Title:

Work Related Motor Vehicle Incident Profiles: An Analysis of Costs and Frequencies

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Work related road safety research is scarce. Due to an increasing awareness of workplace health and safety issues and the impact of fleet safety on business effectiveness, the current demand for fleet safety information has grown. To assist organisations in managing their fleets in an informed manner, this study analysed the frequency and severity of various types of motor vehicle incidents in a large Australian fleet of greater than 10,000 vehicles. Data pertaining to motor vehicle incidents that occurred between 1999 and 2003 was sourced from archival records of property damage, workers compensation and third party claims. The data includes 321 motor vehicle incidents that occurred during this period where a property damage claim was filed in relation to the researched fleet that could be matched with either a workers compensation claim or compulsory third party (CTP) claim. Therefore all estimates in this paper refer to average injury crashes. It was observed that incident frequency and severity varied substantially between different incident characteristics. This paper provides current data which could be utilised to guide judgements of the cost effectiveness of proposed interventions both within the fleet and broader road safety community. For example, most road safety programs are aimed at younger drivers. This study found that 60 percent of the drivers involved in an incident were between the ages of 31 and 50 years, and that drivers who were between the ages of 41 and 50 years had the highest average total incident cost. This would suggest that traditional programs may need to be modified to target this more mature audience.

Work Related Motor Vehicle Incident Profiles: An Analysis of Costs and Frequencies

By Tamara Banks & Jeremy Davey

Fleet and work related motor vehicle incidents represent a substantial emotional and financial cost to society. It has been estimated that the total cost of work related road incidents in Australia may be in the range of $1 billion to $1.5 billion per annum (Wheatley, 1997) and that the average total insurance cost of a fleet incident is approximately $28,000 with costs incurred to both the company and society (Davey & Banks, 2005). To build upon these broad based estimates, targeted exploration of fleet related incidents is currently needed to identify specific factors with high crash costs and/or frequencies. Analysing disaggregated costs and frequencies across multiple factors will provide meaningful statistics that may have potential applications for guiding fleet policy and purchasing decisions. Motor vehicle incident outcomes vary in relation to many different factors. Some factors which have previously been identified as influencing motor vehicle incident outcomes include driver gender, driver age, vehicle type and nature of the collision.

Research suggests that driver gender may be associated with crash outcomes, with males having a higher rate of crashes than female drivers (Waller, Elliot, Shope, Raghunathan & Little, 2001, Norris, Matthews & Raid, 2000; Lawton, Parker & Stradling, 1997). This risk pattern difference remains when comparing genders in relation to driver deaths per 100 million miles driven (Social Issues Research Centre, 2004). Males have also been shown to be more likely to be at fault in crashes (Waller, Elliot, Shope, Raghunathan & Little, 2001). For individuals that are involved in a collision, research suggests that females may be at a higher risk of whiplash injury than males (Berglund, Alfredson, Jensen, Bodin & Nygren, 2002), however overall differences in injury rates between males and females have been found to be negligible (Maycock, Lockwood & Lester, 1991). In regards to the effect of gender upon company car crash risk, the evidence is mixed. For example, Chipman, MacGregor, Smiley and Lee-Gosselin, (1992) found that per 1,000 drivers, males had twice as many crashes as females. Cartwright, Cooper and Barron (1993) found no significant differences regarding gender and accident involvement and Lynn and Lockwood (1998) found that female company vehicle drivers had a higher average annual frequency of incidents than male company vehicle drivers. Lynn and Lockwood do state that their results should be viewed with caution considering the small sample size of female drivers and the small number of incidents.

The demographic of age also appears to be related to risk of road traffic incidents. Research has found that both young and old drivers were more likely to be considered at fault than middle age drivers. Crash characteristics associated with older drivers include crashes at intersections and/or involving failure to yield the right of way, failure to observe stop signs or signals, crashes occurring while turning and changing lanes and crashes due to unseen objects. Alternatively crash characteristics less associated with older drivers comprise accidents involving driver fatigue, alcohol, high speeds, adverse weather, and curved roads. It has been suggested that the driving ability of older people may be impaired due to perceptual problems and limitations in judging and responding to traffic. Alternatively, it has been suggested that the driving ability of younger people may be impaired due to lack of skill, less experience, overestimations of ability and underestimations of danger (Bjornskau, 2000; Brown & Copeman, 1975; McGwin & Brown, 1999; Trimpop & Kirkcaldy, 1997). Based on research pertaining specifically to accidents involving company car drivers, Cartwright, Cooper and Barron (1993) found no significant differences regarding age and accident involvement. Alternatively, more recent Australian research pertaining to fleet safety has found that drivers in the 41-50 year age category comprised the highest proportion of drivers involved in crashes (Wishart, Davey, Manderson & McKinnon, 2004). This Australian finding is consistent with American fleet risk patterns. Based on the number of people employed within each age category, the 16 to 19 year old age group had the lowest relative risks, with relative risk increasing with age and peaking at vehicle operators aged 65 and over (Janicak, 2003). It is suggested that this occupational road risk pattern may be influenced by younger drivers potentially having lower on-the-job exposure to vehicle accidents and mature drivers' reduced ability to heal and survive if involved in an incident.

Understanding the combined risk to drivers and other road users associated with various vehicle models is important for fleet selection. It is commonly believed that the capability of a vehicle to protect its occupants in a crash is related to the mass of the vehicle. However some research pertaining to vehicle model types has found that levels of driver safety remain fairly constant across most car models and sport utility vehicles (SUVs). For example, it was observed that the increased risk of a rollover in a SUV counterbalanced the higher risk for cars that collide with SUVs and Utilities (Wenzel & Ross, 2005). A review of Australian and New Zealand incidents from 1987 to 2002 reveals local crashworthiness and aggressivity ratings for vehicle types (Newstead, Cameron & Watson, 2004). In regards to risk for other drivers, the average number of people killed or seriously injured per 100 people involved in two car tow-away collisions was 2.77. Large four-wheel-drive vehicles were found to be the most aggressive towards others, with an average of 4.07. In comparison, light cars were found to be the least aggressive towards others, with an average of 1.65. In regards to risk to the driver of a specific vehicle type, the average number of people killed or seriously injured per 100 people involved in two car tow-away collisions was 3.61. Luxury vehicles (defined as highly specified passenger vehicles priced above the luxury tax threshold) were found to have the greatest crashworthiness rating offering the most protection towards their driver, with an average of 2.56. In comparison, light cars were found to have the lowest crashworthiness rating with an average of 5.05.

The nature of the collision also appears be associated with crash outcomes. Research suggests that the most common circumstances of vehicle collisions include rear-end collisions, and drivers disregarding traffic controls or failing to follow right-of-way (Retting, 1996; Wang, Knipling & Blincoe, 1999). In regards to overall losses incurred as a result of a collision, crash geometrics classified as multiple-vehicle cross path incidents and multiple-vehicle rear-end incidents account for the greatest total losses in terms of both direct costs and life years as compared to other crash types (Miller et al, 1997). More specifically, rear-end collisions have been found to be associated with greater risk of whiplash injury than side impact collisions (Berglund, Alfredson, Jensen, Bodin & Nygren, 2002).

The research outlined above provides some crash costs and frequencies in relation to specific crash characteristics. This study expands upon previous research which has often looked at different aspects in isolation, by analysing a combination of both disaggregated costs and frequencies across driver gender, driver age, vehicle type and nature of the collision. As road safety interventions are often designed to reduce a specific type of incident cost, disaggregated statistics may have applications for predicting cost-benefits of potential safety interventions.

METHOD

Insurance costs incurred by both the company and society were obtained for incidents pertaining to vehicles from a large Australian fleet. This fleet comprised a range of passenger and light commercial vehicles with some heavy vehicles. The terms incidents and fleet vehicles are used in this paper within the context defined by Davey and Banks (2005). Data for this project was sourced from archival records pertaining to motor vehicle incidents that occurred from July 1999 through to July 2003 in relation to the researched fleet. To obtain comprehensive incident cost estimates, data sets containing vehicle/property damage claims, workers compensation claims and compulsory third party (CTP) claims were matched. The data includes all motor vehicle incidents that occurred during this period where a property damage claim was filed in relation to the researched fleet that could be matched with either a workers compensation claim or compulsory third party (CTP) claim. Therefore all estimates in this paper refer to average injury crashes.

Data was matched across the three databases using common data fields including the incident date, time and location. This process resulted in data being retrieved for 321 incidents. Of theses incidents workers compensation claim data was able to be matched with 154 of the property damage incidents. CTP data was able to be matched with 210 of the property damage incidents. Total incident costs were derived for each of the 321 incidents by combining property damage costs with matched injury costs from workers compensation and/or CTP payments. The Total Incident cost will not appear to be additive due to the different denominators that were used in obtaining the averages for each database. For example 321 cases contributed to the average Total Incident cost in comparison to CTP costs where the average was derived from 210 cases. As Gross costs were not available, Net insurance payouts across each of the insurance domains were used for calculations.

Property damage costs included either estimates for the vehicle and the third party's vehicle in incidents where the driver of the vehicle was 'at fault', or the final costs for these if the vehicle/property have been repaired. The total property damage cost is net of the excess if payable and also includes proceeds of salvage and where applicable, any recoveries from third parties 'at fault'. The total workers compensation payments comprised costs where applicable in regards to: Compensation Payments, Services/Goods Payments for example medical treatment and clothing, and Non-Compensation Payments for example transport and legal costs. The CTP data was supplied at an accident level. Total CTP costs comprised economic loss, general damages, investigation, legal, treatment rehabilitation and associated costs. In this study, data pertaining to crash severity type was not able to be obtained. A more detailed discussion of the relationship between the three insurance domains and a brief comparison between the Australian CTP scheme and the accident compensation scheme in New Zealand is provided in Davey and Banks (2005).

Figures presented in this report are based on claims data sourced in September 2003. As claims for some crashes take 12 months or longer to finalise, it is acknowledged that claims data may change for some incidents as late reports are filed/updated. This may result in an underestimate of the true average claim cost, especially for cases involving long term or permanent disability.

RESULTS AND DISCUSSION

Driver Gender

A review of the claims revealed that the driver was male in approximately 61 percent of the incidents. To account for exposure, demographic data was accessed pertaining to all employees in relation to the researched fleet. It was identified that approximately 40 percent of the employees were male. Data pertaining to driver demographics was not available, however it is suggested that the exposure may differ between male and female employees with male drivers potentially operating heavier vehicles and driving longer distances.

The finding that males are overrepresented in terms of incident frequency is consistent with research relating to the general public where it has been observed that males are substantially more likely to be involved in a crash than females (Waller, Elliot, Shope, Raghunathan & Little, 2001, Norris, Matthews & Raid, 2000) and also consistent with fleet research (Chipman, MacGregor, Smiley & Lee-Gosselin, 1992).

A significant difference was observed between the average total cost of incidents involving a male driver as compared to a female driver (F (1, 317) = 8.12, p <.005). The average total cost of male driver incidents ($28,875) was more than double the cost of female driver incidents ($13,823). A significant gender pattern was also observed in relation to average CTP costs (F (1, 205) = 5.69, p <.05). Similarly the average CTP cost of male driver incidents ($31,897) was more than double the CTP cost of female driver incidents ($13,721). No significant difference was observed between genders for property damage or work cover costs. Table 1 presents crash frequencies and means as a function of driver gender for total costs and CTP costs.

Table 1: Frequencies and Means as a function of the Driver's Gender

Driver Gender	Number of Cases	Mean Total Costs	Mean CTP Costs
Female	124	13,823 (SD = 19,104)	13,721 (SD = 17,435)
Male	195	28,875 (SD = 56,786)	31,897 (SD = 62,455)

Driver Age

A review of the claims revealed that the age of drivers involved in incidents varied between 19 years and 61 years, with an incident distribution pattern similar to the typical working life span. Incidents were analysed in relation to six age brackets. The age brackets with the highest frequencies of claims were the 31-40 year and 41-50 year old drivers. Over 60 percent of the claims filed pertained to drivers between the ages of 31 and 50 years. This pattern reflects the exposure pattern within the researched fleet. Demographic data pertaining to all employees in relation to the researched fleet reveals that almost 60 percent of the employees were between the ages of 30 and 49 years. Furthermore the finding that drivers aged between 41 and 50 years are over represented in crash frequency is consistent with other research pertaining to accidents involving company car drivers (Wishart, Davey, Manderson & McKinnon, 2004).

Similar to Cartwright, Cooper and Barron (1993), no significant differences regarding age and accident involvement were observed for average total costs, average CTP costs or average work cover costs. In regards to average total costs, the effects of age appear to some extent to have been counterbalanced across the different costing areas of an incident. Although incidents involving younger drivers typically had higher property damage costs than incidents involving more mature drivers, they also typically had lower injury costs. It is unclear from the data whether the slightly higher injury costs associated with more mature drivers reflected more severe injuries or more costly lost time due to higher salaries. A significant difference was observed between the age brackets for average property damage costs (F (5, 305) = 2.60, p <.05). Drivers between the ages of 21 and 30 years had the highest average property damage costs ($10,016) followed by drivers between the ages of 51 and 60 years ($8,856). Table 2 presents crash frequencies and means as a function of driver age for total costs and property damage costs.

Table 2: Frequencies and Means as a function of the Driver's Age

Driver Age	Number of Cases	Mean Total Costs	Mean Property Damage Costs
<20	3	1,314 (SD = 2,181)	524 (SD = 908)
21-30	66	21,621 (SD = 37,887)	10,016 (SD = 14,472)
31-40	97	17,947 (SD = 41,772)	4,826 (SD = 5,953)
41-50	97	28,874 (SD = 59,644)	5,754 (SD = 9,333)
51-60	42	25,444 (SD = 41,435)	8,856 (SD = 13,809)
>61	6	25,442 (SD = 32,748)	7,287 (SD = 14,742)

Vehicle Type

Claims were filed in relation to a range of different vehicle types covering 8 classifications. Approximately 50 percent of claims pertained to Sedans. When reviewing the frequencies of crash involvement, it is critical to consider these statistics within the context of the fleet composition. The product mix of the researched fleet was 62% passenger vehicles, 37% light commercial vehicles and 1% heavy vehicles. Although Sedans appeared to be over represented in regards to crash involvement, Sedans account for a large proportion of the researched fleet. Therefore with increased exposure, it is possible that there would be increased risk of incident and that these frequencies may be a product of exposure as well as model body risk.

Although Utilities had the highest average total cost ($49,290), no significant differences were observed between the vehicle type classifications for average total costs, average property damage costs, average CTP costs or average work cover costs. This finding would suggest that risk levels remain fairly constant across most vehicle models, however differences in cost patterns may be observed if types of vehicles are grouped by vehicle weight or size. Table 3 presents crash frequencies and means as a function of vehicle body type for total costs and property damage costs.

Table 3: Frequencies and Means as a function of the vehicle model body

Vehicle Type	Number of Cases	Mean Total Costs
Bus	4	9,415 (SD = 13,028)
Cab Chassis	15	21,455 (SD = 44,032)
Hatchback	6	14,253 (SD = 34,654)
Liftback	4	11,431 (SD = 10,481)
Sedan	160	18,540 (SD = 29,263)
Utilities	57	49,290 (SD = 154,083)
Van	12	38,156 (SD = 64,955)
Wagon	63	26,653 (SD = 52,020)

Incident Type

Insurance claims were filed in relation to a range of different incident types covering 10 classifications. Of these classifications, rear-end crashes were associated with the highest frequency of claims (47 percent) followed by incidents relating to disobeying signs/failing to give way (22 percent) and incidents relating to overtaking/changing lanes (12 percent). This finding is consistent with previous research by Retting (1996) and Wang, Knipling and Blincoe (1999).

A significant difference was observed between incident types in relation to the total cost (F (9, 311) = 61.67, p <.001), property damage cost (F (9, 311) = 7.43, p <.001) and CTP cost (F (8, 200) = 49.47, p <.001). Although the classification of theft comprised less than one percent of claims, it consistently had the highest average cost in relation to the total cost ($1,059,156), property damage cost ($19,342) and CTP cost ($1,039,814). This presents an interesting case as incidents of Theft would typically be viewed only in terms of property damage costs and be considered outside of the scope of road safety. However in this case, the incident of vehicle theft resulted in a third party experiencing substantial loss due to personal injury. Other incident classifications that had high cost averages across the cost dimensions include roundabout incidents and disobeying signs/failing to give way incidents. The finding that multiple vehicle incidents including roundabout incidents and disobeying signs/failing to give way incidents have high costs is consistent with previous research (Miller et al, 1997). Alternatively, previous research does not appear to have identified theft as an incident with high total costs, this may be because theft costs were considered outside of the scope of road safety in previous studies. As there was only one case of theft in this study, the present findings should be interpreted with caution. Table 4 presents crash frequencies and means as a function of incident type for total costs, property damage costs and CTP costs. No significant difference was observed between the incident types for work cover costs.

Table 4: Frequencies and Means as a function of the different types of Incidents

Incident Type	Number of Cases	Mean Total Costs	Mean Property Damage Costs	Mean CTP Costs
Animal	2	8,577 (SD = 3,867)	6,734 (SD = 1,406)	N/A
Disobey Sign/ Fail to give way	70	34,626 (SD = 75,368)	7,195 (SD = 12,565)	40,401 (SD = 84,249)
Loss of Control	28	29,804 (SD = 25,795)	18,696 (SD = 14,117)	16,769 (SD = 24,108)
Other	20	36,288 (SD = 41,652)	13,073 (SD = 15,615)	26,628 (SD = 34,169)
Overtake/ change lanes	38	14,141 (SD = 14,003)	5,824 (SD = 7,342)	23,869 (SD = 44,765)
Park/ reverse	7	13,029 (SD = 16,141)	7,066 (SD = 14,118)	10,468 (SD = 9,116)
Parked Unattended	1	0 (SD = 0)	0 (SD = 0)	14,533 (SD = 0)
Rear end	151	15,554 (SD = 30,784)	3,714 (SD = 6,352)	19,231 (SD = 33,708)
Roundabout	3	122,043 (SD =137,148)	4,281 (SD = 16,778)	100,800 (SD = 133,445)
Theft	1	1,059,156 (SD = 0)	19,342 (SD = 0)	1,039,814 (SD = 0)

CONCLUSION

In recent years demand for fleet safety information has grown as government and industry have become increasingly aware of workplace health and safety issues and the impact of fleet safety on business effectiveness. To achieve cost effective road safety interventions, it is crucial to understand which types of incidents are associated with high incident frequencies and costs. This study assessed incident trends in relation to driver gender, driver age, vehicle type and nature of the collision. Based on the findings of this study, several predictions could be drawn regarding the potential cost-benefits of safety interventions.

When reviewing the findings it is important to note that the driver may or may not have been the at fault party, however considering male drivers were found to have greater crash frequencies and costs, interventions designed to improve safety through targeting the driver may be more effective for male rather than female drivers. In regards to the demographic of age, most road safety programs are aimed at younger drivers. However, this study found that only 20 percent of the drivers involved in an incident were 30 years of age or younger. Considering there is relatively less fleet driving by younger drivers as compared to private driving, this may be a reflection of the different patterns of exposure by age for fleet and private driving. In this study, 60 percent of the drivers involved in an incident were between the ages of 31 and 50 years. This would suggest that traditional programs may need to be modified to specifically target this more mature audience.

In regards to vehicle type, as approximately 50 percent of claims pertained to Sedans and no significant cost differences were found between vehicle types, interventions targeting sedans may provide the most effective advances in road safety. Other intervention targets that may offer attractive cost-benefit ratios include interventions targeting Utilities and Vans, however these interventions would need to be affordably priced as although these vehicle types had above average total costs, the cost are not considered to be significantly higher than for other models. Based on the findings of this study that Utilities and Vans had above average property damage and CTP costs and lower than average workers compensation costs, interventions such as introducing crash avoidance systems or reducing the aggressivity of these vehicle types may be most appropriate to lower crash costs.

Finally, based on the frequencies observed in this study, interventions designed to improve safety through reducing high frequency incidents such as rear-end collisions or disobeying signs/failing to give way collisions may provide substantial road safety advancements. Specific countermeasures designed to reduce these types of incidents may include enhanced education in relation to crash avoidance techniques such as appropriate following distance and visual scanning and enhanced road environments such as installation of left-turn lanes and improving visibility of traffic signals.

This study advances research in the area of fleet safety by identifying motor vehicle incident characteristics that are associated with high collision volumes or insurance costs. The disaggregated statistics provide current Australian data which has potential applications for guiding the development and evaluation of fleet and work-related road safety interventions. To further enhance predictions of cost-benefits for potential safety interventions, future research needs to be conducted to identify frequencies and costs across a range of incident characteristics ideally using gross costs and accounting for exposure. Additionally, future research should strive to obtain a larger sample of incidents and to disaggregate average insurance costs by crash severity type to reduce the volatility in estimates and gain a better understanding of the cost components.

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