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Factors of Fatigue and Bus Accident

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Abstract. The main purpose of this study is to identify the relationship between the factors of fatigue (working schedule, working condition) and bus accident. 60 bus drivers from a bus agency in Kuching, Sarawak, Malaysia were selected as a sample. Survey questionnaire was used for data collection. They were questioned individually because most of them possessed low level of education and facing difficulties in understanding the questions in English. From the Pearson Correlation Analysis, the findings revealed that there was a significant relationship between working schedule ($r=0.486$, $p=0.000$), working condition ($r=0.601$, $p=0.000$) and bus accident. The dominant factor that showed strongest unique contribution based on Multiple Regression Analysis was working condition ($r2=0.404$, $\beta=0.478$). Serious attention should be given to improve the buses and working condition to reduce the accident rates in Malaysia. It is also recommended that the working schedule to be revised accordingly by taking into consideration the bus driver's constraint.

Keywords: Fatigue, working schedule, working condition, and bus accident

1. Introduction

According to Federal Motor Carrier Safety Administration of the United State [1], commercial driver fatigue has long been recognized as a major highway safety problem. While the report of Australian Automobile Association (1999) showed that driving fatigue is one of the factors of accidents among commercial drivers in Australia [2]. Over a quarter of long distance lorry drivers reported falling asleep at the wheel at some time during the last 12 months of driving [3]. Drowsiness is different from fatigue as drowsiness is a feeling of the need to sleep, whereas fatigue is a lack of energy and motivation [4]. Driver fatigue has been identified as a major cause of serious accidents which leads to reduced driving performance efficiency. Many studies have been done to examine the relationship between driver fatigue and accident. One of the first research studies which addressed bus driver fatigue was the October 1978 report prepared for the National Highway Traffic Safety Administration of the United State entitled "Effects of Hours of Service Regularity of Schedules, and Cargo Loading on Truck and Bus Driver Fatigue" by Mackie and Miller [5]. The job responsibilities of bus drivers lead to fatigue and directly lead to accident.

Focus has been given in allocating resources for the research of motor vehicle safety issue in the United State. The 1995 Federal Highway Administration of the United State (FHWA)-sponsored National Truck and Bus Safety Summit and other industry conferences had identified driver fatigue as the top priority commercial motor vehicle safety issue [1]. Driver fatigue is a safety issue of special concern to the bus transportation industry [6]. Fatigue maybe caused by a combination of factors including inadequate rest, sleep loss and/or disrupted sleep, displaced biological rhythms, excessive physical activity or mental and cognitive work, as well as stress [6]. Due to the high annual mileage exposure and other factors such as long trips and others, bus drivers' risk of being involved in a fatigue-related crash is higher than non-commercial drivers. Zuraida Hassan has done a research about the working environment and fatigue among bus driver in Malaysia [2]. Working environment of bus driver does lead to fatigue as they feel constrained in their working environment while they are performing their job. Since there were many previous studies being done in the western countries, this study is considered as a preliminary study which was done in the local society, which means Kuching area in Sarawak, Malaysia. This study was aimed to examine the factors of fatigue among bus drivers that lead to accidents.

2. Task Capability Interface Model

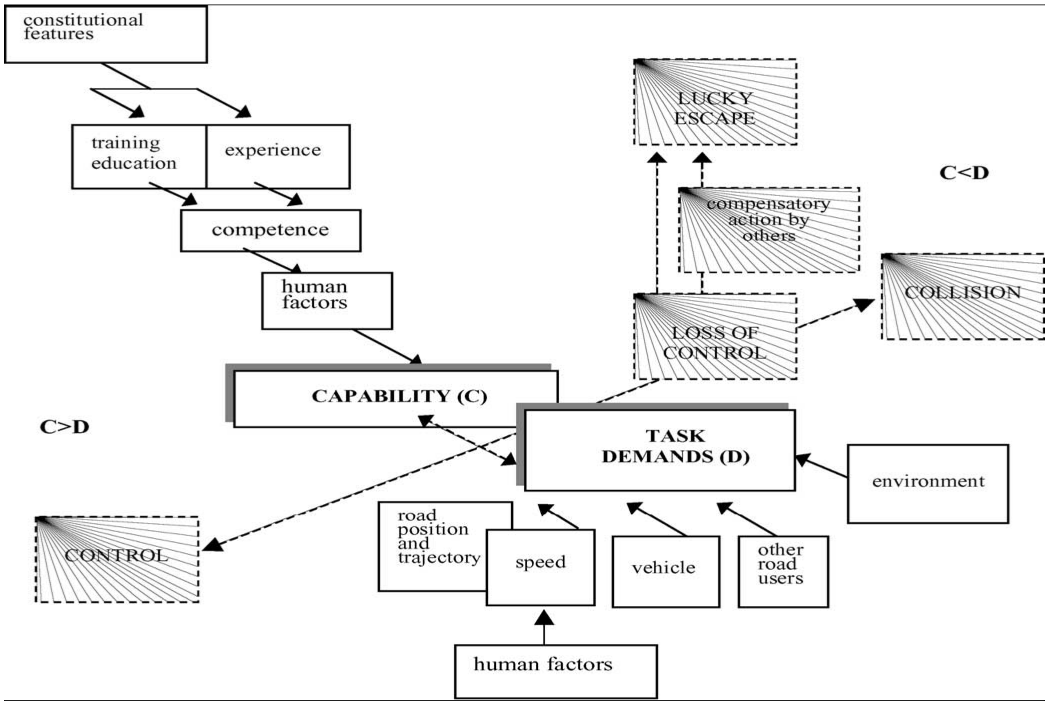

Figure 1: Task Capability Interface Model

Driver's capability and task demands are the two important elements in this Task Capability Interface Model [7] as shown in Figure 1 above. When the capability of the driver exceeds the demands, the task is easy; where capability equals to demand, it means that the driver is operating at the limits of his/her capability, and the task is difficult. If the demand exceeds capability, the task is too difficult to be performed. Fatigue, or tiredness, concerns the inability or disinclination to continue an activity, generally because the activity has been going on for "too long". There are different kinds, such as local physical fatigue (e.g. in a skeletal or ocular muscle), general physical fatigue (following heavy manual labour) or "central nervous" fatigue (sleepiness). The last of these is mental fatigue – not "having the energy" to do anything. According to Åkerstedt and Kecklund (2000), sleepiness is a particularly important form of fatigue related to the level of brain stimulation and the structures that regulate it [8].

Driver decision making skill is important in avoiding an accident. Some authors like Allen et al. (1971), Michon (1985), van der Molen and Bottleher (1985), Hollnagel et al. (2004) have emphasized the hierarchical nature of driver decision making, pointing out the distinctions between strategic decisions (route and timing of the journey), tactical decisions (manouvering) and operational decisions (executive acts) [7]. If a driver is too tired, it will affect the decision making skill as the task at that time is too difficult for him. When a driver feels fatigue, he is in the sensation seeking stage. According to Jonah (1997), evidence supports that individuals high in sensation seeking are more likely to speed, overtake more and adopt shorter headways and over-represented in traffic crashes [7]. For example, a drowsy driver may increase speed. The relationship between the capability of the driver and the task is very important for road safety. If the driver is unable to cope with it, accident is prone to be happened. Under low task demand conditions, the driver would be drowsy and fall asleep at the wheel. Thus, accidents will happen.

3. Methodology

This research was a quantitative research and purposive sampling was used as a sampling method. A set of self-designed questionnaire contained three parts was developed to study the relationship between the factors of fatigue and bus accident without any attempt to influence them. Personal interview was done with the respondents so that more accurate data could be collected. Part A was used to collect demographics factors of respondents covering gender, age, race, highest completed level of education / education background and years of service. While Part B contains 15 self-designed questions about factors influencing fatigue which was divided into the factor of working schedule (7 statements) and working condition (8 statements). Part C contains 10 statements regarding the frequency and severity of accident. The six-point Likert scale assigned points 1,2,3,4,5 and 6 to terms of "Strongly Disagree", "Slightly Disagree", "Disagree", "Agree", "Slightly Agree" and "Strongly Agree" as in the order of the numbers. A pilot test was carried out to test the reliability of the questionnaire statements. Besides, the pilot test was aimed to test the readability and the appropriateness of the language used in the questionnaire. The pilot test involved 20 bus drivers of Universiti Malaysia Sarawak (UNIMAS).

Nunnaly (1978) has indicated 0.7 to be an acceptable reliability coefficient [9]. While Kerlinger (1973) and Mohd Majid Konting (1990) claimed that reliability coefficient which is more than 0.6 always be used [10]. From the analysis conducted, it showed that the reliability coefficient for each factor was more than 0.7 (Working schedule – 0.713; Working condition – 0.737; Bus accident – 0.826) and the overall reliability coefficient was 0.942. Thus, the questionnaire was reliable and could be used to collect data for this study.

There were 60 male respondents from Biaramas Express Sdn. Bhd., Kuching, Sarawak for this study. The primary data was obtained by interviewing each respondent personally (within two weeks time) so that they could understand the questions better and more accurate data could be collected as they have low educational background. Two weeks time was used to collect the data as interviewing personally was needed. After collecting the data, Statistical Package for the Social Sciences (SPSS) version 14.0 for Windows was used to analyze the data. Descriptive statistics (frequency and percentage) was used to describe the demographics factors (age, highest completed level of education/ education background and years of service). Inferential statistics (Pearson Product Moment Correlation Coefficient and Multiple Regression Analysis) was used as well for data analysis.

4. Findings and Discussion

4.1. Respondents' Demographic Factors

There were 60 male respondents in this study. The respondents were in the age range from 25 years old to 64 years old. Majority of the respondents (31;51.7%) were in the age category of 35 to 44 years old. 20 (33.3%) of the respondents were in the age category of 45 to 54 years old while 6 (10.0%) of the respondents were in the age category of 55 to 64 years old.

There were 31 (51.7%) Malay and 11 (18.3%) Chinese respondents. The rest of the respondents (18; 30.0%) were from other races such as Iban and Bidayuh. Majority of the respondents (26; 43.4%) studied up to LCE/SRP/PMR (Assessment/Examination for Form 3 students-age 15 years old in secondary schools) level while 14 (23.3%) of the respondents were MCE/SPM/SPMV (Assessment/Examination for Form 5 students-age 17 years old in secondary schools) holders. Other respondents (20; 33.3%) studied up to other education level such as UPSR (Assessment/Examination for Standard 6 students-age 12 years old in primary schools).

There were 9 (15.0%) respondents who have 0 – 2 years of service, meanwhile 12 (20.0%) respondents have 3 – 5 years of service. There were 22 (36.7%) respondents who have 6 – 10 years of service, whereas 11 (18.3%) respondents have 11 – 15 years of service. There were 4 (6.7%) respondents who have 16 – 20 years of service, and 2 (3.3%) respondents have worked for more than 21 years.

4.2. Pearson Product Moment Correlation Coefficient's Results

Table 1: Correlation between Working Schedule and Accident

Variables	Mean	Std. Deviation	Level of Significance, p	Pearson, r
Working Schedule	5.520	1.597	0.000	0.486**
Working Condition	5.114	1.595	0.000	0.601**

** Correlation is significant at the 0.01 level (two-tailed)

As shown in Table 1, there was a significant relationship between working schedule and accident ($r=0.486$, $p<0.01$). The correlation between working schedule and accident was moderate strong. Therefore, the hypothesis (H1) was accepted. Working schedule does affects the happening of accident as excessive and irregular working hours can lead to fatigue and cause accident. This is because most professional drivers do not work a regular 9-5 shift. Unsuitable working schedule will cause bus drivers lack of rest or sleep and this affects their performance while they are driving. Mello et al. (2000) claimed that 16% of the interstate bus drivers in the United States admitted to have dozed off at the wheel, and 55% knew of someone who had dozed off at the wheel [11]. Mackie and Miller (1978) found that a driver was more likely to be involved in an accident after 5 hours of driving than after less than 5 hours of driving [12]. Besides, Ouwerkerk (1986) found that more than 50% of the professional drivers admitted falling asleep and/or having had near-accidents and the numbers were found for both lorry and bus drivers [13]. A commercial driver spending several nights on the road in abnormal sleeping conditions and limited sleep will accumulate hours of sleep deprivation [4]. If a sleep debt becomes too large, the brain will eventually go to sleep involuntarily and this is called micro-sleep. For example, if a driver has a micro-sleep for just one second while travelling at the speed of 100km/h, the vehicle will have gone 28 metres without the driver in control.

In addition, the findings revealed that there was also a significant relationship between working condition and accident ($r=0.601$, $p<0.01$). The correlation between working condition accident was strong. Therefore, the hypothesis (H2) was accepted. Working condition does affect the happening of accident as the bus drivers spend a lot of time on the road. Thus, the conditions of the bus and the road have high implications towards the happening of accidents. Poor conditions of the roads resulting from deficiencies in maintenance, alignment, traffic signs and safety features were all identified as possible bus accident causes in Nepal [14]. Drivers are exposed to constant noise and vibration from their own vehicles and their working environment is dominated by noise from all vehicles [12]. The working condition affects the working performance of the drivers. For example, if the bus air-condition is spoilt, the bus will be hot and stuffy thus the bus driver cannot drive well.

4.3. Mulltiple Regression Analysis Results

Table 2: Model Summary of Dominant Factors (Working Schedule and Working Condition) Affecting Bus Accident

R	R^2	Adjusted R^2	Std. Error of the Estimate
.636	.404	.383	5.299

Table 3: Coefficients of Dominant Factors (Working Schedule and Working Condition) Affecting Bus Accident

Variable in Equation	Unstandardized Coefficients		Standardized Coefficients		
	B	Standard Error	Beta	t	Sig.
(Constant)	17.011	3.566		4.771	0.000
Working Condition	0.498	0.124	0.478	4.015	0.000
Working Schedule	0.251	0.124	0.241	2.020	0.048

Table 3.0 showed that working schedule and working condition were the dominant factors that contribute to bus accident. Therefore, 40.4% can be explained by working schedule and working condition variables in the table above. However, working condition made the strongest unique contribution as it produced highest beta coefficient result ($\beta=0.478$). Working environment and fatigue among bus drivers could lead to accidents. Findings showed that working environment explains approximately 16% of variance in fatigue among express bus drivers ($r2=0.155$) and the respondents of her study comment that spoilt bus pressures them [2]. There has been deterioration over the last 20 years in working condition for buses and lorries due to traffic congestion and pollution [12]. Driving involves a high level of coordination, decision-making and a

certain level of skill [15]. Thus, a good working condition will decrease the level of fatigue among bus drivers and help to prevent from accidents.

5. Conclusion

The organization plays an important role in the prevention of bus accidents among bus drivers due to factors of fatigue. The organization has to do their part well aligned with the other parties involved. Besides that, future researchers can extend the study to other companies or places or even studying other factors such as the bus driver's personality, working environment, the nature of the job etc. This is important to reduce the rate of accident among heavy commercial vehicles.

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