Automotive Experiences
Vol. 7 No. 3 (2024) pp. 513-524
p-ISSN: 2615-6202 e-ISSN: 2615-6636

Research Paper

Malaysian Public's Perception Toward Event Data Recorder (EDR) in Vehicles

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https://doi.org/10.31603/ae.11706

Published by Automotive Laboratory of Universitas Muhammadiyah Magelang

Article Info
Submitted: 03/07/2024
Revised: 12/12/2024
Accepted: 13/12/2024
Online first: 19/12/2024

Abstract

The Event Data Recorder (EDR) is an important device in a vehicle that can be used to analyze vehicle accidents. EDRs record and store crucial sensor data before, during, and after accidents, which can be used in reconstructing accident events. EDR has been regulated in the US and UK; however, its implementation in the ASEAN region, especially in Malaysia, is relatively new. In this study, a survey is conducted to investigate the perception of Malaysians toward EDR. There are three focuses of this survey: (1) the public's awareness of EDR's existence; (2) their perception of the benefits of EDR; and (3) their privacy concerns with the use of EDR in vehicles. The survey revealed that a majority (75.4%) of respondents were unaware of the existence of EDR, but 72.3% acknowledged that EDR could help identify accident causes, and 59.5% believed it could promote safer driving. Moreover, over 66% of respondents agreed that EDR could enhance vehicle and road safety. Besides, 40.3% expressed concern about potential privacy breaches and misuse of EDR data. Despite that, nearly 80% of respondents were in favor of installing EDR in their vehicles and allowing the data to be used in court. Additionally, 70% indicated that EDR would become a criterion for vehicle selection, and they would support mandatory EDR regulations.

Keywords: Event data recorder; Vehicle safety; Crash investigation; Safety awareness; Data privacy

1. Introduction

There are a recorded 32.6 million people registered as Malaysian citizens while the registered vehicle recorded 33.5 million vehicles which indicates that there is probably a person who might have more than one car in their possession [1]. This also shows that the increasing number of cars is the main reason for traffic congestion in the urban area and leads to an exponential number of accident cases [2]–[5]. Globally, approximately 1.3 million people die each year because of road traffic crashes [6]. In Malaysia, an increasing trend in the number of accident cases is observed, where in 2019 alone, there were 567,159 accident cases recorded [7]. With the increasing rate of accidents on roads worldwide, understanding the causes and dynamics of these incidents has become a matter of paramount importance. Road traffic accidents pose significant risks to human life and property, prompting researchers, engineers, and policymakers to explore innovative approaches to

enhance road safety and accident investigation [8], [9]. One such technological advancement that has gained considerable attention is the Event Data Recorder (EDR).

EDR is a device that records vehicle information for a brief amount of time typically installed in an Airbag Control Module (ACM) that triggers the device before, during, or after a crash event. This information includes vehicle speed, crash severity (delta-V), braking status, seatbelt usage, engine throttle, and many more relevant data from the 15 essential data elements based on NTHSA – 49 CFR part 563 [10] and 65 data elements based on UN Regulation No. 160 [11]. However, this information from data elements is only kept on file permanently when the relevant sensors detect an accident or unusual driving circumstances that might cause an accident. Among these triggers are sudden longitudinal and lateral acceleration as well as the deployment of airbags or seat belt tensioners. In this scenario, the recorded data from the 300 milliseconds before and after the triggering event is permanently retained. By comparing EDR to Airbag Control Module (ACM), the usage of ACM only focuses on the deployment of airbags while EDR only records and stores the information related to incidents of the mishap event which later can be accessed through specialized tools for accident reconstruction [12]. The data collected by EDR devices help the forensics teams in a reconstruction of an event of an accident that occurs during a car crash and the data, and its findings can be used in court for justice.

While EDRs offer numerous benefits in terms of accident investigation, safety improvements, and vehicle performance analysis, their usage raises significant privacy concerns. Firstly, the data stored in EDRs is susceptible to unauthorized access and misuse. If not properly secured, sensitive information collected by EDRs, such as GPS location data or personal identifiers, could be exploited by malicious entities. Similar concerns were raised and discussed regarding the privacy and security of vehicle data in Intelligent Transportation Systems (ITS) [13], [14]. EDRs often operate silently without drivers' explicit knowledge or consent. The absence of clear guidelines and consent procedures regarding data collection and usage undermines individuals' ability to control their personal information [15]. Another concern is the retention and secondary use of EDR data. Data collected by EDRs could be exposed for potential abuse in surveillance, law enforcement, or insurance investigations. Using a fake accident, Kurachi et al [16] were able to make the EDR overwrite inaccurate data. This investigation leads them to the conclusion that EDR is susceptible to hacking and data manipulation. Previous studies showed that despite the willingness of the public in the US and UK in sharing private information, they might not be protected from commercial end-uses [17]. On the other hand, the perception of the Malaysian public towards EDR usage in Malaysia is still unknown since the device is not available in most of the vehicles used in Malaysia. Hence, in this study, the perception of Malaysian towards the EDR and their concern for the privacy of their information is the main objective of this research being conducted.

EDR was first introduced and regulated by National Highway Traffic Safety Administration (NHTSA) where the regulation is subject to the NHTSA Code of Federal Regulation Title 49 Part 563 stated that only 15 essential data elements can record two different events in a multi-event crash as being specified to the vehicle with gross vehicle weight rating of 3855kg or less such as passenger car, or multipurpose passengers vehicle [10]. Many private cars in the United States are equipped with EDR for over 30 years. Saab, car automakers in Sweden follow suit in implementing the tools in their vehicle which are imported by American car manufacturer General Motors [18]. The usage of EDR is also applied to the insurance market such as the United Kingdom, where 17 different insurance companies offered insurance policy that included an EDR-type device that targets new driver aged 18 to 25 who has more tendency involved in accidents. For European countries like Italy and Switzerland, EDR-based insurance was first introduced in the insurance market in 2002 that offer to private vehicles meanwhile the Swiss offered an insurance EDR-based policy to young drivers in 2008 and extended this scheme to all drivers in 2010 [18].

Many researchers have conducted experiments on the reliability of EDR data retrieval and their accuracy during crash events. Bortle et al. has conducted a comprehensive

review of peer-reviewed studies that total up to 187 references providing validation studies on the delta velocity of vehicles and pre-crash data on vehicle speed of EDR [19]. The implementation of EDR is also studied in Japan to investigate the reliability of data retrieval during crash events where Takubo et al. studied the characteristic of EDR by conducting two types of crash tests [20]. Firstly, a standardized crash test was studied where the dataset from EDR was compared to Japanese national car assessment program (J-NCAP) datasets from 2006 to 2009. Secondly, a real-world accident crash test was recreated under more complex crash conditions for studies on the performance during a crash event. Furthermore, Min et al. provide a study under a different spectrum where the study analyzes dangerous driving events that correspond with traffic accidents [21]. The data of the event is collected from the recorded footage of the drive recorder along with GPS data. Based on this study, they found that human factors are the cause of this dangerous driving act, and it shows that human psychological states and the surrounding environment are the main contributing factors.

Several in-depth analyses have been conducted on the real-world application of EDR in forensic investigations by acquiring accident information for solving complex cases. Empirical studies mainly focusing on vehicle velocity change (delta-v) and pre-crash vehicle speed flowed by the discussions on the findings based on these two recorded accident parameters from different car models have been carried out previously in [20], [22]–[27]. Apart from that, there were also several studies conducted in finding the survivability of EDR during the crash [27], [28]. Besides, previous studies also found that the usage of Crash Data Retrieval (CDR) is useful in accessing and extracting the vehicle's EDR data for accident reconstruction [12], [29]. CDR is a crucial component in retrieving the data from vehicle EDR data for forensics investigations, but the accuracy of the data and the survivability of EDR need to be fully considered in analyzing the accident. Therefore, responsible bodies such as lawyers can use EDR data as a court's evidence and forensic investigators can utilize it as a tool to solve the cases through reconstruction of crash events from CDR.

Kowalick et al [15] conducted a pereception study to examine the perceptions of college-age motorists regarding the implementation of EDRs in vehicles. It focused on key areas, including awareness of the technology, perceived benefits and concerns, privacy implications, and the broader impact on safety and policy. Participants were provided with background information about EDRs, specifically General Motors' "black box crash data" technology, through a press release. Following this, they were asked to reflect on the potential advantages and disadvantages of EDRs, allowing researchers to gauge societal attitudes toward their adoption. The findings highlighted several perceived benefits of EDRs. Participants acknowledged their potential to aid in crash investigations, improve vehicle safety, reduce insurance fraud, and encourage safer driving behaviors. Additionally, EDRs were seen as valuable for providing accurate crash data, improving emergency response times, and helping vehicle engineers design safer cars. However, privacy concerns emerged as a significant barrier to public acceptance. Participants expressed fears of unauthorized data access and misuse by insurance companies, law enforcement, and government agencies. Other concerns included increased vehicle costs, the complexity of repairs, and the potential infringement on constitutional rights

Similarly, Gabler et al [30] explored public awareness and acceptance EDR in the US through a survey. The survey sought to understand perceptions regarding awareness of EDRs, preferences for installation, legal issues surrounding data access, and the potential influence of EDRs on driving behavior and purchasing decisions. The findings revealed that awareness of EDRs was relatively low, with only 34% of respondents having prior knowledge of these devices. Furthermore, two-thirds of the participants preferred EDR installation to remain optional, while 57% did not view EDRs as an invasion of privacy. However, many respondents stressed the importance of regulating data access to safeguard individual rights. Older, affluent, Caucasian males expressed greater concerns over data control, whereas minority and lower-income groups were more supportive of mandatory EDR installation, citing safety benefits. Although most respondents did not expect EDRs to alter their

driving habits, they recognized the potential benefits of these devices in accident investigations, lowering insurance costs, and encouraging safer driving practices. However, many remained cautious about privacy implications and the broader use of data.

Another study examined public perceptions of three traffic safety technologies: Section Control, Informative Intelligent Speed Adaptation (ISA), and EDR [31]. It assessed awareness, beliefs (e.g., effectiveness, fairness, privacy concerns), and acceptability of these measures among car users in Norway, Sweden, and Denmark. Awareness of EDRs was the lowest, with Danish respondents showing the highest familiarity due to local trials. EDRs were perceived as more intrusive to privacy than the other technologies, while Section Control and ISA were seen as fairer and more effective. Acceptability was highest for Section Control, followed by ISA, and lowest for EDRs. Factors like awareness of traffic safety issues, perceived fairness, and effectiveness increased acceptability, while privacy concerns significantly reduced it, particularly for EDRs. Furthermore, de Oliveira et al evaluated the impact of Event Data Recorders (EDRs) on truck driver behavior using three main criteria: safety, economy, and operational efficiency [32]. Safety was assessed through indicators such as the number of speeding events and the percentage of driving time above the speed limit. Economic performance focused on fuel consumption, while operational efficiency measured the percentage of driving time within the optimal engine economy zone. The results highlighted significant improvements in driver safety, fuel economy, operational efficiency and indicate better resource utilization.

In addition, the European Committee expressed that EDR was an important tool that is particularly efficient at providing better comprehension of the causes and mechanism of the injury and upgrading pre-crash investigation and crash reconstruction. However, for the ownership of the data and privacy, they are compiled for different European Committee members. The United States for example stated that any information or data rightly belongs to the owner [18]. Eyssatier et al. found that French people are willing to drive a vehicle with EDR equipped but their opinion is influenced based on societal and professional context [33]. Furthermore, EDR was argued to pose a privacy risk and concerns for personal data protection where the driver may not consent or be aware of the collection of user personal data. Garthe et al. implied that the data must be preserved and protected by the parties concerned such as NTHSA and Medical Response team [34]. Meanwhile, several papers discussed the setup of the vehicular ad-hoc network (VANET), an infrastructure installed along the road to communicate with other vehicles by distributing EDR data to a nearby vehicle [14], [35]. However, these papers did not highlight the security measure for VANET setup, Chim et al. proposed a solution to this issue in distributing EDR data safely in a secure, private manner [14].

The studies discussed above examined key criteria surrounding the implementation and perception of EDRs. These included public awareness of EDR technology, perceived benefits like improved crash investigations, safety benefits, public acceptability and privacy concerns about data misuse. Acceptability was linked to factors such as fairness, effectiveness, and data security, with preferences leaning toward optional installation and regulated data access. Thus, in this study, the survey is designed to assess Malaysian perceptions of EDRs, specifically investigating their attitudes and responses toward awareness of EDR usage, the safety benefits of EDRs, and concerns regarding EDR privacy.

2. Methods

The objective of this survey is to assess Malaysian perception of the EDR specifically to investigate their attitude and response toward the awareness of EDR usage, EDR safety benefits, and EDR privacy concerns. The survey was held between 27th January 2023 and 13th February 2023 and collected a sample size of 102 respondents from the Malaysian public. The individuals who participated in this survey are comprised of 69 male and 33 female respondents with ages between 23 to 75 years old. The survey was carried out via an online survey via a Google form. The survey consists of two different sections where the first section gathered participants' information such as their age, gender, place of residence, personal vehicle ownership, and vehicle information, along with their years of

driving experience. In the second section, 3 questions are asked to highlight their awareness of EDR, 6 questions on the benefits of EDR, and 5 questions on the concern on privacy and personal data concerns. Before the respondents are asked to answer the second section, they were given a brief introduction of EDR, as illustrated in **Figure 1**. This is to ensure that participants get an idea of what is EDR and its basic functionalities to ensure that they do not draw quick conclusions without knowing what EDR is.

To measure the attitude and opinions of the respondents, this survey uses the Likert scale. In social science research, the Likert scale is a popular rating system for gauging people's attitudes, opinions, and preferences toward a certain subject or construct. It was created by psychologist Rensis Likert in the 1930s and has since gained popularity as a technique for gathering and analyzing data. The Likert scale is made up of several statements or questions that represent various degrees of agreement, disagreement, or fervor over a particular topic. On a normal 5- or 7-point scale, respondents are asked to indicate how much they agree or disagree by selecting a response option. Typically, the scale offers the following response options: Strongly Disagree (1), Disagree (2), Neither Agree nor Disagree (Neutral) (3), Agree (4), and Strongly Agree (5). Multiple choice questions and subjective questions are also used in this questionnaire to record participants' reasons and own views of the question. The collected data is held as confidential data and the usage of the recorded responses from the survey is intended to be used for research purposes only. The results generated from the survey are discussed in the next chapter alongside the discussions.

3. Results and Discussion

The survey questions comprise three different focuses including respondent's awareness of EDR existence, perception of EDR safety benefits, and the perception of privacy and personal data concern due to EDR implementation in cars. This survey managed to gather 102 responses from members of the public in Malaysia where most of the respondents live in urban areas. Moreover, the majority of the respondents owned a car or drove a car from one place to another. The survey also asked about the participant's driving experience where 78 respondents have more than 15 years of driving experience. In addition, 12 respondents have 10 to 15 years of driving experience while the rest have 5 to 10 years of driving experience (6 respondents), 1 to 5 years (4 respondents), and less than a year of driving experience (2 respondents). The respondents' details are tabulated in **Table 1**.

3.1. EDR Awareness

The survey first investigates the awareness of the respondents on the existence of EDR in general, and whether EDRs are installed in their vehicles. The aim is to gauge whether the public is aware of the EDR and its functions. According to the result shown in **Figure 2**, it can be observed that 57.8% of the respondents are not aware of the

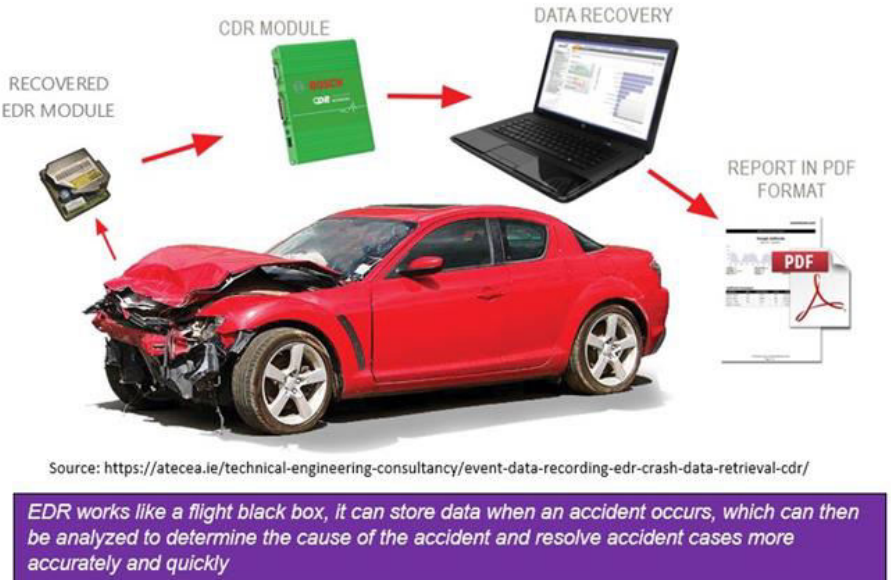
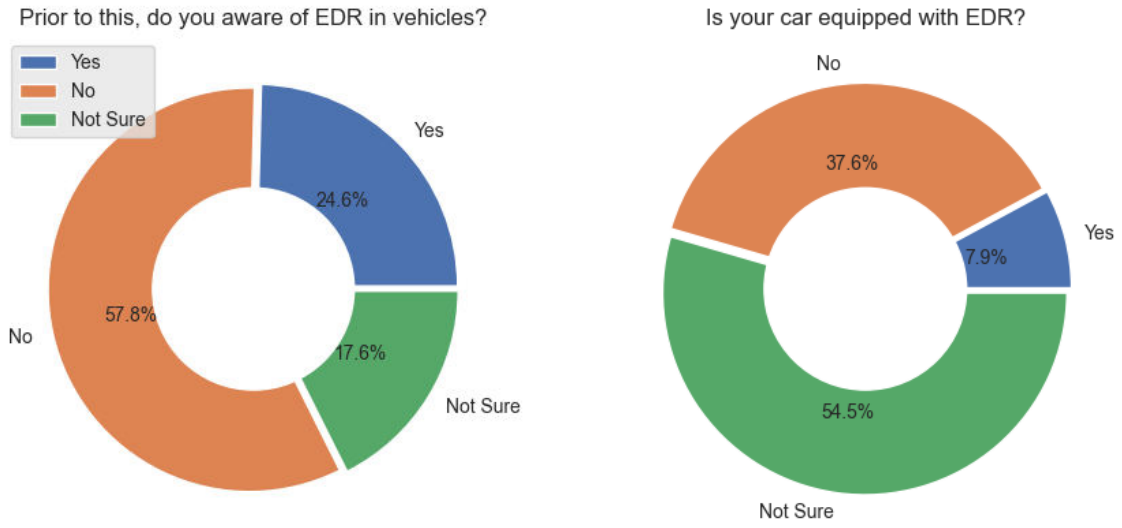


Figure 1. Brief introduction of EDR, as given in the survey

Table 1. The details of the respondents in this survey

Respondents' Details		Number of Respondents
Gender	Male	69
	Female	33
Residential	Urban	87
	Rural	15
Car Owner	Yes	98
	No	4
Car Driver	Yes	98
	No	4
Driving Experience	>15 years	78
	10 – 15 years	12
	5 – 10 years	6
	1 – 5 years	4
	< 1 year	2



(a) (b)

Figure 2. (a) Participants' awareness about EDR and (b) their responses on whether their vehicles are equipped with EDR

existence of EDR and 17.6% of the respondents are not sure themselves. This equates to 75.4% of respondents who aren't fully aware of EDR's existence.

Only 24.6% of respondents are aware of the existence of EDR. Meanwhile, only 7.9% of the respondents stated that their car was equipped with EDR, whereas 37.6% of respondents specified that their car is not equipped with EDR. Besides, most of the respondents are not sure (54.5%) whether their vehicle has EDR installed or not. This result shows that among the respondents, there is still low awareness of EDR. There is also a possibility that the respondents responding 'Yes' misunderstood the EDR as similar to the Airbag Control Unit (ACU). This is since none of the local car makers have EDR installed in their vehicles and there is also no obligation for either the local or foreign car maker to equip EDR in the cars sold in Malaysia. Thus, most of the members of the public are not fully aware of EDR and its functionalities. Besides, from this survey, 50% of the respondents stated that they learned about EDR through social media.

3.2. *Perceptions Towards EDR Benefits*

Subsequently, the survey investigates the perception of the respondents towards the benefits of EDR. The aim is to measure the respondents' attitudes by asking the extent to which they agree or disagree with a particular question regarding the benefits of EDR towards identifying accidents, improving driving

behaviors and vehicles as well as road safety. Figure 3 illustrates the results. According to Figure 3a, at least 72.3% of respondents agree that EDR can help identify the cause of accidents whereas 7.0% of the respondents believe that EDR cannot help in identifying the causes. Besides, in Figure 3b, it is apparent that 59.5% of respondents at least agree that EDR can make them drive more safely while only 14.8% of respondents have the opposite opinion on this matter.

Based on Figure 3c, more than 66% of respondents agree that the use of EDR can improve vehicle and road safety. While only 13% of respondents disagree with this statement showing that most respondents perceived EDR as one of the devices that will help improve overall safety. According to Figure 3d, 32% of the respondents stated that they have been in situations where EDR could have potentially helped them. Overall, in terms of the benefits of EDR, most respondents agree that EDR can help in the investigation of accident cases, improving their driving behavior and improve overall vehicle and road safety. One-third of the respondents also believe that EDR could have helped them in several situations that they had encountered before.

3.3. *Perceptions Towards Privacy and Personal Data Concerns*

In the final section of the survey, the respondents are asked several questions to investigate their perception of the impact of EDR on their privacy and personal data. They were also asked about their willingness to have EDR equipped in their vehicle and their data to be used

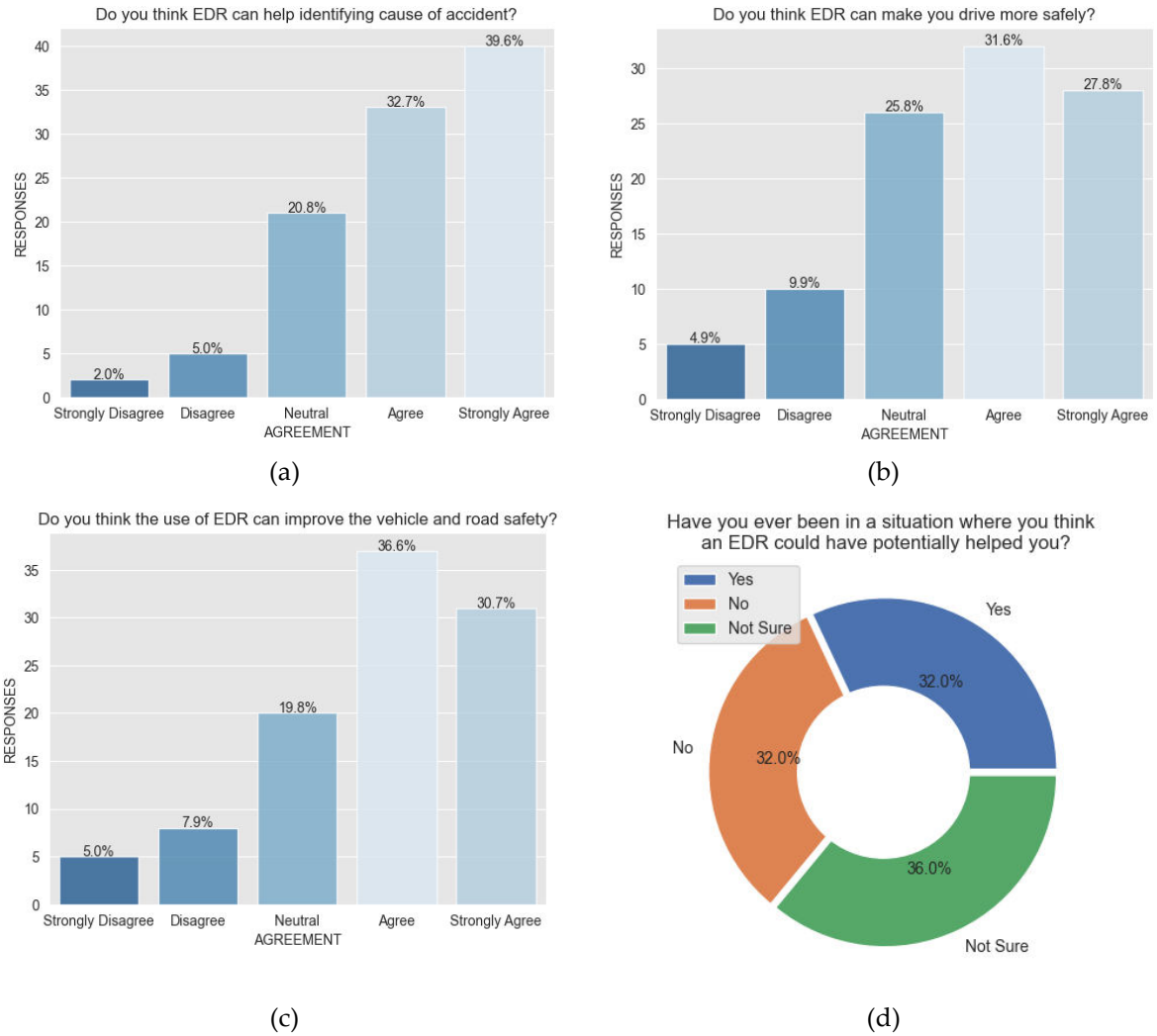


Figure 3. (a) Participants' responses on whether EDR can help in the process of identifying accidents' causes, (b) their responses on whether EDR can make them drive safely, (c) their perception towards EDR in improving the vehicle and road safety, and (d) their responses when asked whether EDR could have helped them before

in court. **Figure 4a** shows the respondents' responses regarding whether they agree to have EDR installed in their vehicle and to have their data used in court, which presumably could also be against them. Almost 80% of respondents agree to have EDR installed, and their data is used in court, which highlights that they are confident that the benefits of EDR potentially overcome its limitations. Among the reasons given by the respondents that agree, as shown in **Figure 4b**, are that EDR can help in accident investigation (45.9%), improve safety (24.3%), improve driving behavior (9.5%), helps in an insurance claim and vehicle warranty (2.7%) and good risk management (1.4%). Around 8.1% of respondents were unsure about the specific reasons to agree to have EDR. On the other hand, only 7% of respondents disagree to have EDR and their data used in court, stating that EDR could potentially increase vehicle cost (4.1%) and cause driving interruption (1.4%).

Furthermore, the respondents were asked to state whether they have concerns about the privacy implications of having EDR equipped in their vehicles. Based on **Figure 4c**, 40.3% of the respondents agreed that they have concerns about privacy implications whereas 31.7% of the respondents stated that they disagreed with the statement. The figure also indicates that almost 28% are neutral about this question because they have a divided opinion due to the lack of a clear definition of the functions of EDR and its data handling. Some of the reasons given by the respondents who have privacy concerns are shown in **Figure 4d**, include privacy breach (36.8%), there is the possibility that the EDR data will be misused (31.6%), leaked to a 3rd party (10.5%), false claim (7.9%). Interestingly, there is also concern about EDR collecting audio from the vehicle cabin (7.9%), and the possibility of EDR causing the vehicles and drivers to be more prone to crime and theft (5.3%) showing that some res-

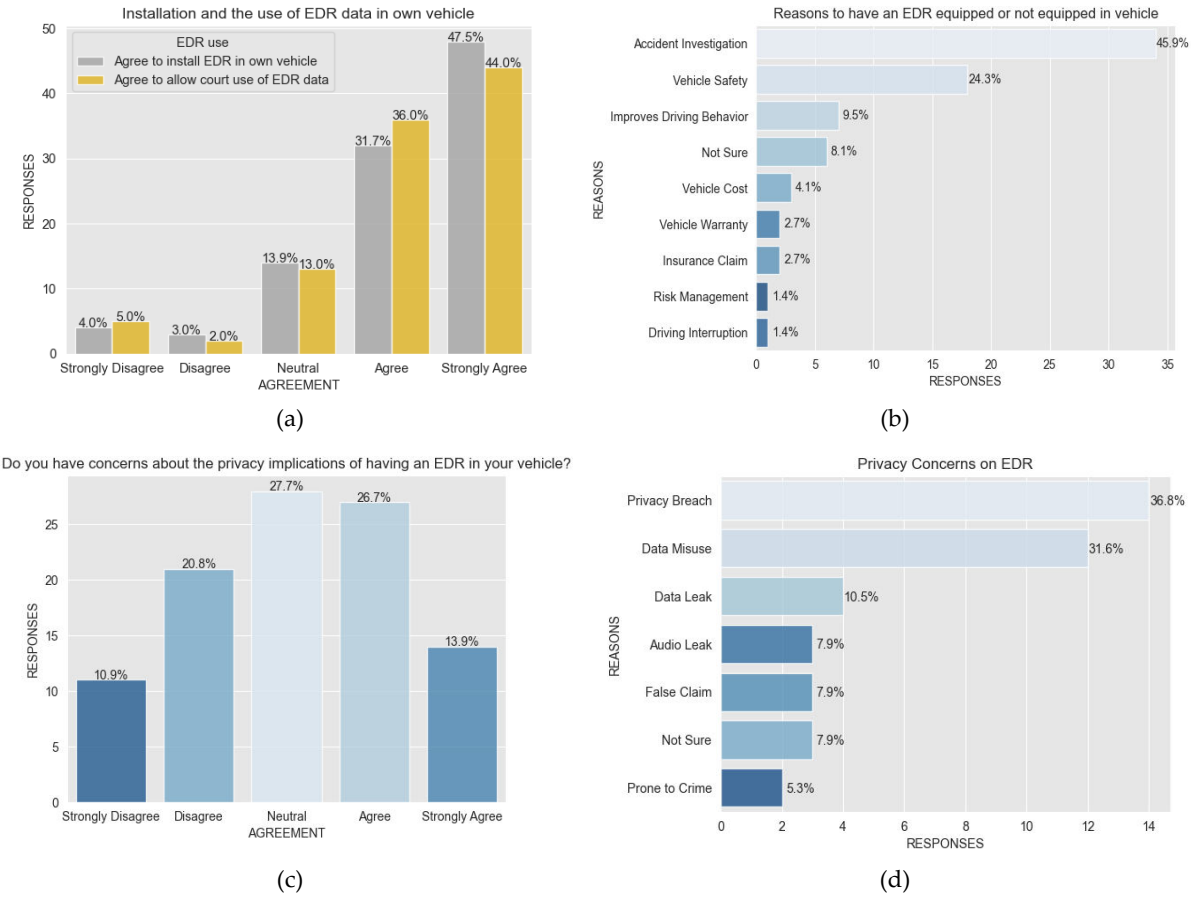


Figure 4. (a) Participants' responses when asked whether they agree to install EDR in their vehicle. They were also asked whether they would allow their EDR data to be used in court for accident cases, (b) reasons stated by the respondents who either agreed or disagreed to have EDR in their vehicles, (c) respondents' perceptions on the privacy implications if EDR is used in their vehicle, and (d) reasons stated by respondents who have privacy concerns on EDR

pondents are unaware of how the EDR works. Several respondents also mentioned that the EDR data should be handled according to Personal Data Protection Act (PDPA) 2010 to alleviate any concerns about data leaks and data misuse.

According to **Figure 5**, almost 70% of respondents stated that they agree to make EDR one of the selection criteria when buying new vehicles. Besides, 70% of respondents also agree that the government made EDR mandatory in new vehicles. Only 8% of respondents disagree with both statements, which highlights that most respondents acknowledge the importance and benefits of EDR in vehicles and would welcome any decision by the government regarding making EDR compulsory in new vehicles.

4. Conclusion

The gathered information from EDR can potentially be used by automakers to enhance design safety features. Even though the EDR has been made mandatory in the US and EU, its implementation in the ASEAN region, especially in Malaysia is still in the early stages. Thus, in this research, a survey was conducted to investigate the perception and awareness of the public toward EDR. Based on the findings from this survey, it has been found that 75.4% of respondents are not fully aware of EDR's existence in vehicles and 54.5% of respondents are not sure whether their vehicles are equipped with EDR or not. Despite that, 72.3% of respondents agree that EDR can help identify the cause of accidents and 59.5% of respondents agree that EDR can make them drive more safely. Besides, more than 66% of respondents agree that the use of EDR can improve vehicle and road safety. Additionally, almost 80% of respondents agree to have EDR installed in vehicles, and their data to be used in court. However, 40.3% of the respondents stated they have concerns about privacy implications from EDR usage. The main reasons for this concern are potential privacy breaches and misuse of EDR data. 70% of the respondents also stated that they will make EDR a new vehicle selection criterion and have full support if the government decides to make EDR mandatory in vehicles. These findings showed that the awareness of EDR is still very low among the Malaysian public, but they are confident about the benefits that EDR will bring and will support any regulations to make EDR compulsory. However, it is important for the policymakers and the responsible government agencies to handle the EDR data accordingly and to give assurance to the public that their data is secured and will be used only for the intended purpose.

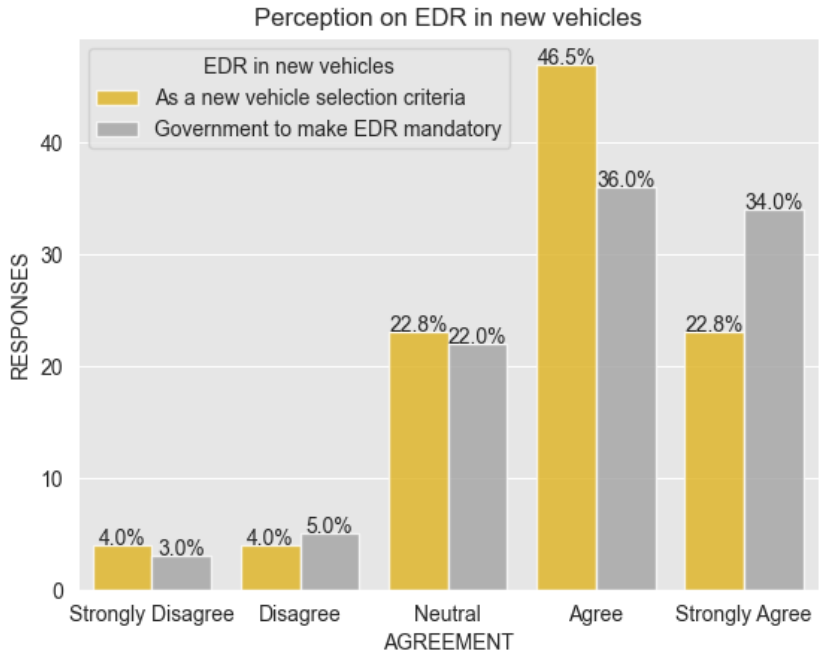


Figure 5. The respondents' perception of making EDR one of a criterion when buying new vehicles and whether they agree that the government makes EDR mandatory in new vehicles

Acknowledgments

This research is funded by the Society of Automotive Engineers Malaysia (SAE Malaysia) and Universiti Teknologi MARA (UiTM), Shah Alam, Selangor, Malaysia under the Research Grant Scheme No: 100-TNCPI/INT 16/6/2 (052/2022). The authors also gratefully acknowledge the College of Engineering, UiTM Shah Alam for all the support given during this research.

Author's Declaration

Authors' contributions and responsibilities

The authors made substantial contributions to the conception and design of the study. The authors took responsibility for data analysis, interpretation and discussion of results. The authors read and approved the final manuscript.

Funding

This research is funded by the Society of Automotive Engineers Malaysia (SAE Malaysia) and Universiti Teknologi MARA (UiTM), Shah Alam, Selangor, Malaysia under the Research Grant Scheme No: 100-TNCPI/INT 16/6/2 (052/2022).

Availability of data and materials

All data are available from the authors.

Competing interests

The authors declare no competing interest.

Additional information

No additional information from the authors.

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