



ARE GOOD TRUCKS THE SIGN OF A GREAT OPERATOR?

A SPECIAL REPORT INTO HEAVY VEHICLE ROADWORTHINESS

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NTI National Transport Insurance

NTARC

 NHVR

EXECUTIVE SUMMARY

At its heart, this report sets out to answer a very basic question:

Do transport operators with trucks that are well maintained have better safety outcomes?

It brings together data on the condition of heavy vehicles from the National Heavy Vehicle Regulator's (NHVR) National Roadworthiness Baseline Survey (NRBS) and data on heavy vehicle crashes from NTI limited, Australia's largest truck insurer.

Through carefully managed data handling, it was possible for the two data sets to be queried whilst not allowing either side to directly view the other's data, thereby meeting the privacy obligations of all sides.

The results revealed that there was a correlation between operators with trucks inspected and found to be conformant to vehicle standards regulations and lower frequency and cost of truck crashes.

Conversely, operators with trucks with minor defects showed a small (2%) increase in the frequency of claims, while operators with trucks with major defects showed a significant increase (14%) in the cost and frequency (7%) of claims per powered unit per year.

It is important to emphasise that **this research does not identify a causal relationship**, very few incidents can be linked to vehicle standards non-conformities, it only demonstrates there is a correlation. This could be the result of other confounding factors, such as operators with poor maintenance practices also having a poor approach to driver management or fatigue.

A deeper examination of the results that non-conformity to standards for certain vehicle systems had the strongest correlation to increased truck crash cost and frequency, specifically (in alphabetical order):

- Couplings
- Steering and Suspension
- Wheels and Tyres

Of particular note was the lack of significance (positive or negative) of defects identified a vehicle's braking system, further examination suggests this may relate to issues with the test procedures used at the time in roller brake testing, which have been subject to significant change subsequent to the completion of the NRBS.



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INTRODUCTION

This report examines the relationship between vehicle standards non-conformities and the safety performance of a heavy vehicle operator.

As hypotheses go, the suggestion that these two factors would correlate is unlikely to be controversial to many people. There is however very little data in this space, predominantly because of a separation between the organisations who hold data on vehicle condition and organisations who have access to data on crashes.

This research brings together NTI's extensive data on Australian heavy vehicle road crashes with the vehicle condition data held by the NHVR.

METHOD

This research was made possible by bringing together two different datasets, the NRBS data held by the NHVR and claims data held by NTI.

NHVR NATIONAL ROADWORTHINESS BASELINE SURVEY

From August through October 2016, the NHVR coordinated the first ever health check of the Australian heavy vehicle fleet under the name of the National Roadworthiness Baseline Survey. Conducted as part of the broader Roadworthiness Program, it sought to create a point in time snapshot of the mechanical condition of Australia's heavy vehicle fleet.

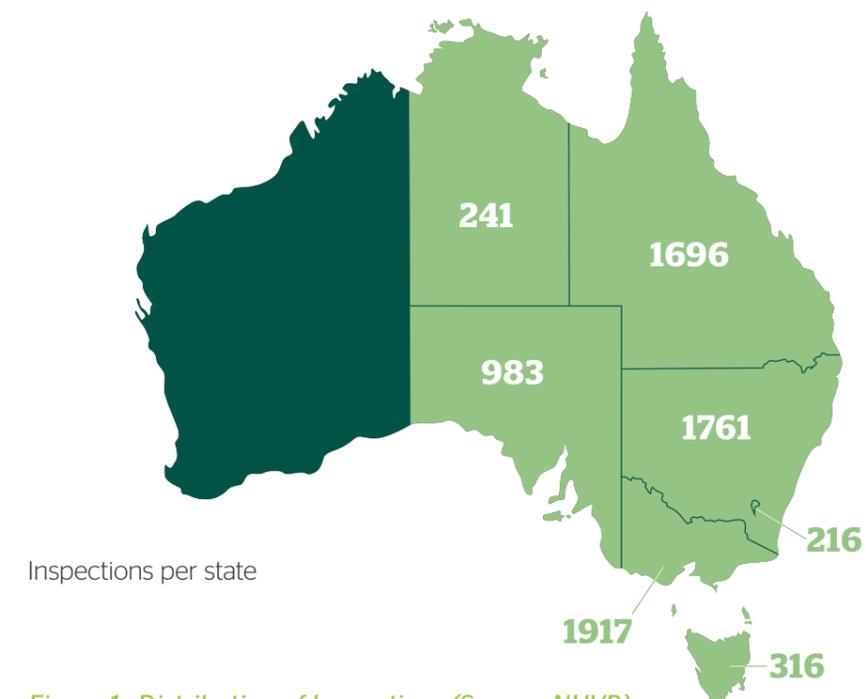


Figure 1 - Distribution of Inspections (Source: NHVR)

The NRBS provides a discrete, representative, randomised sample of vehicles and the data gained from a comprehensive mechanical inspection aligned to the data structures of the National Heavy Vehicle Inspection Manual.

NTI CLAIMS DATA

As Australia's largest insurer of heavy vehicles, NTI processes over 20,000 heavy motor insurance claims each year, this creates a rich repository of data on one form of harm - property damage - arising from the operation of heavy vehicles. Whilst not a complete picture of all harm, it serves as a valuable proxy for others where data is not as easily available.

DATA PRIVACY

NTI and the NHVR are both bound by stringent privacy obligations and this created significant logistical challenges which needed to be overcome in order to undertake this research.

In order to reconcile a particular vehicle inspected during the NRBS with an operator within NTI's portfolio, it was necessary for this research to be undertaken on data which contains personal identifiers, but to do so in a way which never allows a party to see the other's data directly.

To achieve this, firstly the NHVR provided NTI with the NRBS dataset with the fields containing unique identifiers having been hashed to anonymise them, along with information about the data structures within the NRBS data.

This allowed NTI's data scientists to familiarise themselves with the structure of the NRBS data and to design the database queries which would be used for matching. With that process complete, the two data sets were uploaded to a secure system, the database queries were run against the two data sets and used to populate results tables and then original data sets were wiped.

The resulting tables do not contain any personal identifiers, however provide sufficient information to allow the safety performance of various segments of the overall data to be assessed.

MATCHING

The sample of vehicles from the NRBS was relatively small, 7130 powered units and 3936 trailers for a total of 11,066 units. To provide the broadest range of data for analysis, once a vehicle is matched between the NRBS and NTI data, all other vehicles from the same operator are included and the three most recent years of data for that operator are used to calculate the metrics below.

METRICS

There are two metrics which will be used throughout this report, each capturing a different view of the claims performance of heavy vehicle operators. Throughout the results, the impact of a particular result or characteristic within the NRBS data is assessed by looking at the relative change in these two measures compared to all operators who are matched between the two datasets.

Frequency

The first metric is 'Frequency', which for the purpose of this report is defined as:

$$\text{Frequency} = \frac{\text{(Number of Incidents)}}{\text{(Number of Powered Units)}}$$

In plain English, this captures how what percentage of the trucks in a given sample would be expected to have a crash resulting in an insurance claim per year.

Cost

The second metric is 'Cost', which for the purpose of this report is defined as:

$$\text{Cost} = \frac{\text{(Value of >\$10,000 Claims)}}{\text{(Number of Powered Units)}}$$

This captures how many dollars' worth of harm arising from crashes would be expected per vehicle per year in any given sample.

RESULTS

NTI/NRBS MATCHED SAMPLE

This sample provides the baseline figures against which all other samples within this report will be compared.

In bringing together the NRBS and NTI data sets, 2710 vehicles which were subject to NRBS inspections were matched with vehicles in the NTI portfolio. These vehicles were associated with 668 different policies and taking up to three years of data on those policies where available, this gave 66213 'item years' (e.g. around 22,000 items multiplied by three years of data in scope) of data which were associated with those policies.

This means that just under 24% of the units inspected in the NRBS were able to be matched to NTI's data. This is slightly lower than the anticipated number of around one in three, however two factors may be contributing to this, firstly NTI's market share is greater in the heavier duty end of the market while the NRBS sample has a greater number of rigid trucks (e.g 3164 rigid trucks vs 789 B-doubles).

Secondly there is likely to be some vehicles where the unit was insured with NTI however not matched due to issues with either how the detail is held in NTI's system or how registration data was generated for the NRBS data.

NTI/NRBS MATCHED SAMPLE



DEFECT SEVERITY

Before getting to the results, it is pertinent to examine why the proportions of operators in the table below differ from the proportions of defects found in vehicles in the NRBS. Where an operator had multiple vehicles inspected, the category into which they were grouped for this analysis was determined by the least compliant vehicle inspected.

An operator with 10 units inspected, nine with no defects and one with a major defect, would be grouped into the 'Major Defect' category.

The probability that all units inspected for an operator will have no defects decreases as the number of units inspected increases with the equation:

$$P_{operator} = P_{unit}^n$$

Where 'p_{unit}' is the probability of any unit having no defects and 'n' is the number of units inspected for that operator. So with 52% of units inspected having no defect, this means that if vehicle condition were randomly distributed, then the probability of an operator with two trucks having no defects found is 0.27.

Evaluating the Major Defect category in these results by a similar process shows that if an operator were to have 7 units inspected, which is the approximate ratio of matched inspected units per policy, that the probability of having no units with a major defect is 0.409.

This will have two likely impacts on the data, firstly by larger operators being more likely to be reported in the defective vehicle categories and secondly by operators of larger combinations being reported in the defective vehicle categories, since most commonly all units of a B-double or road train will be owned by the one operator.

With those caveats in place, moving onto the results, firstly examining operators where none of the matched units had defects identified. This shows that operators whose had a vehicle or vehicles inspected have 23% lower cost in claims per powered unit per year than the entire population of matched operators.

Operators where the highest level of defect found in an inspected unit was minor had an increased frequency of losses (+5%) compared to the baseline but actually had a lower incident cost per vehicle than the baseline figure (although not as low as operators with at least one unit found to have a major defect).

These 'minor defect' group had a 5% greater frequency of losses and 4.4% increased severity. Where cost is lower but severity is higher, this corresponds with a lower average sum insured.

Where at least one inspected unit had a major defect, the operators were found to have a cost metric which was nearly 12% higher than baseline. This gives a total spread of 35 percentage points between the 'no defect' and 'major defect' groups. Viewed another way, operators in the 'major defect' group have an annual claims cost 45% higher than those in the 'no defect' group.

DEFECT SEVERITY

	Inspected Units Matched	Policy Count	Policy Item Years	Baseline Frequency	Baseline Cost
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No Defect



Minor Defect



Major Defect



VEHICLE SYSTEM

Examining the results by the NHVIM section yields some interesting data. Two vehicle systems (as defined by the NHVIM sections) showed a strong correlation with both increased claims frequency and cost:

- Couplings
- Wheels and Tyres

Couplings showed a correlation with a 29% increase in the frequency and a 22% increase in the cost of claims. For Wheel and Tyre defects the frequency was 32% higher than the baseline while cost was 26% higher.

There was also a lower, but still notable increase in claims for operators where one (or more) of their vehicles had defects associated with three other vehicle systems:

- Lights
- Steering and Suspension
- Structure

It is important to emphasise again that:

This does not show that crashes were caused by defects in these systems, but rather that operators on whose trucks these systems are not well maintained are involved in a greater number of claims.

That defects in these systems would correlate with increased crashes is unlikely to come as a surprise to people familiar with heavy vehicles. Potentially more significant are the results for another vehicle section, Brakes.

Operators who had vehicles with defects in their braking system do not show significantly worse performance than the baseline, with only a 3% higher frequency and 4% higher cost when compared to the 'all matched units' baseline. The overwhelming majority of brake system defects were detected through the use of roller brake testers, a broader evaluation of the impact of this is contained in the discussion section below.

VEHICLE SYSTEM

Group Name	Inspected Units Matched	Policy Count	Policy Item Years	Baseline Frequency	Baseline Cost
Brakes	1884	352	47681	3%	4%
Couplings	575	49	15761	29%	22%
Steering & Suspension	1401	216	34403	21%	11%
Wheels & Tyres	942	136	24075	32%	26%
Structure	764	121	21029	12%	11%
Seats	439	41	15002	8%	-5%
Lights	872	132	26484	13%	19%
Mirrors	9	77	285	-	-
Windscreen	521	77	16821	1%	-8%
Engine & Driveline	759	107	20434	-2%	8%

DISCUSSION

The existence of such a strong correlation between operators with defective trucks and worsened claims performance is intriguing although not surprising. Again reiterating that the data only show correlation, there is nothing here to suggest a causative relationship and NTARC's other research would suggest that a direct causative relationship is not indicated.

So what does this finding offer? It supports the use of random on-road heavy vehicle inspections as part of an effective assurance regime, although not for what is generally regarded as its traditional function, to directly manage risk by ensuring vehicle standards are complied with. Rather it indicates which operators may pose a higher risk via whatever undetermined mechanism(s) link the vehicle standards non-conformity and increased cost and frequency of crashes.

Further research could be undertaken to evaluate potential causal links between vehicle condition and increased crash cost and frequency, either by starting with operators with known claims performance (good or bad) and seeking to identify common attributes, or by starting with operators with known vehicle condition and then evaluating the incidents they have.

The results by vehicle systems who the strongest correlation between what are generally regarded as the 'safety critical' systems and worsened claims performance, with the noteworthy exception of Brakes (discussed below). This would suggest that for 'good' operators, they are aware of the systems which pose the greatest safety risk and are ensuring that these systems are maintained appropriately.

Windscreen defects displayed a slightly negative correlation with operators whose trucks had windscreen defects having better than baseline claims performance, this could be explained by the types of freight tasks (remote/regional) where windscreen damage is more likely also having better safety practices or that operators regard windscreen damage as less critical for safety and are deprioritising replacement accordingly.

BRAKES - ROLLER BRAKE TESTING

In the results, noteworthy by its absence was a significant impact on claims performance for operators with defects identified in their vehicles' braking systems. One of the key features of the NRBS was the near universal use of Roller Brake Testers (RBT) and the overwhelming majority of brake system defects identified during the NRBS were as a result of this equipment.

The delivery of the NRBS also coincided with the roll-out of the second edition of the National Heavy Vehicle Inspection Manual and a move by the NHVR to standardise jurisdictional testing via RBT at the performance level of 4.5kn/t set by the NHVIM. As an indirect result of the NRBS and the changes in RBT criteria from the introduction of the NHVIM, issues were identified with the then current procedures for Roller Brake Testing.

This had the effect of creating a significant number of false positive results, particular for trailing arm airbag suspension equipped trailers. As a result of the identification of these issues, a significant body of work was undertaken by the NHVR and a new National Roller Brake Testing Procedure was developed and has subsequently been implemented to address the identified issues.

CONCLUSION

These results demonstrate that of operators within NTI's insured portfolio, those with better maintained vehicles have both a lower frequency of claims and a lower claims cost per powered unit.

The data, particularly when viewed in concert with the NTARC Major Accident Investigation Report suggests this linkage is correlative, not causative in nature, with very few serious crashes being linked to mechanical failures.

It would appear likely, although not able to be established by reference to these datasets, that operators with effective maintenance regimes may also have better general systems to manage risk within their business and therefore better outcomes for the factors known to directly cause incidents such as fatigue and driver behaviour.

The findings regarding specific vehicle systems suggest that simply checking the condition of the tyres on a truck may provide a significant insight into effectiveness of transport safety management practices within the business operating that vehicle.

There are significant opportunities for future research to determine the causative mechanisms behind the correlations found within this report.

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ABOUT NTI

As Australia's Number 1 Truck Insurer, NTI prides itself on being a part of the transport industry. It provides award winning service through a deep understanding of its customers and a commitment to putting itself in the customer's shoes when making decisions.

NTI is a foundation sponsor of the Australian Trucking Association and supports a number of important causes such as Transport Women Australia, the Burrumbuttock Hay Runners and Motor Neurone Disease research.

ABOUT THE AUTHOR - ADAM GIBSON

Starting his career in the transport and logistics industry as a heavy vehicle consulting engineer, Adam developed a deep interest in the not just the how of heavy vehicle regulation, but also the why.

This led to Adam leading the NHVR's Roadworthiness Program which was one of the responses resulting from a spate of serious truck accidents in the early 2010s.

He then returned to the commercial world taking a role as an Engineer with Penske Commercial vehicles before joining the team at NTI in 2018 and has since written two editions of the NTARC Major Accident Investigation Report.

Adam is passionate about achieving road safety outcomes through industry-led initiatives where the interventions to improve safety relate directly to the specific hazard being addressed.

ACKNOWLEDGEMENTS

This work was only possible thanks to the openness, patience and vision of the National Heavy Vehicle Regulator, in particular the NHVR's Vehicle Safety and Performance, Legal and Data Analytics teams.

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Finally we would like to acknowledge NTI's customers, without their ongoing support, we would not be able to undertake this and other heavy vehicle road safety research under the NTARC banner.

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