Assessing the safety of express bus from passengers’ perspective

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Abstract. This paper presents an analysis of express bus passengers’ perspective towards the safety and causes of express bus accidents. Express bus is an important mode of transport as it is cheap and has high connectivity between cities. However, the safety of express bus is a major concern in Malaysia. There have been many high-profile express bus accidents that have caused deaths to innocent victims. Therefore, it is important to study the safety of express bus and increase its safety. A survey with 880 respondents was conducted in Malaysia to study passengers’ perspective on the safety of express buses. The questionnaire is divided into seven sections: respondent background and demography, service, comfort, safety, information technology and safety education. The results are presented in a spider web diagram and shows the 12 most important factors that relate to express bus safety. In conclusion, this study helps to understand the perspective of express bus passengers on the safety of express bus and determine the important factors related to express bus safety and reduce the number of express bus accidents in Malaysia.

1. Introduction
Express bus is an important mode of public transport. It is an effective solution for mass transportation and to reduce road congestion. Express bus is a practical mode of transport for various age groups in the society, is cheap and highly connected between cities. However, despite its popularity, the safety of express bus is a major concern. In Malaysia, the Malaysian Institute of Road Safety Research (MIROS) reported that annually on average 1855 bus accidents occurred between 2012 to 2015. This is an alarming statistic and it affects the public confidence and public view to use express bus for their commute. Express bus accidents cause deaths to innocent victims and frequently grab the national headlines in major media outlets [1]. Express bus accidents are due to human errors, technical failure of the bus and due to the surrounding infrastructure. Hence it is important to study the causes of these accidents and study how to improve safety [2]. Brake failure is the main element in technical component failure [3]. Driver fatigue and driving etiquette also play important roles in ensuring high level of safety of express busses [1]. A study among bus drivers in Greece and Norway showed that there is a relation between express bus driver behaviour and bus accidents. Here the results show that

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bus drivers with less volatile behaviour were involved in fewer bus accidents [4]. Research has shown that retaining drivers is more important than driver recruitment [5]. Bus drivers who have left their companies have forty percent more accidents involvement compared to those who stay at the company. Apart from driver behaviour, another factor in bus accidents is express bus driver salary. The organization and management of express bus companies play an important role in their service and safety. In Germany, express buses were previously state run and were only privatized since 2013. Studies showed that the liberalisation of express bus in Germany have an influence on the perspective of users and an increase in market growth [6]. In Malaysia, express buses are privatized, and various institutions, agencies and government bodies are involved in the management of express bus [7]. The privatisation of express bus in Norway in the mid-1990s have also contributed to a positive influence in the sector. However, recent competition from other modes of transports and low-cost airlines have seen recent decline in the use of express bus [8]. An improved understanding of express bus operation is important to maintain well managed bus services and to encourage the public to use express bus as their mode of transport. The quality of service from bus express operators have direct influence on the confidence of the passengers [9].

New technologies such as Assistive Driving Aids (ADA) have been introduced to increase express bus safety [10]. Other technologies include driver-centred assessments such as passive infrared sensor button, RFID reader and alcohol detection to provide effective prevention mechanism and awareness to the driver [11]. The progress in technology with the help of Assistive Driving Aids (ADA) has not yet proved to increase the safety of express buses. Each technology must be evaluated to discover its effectiveness in reducing bus accidents [12]. Previous inventions have already been added to increase safety, for example seat belts, but without education, passengers who ride without wearing their seat belts risks being ejected through the window in case of accidents [13]. Hence the important role of education in increasing safety, as well as the introduction of new technologies [14]. Khoo et. al proved that the type of bus and the experience of the bus driver can have an influence on passenger’s perception on the safety of their buses. A high level of safety will increase the ridership of bus express and increase the revenue in the sector [15]. Passengers satisfaction will increase their loyalty to the express bus company [16]. The aim of this paper is to investigate the perception of express bus passengers towards express bus safety and determine the main factors of accidents and how to increase express bus safety. The scope of the study is limited to the survey of express bus passengers in Malaysia to obtain their perceptions on express bus safety. The expected outcome from this research is to understand the perspective of express bus passengers on the safety of express bus in Malaysia and the causes of accidents and how to increase safety and reduce the number of express bus accidents in Malaysia.

2. Methodology
The study was conducted in Malaysia, focusing on both male and female and various age groups and demographics. The data required for this research was collected through the survey with a set of questionnaires which are distributed to respondents. Figure 1 shows the flowchart of this research. This paper was based on a quantitative approach and purposive sampling was used as a sampling method. A total of 880 questionnaires were distributed to conduct this survey to study the perspective of express bus passengers on the safety of express bus. The aim is to study the relationship between the factors that influence the safety of express bus from a passengers’ point of view. The questionnaire consists of seven sections, as shown in Table 1. The questionnaire is constructed based on the objective targeted, hence it is divided into different categories each with a specific criterion. From the literature, it is recommended that the questionnaire on passenger perspective encompasses questions regarding all three of the following aspects: driver-related, transport operator-related and vehicle related [17]. Section A details the demographic and background information of the respondents, consisting of frequency of using express bus, education background, and their frequent destinations.
**Figure 1.** Flowchart of the methodology

**Table 1.** Construction of the questionnaire.

| Section A: Respondent background | Section D: Safety |
|----------------------------------|-------------------|
| **Name** | **Age** | **Changing lanes dangerously** | **Overtaking other vehicles** |
| **Income** | **Education** | **Use of mobile phone while driving** | **Using emergency lanes without reason** |
| **Section B: Service** | **Tailgating** | **Jumping traffic lights** |
| **Driver uniform** | **Beating the queue** | **Beating the queue** | **Driving over the speed limit** |
| **Seat belt available** | **Sudden braking** | **Sudden braking** | **Overtaking vehicles at double line** |
| **Section C: Comfort** | **Announcements made by the driver** | **Section E: Information Technology** |
| **Clear information signboard** | **Punctuality** | **Availability of Wifi** | **Availability of emergency eCall** |
| **Section E: Information Technology** | **Availability of apps** | **QR code** |
| **Bus cleanliness** | **Adequate time for rest** | **Section F: Safety Education** |
| **Seating comfort** | **Age of bus** | **Through audio** | **Awareness of emergency number** |
| **Interior smell** | **Excessive smoke from bus exhaust** | **Through video** | **Awareness of second driver** |

Section B contains questions regarding the performance of the service provided by the express bus company. Section C includes eight questions on the comfort of the express busses. Section D contains questions on the safety aspects of express bus. Section E contains questions regarding information technology in the express busses. Section F consists of four questions regarding the safety education on express bus. Finally, section G asks respondents of questions regarding their experiences on the use of express busses. In the construction of the questionnaire, a Likert scale was used. Respondents can be
indecisive when choosing an answer. In case of vague statements which may cause confusion, the answer may not be clear, hence a scale of three is not chosen. A Likert scale consisting of five range choices is used, ranging from highly agree, agree, not sure, disagree, and highly disagree to have high accuracy of the results.

3. Results and discussion
This section presents the results of the survey conducted. A total of 880 respondents were gathered from the survey. The respondents are from various regions in peninsular Malaysia with different demographic background. Figure 2 shows the respondents who have previously experienced travelling using an express bus. Only 6 respondents (0.68%) of the 880 respondents have never travelled in an express bus, whereas 874 respondents (99.32%) have travelled in an express bus. Section A of the questionnaire focused on the demography of the respondents, which includes gender, age, status, education background and income. Figure 3 shows the frequency the respondents travelling in an express bus. From the results obtained, 35.48% (309) of the respondents’ travelled using an express bus once a year, while 38% (331) respondents travelled once every two to three months. 21.7% (189) of the respondents travelled using express bus monthly, 4.36% (38) weekly and only 0.46% (4) daily.

Figure 2. Respondents with express bus travel experience.

Figure 3. Frequency travelling using express bus

Figure 4 shows that over half of the 880 respondents were female, at 51.37% (450). Figure 5 shows the age of the respondents. Most of the respondents are 16-20 years old, at 43.81%, next is 21 to 24 years old at 29.09%. The education background of the respondents is divided into five categories, primary school, secondary school, diploma, bachelor’s degree, master’s degree and PhD, as shown in Figure 6. It is interesting to note that most of the express bus passengers were undergraduate university students, totalling 698 students. Figure 7 shows the profession of the respondents of the survey. The majority at 70.65% are students, second highest are employees from the public sector, third is employees from the private sector at 9.89%, self-employed workers at 3.87% and 2.28% are unemployed.

Figure 4. Respondents gender

Figure 5. Respondents age
Figure 6. Respondents background

Figure 7. Respondents working background

Figure 8 shows the financial background of the respondents. The income of the respondents is divided into four categories, less than RM 1000, RM 1000-2000, RM 2001-3000, and more than RM 3000. 8.81% of the respondents have an income of less than RM 1000, while 7.55% have an income between RM 2001-3000, 5.95% of the respondents’ income is between RM 2000-3000, and the majority of the respondents at 46.21% have an income of more than RM 3000. Figure 9 shows the criteria chosen by the passengers when choosing an express bus. The highest criteria chosen is safety, at 42.67%, second highest in comfort at 33.10%, next is the departing time at 21.63%. The questionnaire for the passengers contains 47 items which are divided into seven categories as followed: service (16 items), comfort (8 items), safety (10 items), information technology (6 items), safety education (4 items) and user experience (3 items). Each item refers to a statement related to the respondents’ response. In this paper, exploratory factor analysis (EFA) was conducted to explore factors and variables of the survey. SPSS Statistics is used to study the results of the survey. The correlation matrix can be determined from the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy. Table 2 shows the KMO analysis and Bartlett’s test of sphericity. Overall, the KMO measure of sampling adequacy obtained is 0.881 (above the required 0.5 value) which shows that the data does not have multicollinearity. The value from Bartlett’s Test of Sphericity is 17482.287 is adequate and significant (p < 0.05), which shows that the relation between the sub-scale and that the data is suitable for performing factor analysis. The results from both analyses shows that factor analysis can be conducted.
Table 2. Measure of sampling adequacy

| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | 0.881 |
|-------------------------------------------------|-------|
| Bartlett's Test of Sphericity                    |       |
| Estimated square root                            | 17482.287 |
| Degree of freedom                                | 1326  |

The factor analysis of the factors related to the safety of express bus are presented in a spider web diagram based on the causes and factors related to express bus accidents. The respondents were asked to answer questions related to express bus in Malaysia and were required to choose one answer, with the corresponding score: highly disagree (1.00), disagree (2.00), unsure (3.00), agree (4.00) and highly agree (5.00). Based on answers from the respondents, the average score from each item can be obtained as shown in Table 3.

Table 3. Average score of each item

| Factors | Average score | Item |
|---------|---------------|------|
|         |               | 1    | Express bus safety |
|         |               | 2    | Express bus comfort |
|         |               | 3    | Information technology system |
|         |               | 4    | Emergency number and information signboard in the express bus |
|         |               |      | Safety rules for the driver and passengers |
|         |               | 5    | Experience travelling in an express bus |
|         |               | 6    | Second driver |
|         |               | 7    | Education on express bus safety |
|         |               | 8    | Express bus speed |
|         |               | 9    | Journey briefing |
|         |               | 10   | Stop at the service centre |
|         |               | 11   | Service provided by the express bus |

From the answers obtained, a spider web diagram is constructed. The spider web is based on the factors that cause express bus accidents. Only items with an average matrix value of more than 0.4 is accepted. The spider web contains 12 factors that contribute to express bus accidents based on the average score from the questionnaire. The highest factor is the express bus safety, which consists of criteria such as driver etiquette, the use of mobile phone while driving, tailgating, and driving over the speed limit. The second most important factor is information technology available in the express bus, this includes availability of an emergency eCall system. It is important for long journeys to have a second driver to avoid fatigue and accidents. In cases of emergency, express bus companies must show emergency numbers clearly. Figure 10 shows the spider web of the factors that contribute to express bus safety. It can be observed that express bus safety is the most important aspects that passengers consider when travelling on an express bus. This shows that it is important to investigate and increase the safety of express bus. An aspect of the safety of express bus relates to the behaviour of the drivers. For example, using emergency lanes without reason, jumping traffic lights, changing lanes dangerously, tailgating, beating the queue, sudden braking and driving over the speed limit. The safety of express bus, public, drivers and passengers must be improved.
The progress in technology helps to make the learning experience more effective and efficient. Passengers were asked on their perception towards learning and education awareness on express bus safety. 77.42% agreed that they preferred safety briefing through audio as shown in Figure 11, and 64.52% preferred through video. Bus driver education can be achieved to improved training modules and methods. In the era of Industry Revolution 4.0 (I.R. 4.0), the use of augmented reality (AR) can help increase the awareness and training of the express bus drivers. 83.33% of the respondent agreed that it is important to have a safety line that can be contacted during emergency and 97.44% of the respondents agreed that there is a need of a second express bus driver, as shown in Figure 12. Drivers need to have a rest after 2 hours of driving and for longer distance journeys, it is important that express bus companies consider a second driver to ensure that the drivers are alert when driving to avoid fatigue. The service provided by the express bus company is perceived by the passengers as an important aspect when choosing to travel by express bus. This includes the availability of seat belts, punctuality and clear information given through signboards. Passengers also consider if there is a second driver for long journeys, the driving speed and the discipline of the express bus driver, his or her driver uniform and appearance.
4. Conclusion

In conclusion, passengers’ feedback showed that using mobile phone while driving, tailgating, driving over the speed limit, cutting lanes dangerously and sudden braking are major concerns in express bus safety management. Audio safety briefing are suggested to help increase express bus safety. Hence, it is recommended that related governing bodies and institutes work together to ensure the driver monitoring and training is sufficient to avoid risky behaviour. This study helped understand the perspective of express bus passengers on the safety of express bus in Malaysia and determine the important factors related to express bus safety and reduce the number of express bus accidents.

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