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Commercial Bus Accident Analysis through Accident Database

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Abstract

This paper presents discussion on bus accident data for period of 2003 – 2012 retrieved from Malaysian Institute of Road Safety (MIROS). A statistical analysis was conducted to gain insight into the trend, factors affecting accident occurrence and severity of commercial buses. 47% of cases investigated by MIROS between 2007 and 2010 resulted in fatalities, with fatality rate of 1-3 persons being the most frequent while accident with minor injuries having at least 22%. Understanding these factors can help to bring forth realistic strategies to improve the safety of these bus services. Express and stage buses have the highest rate of accident and causalities by road. Express roads record more accident compared to other categories of road. The major cause of mechanical failure among all types of buses was identified to be brake failure with about 56% of the total mechanical failure, and about 52% of all commercial buses were involved in traffic accident with a yearly means of 3.8 accidents per commercial bus (based on commercial bus involved in accident). This knowledge is useful for stake holders and policy makers in transportation industries to improve road safety and reduce accidents.

Keywords: Bus accident, database, factors, driving risk and analysis

1. INTRODUCTION

Commercial bus accidents have become a serious menace that threatens life and properties at an alarming rate particularly in developing nations such as Malaysia. The number of fatalities in traffic accidents has become relatively high as car ownership increases. Statistics shows that total number of commercial bus accident increased from 106 in 2003 to 182 in 2012. Between 2007 and 2010, 439 cases of accident were investigated by MIROS' crash investigated team, indicating increase in the number of injuries and fatalities.

Although commercial bus represents only about 1.2% of the total number of registered vehicles in Malaysia, the number of it causalities are always high due to the high number of passengers involved [1]. Fatalities per crash rate equally increases from 36% in 2007, 32.4% 2008, 14% in 2009 and 18.4% in 2010 as stated in MIROS investigation report 2012.

Commercial buses are considered the main mode of transportation in most developing countries. In Malaysia, commercial buses are privately owned and operated generally by individuals and transportation firms, as studied by Nailul et al (2011) in their work on factors of fatigue and bus accident [2].

To date, literatures on commercial bus accident is limited with virtually no serious attempt to study commercial bus traffic accidents since most studies

were concerned with other modes of transportation such as private vehicles and trucks.

Hamed et al (1998)[2] analyzed commercial mini-bus accidents and proposed two disaggregate models related to time until accident occurrence and the number of accident injuries. They found that higher accident rates were associated with driver who are unmarried, took few rest breaks and had short time intervals since previous accident. [2] In the study, they had also identified the relationship between the factors of fatigue (working schedule, working condition) and bus accident.

The dominant factor that showed strongest unique contribution based on Multiple regression analysis was working condition. The authors recommended that serious attention should be given to improve the buses and their working condition to reduce accident in Malaysia.

The webpage Mail online (www.mailonline.com) reported that each year, an average of 1.24 million people die in road related accidents and that the world's roads are getting more deadly. It was projected that by 2030, the number of fatalities is expected to triple to 3.6 million. Nevertheless, Koshy et al (2012) [6] said that recent statistics indicate that the number of crashes and fatalities occurring on our nation's roadways involving large trucks (≥10,000 pounds) are decreasing due to introduction of new safety technologies.

2. MAJOR CAUSES OF BUS ACCIDENT

Hermans et al 2008 & 2009 [13, 14], in their study, classified road accidents and indicated the potential of different road safety areas for increasing road safety based on the experiences and data available. Seven problem areas were designated as central to road accident activities in Europe, which are: (1) alcohol and drug-use; (2) speeds; (3) protective systems; (4) daytime running lights; (5) vehicles (passive safety); (6) roads and (7) trauma management.

Table 1. Most Common Critical Causes of Accident (MIROS Investigation Report 2012)

Causes of Accident	Percentage
Regular Occurrence	Percent level
A. Injury	
Crash Compatibility	24.2%
Mechanical defects	21.4%
Use of restraint device	22%
Road side hazard	14.7%
Structure Integrity	23.5%
Substandard crash	23.5%
B. Crash	
Conspicuousness	27.8%
Fatigue	23.6%
Brake defects	2.15%
Risky driving	9.1%
Road defects	19%
Speeding	22.6%
Tyre defects	28.6%

2.1 Road Situation

Road situations especially road design attributes, namely road alignment, grade and curvature, section type, traffic-way type, number of lanes, and speed limit are significantly associated with accident occurrence. Two-way traffic and multi-lane roads increase the probability of higher accident severity. Relative to one-way roads, two-ways roads are 54.5% - 82.7% more likely to result in severe non-incapacitating injuries and 21.4% - 22.6% more likely to result in incapacitating injuries. According to [15], accidents that occur in multi-lane roads are more likely to be significantly associated with severe non-incapacitating injuries (7.3%), incapacitating injuries (4.5%), and fatalities (0.9%). Road curvature is positively associated with increased accident severity. The occurrence of bus accidents on straight sections has low probability of light injuries (−15.1%), severe non incapacitating injuries (−60.4%), incapacitating injuries (−31.0%), and deaths (−5.1%). Road sections at level grade are positively associated with increased accident severity level, while those with slopes are related to less severe accidents. In fact, accidents that occur at level grade are more likely to result in light injury (19.8%), severe non-incapacitating injury (16.8%), incapacitating injury (20.4%), and death (3.7%).

Table 2. Injury and Crash by road type (MIROS Investigation Report 2012)

Factors	Municipal	Expressway	Federal	Private	State
A. Injury					
Crash Compatibility	1.1%	11.1%	3.7%	0%	13.5%
Mechanical defects/others	0%	3.5%	4.7%	0%	3.9%
Use of restraint device	0%	3.1%	9%	33.3%	12.6%
Roadside hazard	0%	5.1%	5%	0%	4.8%
Structure Integrity	0%	3%	2.2%	0%	2.4%
Superstructure	0%	1%	0.4%	0%	0.5%
B. Crash					
Conspicuousness	0%	2.5%	4.3%	0%	0.5%
Fatigue	0%	16.7%	9%	0%	4.8%
Brake defects	0%	3%	2.9%	0%	2.9%
Overloading	0%	1.5%	1.8%	0%	1.4%
Risky driving	0%	8.6%	20.1%	0%	21.7%
Road defects	0%	3.1%	5%	33.3%	7.2%
Speeding	0%	17.7%	11.2%	33.3%	12.1%
Tyre defects	0%	1.5%	2.5%	0%	1.9%

2.2. Hazards Identification

A hazard can be any possible source of danger on or near the road that could lead to a crash, and it can come from any source or direction. It could be a child chasing a ball into the road, parked car door opening, vehicle merging into your lane or stopping suddenly in front of you, or slippery road after rain. According to the Department of Transport and Main Roads, a driver gains experience as they develop skills in scanning the road ahead and around them, and they gradually become better at recognizing developing potentially dangerous situation. This early detection gives them more time to make a decision about the hazard and respond to it adequately. The following can be source of hazard identification.

1. Identifying hazards when driving through crowded business areas.
2. Identifying hazards when driving through road works.
3. Identifying hazards when driving through school zones.
4. Identifying hazards when sharing the road with other road users.
5. Identifying hazards when driving through suburban streets.
6. Identifying hazards when driving as night approaches.

Table 3. Distribution of Injury and Crash occurrence factors by time (MIROS Investigation Report, 2012)

Factors	00.01–6.00	6.01-9.00	9.01-12.00	12.01-14.00	14.01-16.00	16.01-20.00	20.01-24.00
A. Injury							
Crash Compatibility	6.4%	19.1%	14.6%	15.2%	13.3%	13.9%	18.2%
Mechanical defects/others	4.1%	5.3%	4.2%	1.5%	3.3%	2.8%	6.8%
Use of restraint device	6.4%	3.2%	11.5%	7.6%	8.3%	13.9%	10.2%
Roadside hazard	5.3%	7.4%	3.1%	6.1%	6.7%	2.8%	3.4%
Structure Integrity	3.5%	3.2%	2.1%	3.1%	3.3%	0%	2.3%
Superstructure	0.6%	2.1%	0%	0%	1.7%	0%	1.1%
B. Crash							
Conspicuousness	2.9%	1.1%	3.1%	4.5%	1.7%	0%	1.1%
Fatigue	19.3%	9.6%	4.2%	10.6%	6.7%	1.9%	4.5%
Brake defects	2.3%	3.2%	4.2%	3%	3.3%	7.4%	2.3%
Overloading	1.8%	0%	4.2%	1.5%	3.3%	2.8%	0%
Risky driving	10.5%	14.9%	19.8%	22.7%	20%	0.9%	22.7%
Road defects	4.1%	4.3%	5.2%	3.5%	6.7%	9.3%	4.5%
Speeding	13.5%	10.6%	17.7%	6.1%	11.7%	6.5%	13.6%
Tyre defects	1.8%	1.1%	2.1%	4.5%	3.3%	0.9%	2.3%

2.3 Risk Perception

Risk perception is the subjective judgment that people make about the characteristics and severity of a risk, especially for young novice drivers who have a significantly higher risk of facing a fatal vehicle crash than experienced drivers. According to [20], one of the main causes of accident is that novice drivers lack risk perception skills, as they have not developed the ability to efficiently perceive or predict risks while driving. Some of the items used in the survey including:

1. Overconfident in driving is a powerful source of bias in the perception of risk.
2. Subjective perception of risk plays an important role in driver safety.
3. Over speeding is an involvement in risk behavior.
4. Fixate more on stationary object is a risk behavior.
5. Overloading.

3. METHODOLOGY

3.1 Data

Bus accident data analyzed in this study were extracted from the Malaysian Institute of Road Safety (MIROS) accident statistical data, which contained mainly police accident reports. Information about the accidents included type, weekday and time of day, severity level, fatalities by driver age, yearly commercial bus accident data from 2003 to 2012, types of buses involved in road accident, road death, serious injury, minor bus accident, number of vehicles and road users involved. Hence, information about the persons involved, age of the driver involved demographics, license validity and injury severity.

The results of the analysis from the accident database can be presented by considering driver causalities according to road categories, number of buses involved in road accident, death and causalities from 2003 to 2012 involving all categories of commercial vehicle, and bus accident due to age influence. [19] stated that the safety scheme and accident database gave three main factors influencing vehicles accidents within their

case study, which were road environment, driver attitude and the role of management.

Road environment is considered as an important factor in causing road accident. Most of the accidents that occur in multi-lane roads are more likely to be significantly associated with severe non-incapacitating injuries than that of one way road.

Drivers have a big influence on the rate of accident. Statistics obtained from the Malaysian Institute of Road safety (MIROS) database for 2003 to 2012 shows increase in total number of road accident on yearly basis, in which buses claimed more lives due to high numbers of passengers on board. Figure 1 shows that federal and state highways have the larger number of minor, serious and death categories of vehicle accident due to high number of motorist on this road.

4. DISCUSSION

4.1 Commercial Bus System Characteristics

Commercial buses are considered as the main mode of transportation in most developing countries. The investigation databases from 2003 to 2012 and 2007 to 2010 show that commercial bus accident increases on yearly bases, and this is due to a number of factors ranging from road users to road infrastructures. Table 1 presents seven most common critical factors of road accident. From four critical factors (compatibility, fatigue, risky driving and speeding), three are concerns with human factors. Also, most cases of accident occurred on expressways, federal and state road as high as 16.7%, 20.1% and 21.7% both for injury and crash cases, as stated in Table 2 above.

Human factors like age – related declines in sensory processing, distraction, fatigue and perceptual processing have contributed in a way to road safety and accident causation. A number of factors are likely to contribute to the increased risk for older drivers, which include visual acuity, decline in motion perception and divided attention tasks. Different findings and consistent research regarding driving safety indicate that accident risk increases for older driver group.
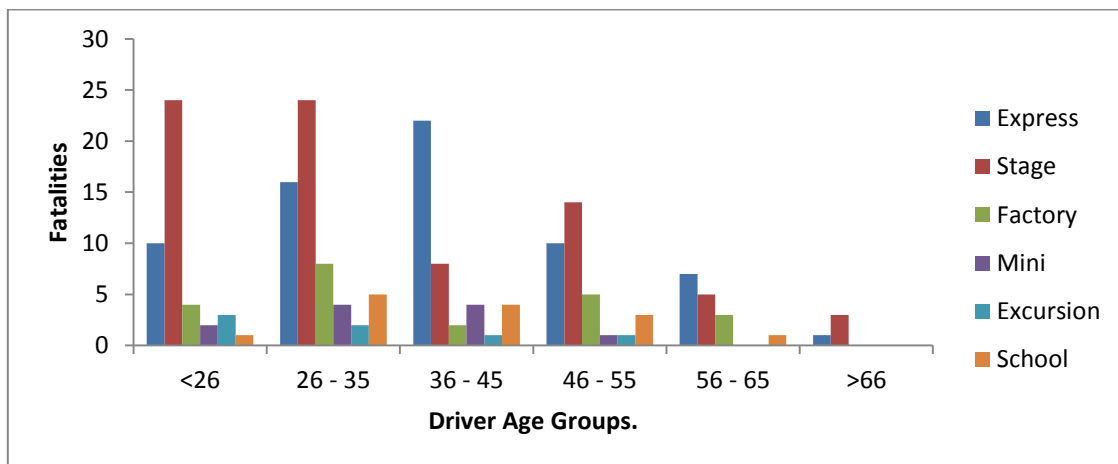
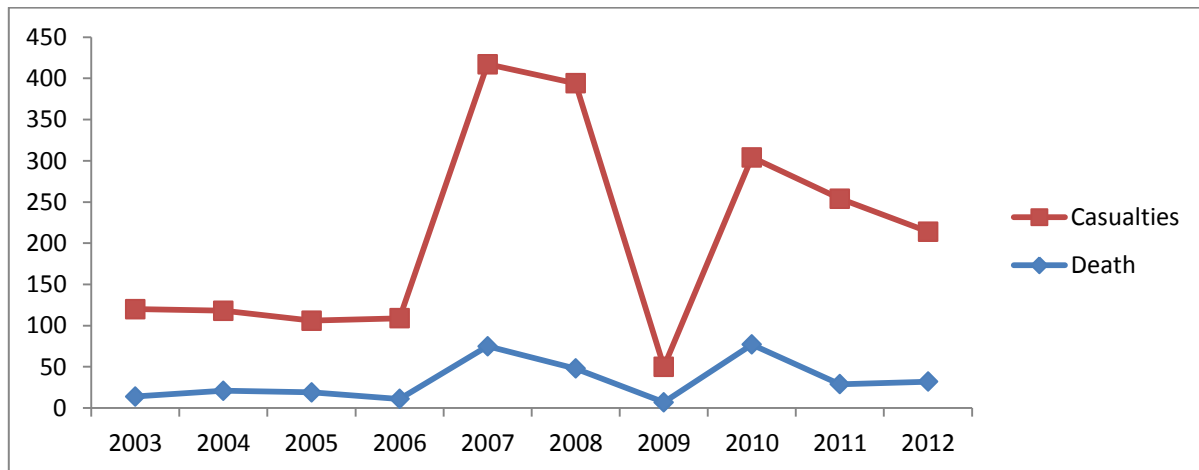**Figure 1. Fatalities according to drivers' age group**

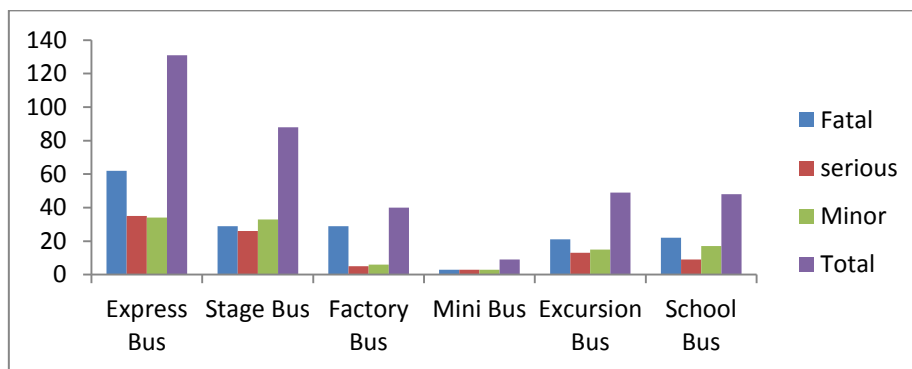**Figure 2. Yearly commercial bus accidents (2003 to 2012)**

Figure 3. Types of Buses Involved in Road Accident

However, in this study, as shown in Figure 1, fatalities are more imminent among younger drivers. Stage bus has the highest fatalities among age less than 26 and 26 – 35 years old and high for express bus among age group 35 – 45 years old.

Figure 2 shows yearly commercial accident buses; with a sharp drop in year 2009 as a result of

government intensive road safety campaign. Nevertheless, express bus and stage bus have high total number of all categories of accident since they are the type of buses mostly on the road for commercial activities. The higher accident rate among commercial bus stem from their operating characteristics of drivers performing the usual driving task, who face stress that are associated

more with commercial drivers compared to other types of driving. Express bus and stage bus are the most common commercial bus, and consequently have the highest rate of accident among various categories of buses which form our focus of study in this paper.
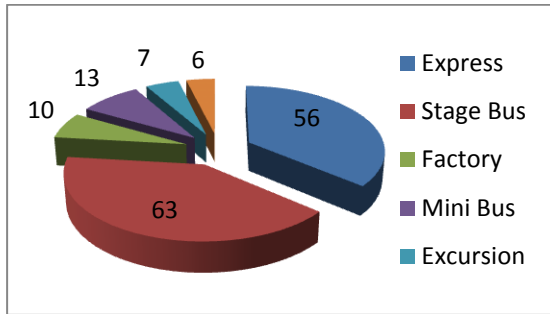
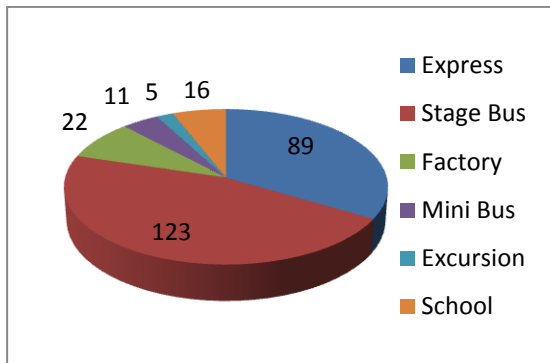

Figure 4. Road deaths according to bus type

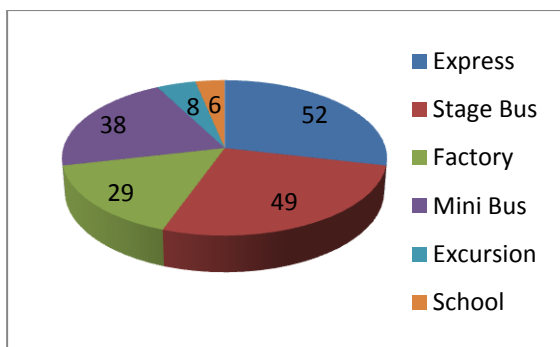**Figure 5. Serious accidents according to bus type**

Figure 6. Minor accidents according to bus type

4.2 Accident Analysis

Commercial bus registration increases yearly due to its high demand from transporters for commercial activities. Most accidents occurred during the midnight to early hour between 12 – 6.00am. Table 3 shows human related risk factors such as fatigue, risky driving and speeding, which are prevalent during the early hours of the day, while more than

50% of accidents occurred after office hours which are related to using restraint device like hand phone usage while driving.
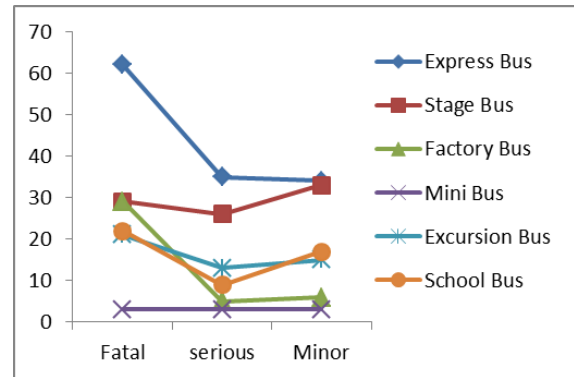

Figure 7. Severity of Bus Accident

Causalities always involve large number of people, which provide insight into the risk factors that are positively and negatively related to the variation of the probability of bus accident severity and injury occurrence to bus passengers, and hence stimulates thought concerning the necessity to raise awareness by bus operators, drivers and road authorities about the circumstances that bear risk in bus operations.

5. CONCLUSION

This paper has presented discussion on the trends and causes of commercial bus accident referred from database, showing about 52% of commercial buses were involved in traffic accident with a yearly means of 3.8 accidents per commercial bus. The analysis shows that commercial buses on express road recorded high accident rate, while the major causes of accident among commercial buses are brake failure and driver risk with driver's age between 26 – 35 old and 36 – 45 old having highest rate of accidents of about 11.6% of yearly accident. From these findings, it can be concluded that operators of commercial bus require special skill to meet the community needs, as well as drivers ought to receive special training prior to obtaining a commercial bus driving license. It is recommended that a training manual be prepared for this purpose; these drivers should obtain a special license to operate commercial bus. The license should be issued after the driver passes a special driving test in which the driver demonstrates the required driving skill, such as quick recognition of road

hazards and good driving behaviour. It is recommended that driving license renewal for commercial bus drivers should be given a rigorous checking, especially regarding road test apart from the regular vision test. Also, commercial bus operators should consider the driver's accident record history before hiring them. It is therefore recommended for the establishment of a mass accident database together with criteria for its assessment and administration. This database must provide records of traffic accidents, dates, causes, and number of injuries. Eventually, drivers with poor driving records would be weeded out of driving force.

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