

Heavy truck safety

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Abstract:

Heavy truck occupant crash protection has become a safety concern because of increasing numbers of occupant fatalities. However, little is known about the causes of truck accidents and the way in which injuries and fatalities occur to heavy truck occupants. The purpose of this paper is to review the major causes of heavy truck accidents and to suggest important steps and changes which might be undertaken in reducing heavy truck accidents, injuries and fatalities.

The analysis for this paper was based on the available data concerning heavy truck accidents, registrations, kilometres of travel, vehicle type and load carried. It was concluded that revisions to the regulatory provisions that govern the trucking industry and the transportation of hazardous materials in NSW were warranted and appropriate. Recommendations for the revision of some of the State's regulations and enforcement program activities were offered.

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Introduction

Despite significant progress on overall road fatalities, it appears New South Wales continues to face problems of reducing the terrible toll of road accidents, and of integrating the road transport system with its current economic, environmental and social conditions - heavy truck safety problems. Although heavy vehicle accidents might never be eliminated, their incidence and fatalities can be greatly reduced.

A number of recent heavy vehicle accidents on New South Wales major highways have attracted much attention by the State Transport and Road Safety Commission, in particular the tragic accidents involving heavy vehicles on State highways. This has brought the question of safety of heavy trucks and vehicles very much into public awareness. Both State and Federal Governments have been urged to show concern about statistics reflecting significant increase in the involvement of heavy vehicles in traffic crashes and fatalities, especially when hazardous materials have been involved.

In New South Wales, trucks constitute about 7 per cent of all vehicle registrations and they are involved in 18.3 per cent of all accidents on State highways. Although the proportion of heavy trucks in total vehicle registration is small, their exposure is disproportionately great and their increasing involvement in fatalities is a major safety concern. The observed increases in a number of heavy vehicle accidents, injuries and fatalities need to be considered in perspective because the level of exposure that these vehicles have in the traffic stream is increasing. A major portion of the nationwide increase in fatalities, particularly in New South Wales, can be explained by the fact that there are more vehicles in the traffic stream thereby increasing the risk of heavy vehicle accidents.

Proper application of the State safety measures which now exist could significantly reduce the death toll. However, it is important to take stock of available accident countermeasures and review their efficiency. Also, more detailed heavy vehicle accident and exposure data are necessary to identify specific heavy vehicle safety problems and possibly increase countermeasures.

Literature Review

In October 1974, 12,604 semi-trailers were registered in New South Wales, this represents about 0.56 per cent of the total of 2,271,829 vehicle registrations. Herbert (1980) reported that in the State, between 1976 and 1978, the average number of vehicles registered was about 14,000 articulated trucks, and for rigid trucks 122,000 including rigid trucks of all sizes. Within this period, the total number of deaths in crashes involving articulated trucks was 301 with 64 drivers killed. For heavy rigid trucks 72 drivers were killed and 348 total deaths.

Also, Vaughan (1975) has documented that fatalities from crashes involving semi-trailers were fairly constant at around 7 to 8 per cent of all accident fatalities; indicating that this category of heavy vehicles (ie, semi-trailers) appears to be about 15 times as involved in fatalities compared to the total numbers registered. Further, in New South Wales semi-trailers make up less than half a per cent of registered vehicles, yet they were involved in more than 14 per cent of fatal crashes in 1988. These categories of vehicle are 20 times more likely to be involved in fatal crashes than cars (NRMA 1989).

With regards to heavy vehicle speed, Cowley (1980) and Cowley et al (1984) survey of rural highways in New South Wales have shown that most trucks do not comply with the road speed limit. These reports have indicated that the truck drivers' non-compliance were often a reflection of both the drivers' behaviour and in part the economic pressures on the long distance road freight industry. Further, Linklater (1977) reported that a sample of long distance truck drivers in NSW do experience more traffic crashes than a sample of other categories of motorists, however the report did not disclose why this was so. Moreover, in the 1970's, the most common types of crashes involving semi-trailers were rear-end and head-on collisions and were reported as the third most serious type of crashes in terms of fatalities. Other types of crashes involved side-wipes with other vehicles travelling in the same direction and those running off the road (Linklater 1977).

Several studies including that of Strotton and Schnerring (1982); Hartwig (1980); Corben et al (1980); Griffiths and Linklater (1984) and Amour (1984) found that fatal crashes that involved heavy trucks is increasing. Although some of these studies have focused on specific crashes or fatalities involving heavy vehicles, for instance Hartwig (1980) and Strotton and Schnerring (1982). Overall, most heavy vehicle crashes investigated were found to have no single cause. Driver negligence and non-compliance, vehicle as well as road conditions, were identified as either the primary cause or contributing factors to heavy vehicle crashes and fatalities.

Driver behaviour has been identified as one of the primary causes of accidents involving heavy trucks. According to Griffiths and Linklater (1984), the common behavioural findings of NSW tanker drivers between May 1979 and September 1980 (whereby 42 incidents involving heavy vehicles carrying bulk flammable liquid were investigated) were excessive speed, driver fatigue and driving a vehicle with known defects. In the majority of the truck fatalities, truck drivers involved were at fault. Among other causes detected were making unsafe lane changes or overtaking. Mechanical failures and vehicle defects have also been reported as a determining factor in most crashes of heavy trucks. Similarly, Strotton and Schnerring (1982) study revealed defects in some truck accidents investigated.

Data Analysis and Discussion

Data reviewed for analysis in this paper was extracted from the NSW Traffic Authority Research Reports and Statistics. The number of truck vehicles in the total reported accident statistics was computed.

Vehicle Registration: Figure I shows the trend in vehicle registrations and vehicle type involved in fatal accidents in NSW between 1976 and 1988. The figure indicated that trucks were just about 7 per cent of total vehicle registrations and this was slowly increasing; but they do amount to 18 per cent of the total vehicles involved in the State fatal crashes in 1981. This accident rate is rising faster than their proportion of the total registrations. In contrast, of course, car involvement in fatal crashes is decreasing more slowly than the total number of registrations. At the end of the year 1988, the State vehicle population encompassed about 2,313,000 car/station wagons; 183,000 utility; 218,000 panel vans; 176,000 rigid trucks; 16,000 articulated trucks; 14,000 other truck types; 54,000 buses and 105,000 motor cycles (NSW Traffic Authority 1988).

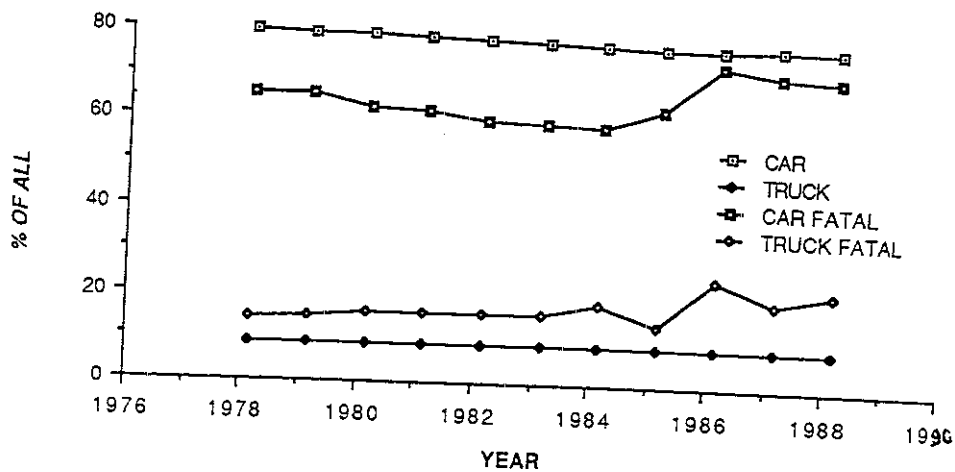


Figure 1: Percentage of Trend in Vehicle Registration

Vehicle Speed: Table I shows the mean and the 85th percentile speeds of cars, rigid and articulated trucks in the State. Similarly, these speeds were shown in Figure II. However, the speed measurements for the year 1987 and 1989 summarized in Table I were the free vehicle speed recorded in daytime by using a simple technique of speed measurement with stopwatch. It was revealed that following the introduction of 100 km/h the road toll involving rigid and articulated (ie, semi-trailers) trucks in NSW increased significantly.

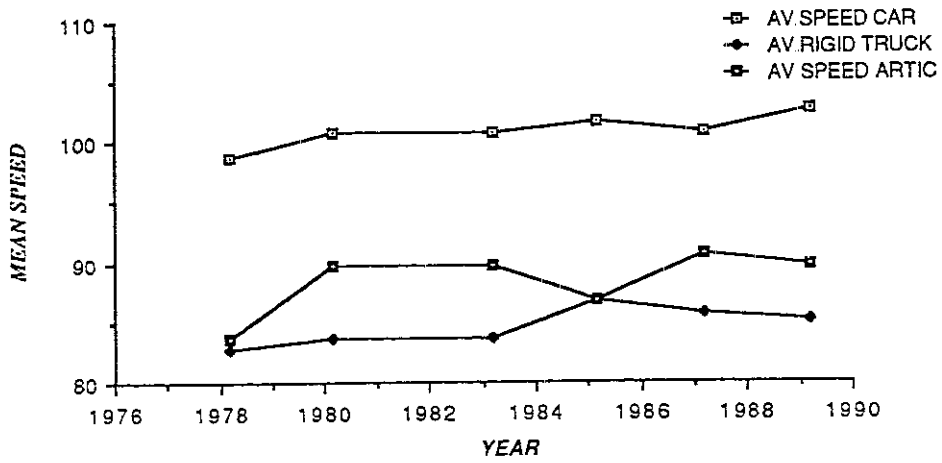


Figure II: Mean Vehicle Speed in NSW

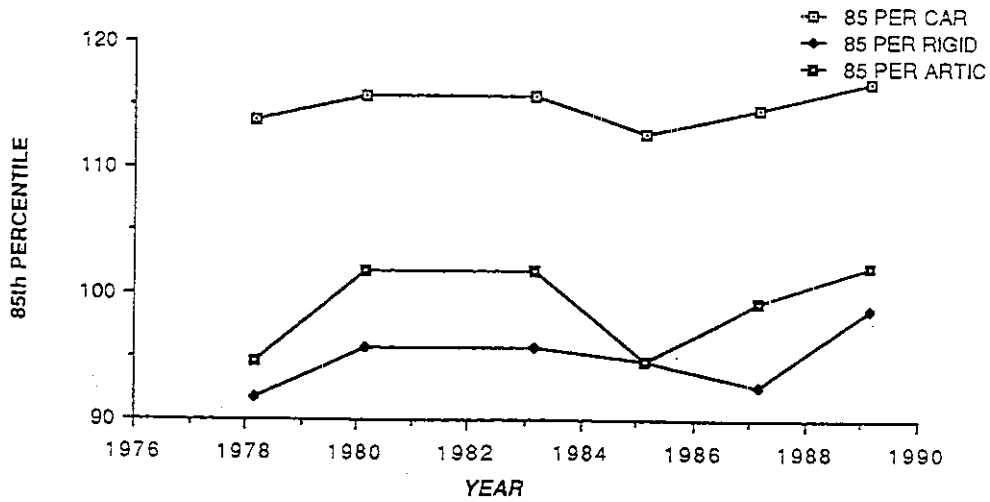


Figure II: 85th Percentile of Vehicle Speed in NSW

Table I: Free Speed km/h - An Overview

Year of Survey	Rural NSW Speed Limits	Speed Characteristics	Cars	Rigid Trucks	Articulated Trucks
1978*	Cars = 100 km/h Trucks = 80 km/h	Mean 85th Percentile	98 113	82 91	83 94
1980*	Cars = 100 km/h Trucks = 80 km/h	Mean 85th Percentile	100 115	83 95	89 101
1983*	Cars = 100 km/h Trucks = 80 km/h	Mean 85th Percentile	100 115	83 95	89 101
1985*	Cars = 100 km/h Trucks = 80 km/h	Mean 85th Percentile	101 112	All Heavy 86 94	
1987	Cars = 100 km/h Trucks = 80 km/h	Mean 85th Percentile	100 114	85 92	90 98.5
1989	Cars = 100 km/h Trucks = 80 km/h	Mean 85th Percentile	101.9 116	84.4 98	89.3 101.5

Note: The year of survey in asterisk was extracted from Peter Croft (1985) Review of the Speed Limit Differential for Heavy Vehicles, RTA, NSW

Heavy Truck Fatalities: Figure III presents the extracted data for heavy trucks, in particular the rigid and articulated truck fatalities in NSW between 1978 and 1988. Figure III shows year-to-year increase in fatalities. Prior to 1985, the number of people killed in heavy truck accidents was lower, this means that it appears safer ten years ago to travel in heavy trucks than now. However, productivity concessions of 100 km/h and 42.5 tonne limits have not been matched by the corresponding safety measures. Figure IIIa shows that 151 people were killed in crashes involving articulated trucks while 90 people died in crashes involving rigid trucks in 1988. It should be noted that the number of people killed in crashes involving articulated trucks in 1988 was twice the number killed in 1987. Table II also shows the number of vehicles involved in accidents per 10,000 registered vehicles of the type indicated. Heavy vehicles (both rigid and articulated) are often involved in serious/fatal accidents.

*Source is R.A.
but this conflicts with
KOS data (see Hensher
& Battellino, p 539)*

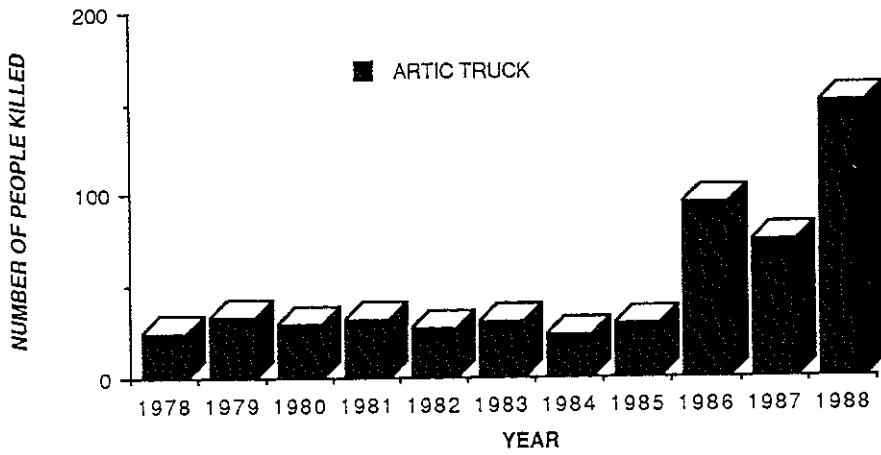


Figure IIIa: Articulated Truck Fatalities in NSW

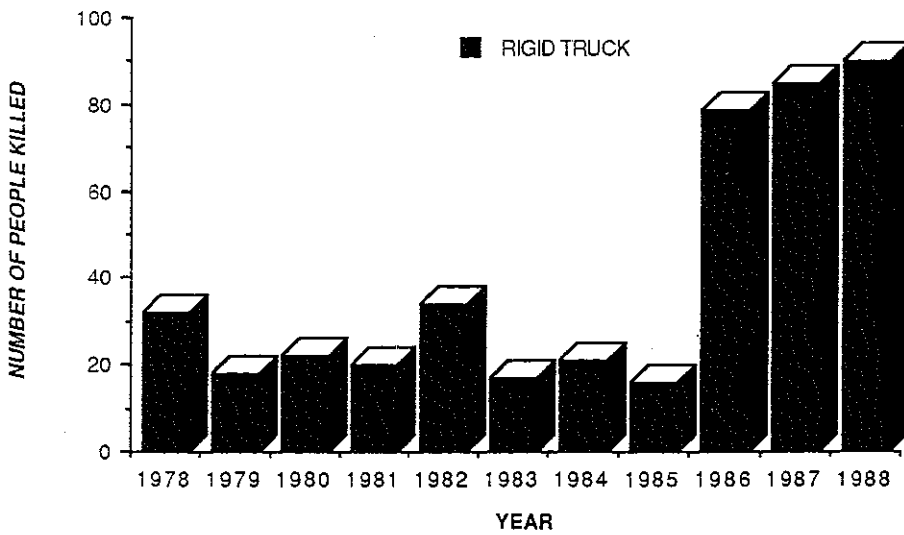


Figure III: Rigid Truck Fatalities in NSW

Table II: The Number of vehicles involved in accidents per 10,000 registered vehicles of that type

Year	Involvement	Rate	
1986	Fatal Accidents	Serious Injury Accidents	
	Car	3.7	29.5
	Rigid Truck	6.1	35.4
	Articulated Truck	49.4	145.4
1987	Fatal Accidents	Serious Injury Accidents	
	Car	3.3	29.4
	Rigid Truck	8.1	37.4
	Articulated Truck	40.4	122.9
1988	Fatal Accidents	Serious Injury Accidents	
	Car	3.5	28.2
	Rigid Truck	8.0	40.0
	Articulated Truck	79.5	109.9

Accident Causal Factors

Most truck accidents often represent a complicated sequential chain of events that can be related to several contributory factors or variables. Review has revealed that these factors are exceedingly complex in that they range in degree from the physical, ie, road and weather conditions to mechanical, ie, vehicle condition, to human factor, ie, driver behaviour. For human factors the chief causes are driving at an unsafe speed and making unsafe lane manoeuvres. So also is driver fatigue. The majority of truck drivers involved in fatalities have been found driving under stress. Driving under the influence of alcohol or certain drugs. Analysis found that up to 85 per cent of truck accidents were caused by driver's action.

Vehicle defects and/or mechanical failures often play a significant role. Fatalities resulting from such factors are on the increase; proportion is between 10 to 13 per cent of total number of recorded fatalities. Specifically, brake failures and inadequate braking ability accounted for the greater proportion, although steering (resulting from defects in wheel bearing and spring) and tire blowout have also been documented in a number of cases. Also, road and weather conditions are often contributing factors in heavy truck accidents hence it does interact with primary cause in any case of fatality.

On the whole, this review has led to the following specific issues that need to be considered for heavy truck safety

Current Safety Issues to be Considered

The reviewed literature has clearly indicated that heavy truck safety depends on the vehicle, the driver and driver behaviour as well as the road environment. Also, the importance of the combined safety and accident factors involved cannot be adequately evaluated without first accounting for the specific truck accident conditions. For instance, the relationship of State road environment, specifically, the deteriorating conditions to heavy vehicle truck feature failures and driver non-compliance, fatigue or negligence are of great safety concern. Briefly, this section will discuss what appears to be the current heavy truck safety issues within the NSW State.

Thus the NSW Traffic Authority Research Reports have revealed the major heavy truck safety problems as follows. Driven behaviour associated with

- o Drink Driving (Alcohol and Driving)
 - with speeding
 - with low education and below average skills
- o Road Environment
 - associated with inadequate road signals and signs
 - poor road surface
- o Vehicle condition
 - associated with mechanical defects

The Issues

Drink Driving

The issue of drink driving among heavy truck drivers has recently gained increasing awareness. Alcohol has been recognised as a major contributing factor in traffic crashes. Currently, the legal blood alcohol limit in NSW is 0.05g/100 ml. Since December 1982, there has been a legal requirement in the State for blood samples to be taken from certain persons injured in traffic crashes; treated in a hospital as a consequence of a traffic crash. Similarly, the Police Department require a driver or motorcycle rider involved in a traffic crash to undergo a breath test.

Also, random breath testing was first introduced in NSW for a three year trial period on 17 December 1982 and was made permanent on 10 December 1985 (Traffic Authority NSW 1985: 31-35). For the present advocacy of minimum alcohol level limit to be effective, there is a need to have adequate law enforcement agents, the Police, on the road. It should be noted that the incidence of alcohol involvement in heavy truck accidents appears greatest during the night and early morning. Also the presence of alcohol is often associated with lower rate of safety belt use and non-compliance with other safety techniques. Clearly, excessive speeding has always

been associated with alcohol. Heavy vehicles may travel at speeds up to 80 km/h on highways. Figure II shows the mean and 85th Percentile of vehicle speeds of cars, rigid and articulated vehicles, their free speed characteristics differ (see Table I). Heavy vehicle speed limits need to be reduced because vehicle trucks are not only more aggressive than cars because of their greater weights.

The issue of driver education constitutes a part in the integrated approach to the problem of heavy vehicle safety. Similarly, drivers' traffic knowledge, skills and behaviour also play an important role in reducing accident risks. Thus, traffic and road safety education programmes are traditional means to develop appropriate and current knowledge and skills needed for safe driving. Road safety programme objectives should focus on improving knowledge and changing heavy vehicle drivers' behaviour. With the use of practical training and employment of techniques of behaviour modification such aims could be achieved.

There is a need to review the heavy vehicle drivers' licensing laws, instructions and the driving examination system. It is surprising to note that so far evaluation studies on the effectiveness of truck driver instruction or both in terms of ultimate criteria such as the number of accident and traffic offences have not yet revealed conclusive evidence as to whether driver instruction does or does not reduce accident involvement during subsequent traffic participation.

Road Environment

The issue of increased road funding and deteriorating road condition always come up with any fatality involving heavy vehicles. Although the State Government continues to improve the road and road environment to enhance safety, efforts should not be reduced. For instance, as of 1984, the road fatality in NSW appears higher compared to other States. The NSW rural fatality rate was reported to be 17 per cent (Armour 1984) and this could be signify the poor rural road conditions. In fact, nationwide, statistics indicate that 36 per cent of reported rural crashes were casualty crashes compared to 21 per cent for the metropolitan area. Areas which need to be improved include pavement resurfacing, road delineation and lane widening, position of overtaking lanes and adequate road signs and signals.

Traffic research is needed to identify locations likely to benefit most from delineation, to identify the combination of traffic volumes and certain road geometric parameters which justify increased lane and shoulder width. Good pavement resurfacing is required to enhance heavy vehicle safety. Most traffic investigation has shown pavement resurfacing to be a highly effective measure. Further, the safety benefits of urban freeways for heavy vehicle use should not be overlooked. This often relates to the degree of the type of access control. Studies both in Australia and other countries have suggested that access control does have the potential of reducing truck crash rates by up to 60 per cent and that even partial control of access could substantially reduce crash rates (Stover et al 1982; Armour 1984).

Vehicle Condition

With regards to fatalities resulting from mechanical defects, it is suggested that extensive research be done to verify situations. If possible, there should be establishment of centralised State Government centres for heavy inspection to ensure that trucks and semi-trailers are in excellent mechanical condition. Heavy vehicle inspection should be done either on half-yearly or yearly basis.

Reduction in severity of heavy vehicle accidents will require manipulation of situational factors related to the vehicle and physical environment. However, it should be realised that the major road safety improvements are always cost-effective and it is thus a question of allocation of funds to implement them in an appropriate order or priority. The State has proposed an increase in petrol price for State road rehabilitation but even for such programs it might take some years to complete or cure the problem of deteriorating/bad road conditions across the State.

Conclusions

Heavy truck drivers' behaviour is of central importance in the prevention of road accidents and some road safety issues. Restriction of truck safety studies to individual issues is of limited value. In NSW, it is recommended that current heavy truck (vehicle) safety issues need to be reviewed from the perspective of drivers, passengers, State Police, the vehicle manufacturers, the medical personnel and highway users.

The overall review of truck accidents showed that the vehicles and highway condition can contribute to the severity of an accident, while the human factor is the major contributor to the accident. Because of the dominant role of the human factor in truck fatalities and road accident occurrence, efforts need to be centred heavily on measures regarding specific high risk truck drivers. Substantial safety improvements in this area are quite possible. It is clearly obvious that improved education could play a significant role in improvement of heavy vehicle drivers and traffic management authorities in safety management.

Finally, heavy truck fatalities are increasing at a rate greater than that of fatalities in car vehicles. However, available data and information regarding heavy truck accidents in NSW is far from definitive and data between 1989 and now is yet unavailable.

Although the limitations of the data (in terms of the latest data availability) prevent a strong conclusion that NSW currently has a serious heavy vehicle accident problem, the problem clearly exists and it is definitely worsening at an increasing rate. Safety in heavy truck transportation should be of concern to individuals at different levels of government. It should be noted that certain revisions to the regulations that govern truck transport is warranted.

Development aimed at raising safety standards of heavy trucks should not be restricted and further progress on prevention of accident fatalities should continue. Considerable further research in NSW seems appropriate, together with a standardisation in data recording and more standard approach to recording the result of research.

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