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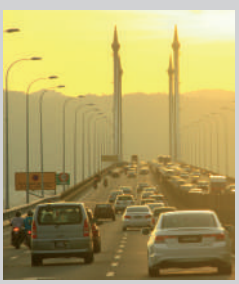

Research Report

Understanding Characteristics of Motorcycle-Car Crashes Using Self-Reported Approach: A Case Study

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Abstract

Road traffic crashes are becoming an increasing contributor to the mortality rate of Malaysians especially motorcycle users. Although various initiatives have been implemented in the country since decades ago, the number of motorcycle fatalities is still increasing. In order to propose effective intervention activities, accurate and in-depth information on crash data is needed so that certain issues can be prioritised. Due to limitations on existing crash databases, this study embarked on a new method of self-reporting to obtain additional information, especially on detailed crash configurations. In this study, an automotive company was selected as the study population to serve as a case study. Based on the self-reports from 141 participants, the findings revealed that most of the crashes involved males and aged in the 30s, were slight and severe injury cases, occurred during peak hours travelling to and from work places and were side and rear end collisions. It was also revealed that side impacts were primarily due to drivers' faults, specifically performing dangerous turnings at intersections. As for rear impacts, most faults lie with motorcycle riders who followed too close to the cars in front. These findings can be further explored by proposing specific intervention programs so that the number of commuting crashes and injuries can be significantly reduced among the workers. This self-reporting approach can also be replicated and improved for other settings.

1. Introduction

Malaysians rely largely on privately owned vehicles to travel. This is portrayed by the high number of registered vehicles in the country (23.8 million in 2013) which is dominated by cars (44.9%) and motorcycles (46.6%) (WHO, 2015). Despite almost equal exposure on the road based on numbers, as compared to cars, motorcycles are consistently the most vulnerable means of transportation in Malaysia's context. According to 2013 data, motorcycle users contribute 62% of the total fatalities, followed by car occupants (24%) (WHO, 2015).

Traffic crashes involving motorcycle users represent a very significant cost to the Malaysian society. Taking into account the estimated value of statistical life (VOSL) of RM1.15 million per motorcycle fatality (Mohd Faudzi et al., 2013), the number of fatalities involving these groups has cost the country approximately RM8 billion in 2013. If "Do Nothing" until 2020, it is statistically projected that the total number of road fatalities will increase up to 10,716; a significant loss to Malaysia which is estimated at RM20.6 billion (Rohayu et al., 2012).

Therefore, there is a need to "Do Something" in order to curb the situation. There are various initiatives and interventions from national to community levels that had been carried out to reduce the number of motorcycle crashes and injuries in Malaysia for the past 20 years. Despite the paramount efforts to improve the safety of motorcycle, the frequency of motorcycle fatalities is increasing and shows no sign of abating, or even declining in the near future (Abdul Manan & Várhelyi, 2012).

With that in mind, New Car Assessment Program for Southeast Asian Countries (ASEAN NCAP) has taken another step further through its strategic approach with regards to elevating the motorcycle safety from the perspective of car technologies. One of the six ASEAN NCAP strategic approaches aims to "encourage crash avoidance technology fitment in car, especially for saving motorcyclists" (Khairil Anwar et al., 2015). This

approach is necessary for road safety improvement in Malaysia as the main type of fatal collision involving a motorcycle in Malaysia is against a car (Abdul Manan & Várhelyi, 2012).

A similar situation can be predicted in other ASEAN countries as well due to the high number of crashes involving motorcyclists in the region. The highest contributors (more than 50% fatalities in each country) were recorded in Thailand (73%), Cambodia (71%), Laos (67%), Malaysia (62%) and Philippines (53%) (WHO, 2015). This could be attributed to the rapid motorisation in the region in which motorcycle is the dominating mode of transport as motorcycles constitute more than half of the registered vehicles in all countries except Singapore, with the highest in Vietnam at 95%.

Nevertheless, prioritization of car technology to be promoted in the program that can improve motorcycle safety has to be based on reliable data of motorcycle-car crashes in each country of the region, to properly address the unique underlying problem of each country. In Malaysia, although the existing Royal Malaysia Police (RMP) data can offer such information through its POL27 form, the raw data obtained from MIROS Road Accident Database System (M-ROADS) may not be reliable enough due to large missing values on key and targeted variables especially for non-fatal cases i.e. slight injury, serious injury and damage only. If further analysis is to be conducted on the "imperfect" data, it may be misleading and may not be representative of the real problems (Abdul Manan & Várhelyi, 2012).

Another option would be the data from MIROS' in-depth crash investigations by Crash Reconstruction Unit (CRU). As far as MIROS is concerned, most of the investigated cases were skewed to fatal crashes due to the criteria of cases. And according to the recent publication of four-year operation (2007-2010), motorcycles were the lowest vehicle type being investigated (Ahmad Noor Syukri et al., 2012). Thus, there is a need to establish an alternative method for collecting crash data in the country. One of the established methods is through self-reported survey. This method has been used to study numerous road safety issues through crash involvements from the perspective of road users (Marottoli et al., 1997; Mullin, 2000; Sagberg, 2006; Wood et al., 2009).

Thus, this study has employed a self-reported method in order to understand the characteristics of motorcycle-car crashes within a small scale sample as a case study. With this new approach of data collection in Malaysia, it is hoped that it can complement and enrich the existing RMP and CRU data in understanding the real situation of traffic safety in the country and related interventions can be properly addressed.

1.1 Aims and Objectives of the Study

The specific objectives of this study are:

i. To investigate the demographic profiles of motorcycle riders and car drivers who were involved in motorcycle-passenger car crashes.
ii. To determine the characteristics of motorcycle-passenger car crashes from the perspective of motorcycle riders.
iii. To determine the characteristics of motorcycle-passenger car crashes from the perspective of car drivers.

1.2 Scope and Limitation of the Study

The study population is limited to an automotive company in an urban setting. The selection of the company for this case study was based on the highest commuting crashes as reported by Social Security Organisation (SOCSO). In view of the limitation, future studies should be carried out to include respondents from different job sectors and rural areas.

2. Methodology

This study utilised a cross-sectional approach and a semi-structured interview with open and close-ended questions. The following subsections highlight the detailed methods specifically on the development of data collection form, selection of participants, data collection and data analysis.

2.1 Development of Data Collection Form

In order to capture the required parameters needed for the study objectives, two (2) sets of dedicated forms were used; Passenger Car Driver Form and Motorcycle Rider Form. Both of the forms were developed by using the traffic police investigation form (POL27) and also MIROS' in-depth crash investigation form. Crucial parameters needed for the study such as demographic profiles (age, gender, highest education and income level), characteristics of the said crash (including sketch of the crash scene), environment and vehicles involved were included in the developed data collection form.

2.2 Selection of Participants

An automotive company was chosen as the study population. The name of the company is not revealed in this paper due to confidentiality issue. The company was selected as it was listed as one of the companies with high commuting crashes in Klang Valley by SOCSO. The collaboration effort was initiated with the company's Safety Health and Environment (SHE) Department. It was also part of the company's initiatives in significantly reducing the involvement of their workers in commuting crashes especially those who frequently ride motorcycles to and back from their work places.

The selection of participants was those who had experienced any motorcycle crashes for the past five (5) years either as motorcycle riders or car drivers which had resulted in slight or severe injuries, and damage only cases. All participants were recruited from six (6) different departments in the company.

2.3 Data Collection

Prior to actual data collection, a pilot study was conducted among a small sample of the respondents to ensure that the designed data collection form was able to capture the required information accurately. In order to ensure the reliability of the information obtained from the respondents, the research assistants were trained regarding the interview process and how to properly engage with the respondents.

The study was conducted between February and March 2017 at six (6) different premises within the company. The briefing was conducted to all the participants stating the objective of the study and their information would not be revealed to ensure genuine responses. Figure 1 shows the data collection process being administered by a MIROS research assistant.

Representatives from SHE department were also present during each data collection to provide assistance in coordinating the flow of the data collection. In total, 235 questionnaires were distributed to the potential respondents; nevertheless, only 141 responses that met the inclusion criteria were analysed i.e. those who had been involved in motorcycle versus car crashes only, either from the perspectives of motorcycle riders (117 cases) or car drivers (24 cases).

2.4 Data Coding and Analysis

All the collected data were cleaned and pre-coded. The collected data set was also properly verified to ensure any missing information was dealt with before the data analysis began. As for the crash configuration and who was at fault, the drawings on the

crash scenes were partly utilised to verify participants' declared responses. To assess who was at faults, the right of way approach was mainly used as the basis of judgement. All the descriptive analyses, presented in the form of number (N) and percentage (%) or mean (SD), were performed using IBM SPSS Statistics Version 21.

Figure 1 Data collection at one of the six premises in the company

3. Results

3.1 Demographic Profiles and Crash Severity

Table 1 summarises the demographics of participants. From the total of 141, most of them were males (87.94%), married (80.14%) with the highest education of secondary schools (58.16%), and earned in the range of RM1001 until RM2500 (56.74%). Their age ranges from 19 to 57 years old, with mean of 37.79 (SD = 9.60). Further, more than half of these crashes (58.16%) involved slight injuries. From the total participants, 117 of them were involved in the crashes when riding motorcycles, whereas the remaining participants were driving cars.

Table 1 Demographic of participants

Variable		N (%)
Gender	Male	124 (87.94)
	Female	17 (12.06)
Highest education	Secondary school	82 (58.16)
	Diploma	41 (29.08)
	University	18 (12.77)
Income level	Less than RM1000	5 (3.55)
	RM1001–RM2500	80 (56.74)
	RM2501–RM4000	44 (31.21)
	RM4001–RM5500	4 (2.84)
	RM5501–RM7000	4 (2.84)
	RM7000 and above	4 (2.84)
Crash severity	Severe injury	25 (17.73)

	Slight injury	82 (58.16)
	Damage only	34 (24.11)

3.2 Crash Characteristics from the Perspective of Motorcycle Riders

From the 117 cases, only 51 (43.6%) lodged an official report to the police. Distribution of the cases in Table 2 suggested that most of the crashes happened during peak hours – 26 cases occurred during morning peak hour, while 23 cases occurred during afternoon peak hour. Most participants also reported the reasons for the trip were going to (41 cases) and came back from work (35 cases) – categorising these as commuting crashes.

Table 2 Time of collision for motorcycle riders' perspectives cases

Time band	Crash cases
0001–0501	1
0601–0700	5
0700–0800	26
0801–0900	3
0901–1000	5
1001–1100	1
1101–1200	4
1201–1300	6
1301–1400	4
1401–1500	5
1501–1600	5
1601–1700	8
1701–1800	23
1801–1900	6
1901–2000	7
2001–2100	5
2101–2359	3

The configurations of these crashes are shown in Table 3. The highest cases involved side collision (57.26%), either to the side of the motorcycle, or the car. The next prominent configuration is rear end collision (29.91%), regardless whether the hitter was motorcycle or car. Further scrutiny of these top two configurations revealed detailed configurations and the description of the faulty party on each relevant vehicle (see Figure 2 and Figure 3, respectively).

Table 3 Configurations of cases from motorcycle riders' perspectives

Type of configuration	N (%)
Side collision	67 (57.26)
Rear end collision	35 (29.91)
Side swipe	9 (7.69)
Front collision	4 (3.42)
Squeezed	2 (1.71)

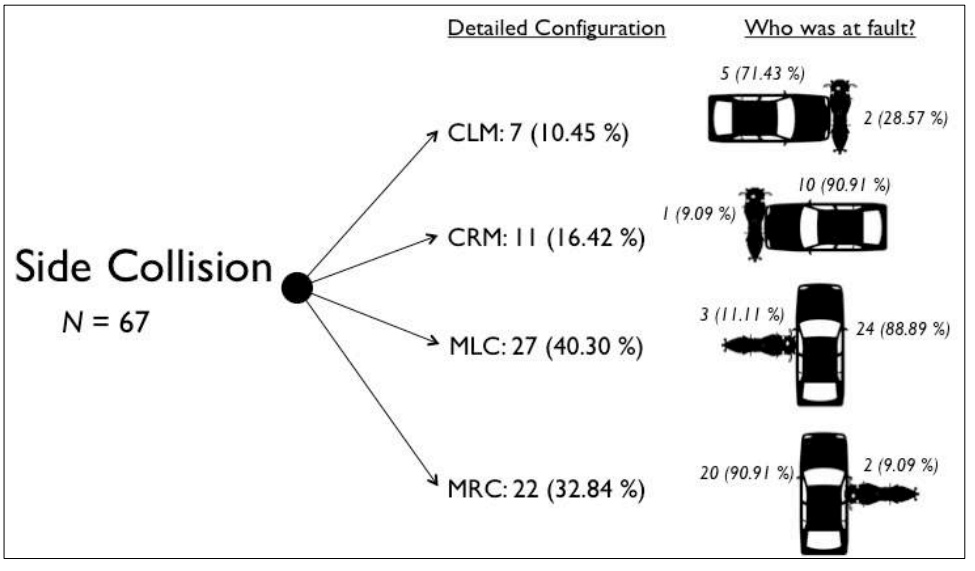

Figure 2 Detailed configurations of side collision cases for riders' perspectives

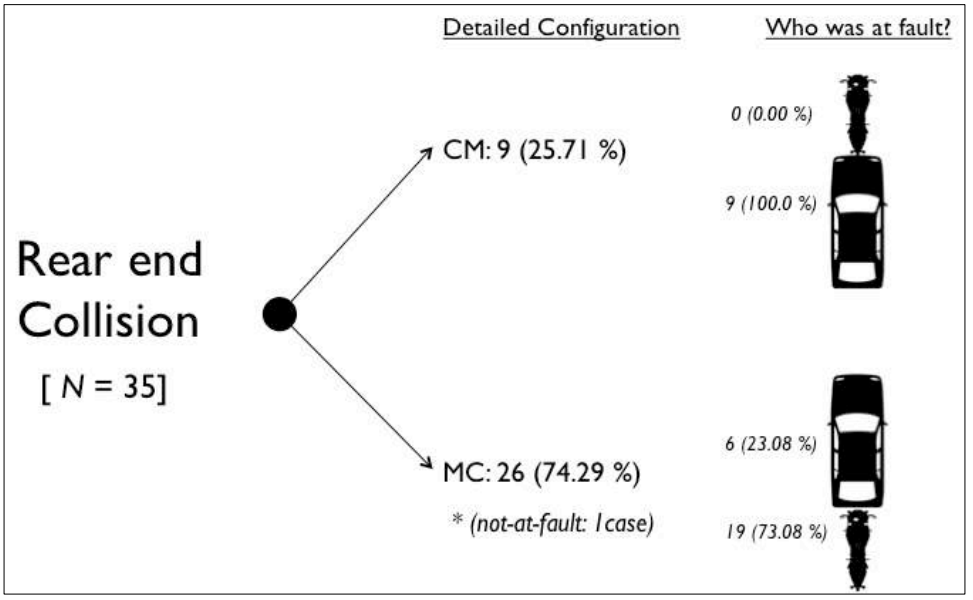

Figure 3 Detailed configurations of rear end collision cases for riders' perspectives

There were four (4) possible detailed configurations constituted side collision cases: car hitting the left side of motorcycle (CLM), car hitting the right side of motorcycle (CRM), motorcycle hitting the left side of car (MLC), and motorcycle hitting the right side of car (MRC). Among these four (4) configurations, the highest cases were MLC (40.30%) followed by MRC (32.84%), CRM (16.41%), and finally CLM (10.45%). Most of the side collisions occurred at either signalised or unsignalised intersections (64.2%). In every configuration, the faults were mostly attributable to the cars; which were mostly due to dangerous exit and entrance at intersections.

Rear end collision cases entailed two (2) possible detailed configurations: car hitting motorcycle (CM), and vice versa (MC). The former configuration contributed only to 25.71% of the studied rear end collision cases, whereas the latter was more dominant with 74.29% of the cases. As the nature of any rear end collision, the rear vehicle holds the responsibility of faults, except only one (1) case of MC. Most faults were attributed to motorcycle riders due to following too close to the cars in front.

3.3 Crash Characteristics from the Perspective of Car Drivers

From the perspective of car drivers, there were 24 relevant cases with only 13 (54.2%) of them were in the official police records. Similar to the cases of riders' perspectives, most of the cases were commuting crashes – they happened during the peak time of going to, and coming back from work (see Table 4). Half of the cases involved side collisions; while the next prominent configuration was rear end collisions (29.17%). Figure 4 and Figure 5 contain detailed configurations of these two (2) dominant configurations and the description of the faulty party on each subsequent vehicle.

Table 4 Time of collision for car drivers' perspectives cases

Time band	Crash cases
0001–0501	0
0601–0700	0
0700–0800	6
0801–0900	1
0901–1000	1
1001–1100	1
1101–1200	0
1201–1300	1
1301–1400	0
1401–1500	2
1501–1600	0
1601–1700	0
1701–1800	6
1801–1900	1
1901–2000	2
2001–2100	0
2101–2359	2

Table 5 Configurations of cases from motorcycle riders' perspectives

Configurations	N (%)
Side collision	12 (50.00)
Rear end collision	7 (29.17)
Front collision	3 (12.50)
Side swipe	2 (8.33)

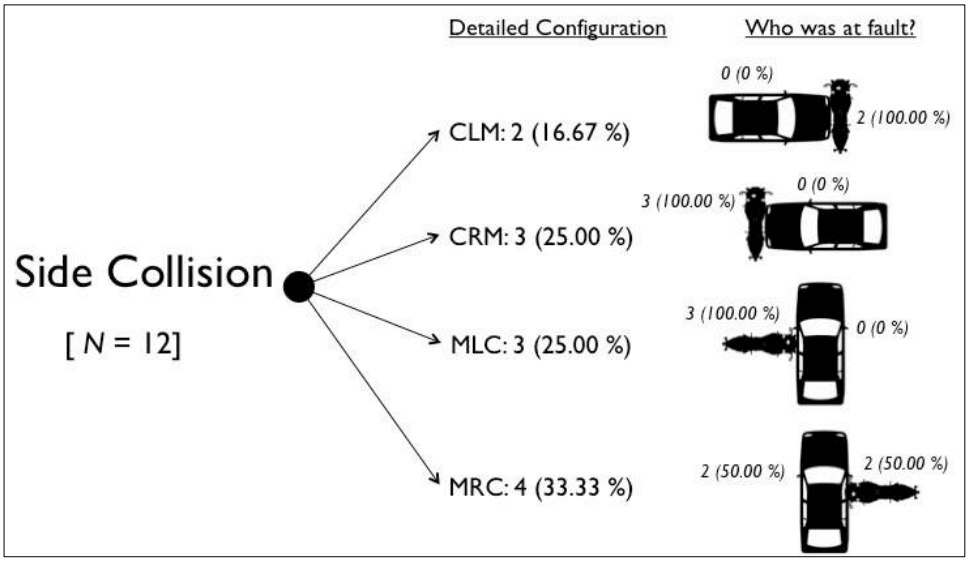

Figure 4 Detailed configurations of side collision cases for drivers' perspectives

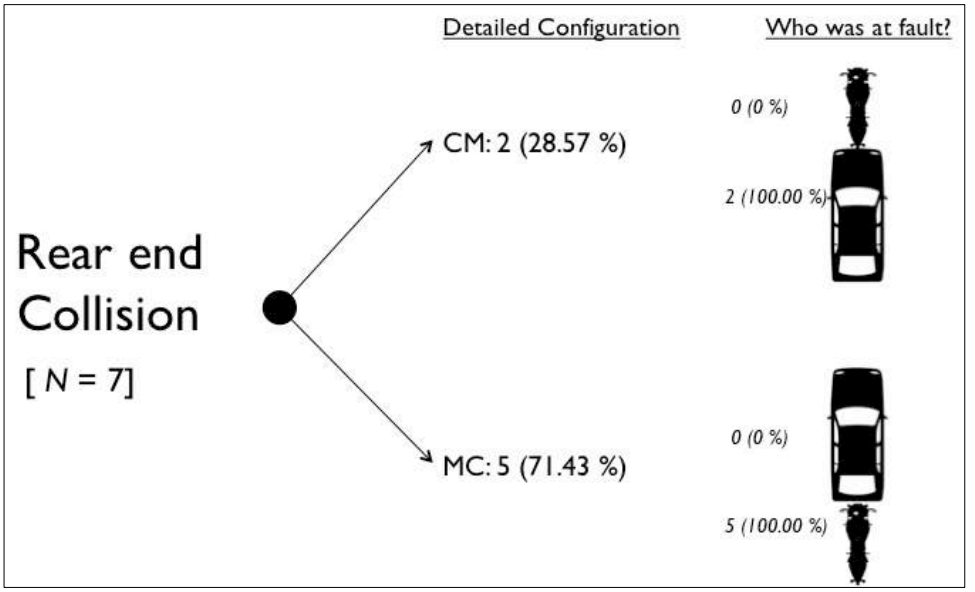

Figure 5 Detailed configurations of rear end collision cases for drivers' perspectives

The four (4) detailed configurations in riders' perspective cases were also applicable to drivers' perspective cases. The most frequent detailed configuration was MRC (33.33%); the next common configurations were MLC or CRM (both at 25.00%). CLM was the least common configurations (16.67%). In CLM, CRM, and MLC configurations, all of the cases were at the fault of motorcycle riders. Only in the case of MRC, both riders and drivers were equally at fault. The rear end collision crashes involved two (2) possible detailed configurations, of which MC (71.43%) is more common than CM (28.57%). In both configurations, respectively, motorcycle and car were at faults.

4. Discussions

The study set out to understand the user demographics, characteristics and collision scenarios of motorcycle-car crashes based on self-reports. Based on the self-reports from 141 participants, majority of the respondents were males and young (aged in the 30s). It was also revealed that most of the crashes occurred during peak hours travelling to and from works and were side and rear end collisions. The findings on the type of collisions are comparable with the RMP's recent statistical report which indicates that side and rear collisions are the main types of first collision for serious and minor crashes involving motorcyclists (Royal Malaysia Police, 2016).

For side collisions, most of the cases were at intersections and car drivers were mostly at faults. It was due to entering and exiting the junctions dangerously which can be further classified as risk taking behaviour, failure to judge the speed and distance of incoming vehicles and lack of hazard perception. Collisions caused by car drivers may also be due to driving under distraction and the tendency to commit violations such as red-light running and speed limit violation as exhibited in a Malaysian study on driver behaviour (Azman & Mohamad, 2016). On the other hand, a survey by VicRoads (2009) found that drivers have a stronger agreement than riders that they are unable to judge the speed or distance and predict the behaviour of motorcycle riders which may lead to a collision.

For rear end collisions, most faults lie with the motorcycle riders who mostly reported following too close to front vehicles. This can be seen in Malaysian roads where motorcycles tend to lane splitting and change lane suddenly. Noting that the majority of the participants were males and all collisions were non-fatal, a study by Pang et al. (2000) on the characteristic of motorcycle accident found that non-fatal accident is more likely to occur in presence of several factors including males and collision at junctions which coincide with the findings in this current study. Risk-taking behaviour was also found more prevalent among the males especially on speeding (Ibrahim et al., 2012).

Speeding behaviour among riders and the prevalent male participants may as well be the factors that affect the characteristics of the collisions.

In both rider and car driver perspectives, the collisions occurred mostly due to motorcycles crashing into cars regardless of who was at fault. This is another indicator of the vulnerability of motorcyclists on the road as also evidenced from the large number of fatalities and injuries involving the motorcyclists (Royal Malaysia Police, 2016). Based on the findings obtained from this study, it can be concluded that self-reported approach may provide detailed information on certain aspects such as crash configuration and who was at faults, as compared to RMP report and M-ROADS.

Despite that, there were also several limitations identified from this study. Firstly, there was a potential bias in the self-reporting approach i.e. the respondents tend not to report the actual situation. Secondly, the obtained information on common variables such as time of crash and information on crash scene were not verified with the RMP or SOCSO records. Thirdly, the number of severe injury cases and relevant cases from the perspective of car drivers were found to be relatively smaller as compared to slight injury cases and relevant cases from the perspective of motorcycle riders respectively. All of these limitations should be taken into consideration if similar approach is to be utilised for future studies.

5. Conclusions and Recommendations

Overall, these findings suggest that most of the workers involved in the motorcycle versus car crashes were male, aged in the 30s, sustained slight and severe injuries, commuted to and from work places and involved in side and rear end collisions. With the vision to reduce the frequency of commuting crashes and injuries in the selected company and based on the findings of the study, the following recommendations can be considered:

i Establish a commuting safety program targeting specific motorcycle safety issues as stipulated in the findings such as managing conflicts at intersection with specific modules on hazard perception, safe positioning, gap acceptance and situational awareness.

ii Include other best practices as highlighted in the SIRIM 4:2014 (Good practices in implementing commuting safety management) such as route hazard mapping and family safety reminder.

iii Introduce and implement MS ISO 39001:2013 – Road Traffic Safety Management Systems certification. This will require management commitment in combating the high number of commuting crashes and injuries in the company as well as encouraging safer travel cultures among the workers.

Although the findings cannot be generalised for the whole population in Malaysia as it only covers a sample from an automotive company in an urban setting, the self-reporting method used in this study can be improved and extended to other job sectors and rural areas.

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