Road Train Type I	23	907	135,600	18.9	(256) [1]
Road Train Type II	15	515	151,461	19.3	(292) [1]
Quad Trailer	2	42	196,286	26.5	nsv
Combined Articulated	294	19,894	106,800	13.8	148
Rigid Truck & Dog	17	2,783	30,386	7.9	61
Rigid Truck	50	17,006	77,034	9.6	29
Combined Rigid	67	19,789	36,946	9.1	34

Source: National Truck Accident Research Centre , ILI estimates. Note: nsv Not statistically valid.

Appendix D: Fatal Accident Comparisons

Table D1. Conventional Vs PBS Fatal Accident Rates by Truck Configuration: 2009 – 2016.

Truck Type	Fatalities per 100m kms (Rate as at 2014)	Fatalities per 10K vehicles (Rate as at 2015)
Rigid Trucks	0.80	2.23
Rigid PBS	0.00[1]	0.00[1]
Articulated Trucks	1.30	10.53
Articulated PBS	0.49	1.07

Source: NTC 2017 Note: 1. Suicide not counted.

These comparative results were obtained through the two operator surveys, 2014 and in 2017. As the national fatal accident statistics file does not highlight PBS vehicles as such, nor does it any deeper configurations than 'rigid' or 'articulated' truck, then this is the best comparative PBS fatalities data collected so far in Australia.

Appendix E: Accident Metrics for Survey 1 (2014) and Survey 2 (2017)

Table E1. Accident and Kilometre travelled data by PBS Configuration Survey 1: 2009-2012.

PBS Vehicle Type	Vehicle Numbers	Years of Operation	Kms Million	Accidents Minor	Accidents Moderate	Accidents Serious	Accidents Major	Total
6/7AA	91	1.35	**18.94**	5	4	1	0	10
HR3ATD	19	2.15	**25.73**	0	1	1	0	2
HR4ATD	159	2.08	**46.11**	13	23	3	2	41
HR5ATD	29	2.11	**13.32**	5	0	0	0	5
HR6ATD	20	1.00	**5.50**	0	0	0	0	0
8x4 Rigid	1	2.00	**0.31**	0	0	0	0	0
EBD	71	3.25	**74.41**	1	1	0	5	7
SBD	37	2.55	**10.10**	1	0	0	0	1
AD	59	1.95	**29.74**	1	0	2	4	7
BB-Triples	79	8.32	**49.70**	3	0	1	2	6
AA AB BA Triples	0	0.00	**0.00**	0	0	0	0	0
BAB AAB Quads	35	1.00	**18.23**	6	0	0	0	6
Total	600		**292.08**					**85**

Source: Austroads 2014

Table E2. Accident and Kilometre travelled data by PBS Configuration Survey 2: 2013-2016.

PBS Vehicle Type	PBS Vehicle Numbers	Accidents Minor	Accidents Moderate	Accidents Serious	Accidents Major	Ave kms per vehicle	Total million kms	Kms over 4 years of Operations
6/7AA	180	24	20	19	11	279,210	50.26	201.04
HR3ATD	21	0	0	0	1	130,710	2.74	10.96
HR4ATD	170	64	63	48	20	115,310	19.60	78.40
HR5ATD	39	8	14	8	1	165,200	6.44	25.76
HR6ATD	45	0	4	2	0	164,440	7.40	29.60
8x4 Rigid	1	4	0	0	0	95,076	0.095	0.38
EB-Doubles	206	2	2	3	9	379,870	78.25	313.00
Super B-Doubles	36	1	0	0	1	90,440	3.26	13.04
A-Doubles	80	11	13	20	16	197,880	15.83	63.32
B-Triples	49	1	1	2	1	212,220	10.40	41.60
AA AB BA Triples	57	0	2	1	3	227,540	12.97	51.88
BAB AAB QUADS	35	6	0	0	1	187,710	6.57	26.28
Totals	919				**403**		**213.82**	**855.26**

Source: NTC 2017.

Appendix F: Commodities Carried

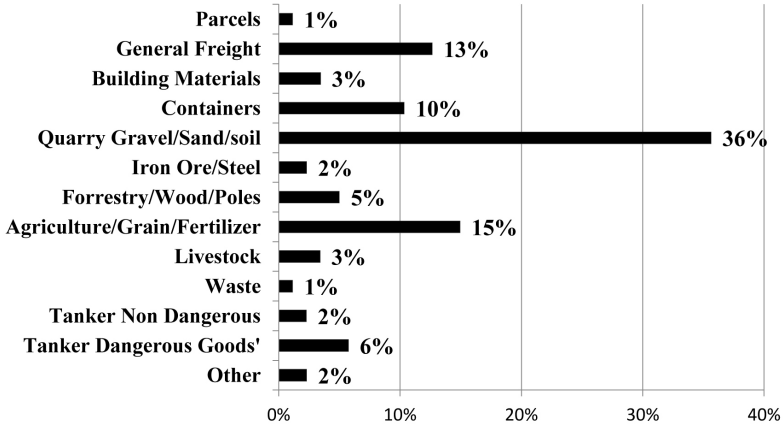

Fig. F1. Commodities carried profile carried by PBS Vehicles. Survey 1 2009 - 2012.
Source: Austroads 2014.

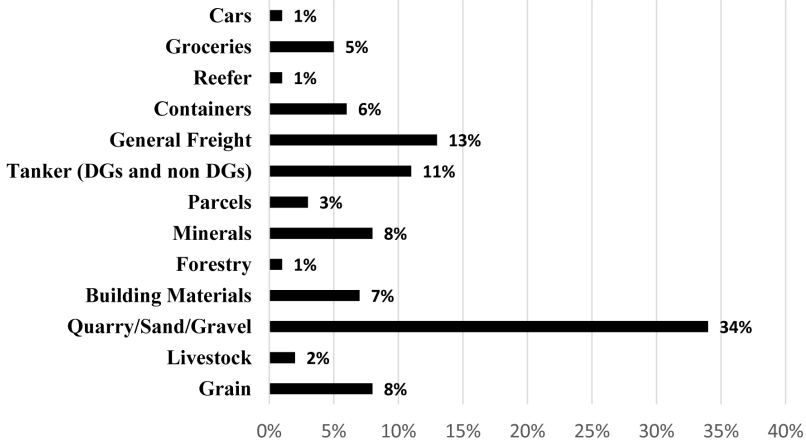

Fig. F2. Commodities carried profile carried by PBS Vehicles. Survey 2 2013-2016.
Source: NTC 2017.

Appendix G: Abbreviations for Vehicle types used in the 2014 and 2017 Australian PBS Studies

Vehicle Type	Vehicle Abbreviation	Description
1. Single Semi-Trailer 6 or 7 axles	6/7AA	Extendable to 20m, 6 axle semi-trailer or 7 axle semi-trailers with quad axle group. Can operate on Higher Mass Limits (HML) or Concessional Mass Limits (CML). Quad axles appeared in the survey.
2. Twin Steer Semi-Trailer 19 or 20m	6/7AA	Twin steer 7 axle semi-trailer. Can operate on HML or CML. Both configurations are reflected in the survey.
2. Enhanced B-Double	EBD	B-Double with either quad axle trailer groups or length up to 30m or both. Up to 11 axles. Can be operate on CML or HML
3. Super B-Double	SBD	B-Double up to 30m with equivalent length for A and B trailers. Can operate on HML or CML.
4. A-Double (PBS Type I Road Train)	AD	An A-Double can be considered a mini Type I Road Train. It is usually less than 30m long, with 11 or 12 axles. Can operate on HML or CML
5. BB-Triple	BT	Triple trailer combination, up to 36.5m. 5 axle groups, 12 to 14 axles. Can operate under HML. BB, AB and BA configurations are operational.
6. Quad Trailer Combination	QT	Articulated combination with 4 trailers. 7 axle groups, with 17 or more axles. Various configurations such as BAB or AAB variations are usual. Often referred to as a double B-Double. Combinations are over 33m and can operate on HML.
7. AA, AB, BA -Triple (PBS Type II Road Train)	AT	Triple trailer combination, up to 36.5m. 5 axle groups, 12 to 14 axles. Can operate under HML or CML. Can use AA, BA or AB dolly configurations of 2 or 3 axles.
8. Rigid Truck and 3 Axle Dog Trailer	HR3ATD	Three-axle truck and three-axle dog trailer. 6 axles, 4 axle groups. GCM over 42.5 tonnes. Can operate under HML.
9. Rigid Truck and 4 Axle Dog Trailer	HR4ATD	Three-axle truck and four-axle dog trailer. 7 axles, 4 axle groups. GCM over 42.5 tonnes. Can operate under HML.
10. Rigid Truck and 5 Axle Dog Trailer	HR5ATD	Three-axle truck and five-axle dog trailer. 8 axles, 4 axle groups. GCM over 42.5 tonnes. Can operate under HML.
11. Rigid Truck and 6 Axle Dog Trailer	HR6ATD	Three-axle truck and six-axle dog trailer. 9 axles, 4 axle groups. GCM over 42.5 tonnes. Can operate under HML.

Source: ILI Definitions 2014 with 2017 additions

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GLOSSARY

6/7AA	6 or 7 Axle Semi-Trailer Combination
ABS	Australian Bureau of Statistics
AD	A-Double (PBS Type I Road Train)
AT	A-Triple (PBS Type II Road Train)
ATA	Australian Trucking Association
BD	B-Double
BT	BB-Triple
CML	Concessional Mass Limit
EBD	Enhanced B-Double
GCM	Gross Combination Mass
gtkms	gross tonne kilometres
GVM	Gross Vehicle Mass
HML	Higher Mass Limit
HPV(s)	High Productivity Vehicle(s)
HR3ADT	Rigid Truck plus 3 Axle Dog Trailer
HR4ADT	Rigid Truck plus 4 Axle Dog Trailer
HR5ADT	Rigid Truck plus 5 Axle Dog Trailer
HR6ADT	Rigid Truck plus 6 Axle Dog Trailer
ILI	Industrial Logistics Institute
NRTC	National Road Transport Commission
NHVR	National Heavy Vehicle Regulator
NTARC	National Truck Accident Research Centre
NTC	National Transport Commission
p.a.	Per Annum
PBS	Performance Based Standards
QT	Quad Trailer Combination (Double B-Double)
SBD	Super B-Double
R100mK	Accident rate per 100 million kilometres travelled
R10K	Accident rate per 10,000 vehicles
SMVU	Survey of Motor Vehicle Use
tkms	tonne kilometres
VFLC	Victorian Freight and Logistics Council

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Kim Hassall
The University of Melbourne, Australia
hassallk@unimelb.edu.au