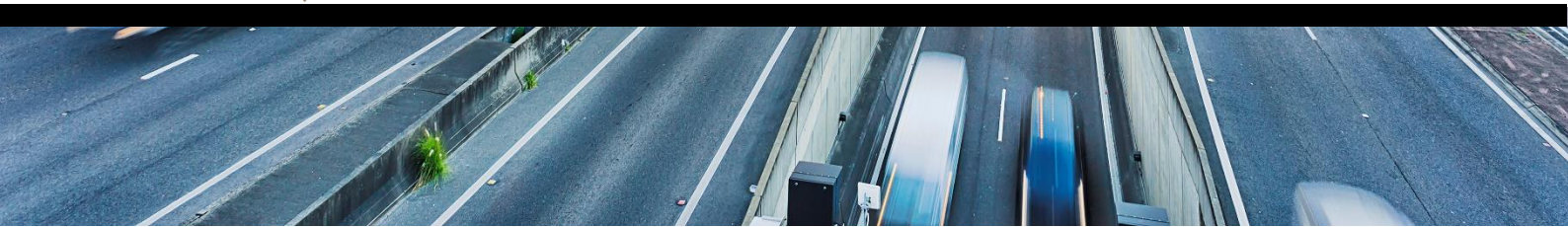
Review of Major Crash Rates for Australian Higher Productivity Vehicles: 2015 – 2019

Prepared for the National Heavy Vehicle Regulator

MARCH 2021

The Chartered Institute of Logistics and Transport

NTARC



Conventional

PBS

Rigid Trucks

16.7

Crashes per 100m km

8.8

Crashes per 100m km

Articulated Combinations

17.6

Crashes per 100m km

5.4

Crashes per 100m km

Executive Summary

This report examines the safety performance of the Australian Performance Based Standards (PBS) fleet over the five year period 2015 to 2019 inclusive.

The results show an overall **improvement in safety** outcomes of **60%** when compared to the conventional fleet on a distance travelled basis.

This is a significant improvement over the results in a 2017 report which found a 46% improvement over the conventional fleet.

When comparing conventional rigid trucks (with or without trailers) to their PBS equivalents, the improvement in safety is slightly less pronounced than the overall average however still marked at 47.3% on a distance travelled basis.

PBS articulated combinations had the lowest rate of crashes per distance travelled with 5.4 crashes per 100 million kilometres travelled, almost 70% lower than the rate for their conventional counterparts.

Applying these safety performance figures and forecasting over a period from 2013 to 2033, this should result in a saving of **143 lives not lost** in heavy vehicle involved crashes.

Contents

Introduction

The concept for Performance Based Standards (PBS) vehicles was initiated in 1998 by the then National Road Transport Commission (NRTC). The scheme was formally introduced in 2007 and continued to evolve with full operational implementation being given to the National Heavy Vehicle Regulator (NHVR) in 2013.

Since that time the PBS scheme has continued to grow from 1169 vehicles in 2013 to 9917 vehicles by the end of calendar year 2019. This was an observed per annum compounding growth rate of 42.8% since the NHVR assumed the scheme's operational control.

The ability of PBS to enhance road freight productivity while offering at least equivalent safety outcomes to the conventional fleet has been a key consideration for road managers. Consequently there has been a series of reports investigating the safety performance of the PBS fleet, of which this report effectively forms the third edition.

Metrics

In this study as mentioned, there was a population of 9917 PBS vehicles registered at the end of calendar year 2019. So overall, the performance of the major crashes as per the 10,000 vehicle metric has become more robust in this study as the PBS population approached the actual 10,000 population mark. The second metric, the major crash rate per 100million kilometres travelled, has shown significant improvement in the crash rates for some of the most common configurations and there are certain explanations for this improvement.

It should also be argued for this specific second comparative safety metric, *major crashes per 100 million kilometres travelled*, there is somewhat of an inherent advantage for the PBS configurations as they do travel not only much greater kilometre than their general industry counterparts in both the ancillary and hire and reward sectors, but they also perform more kilometres than their direct comparative counterparts in the 'hire and reward' freight sector.

Some 99% of PBS vehicles operate in the 'hire and reward' sector so comparing the PBS fleet kilometres to the non PBS 'hire and reward' sector is a more appropriate comparison than is a total industry comparison, which contains the lower kilometre performing 'ancillary' freight sector.

These extra kilometres travelled by PBS vehicles leads to an overall net kilometre saving if a similar capacity task was to be performed by conventional vehicles only. As such PBS delivers better operational productivity. Secondly, and also importantly, a PBS fleet, when compared to a larger conventional fleet with the same carrying capacity, will see that PBS fleet performing that same capacity freight task with a lower level of gross tonne-kilometres, and this saving does lead to calculable road wear savings.

With this in mind the third, and newest, safety metric is the major crash rates per 100 million gross tonne kilometres. This metric was calculated for this and the two previous studies PBS safety studies, Austroads 2014, and NTC 2017 giving three reference data points. Across these three years PBS vehicles yielded a near 33 percent better outcome than conventional trucks.

Methodology

This safety review uses the same crash classification definitions used by National Transport Insurance's National Truck Accident Research Centre (NTARC). These definitions are presented in Table 1. The focus of this analysis is the crash frequencies for the major crash class, which is the greater than $50,000 claims incidents.

Table 1: Accident Severity Categorization

Accident definition	Minor	Moderate	Serious	Major
Claim Size ($)	</= $5,000	> $5,000 to $14,999	> $15,000 to $49,999	=/> $50,000

Source: NTI 2015

Of lesser focus were the 'serious crashes' which are briefly addressed in Appendix II.

The size of the PBS population over the five years examined grew at a compound rate of 28.7% from 2015 to 2019. Since the end of calendar year 2016 to the end of 2019 the PBS population grew by 97.6%, almost doubling. The PBS population by year since 2015 is presented in Table 2.

Table 2: Growth in the PBS population 2015-2019

Year	2015	2016	2017	2018	2019	2020[1]	Average 2015-2019
PBS Articulated Combinations	1546	2132	2643	3321	4172	4748	2763
PBS Truck and Dog Trailers	2072	2886	3780	4847	5745	6230	3866
Total	3618	5018	6423	8168	9917	10978	6629

Source: NHVR pers comm, Note 1: 2020 insurance data is not currently available for inclusion

The distribution of the PBS crashes examined are presented in Table 3. In all 116 major PBS crashes were found for the five year period 2015 to 2019 inclusive.

Table 3: PBS Accidents 2015-2019

Minor	Moderate	Serious	Major	Total
364	64	75	116	619

Source: NTARC databases and fleet surveys

The fleet base from which conventional vehicle crashes were extracted spanned some 20,000 insured vehicles. These conventional vehicles were from the same classes of vehicles that had a near match to a PBS vehicle type.

This meant that a conventional B-Double could be compared to a PBS Super B-Double or a PBS quad axle B-Double. There were no two or three axle conventional rigid trucks in the benchmark group as there was no equivalent single rigid PBS vehicles without trailers in the comparison basket. The conventional truck basket saw 2420 major crashes over the examination period, or equivalently 484 annual major crashes.

The PBS basket, which was comprised of an average population of 2353 for each year over the 2015 to 2019 period. Some 116 major crashes were observed, which was some 23 major crashes per annum. The vehicle sample sizes and major accidents observed across both fleet types are presented in Table 4.

Table 4: Conventional and PBS vehicle data examined 2015-2019

Population and Crashes	Conventional Vehicles	PBS Vehicles
Vehicles Tracked	20091	2353
Major Crashes over period	2420	116
Major accidents p.a	484	23

Note: 2 Sourced from NTARC databases

Again, it should be stated that the study does not attribute blame for the incidents to either the conventional vehicles or the PBS vehicle fleets. The incidents are evaluated on face value whether there is an at-fault or not-at-fault claim. Accidents claims were matched against either of registration number or Vehicle Identification Number (VIN) in both the insurance and regulator databases. This streamlined the previous highly manual matching and survey processes.

The profiles of the fleet populations that were surveyed reflected the configuration presented in Table 5. The obvious differences are that in the conventional fleet contains a dominance of semi-trailers and B-Doubles, whereas the PBS fleets are dominated by rigid trucks with 4 axle dog trailers, A-Doubles and enhanced semi-trailers

Table 5: Surveyed population profiles of Surveyed Conventional vs PBS Fleets

Conventional Configurations	Fleet Profile	PBS Configurations	Fleet Profile
Semi	50%	e-Semis	18%
3,4 AT 4ADT	8%	2,3AT 3ADT	8%
B-Double	27%	3,4 AT 4ADT	31%
Double Road Train	9%	3,4AT 5ADT	4%
Triple Road Train	5%	3,4AT 6ADT	1%
B-triples (permit)	1%	Super B-Doubles	6%
Quads Combination	<1%	Enhanced B-Doubles	2%
		A-Doubles	24%
		BB, AB, BA Triples	6%
		Quads BAB, AAB etc	1%
Total	100%		100%

Current PBS Safety Analysis

Using the two large vehicle data populations described previously, as well as the kilometres performed by each configuration has provided the inputs to calculate the two of the major comparative safety metrics.

Table 6 presents the breakdown by configuration of the comparative performance of the conventional Australian trucking fleet, for each specific configuration, against the PBS fleets operating equivalent, or near equivalent configurations when measured against major observed crash data.

Table 6: Major crash rate comparison between Australian conventional vs PBS vehicles 2015 - 2019

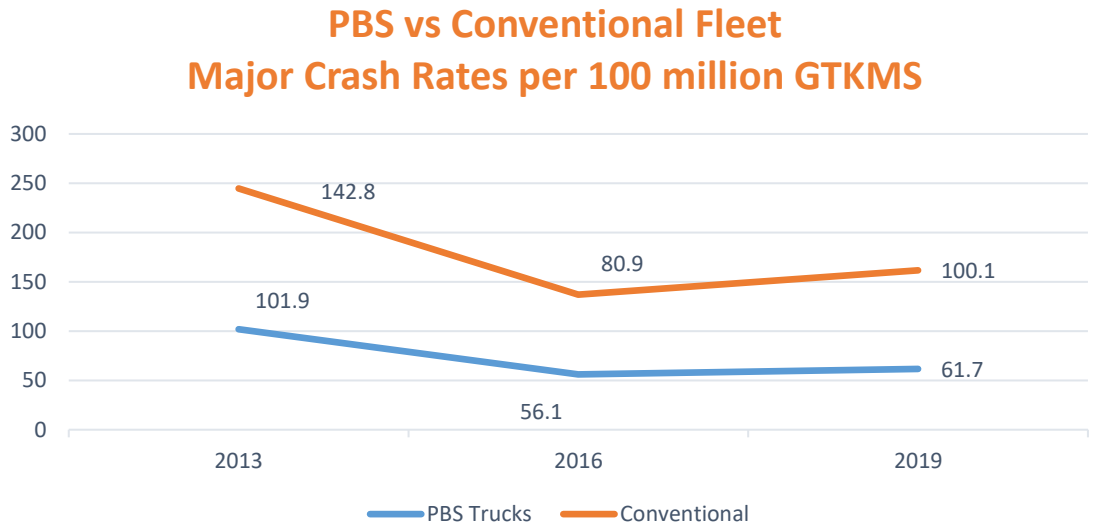
Conventional Vehicle Configuration	Accident Rate per 100m km	Accident Rate per 10K vehicles	PBS/HPV Vehicle Configuration	PBS Accident Rate per 100m km	PBS Accident Rate per 10K vehicles
HR2 or 3 axle truck with 3 axle trailer and HR3 or 4 axle truck with 3 or 4 axle trailer	16.7	119.0	HR 2 or 3 axle truck with 3 axle trailer	3.7 (nsv)	48.0 (nsv)
			HR 3 or 4 axle truck with 4 axle trailer	6.3	80.8
			HR 3 or 4 axle truck with 5 axle trailer	14.2 (nsv)	240.8 (nsv)
			HR 3 or 4 axle truck with 6 axle trailer	10.6 (nsv)	174.2 (nsv)
TOTAL Rigid Configs	16.7	119.0	TOTAL PBS Rigid Configs	8.8	98.7
Semi-Trailer	19.3	152.7	Enhanced semi (e-semi) 20m or twin steer Semi with or without Quad axle rear group	2.8	98.6
B-Double	12.0	158.5	Super-B-Double (SBD)	8.5	122.2 (nsv)
B-Double			Quad axled B-Double (EBD)	3.7	76.4
B-Double			A-Double	6.7	149.1
Double Road Train	24.1	268.7 (nsv)	AA, AB, BA BB Triple	2.8	59.4
Triple Road Train	26.2	261.5 (nsv)			
B-Double	12.0	158.5	AAB BAB Quad	6.2 (nsv)	122.6 (nsv)
TOTAL Articulated	17.6	171.4	TOTAL PBS Articulated	5.4	119.4
TOTAL Conventional Configurations	17.5	158.9	TOTAL PBS Configurations	7.0	110.6
Total Major Crash Benefit of PBS/HPV Trucks over Conventional trucks				60.0%	30.4%

Source: NTARC data extracts and supplementary survey data. Note nsv: not statistically valid

From an overall perspective, PBS vehicles have continued to improve against two major crash metrics. On a per 100 million kilometre, major crash basis, PBS vehicles are proving to be involved in 60% fewer major crashes and 30% better on a per 10,000 vehicle basis, when compared to conventional vehicles. There have been considerable improvements in the crash rates for PBS semi-trailers, A-Doubles and rigid 4axle trailer configurations.

The larger sample sizes and the conventional fleets being benchmarked against new 'Hire and Reward' kilometre measures, is a partial explanation for this improvement. Although there are significant numbers of PBS configurations for which we have data, each configuration, where there are small numbers of a particular configuration in the sample the results for that configuration may not be statistically valid. This is marked as 'nsv', that is, not statistically valid, generally because the observed sample for that configuration is very small.

Figure 1: Behaviour of PBS vs Conventional Trucks on a 100 million Gross Tonne Km basis



Source: Derived for data from NHVR and BITRE 2020

The third and the newest metric to be introduced into the PBS safety portfolio is the major crash rate per 100 million gross tonne kilometres performed. Across the three years for which gross tonne kilometres could be measured the PBS major crash rate performed almost 33% better than was the case for conventional trucks, See Table 7.

Table 7: Major accident crash rate difference for 100m Gtkms with PBS adoption

Year	2013	2016	2019	Average
PBS	101.9	56.1	61.7	73
Conventional	142.8	80.9	100.1	108
PBS Benefit	28.6%	30.7%	38.4%	32.6%

Fatality Savings Forecasts

Over a forecast 20 year period to 2033, by which time the NHVR will have been established for a generation, PBS is forecast to save some 21.45 billion truck kilometres (See Table 8). This Billion kilometres of savings will equate to some 143 lives saved by 2033. This estimate is based on the very conservative assumption that the PBS fleet will only grow at 7% compounding per annum from 2020 to 2033. However, if this forecast is a long term underestimate of PBS growth, then the savings presented in Table 8 will also be an underestimate.

Table 8: Lives saved through PBS Billion VKT savings 2013 - 2033

Year	2013	2018	2023	2028	2033	Cumulative 20 year total
Lives Saved	0.6	2.8	7.7	10.0	13.0	143.1
BVKT Saved	0.07	0.38	1.10	1.54	2.16	21.45

Source: CILTA forecasts

Thus far, from 2013 to 2019 inclusive, some 14 fatalities have been avoided and 1.607 Billion kilometres also saved through the uptake of PBS vehicles.

Summary of Results

The comparative major crash results when comparing conventional fleets against PBS fleets are presented in Table 9. This was for the five year period 2015 to 2019 inclusive. The comparative major crash results, when compared to the most recent 2017 PBS Safety study, for the National Transport Commission's PBS Market Place Report, have seen major comparative crash rates between PBS fleets and conventional fleets improve from a 46% benchmark benefit for PBS vehicles to a higher 60% benefit difference achieved between the two types of fleets, the conventional versus the PBS fleets. (See Table 9).

Table 9: Major crash rate comparison between Australian conventional vs PBS vehicles 2015-2019

Conventional Vehicle Configuration	Accident Rate per 100m km	Accident Rate per 10K vehicles	PBS/HPV Vehicle Configuration	PBS/HPV Accident Rate per 100m km	PBS/HPV Accident Rate per 10K vehicles
TOTAL Conventional Rigid Configurations	16.7	119.0	TOTAL PBS/HPV Rigid Configurations	8.8	98.7
Benefit of PBS/HPV Rigid Trucks over Conventional Rigid trucks				47.3%	17.1%
TOTAL Conventional Articulated Configurations	17.6	171.4	TOTAL PBS/HPV Articulated Configurations	5.4	119.4
Benefit of PBS/HPV Articulated Trucks over Conventional Articulated trucks				69.3%	30.3%
TOTAL Conventional Configurations	17.5	158.9	TOTAL PBS/HPV Configurations	7.0	110.6
Total Major Crash Benefit of PBS Trucks over Conventional trucks				60.0%	30.4%
Average PBS major accident savings on a 100 million Gross Tonne kilometre metric				% Savings for years 2013,16,19 32.6%	
Forecast Billion VKT and Fatality Saving 2013 to 2033				21.45 Billion VKT saved	143 lives saved

Source: NTARC data extracts and supplementary survey sources

The 60% major crash reduction for PBS vehicles on a *per 100 million kilometre travelled* basis, when examined over the last five years, is also complemented by a 30% reduction in major crashes on a *10,000 vehicle population* basis. As at the end of 2019 the population of the Australian PBS heavy truck fleet, totalled 9917 PBS vehicles that could be activated in combination at one time.

This growth greatly improved the accuracy of this second safety metric when examining a benchmark population of 10,000 vehicles which was what the PBS population effectively stood at the end of 2019.

Table 9 describes the better major crash performance of PBS configurations against similar configurations in the conventional fleets. The two broad configuration groupings are rigid truck and trailer combinations, and a variety of articulated truck combinations

As in previous reports where safety benchmarking has been undertaken to establish the comparative performance of the conventional trucking fleet versus the growing PBS fleets in Australia there have been two commonly used metrics used for comparative analysis.

The two metrics calculated are: major crash rates per 100 million kilometres travelled, and major crash rates per 10,000 operational vehicles on a per annum basis. In this study a third safety metric was introduced, *major crash rates per 100 million gross tonne kilometres.* This metric was calculated from data for this and previous Australian PBS safety studies. PBS fleets, measured against this third metric performed at a level that was 33% better than conventional Australian truck configurations.

Conclusion

Generally, the PBS fleets, whose configurations have been certified through the PBS scheme, have performed better in each truck category when compared to their conventional truck counterparts.

In some cases, significant improvements in major crash statistics have been observed for some configurations. This is because some of the expected crashes have not occurred as 'major crashes', but instead have manifest themselves to a minor extent in increased frequencies in the 'serious crash' category when examined over the last five years.

The PBS technology itself, the dedicated efforts in getting PBS vehicles into an operational fleet, the mindful cost of new PBS units, the safety consciousness of many of the PBS adopting fleet operators, often the selection of the PBS truck drivers themselves and the appropriate road infrastructure on which PBS vehicles operate, all add up to a higher productive and safer heavy Australian road transport industry. These findings also support previous safety research findings.

APPENDIX I – Truck Glossary and Definitions

Table A1: Description of the PBS configurations examined in this study

Vehicle Type	Report Abbreviation	Description
1. Single Semi-Trailer 6 or 7 axles or quad trailer	e-Semi	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. Enhanced B-Double	EBD	Enhanced B-Double with at least a 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	Super B-Double up to 30m with equivalent length for A and B trailers. Can operate on HML or CML.
4. A-Double	AD	An A-Double can be considered a PBS Type I Road Train. It is usually less than 30m long, with 11 or 12 axles. Can operate on HML or CML
5. B-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. Combinations are over 33m and can operate on HML.
7. A-Triple	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. Truck and 3 Axle Dog Trailer	HR3&3ATD	Three-axle truck and three-axle dog trailer. 6 axles, 4 axle groups. GCM over 42.5 tonnes.

		Can operate under CML or HML.
9. Truck and 4 Axle Dog Trailer	HR3,4T&4ATD	Three-or four axle truck and four-axle dog trailer. 7 axles, 4 axle groups. GCM over 42.5 tonnes. Can operate under CML or HML.
10. Truck and 5 Axle Dog Trailer	HR3,4T&5ATD	Three-or four axle truck and five-axle dog trailer. 8 axles, 4 axle groups. GCM over 42.5 tonnes. Can operate under CML or HML.
11. Truck and 6 Axle Dog Trailer	HR3,4T&6ATD	Three-or four axle truck and six-axle dog trailer. 9 axles, 4 axle groups. GCM over 42.5 tonnes. Can operate under CML or HML.
Source: Modified NTC 2017 definitions		

APPENDIX II – Serious Accidents by PBS Configuration

Serious crashes are defined as those crashes that span the insurance claim level of $15,000 to $50,000. Over the period 2015 to 2019 there were 75 such serious crash claims, which were actually fewer that the 116 major crashes over the same period.

An interesting observation is that of the 11 PBS configurations examined four PBS configurations dominated the 'serious crash' category. These configurations were: e-semis, 4 axle truck and dog trailer configurations, super B-Doubles and A-Doubles, all of which were responsible for 89% of the 'serious crash' category.

Possibly one of the reasons for the observed improvements in major crashes for these PBS configurations is that we have seen a percentage of major crashes drop into this 'serious crash' category and in fact these four configurations dominate the observed 'serious crash' category.

Table A2: Serious Crashes by PBS Configuration 2015 - 2019

Configuration	Serious Accidents	Percentage
e-Semi	6	8%
3,4AT&4ATD	41	55%
Super B-Double	7	9%
A-Double	13	17%
Sub-Total	67	89%
Other	8	11%
Total	75	100%

Note: There may be a degree of rounding for the percentage estimations

APPENDIX III – Average kilometres by configuration

The safety metric of major accident rate per 100 million kilometres is dependent on the kilometres per annum travelled by vehicles type. The PBS average kilometres by configuration were drawn from this and the two previous PBS safety surveys, Austroads 2014 and NTC 2017.

Table A3: Average kilometres by Vehicle types Conventional vs PBS Trucks

Conventional Configurations (H&R)	Kms p.a.	PBS Configurations	Kms p.a.
Semi-trailer	120,190	Enhanced Semi	244,302
3,4 AT 4ADT	107,921	2,3AT 3ADT	129,036
B-Double	200,640	3,4 AT 4ADT	128,079
Double Road Train	169,276	3,4AT 5ADT	169,100
Triple Road Train	186,984	3,4AT 6ADT	164,440
B-triples (permit)	158,552	Super B-Doubles	89,420
Quads Combination	177,085	Enhanced B-Doubles	327,128
		A-Doubles	224,026
		BB, AB, BA Triples	212,893
		Quads BAB, AAB etc	196,200

Source: PBS Survey for NHVR 2020, Austroads 2014, NTC 2017

The PBS kilometres were compared to a specially undertaken hire and reward operator survey. Why? Because the national kilometres travelled by Australian trucks are heavily weighted with Ancillary operator kilometres. Ancillary kilometres travelled are considerably lower than both hire and reward and PBS operator kilometres. These national averages have not been used in this analysis as PBS operators are very predominately hire and reward operators.

As an aside, using the NTC national average kilometres performed by a particular vehicle configuration lends itself to lower the average kilometres performed by the hire and reward sector which for registration calculations generates a subsidy to the higher kilometres performing hire and reward sector. This mis allocation has never been addressed, and as such for this analysis specific hire and reward kilometres were sought as an apples and apples comparison needed when comparing operation by PBS fleets.

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Glossary

CML	Concessional Mass Limit
EBD	Enhanced B-Double
GCM	Gross Combination Mass
Gtkms	gross tonne kilometres
GVM	Gross Vehicle Mass
H&R	Hire & Reward
HML	Higher Mass Limit
HPV	High Productivity Vehicle
HR2,3&3ATD	Rigid Truck plus 3 Axle Dog Trailer
HR3,4&4ATD	Rigid Truck plus 4 Axle Dog Trailer
HR3,4&5ATD	Rigid Truck plus 5 Axle Dog Trailer
HR3,4&6ATD	Rigid Truck plus 6 Axle Dog Trailer
NHVR	National Heavy Vehicle Regulator
NTARC	National Truck Accident Research Centre
NRTC	National Road Transport Commission
NTC	National Transport Commission
P.a.	Per annum
PBS	Performance Based Standards
SMVU	Survey of Motor Vehicle Use
VIN	Vehicle Identification Number
VKT	Vehicle Kilometres Travelled

Acknowledgements

The CILTA and NTARC consortium is grateful to, not only the continued assistance of the Chief Engineer at the National Heavy Vehicle Regulator, but also the data analytics teams at both the National Heavy Vehicle Regulator and at National Transport Insurance.

Without these resources the detailed analysis would not have been remotely possible for this study. As well, the authors would like to thank those fleets that participated in the study not only contributing specific configuration data but also the many additional insights concerning their PBS and conventional fleet operations.

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