

**ID180****BUS DRIVER : FACTORS THAT INFLUENCES BEHAVIOUR**M.M. Rohani<sup>1</sup>, R. Buhari<sup>2</sup>

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The behaviour of drivers is influenced by many factors, which include the personal characteristics, environmental and vehicle characteristics. Professional drivers, such as bus drivers, generally have higher levels of training and experience, and by virtue of their profession have attitudes, which are more likely to promote safe driving. However, bus drivers experience the same environmental traffic condition as other drivers, as well as additional constraints imposed by the vehicle characteristics, concern for passengers' comfort/safety and the need to adhere to timetables. This paper reviewed these factors from previous researches.

*Keywords:* attitude; behavior; bus driver; passenger; traffic; vehicle

**Introduction**

Driving a bus has been documented and classified as a highly stressful occupation due to high conflicting demand and lack of control over work pace and driving situations (Dorn, Stephen et al. 2010). MFL Occupational Health Centre (1998) reported that city bus drivers are more likely to experience tension, mental overload, and fatigue. This report supported by 50 years of research review on bus driver well-being by Tse et al., (2006) that bus drivers are liable to suffer physical health (e.g. cardiovascular disease, gastrointestinal problems, musculoskeletal disorders, and fatigue) and psychological health (e.g. post-traumatic stress disorder). More specifically, physical and psychological health of the bus driver have been reviewed as critical factors that have some consequences on the organisation performance. Some problems that were reported arise from many literatures including the employees' absence, labour turnover and accidents. Furthermore, on the bus driver's side, physical and psychological illnesses are always resulted from his poor driving performance.

Bus driver behaviour has been studied extensively in various aspects. These comprise their physical and psychological health, accident involvements, driving performance, and bus fuel consumption. Some of the previous studies with the objectives and findings relating to bus driver are summarised in Table 1

Table 1: Review of bus driver behavior studies from previous researcher

References	Objective of the study	Major finding
(D'Souza and Maheshwari 2012)	Explores the problems of distracted driving for bus drivers.	Passengers related activities is the common main distraction to bus driver.
(Dorn, Stephen et al. 2010; Rohani, Felstead et al. 2010)	Investigate bus driving behaviour in regards with fuel consumption when leaving from signalised intersection.	Bus driver who at the front of the queue at intersection has significantly different driving behaviour from driver elsewhere in the queue. This behaviour causes more fuel consumption.
(Osman, Sarani et al. 2009)	Evaluate the occurrence of bus driver speed violation between implementing and non implementing of Safety Health and Environment Code of Practice (SHE COP).	Significant difference of speed violation occurrence between implementing and non implementing SHE COP bus operators.
(Machin and Hoare 2008)	Determine the extent to which workload and self-reported driver coping styles predicted their health.	Workload was a significant predictor of drivers' for recovery (i.e., fatigue).
(Wahlberg 2007)	Relate the bus driver acceleration with bus driver accident records.	Bus driver acceleration was found not strongly related with accident records.
(Meijman and Kompier 1998)	Identify behavioural style of bus driver in coping with psychosocial demand.	Bus driver cope with their job demand in various and different ways.

## Factors Affecting Bus Driving Behaviour

### Individual Differences

Studies on driver behaviour over the past two decades have demonstrated that, characteristics, goals and motivations of bus drivers are important determinants of driving behaviour. In particular, Ivancevich et al., (2005) explained, factor such as an individual difference has a direct effect on behaviour. The explanations of how it can affect the behaviour are summarised as:

- People who perceive things differently behave different.
- People with different attitudes respond differently to directives.
- People with different personalities interact differently with other people (e.g. co-workers, subordinates, customers).

Furthermore, in a workplace, perception, ability and skills, as well as attitudes are explained by Ivancevich et al., (2005) to have a relationship with individual differences. This aspect of differences is also called as individual personality. In general, personality is an individual consistency in thought patterns, behaviour patterns and emotional patterns. It has a control on individual behaviour that directly influences work performance and productivity (see Figure 1). Ivancevich et al., (2005) then further described about 2 diversity groups of factors that control individual differences; primary dimension and secondary dimension. The primary dimension is classified as a stable factor by the researchers, and it is related to factors such as age, gender and race. A secondary dimension that is described as a changeable factor by the researcher, related to factors such as experience, marital status and experience (see Table 2). All these factors distinguished an individual differences one from another.

Ivancevich et al., (2005) explanations can help to clarify the behaviour of the driver such as, why some drivers drive aggressively and others are likely to exhibit safe driving. Moreover, driver’s personality with relation to behaviour has been given much attention by previous researchers. Some of the related studies are summarised in Table 3;

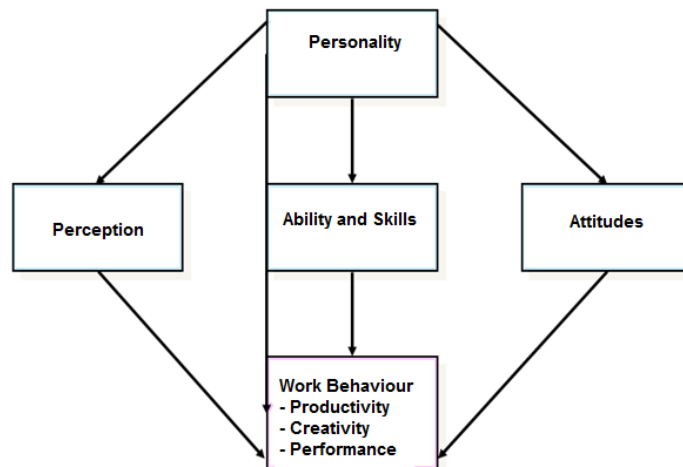


Figure 1: Individual differences control factor in work place (Ivancevich et al., 2005)

Table 15 : Diversity factors that control individual differences (Ivancevich et al., 2005)

<b>Primary Dimensions (stable)</b>	<b>Secondary Dimensions (changeable)</b>
<ul style="list-style-type: none"> <li>• Age</li> <li>• Ethnicity</li> <li>• Gender</li> <li>• Physical attributes</li> <li>• Race</li> <li>• Sexual / affectional orientation</li> </ul>	<ul style="list-style-type: none"> <li>• Educational background</li> <li>• Marital status</li> <li>• Religious beliefs</li> <li>• Health</li> <li>• Work experience</li> </ul>

Table 3 : Review of previous research on personality relationship with driver behaviour

References	Research aims	Significant results
(Taylor 2010)	To study the relationship between driving behaviours and aspects of personality.	<ol style="list-style-type: none"> <li>1. Drivers who are less energetic, less self-disciplined, and less likely to admit their mistakes are more likely to have road accidents than others.</li> <li>2. Professional bus drivers were more conscientious, cautious, methodical and rule-following than the shuttle bus drivers, and tended to admit their mistakes, have empathy for others and were more likely to give way to others in traffic.</li> <li>3. Professional bus driver have higher levels of personal energy, enjoying the company of large groups of people, and being willing to try new things than shuttle bus drivers.</li> <li>4. Both professional and shuttle bus drivers, were reported being less able to cope with stress, less likely to seek out positions of authority and the limelight, and more likely to be moody and self-critical.</li> </ol>
(Schwebel, Ball et al. 2007)	Study the role of personality in dangerous driving behavior among older adults.	<ol style="list-style-type: none"> <li>1. Sensation-seeking personality and an under controlled temperament are related to risky driving among older adults.</li> <li>2. Sensation-seeking was particularly related to history of violations and tickets, while temperamental control was more broadly related to a number of risky driving measures.</li> </ol>
(Lottridge 2006)	Investigate how different notification types impact driving performance.	<p><b><u>Field dependent</u></b></p> <ol style="list-style-type: none"> <li>1. Answered the ringing or beeping more quickly and math questions, more slowly.</li> <li>2. More reactive in their driving responses to interruptions.</li> </ol> <p><b><u>Participant with high desire for control</u></b></p> <ol style="list-style-type: none"> <li>1. Answered ringing and math questions more quickly and accurately.</li> <li>2. Aggressive in terms of throttle usage and lane changes.</li> <li>3. Those with large working memories answered ringing and math questions quickly while maintaining responsive throttle usage and lower heading error</li> </ol>
(Sumer 2003)	Study about personality and behavioural predictors of traffic accidents.	<ol style="list-style-type: none"> <li>1. High in personality disorder in an individual seemed to expose more to accidents.</li> <li>2. Sensation seeking on an aberrant driving behaviour have an indirect effect on the tendency to accidents.</li> </ol>
(Hammond and	Determine whether	Drivers with a high desire of control tended to

Horswill 2002)	drivers with a high desire for control took more, less or the same driving-specific risks as drivers with a low desire for control.	drive at faster speeds and were willing to pull out into smaller gaps in traffic.
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### **Driver Attitude**

The research that considers the association between attitudes, and speeding behaviour varies according to the different ways in which attitude is measured. For example, study conducted in China, on 248 bus and taxi drivers by Ma et al., (2009) showed that the drivers' attitude, have a significant impact on speeding, risky driving and tendency to get involved in accidents. More studies on the impact of bus driver attitudes on behaviour were previously studied by Maunder and Pearce (1998) in Nepal. It was reported that bus accidents represented a significant component of all road fatalities and injuries. Between the period of July 1996 to July 1996, 479 serious bus accidents resulted in 365 deaths and further 1751 injuries were reported to the police. Besides, vehicles and road conditions, driver behaviours and attitudes were suggested as dominant causes of bus accidents.

Asiamah et al., (2002) conducted a study on 43 bus and minibus drivers in the capital city of Acra in Ghana. They reported that most of the respondents except the Muslim drivers drank alcohol for various reasons such as pressures from friends, social gatherings, appetizers, medical reasons and addictions. The respondents informed that alcohol drinking caused a sense of relaxation, releasing their inhibitions, and increasing their confidence in the road use. However, when they were asked about the problem associated with alcohol they expressed an understanding that drink driving was a significant risk factor for crashes. In the study, the researchers suggested that, the drivers have little understanding of the concept of blood alcohol concentration and related legal limits.

Driver's attitude influenced on driving performance has been taken seriously by various relevant agencies to reduce the risk of accidents. Malaysian government, for example, approved Safety Health and Environment Code of Practice (SHE COP) for a transportation sector due to a series of high profile accidents involving commercial vehicles, especially buses (Osman, Sarani et al. 2009). A report published by Malaysian Institute of Road Safety Research (MIROS) outlined 5 key elements of the SHE COP as;

- Policy - It outlines the company's stand and commitment on ensuring safety in the organisation's operations.
- Organisation - refers to selected personnel including the CEO of the company who are basically responsible in ensuring that SHE COP is implemented smoothly.
- Planning and implementation -
- Evaluation - Evaluation is important to appraise the effectiveness of SHE COP especially in reducing accidents on the roads and within the working environment.
- Action for improvement - remedial measures to support continuous improvement.

Particularly, the third key element of SHE COP of planning and implementation is in place to develop for good driver management, vehicle management, journey and risk management and good data management. It was reported that, most of the procedures involved drivers participation. One of the highlighted roles of the company is to ensure the journey service is delivered safely to the driver, passengers and other road users. This includes providing sufficient training that related to emergency's handling, behaviour/attitude of the driver and vehicle handling (Osman, Sarani et al. 2009).

### **Demographic Factors**

Commonly-used demographics such as age has a correlation with the aggressive driving that relates to safety behaviour (Lancaster and Ward 2002). Mather (2007) described how age influences driving behaviour due to the size of human factors, which affect the cognitive phenomena of driving. Those are :

- distraction,
- memory,
- navigation,targets identification
- legibility of street sign and
- judgement of collision.

Similar to other vehicle drivers, the age of the bus driver can have an impact on driving behaviour. For example, study conducted by Andy (2006) suggested that bus drivers older than 46 are more sensitive to the enforcement penalties against traffic violations. This group of drivers has been found to drive the bus less aggressively than those in the group younger than 46 years old. Besides, Andy also suggested that, the younger bus driver habitually ignores the traffic. Andy's study has been supported by a research conducted in Uppsala by Wahlberg (Wahlberg 1997). In the report, the Author submit to the National Board of Road Administration of Uppsala mentioned that younger bus drivers drive faster than older drivers. The aggressive speeding behavior among young bus drivers is enhanced by being late.

Another study that showed similar results was conducted by the Centre for Environment, Construction and Transportation Studies (CECTUS) (2012). This research had collected a speed pattern of school bus drivers when carrying students along a 2.4 km road segment. The driver behaviour database was grouped into those drivers below 50 and above 50 years old. When comparing the driver's speeds, the data showed a significant difference in driving patterns of these two groups of drivers. Drivers below 50 years were found to drive the bus faster than drivers above 50. Figure 2 shows a sample from 2 male bus drivers, age 36 and 64 obtained from the database that indicate the 36 year old driver is likely to have more aggressive driving than the other driver.

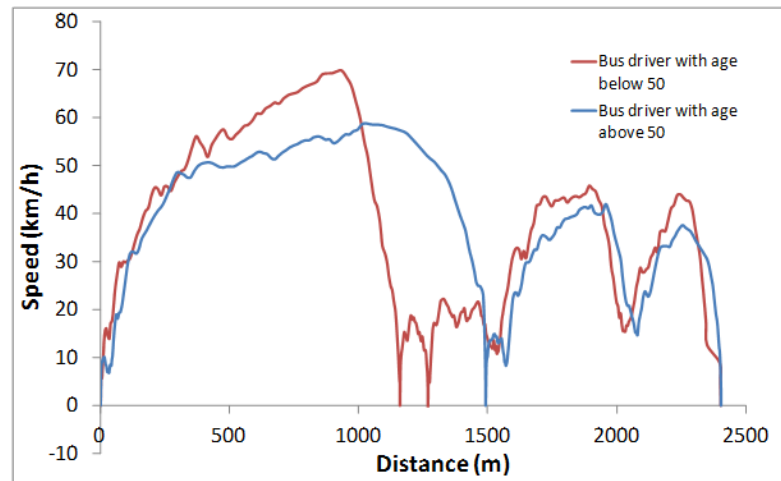


Figure 2: Speed profile from 36 and 64 years old drivers (Rohani, 2012)

### Road and Traffic Impact on Driver Behaviour

Driver's speeds on the urban streets is mainly influenced by traffic controls, street environments and the interaction of vehicles (Aronsson 2006; Wang 2006). Another significant factor that influences the speed is roadway characteristics such as road type, gradient and length of the grade (Ericsson 2000; Wang 2006).

A paper presented by Rohani et. al (2010) relating to bus driver behaviour at signalised intersection indicated that, bus driver behaviour leaving from a red phase of traffic signal is influenced by its position in the queue (Figure 3). The driver in front of the queue who leads the vehicles, leaving from stationary point with a higher acceleration. Driver who leaves from elsewhere in the queue was found to apply moderate acceleration since their driving behaviour was influenced by the headway of the vehicle in front. This study is supported by previous study conducted by Jumsan et al. (2005). The research conducted also indicated that, when a driver passing the intersection, individual vehicle headway is influenced by the front vehicle speed and interval between vehicles.

The acceleration rate applied by a driver is mainly influenced by the interaction of drivers with the local traffic controls and the vehicles in a traffic stream (Snare 2002). The number of stops along the journey is governed by the average rate of acceleration and deceleration for the whole trip (Rakha and Ding 2003). This occurs dominantly in public bus driving cycle. The bus driver is experienced with driving distractions as they are required to obey the traffic rules and also provide better service. Similar to other drivers, bus drivers interact with traffic controls and other vehicles in traffic stream that may caused frequent stops. However, bus drivers also have an extra task of providing for passengers alighting or boarding at bus stops. Therefore, the number of stops the driver had to make influenced the proportion of driving mode period spent along the journey. Figure 4 shows a sample of bus driving cycle from the UK and Malaysia.

Figure 5 shows a driving mode proportion from data collected along 2 routes at different areas in Southampton, UK. In city areas which are considered as the busiest areas, the frequent number of stops caused the proportion of stop driving mode higher than the non-busy areas.

Although, the percentage of time spent on acceleration is also lower than non-busy areas, mean accelerations and decelerations are found to be higher (Table 4).

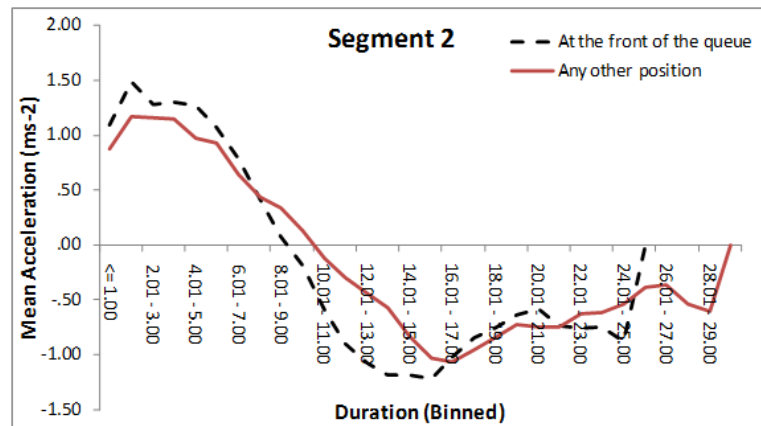
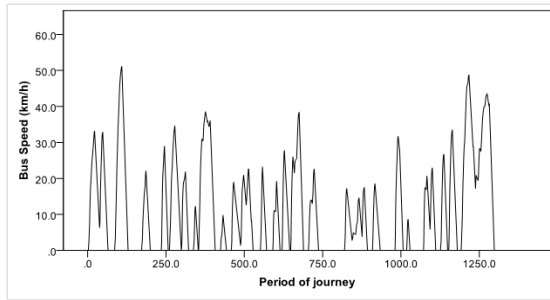


Figure 3 Comparison of acceleration at different bus position (Rohani, Felstead et al. 2010)

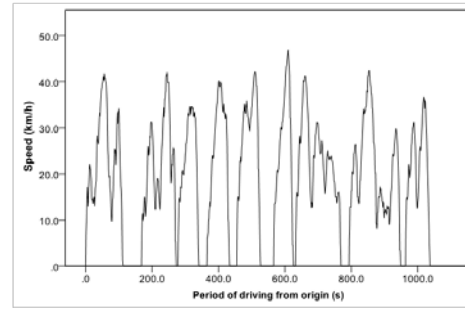
Table 16 Mean of acceleration and deceleration at busiest and non-busiest areas

		non-busy areas	busiest areas
		Mean of acceleration (m/s <sup>2</sup> )	Mean of acceleration (m/s <sup>2</sup> )
Driving mode	Idling	.00	.00
	Acceleration	.39	.54
	Deceleration	-.33	-.49
	Acceleration = 0	.00	.00





(a) *Bus driving cycle in Southampton, UK*



(b) *Bus driving cycle in Batu Pahat, Malaysia*

Figure 32 : Sample of bus driving cycle from different countries

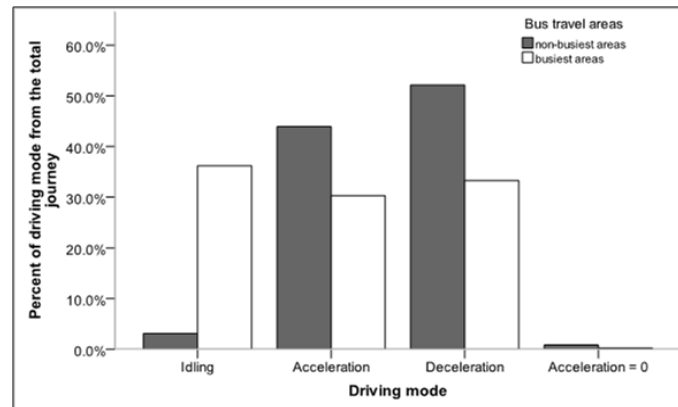


Figure 5 : Proportion of driving mode spent by bus drivers

Ahmed (1999) pointed that, in vehicle following behaviour situations, the acceleration of driver increases with speed, density, and relative speed. However, the acceleration decreases with space headway. Specifically Ahmed (1999) explained that, at low speed, the mean acceleration is lower compared to those of higher speeds. Drivers in high density traffics drive more conservatively than low density traffics due to the influence from rapid changes in ahead traffic conditions.

Wang (2006) in his dissertation listed 8 road geometric categories that strongly influences driver speed as:

- Land use type and density,
- Number of access points,
- Surface type and condition,
- Lateral clearance,
- Vertical grade and length,
- Number of lanes,

- Available sight distance and
- Horizontal curvature.

Another research conducted on urban streets speed characteristics (Aronsson 2006) mentioned that the street designs and environment can influence the driver's speed through the design of carriageway, traffic flow, ratio of through traffic and traffic environment. Aronsson (2006) also added that the street design, function and roadside development become the important factors as regards to speed. Accordingly, Table 5 is a summary of previous studies of road and traffic impact on driver's speed.

Table 17 Summary of road and traffic impact on driver speed from previous study

Reference	Result highlighted
(Cooper, Vladislavljevic et al. 2009)	Driving speed is significantly reduced as the flow increase.
(Wang 2006)	Development of speed model for low speed urban streets that considered road alignment, cross section, road side features and adjacent land uses.
(Fitzpatrick, Carlson et al. 2003)	<ul style="list-style-type: none"> <li>• Lane width has a low correlation with operating speed.</li> <li>• Road design such as horizontal curve has an effect on speed behaviour.</li> </ul>
(Corkle, Giese et al. 2001)	<ul style="list-style-type: none"> <li>• Words painted on the pavement do not appear to reduce vehicle speeds; however, pavement markings in the form of chevrons supplemented with speed limit signage appear to reduce vehicle speeds</li> <li>• Road narrowing reduce driver speed</li> <li>• curb treatments, significantly influence driver speed</li> </ul>
(Harwood 1990)	Road narrowing is an effective road calming in urban arterial road to reduce driver speed and generally reduce accidents by 24 to 53 percent.

### Working Hours Impact on Driving

Working hours have been largely responsible for problems in physical health, work performance, safety and accidents. This is well presented by many researchers. Specifically, working long hours have been identified as having an association with fatigue (Sparks, Cooper et al. ; Park, KIM et al. 2001; White and Beswick 2003). White and Beswick (2003) observed that, the main reason people becoming fatigued is due to insufficient rests. Other than that the authors noted that fatigue can be caused by other reasons, such as too much, or too little stimulation at work, not enough chance to rest and having insufficient time to recover from fatigue. Lack of sleep as a result of long working hours is also thought to contribute to fatigue.

Road accidents that involved commercial buses are of growing concern in Malaysia. It was reported that the majority of bus accidents involved in a long journey bus service. The investigations conducted by MIROS found that, all cases were occurred during and after travelling at the wee-hours. The author of 'An Impact Assessment of Banning Wee-Hour

Express Bus Operation' report published by MIROS, indicated that, the main cause of commercial bus accidents reported in Malaysia is primarily due to the driver's fault. In Malaysia, most commercial drivers particularly those who involved in long distance travels are required to drive around the clock. Bus drivers work based on rotating shift which affect their sleep patterns causing fatigue. Fatigue and falling asleep while driving have been identified as one of the major causes of road accidents. Furthermore, MIROS found that, there are two prominent times of the day when most of the bus accidents occurred (as presented in Figure 6). This finding was claimed to mirror with other studies conducted by Lenne et al. (1997)

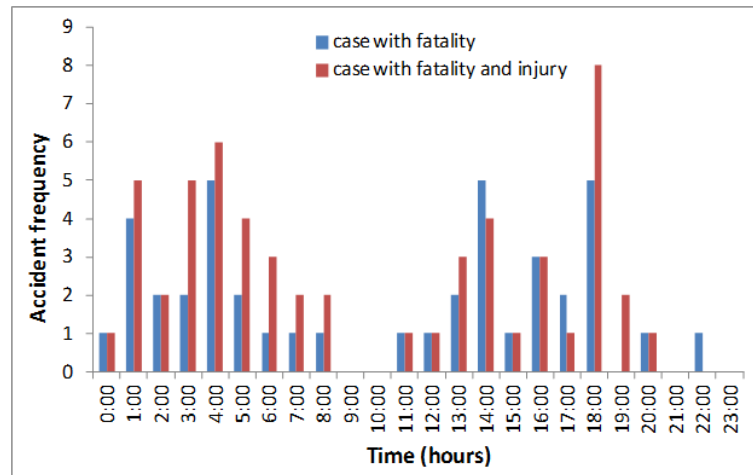


Figure 33 Distribution of bus accidents in Malaysia investigated by MIROS from 2007 to 2008 (Mohamed, yusoff et al. 2009)

McElroy et al., (1993) studied a relationship between career stages, time spent on roads and driver work-related attitudes. These research used career stage and time spent driving on the road as independent variables and truck driver attitudes as dependent variables. The findings showed that, the career stage and time spent on the roads significantly affected the driver behaviour. This can be proven from a research study on taxi driver behaviour, who spent greater time driving than an average driver. Previous studies have reported that taxi drivers are risk takers in driving and have a greater accident risk (McElroy, Rodriguez et al. 1993; Burns and Wilde 1995; Elliott, Armitage et al. 2003). The findings from these research can be very useful to relate between bus driver time spent on driving and their ability to work with greater driving performance.

Recent study conducted by Sando (2011) found a pattern of an increased propensity of collision involvement with the increased of driving hours. This study was conducted on bus accident involvement histories in Florida. In the journal paper, Sando indicated that a bus driver who is involved in a collision would have driven more than 45 hours in seven days prior to the collision. In particular, Sando pointed out that a bus driver who have driven for more than 50 hours per week have a 95% chances of being involved in a collision.

## **Conclusion**

Driving behaviour is influenced by various factors that are mainly affected by human, environment and vehicle factors. Human factor relies on individual differences, demographic factors, mental and physical workloads. These factors basically control the ability of the bus driver to drive. The presence of environment obstacles as well as the vehicle factor in driving task are as an additional factor to influence driver behaviour.

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