ASSESSING MOTORCYCLISTS RISKY RIDING BEHAVIOUR AT THREE-LEGGED STOP-CONTROLLED JUNCTIONS

SHEE TIAN HAO

SCHOOL OF CIVIL ENGINEERING
UNIVERSITI SAINS MALAYSIA
2021

ASSESSING MOTORCYCLISTS RISKY RIDING BEHAVIOUR AT THREE-LEGGED STOP-CONTROLLED JUNCTIONS

by

SHEE TIAN HAO

This dissertation is submitted to

UNIVERSITI SAINS MALAYSIA

As partial fulfilment of requirement for the degree of

BACHELOR OF ENGINEERING (HONS.)
(CIVIL ENGINEERING)

School of Civil Engineering
Universiti Sains Malaysia

October 2021

Appendix A8

UNIVERSITI SAINS MALAYSIA

SCHOOL OF CIVIL ENGINEERING
ACADEMIC SESSION 2020/2021

FINAL YEAR PROJECT EAA492/6
DISSERTATION ENDORSEMENT FORM

Title: ASSESSING MOTORCYCLISTS RISKY RIDING BEHAVIOUR AT THREE-LEGGED STOP-CONTROLLED JUNCTIONS.

Name of Student: SHEE TIAN HAO

I hereby declare that all corrections and comments made by the supervisor(s)and examiner have been taken into consideration and rectified accordingly.

Signature:

Date : 4/8/2021

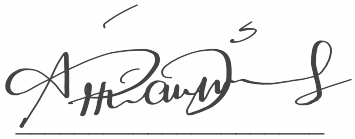
Endorsed by:

(Signature of Supervisor)

Name of Supervisor: Assoc. Prof. Ir. Dr. Leong Lee Vien

Date: 4/8/2021

Approved by:



(Signature of Examiner)

Name of Examiner:

ASSOC. PROF. DR NUR SABAHIAH ABDUL SUKOR
SCHOOL OF CIVIL ENGINEERING
UNIVERSITI SAINS MALAYSIA (ENGINEERING CAMPUS)
14300, NIBONG TEBAL, PULAU PINANG
H/P:+60176159561
Email:cesabahiah@usm.my ; sabahiah@gmail.com

Date: 5 . 8. 2021

(Important Note: This form can only be forwarded to examiners for his/her approval after endorsement has been obtained from supervisor)

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to each and every one, who directly or indirectly, helped me throughout this research study. First and foremost, I would like to express my sincere gratitude to my supervisor, Assoc. Prof. Ir. Dr. Leong Lee Vien for her guidance, continuous support for my Final Year Project study and research.

Besides, I would also like to express my gratitude to Mr. Rasidi Razak, Mr. Shamsul Ishak, Mr. Mohd Mazlan Kamis@Mahmad and Mr. Zulhairi Ariffin, assistant engineers for their guidance during the preparation of fieldwork. I would also like to thank my fellow course mates for their assistance in the work of data collection.

Last but not least, I would like to express my utmost gratitude to my family for their unconditionally supports, patience and encouragements as none of this could have happened without them.

ABSTRAK

Kajian ini dilakukan untuk mengetahui tingkah laku penunggang motosikal yang berisiko di simpang T konvensional dan tidak konvensional. Simpang T Jenis A adalah simpang T biasa, simpang T tidak konvensional Jenis B mempunyai lorong pendek secara eksklusif bagi kenderaan dari jalan utama untuk membelok ke kanan dan jalan bergabung pendek pada pendekatan penerimaan di jalan utama untuk bertindak sebagai lorong keluar untuk kenderaan yang membuat belok kanan dari jalan kecil dan simpang T Jenis C mempunyai lorong pendek secara eksklusif bagi kenderaan dari jalan utama untuk membelok ke kanan dan jalan penggabungan pendek pada pendekatan penerimaan di jalan utama yang bertindak sebagai jalan keluar untuk pergerakan melalui jalan utama. Secara amnya, terdapat lapan kelakuan penunggang motosikal yang berisiko iaitu "RB1-motosikal menunggang tanpa memakai topi keledar", "RB2-tidak ada isyarat ketika membelok", "RB3-tidak menyalakan lampu pada waktu siang", " RB4-menunggang di jalan yang salah", "RB5-melintasi persimpangan tanpa berhenti sepenuhnya", "RB6-menunggang atau melakukan belokan yang tidak sesuai dengan cara pusingan", "RB7-berhenti selepas talian berhenti "dan" RB8-bermain telefon bimbit semasa menunggang motosikal". Berdasarkan dapatan kajian ini, Simpang T jenis A konvensional mempunyai peratusan penunggang motosikal tertinggi dengan tingkah laku berisiko tetapi ia adalah simpang T yang paling selamat di antara 3 jenis persimpangan. Tingkah laku menunggang berisiko dilakukan oleh penunggang motosikal di simpang T Jenis A mempunyai akibat yang lebih rendah berbanding dengan tingkah laku menunggang berisiko lain seperti "RB5 melintasi persimpangan tanpa berhenti sepenuhnya" yang akan membawa akibat serius kepada penunggang motosikal dan pengguna jalan raya yang lain. Ini kerana penunggang motosikal yang melintas jalan tanpa berhenti sepenuhnya adalah salah satu situasi paling berbahaya di simpang T, kelakuan ini akan

mempengaruhi hierarki hak jalan di simpang T dan membahayakan pengguna jalan raya lain terutamanya mereka yang melalui jalan lurus dari jalan utama di simpang T. Selain itu, simpang T jenis B menunjukkan prestasi terbaik di antara 3 persimpangan T. Berdasarkan "RB5 melintasi persimpangan tanpa berhenti sepenuhnya", Ini menunjukkan bahawa penunggang motosikal di simpang T Jenis B sangat agresif ketika membuat belokan kanan baik dari jalan utama atau jalan kecil. Walaupun tingkah laku menunggang berisiko ini mempunyai akibat yang ketara kepada pengguna jalan raya, tetapi ia juga menunjukkan bahawa penunggang motosikal di simpang T jenis B mempunyai keyakinan yang agak tinggi ketika melintasi persimpangan dengan membersihkan kawasan konflik.

ABSTRACT

The study was done to determine the motorcyclist risky riding behaviour at conventional and unconventional T-junction. Type A T-junction is a typical T-junction, while Type B unconventional T-junction with a short lane exclusively for right-turning from major road and short merging lane on the receiving approach on major road to act as the exit lane for a vehicle making right turn from minor road and Type C unconventional T-junction with an exclusive right turn exit lane from major road and a short merging lane on the receiving approach on major road which acts as the exit lane for the through movement from the major road. Based on-site data collection, in general, there are eight risky riding behaviour of motorcyclists determined, which are "RB1-riding motorcycle without wearing helmet", "RB2-no signal when turning", "RB3-not switching on the headlight during daytime", "RB4-riding on the opposite or wrong side of road", "RB5-crossing a junction without fully stopping", "RB6-riding or performing a turn that is not according to the right of rule", "RB7-stop after the stop line" and "RB8-playing mobile phone". Based on the discussions, Type A conventional T-junction has the highest percentage of motorcyclists with risky behaviour. Still, it is the safest junction among the three types of junctions. Based on the findings of this study, although Type A conventional T-junction has the highest percentage of motorcyclists with risky behaviour, but it is the safest junction. Those risky riding behaviours commonly performed by the motorcyclists have a lower consequence as compared with other risky riding behaviour like "RB5-crossing a junction without fully stopping" which will bring serious consequences to the road users. This is because motorcyclists crossing a road without fully stopping is one of the most dangerous situations at the T-junction, it will affect the hierarchy of the right of way at T-junction and it will danger other road users. Apart from that, Type B unconventional T-junction showed the best performance. Based

on “RB5-crossing a junction without fully stopping”, it has revealed that the motorcyclists at Type B junction are very aggressive when making a right turn either from major or minor road. Although this risky riding behaviour has undeniable consequences to the road users, it has also shown that the motorcyclists at Type B unconventional T-junction have relatively high confidence when crossing the junction by clearing the conflict area.

TABLE OF CONTENTS

LIST OF TABLES

Page

LIST OF FIGURES

Page

CHAPTER 1

INTRODUCTION

1.1 Background

Motorcycle is one of the most famous modes of transport in Malaysia. The statistics showed that 80 percent of Malaysian households have a motorcycle (Poushter, 2015). This is because motorcycle is one of the most reliable modes of transport in Malaysia to commute around from place to place. This reliable mode of transportation can guarantee shorter travel time. It is also easy to find a parking spot in any parking lot area. Referring to ASEAN Stats Data Portal from Table 1.1 showed that the total number of registered motorcycles had increased dramatically between 2010 and 2019. There was a significant increase in the number of registered motorcycles from 9,441,910 to 14,322,230 ("ASEAN Stats Data Portal," 2019).

However, riding a motorcycle has a higher possibility of being involved in an accident than other modes of transport. Over the past few years, there has been an increasing trend of accidents that involving motorcyclists. Based on Figure 1.2, the statistic showed that motorcycle is the highest number of new registered motor vehicles in Malaysia in 2020. Therefore, Malaysia has an associated high level of road accidents involving motorcyclists compared with other modes of vehicles. Based on the value of Malaysia Road Fatalities Index by Malaysian Institute of Road Safety Research (MIROS), on average, approximately 18 persons killed in road crashed every day in Malaysia. It had become a big challenge for the Malaysian government to reduce the number of road accidents, significantly reducing the death rate of the road user in Malaysia. Although the Malaysian government had put lots of effort into this issue and shown a steady decreasing trend, motorcyclists are still ranked the highest road fatalities.

Based on Figure 1.1, motorcycle fatalities are roughly two times higher than car fatalities, six times higher than pedestrian fatalities, and almost 30 times higher than bicycle fatalities.

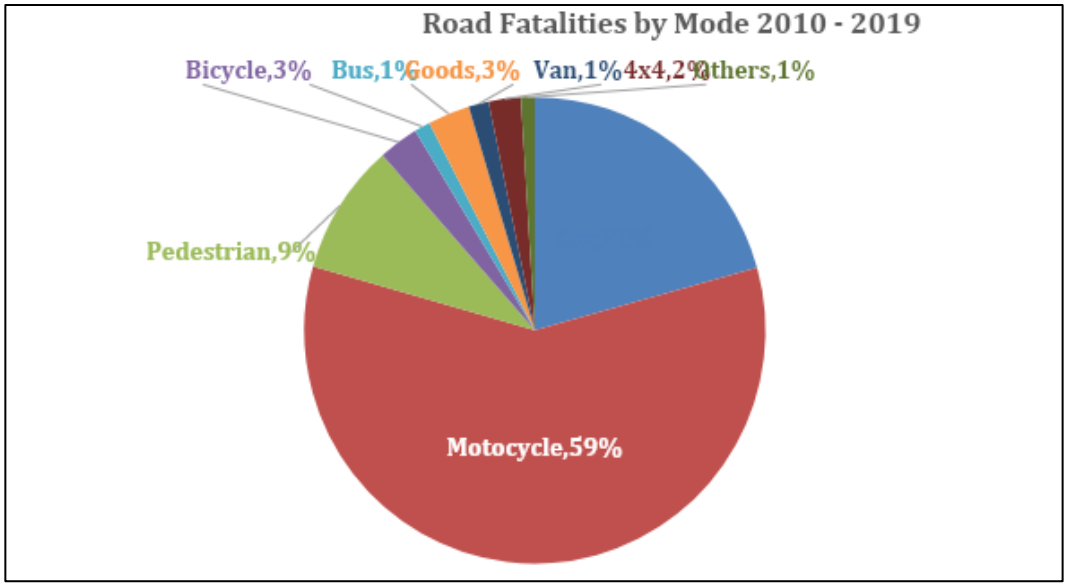


Figure 1.1: Road Fatalities by Mode 2010 – 2019 (Ministry of Transport Malaysia, 2021a)

There are multiple reasons for this discrepancy, including unsafe lane changes, speeding, lane splitting, sudden stops of the vehicle, poor road condition, motorcycle defects, risk-taking behaviours of young drivers, mobility impairment of older drivers, etc. Based on the problems listed, the main factor for this discrepancy is the motorcyclist's behaviour, and it is pointed to the human element as the leading cause (Bucsuházy et al., 2020). The common denominator of human mistakes seems to lack adequate information - from the road, the road environment, other road users, and the vehicle. Hence, various ways had been pointed out to improve the road user performance, such as education, training, enforcement; and multiple ways to adapt road design and delineation, road signs and signals, rules and laws, and vehicle dynamics to human characteristics and limitations (Rumar, 1982).

Apart from that, intersection brings vehicles to form different approaches and directions together. Hence, it is more prone to accident occurrence, especially the stop-controlled junction. This is because, under the stop-controlled junction, drivers are required to come to a complete stop at the intersection and proceed if only no vehicles are approaching from any of the uncontrolled approaches and there are no pedestrians in the intersection. Hence, it might endanger the vehicle that is approaching an intersection that does not require a stop as the vehicle from different approaches might not see your vehicle, make any unexpected moves, or misjudge your speed. Therefore, the possibility of accidents at the stop-controlled junction is higher than signalized intersections as the riding behaviour of the motorcyclist at the two types of junctions is significantly different.

The primary goal of this study is to determine the motorcyclist's risky riding behaviour at unconventional three-legged stop-controlled junctions by comparing it with the conventional three-legged stop-controlled junctions through an observational study. The difference is conventional T-junction is a typical three-legged junction without any short lane on major road, while unconventional T-junction has either a short right-turn/through lane at the far side of major road or a short exit lane at the far side of major road (Leong et al., 2020). The video camera is installed and used to record the motorcyclists' behaviours at the selected stop-controlled T-junctions. The collected data is extracted, analysed and compared among the selected stop-controlled T-junctions.

Table 1.1: Total number of registered motorcycles (in thousand) (“ASEAN Stats Data Portal,” 2019)

Country	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Brunei Darussalam	2.59	3.28	4.00	4.00	6.00	3.00	10.27	10.31	-	-
Cambodia	236.61	218.22	233.50	244.97	303.18	342.08	464.97	381.40	502.70	540.00
Indonesia	61,078.19	68,839.34	76,381.18	86,253.00	94,243.00	10,0457.00	106,538.00	108,594.00	114,786.00	106,654.00
Lao PDR	804.19	818.34	1,005.00	1,111.96	1,218.00	1,318.00	1,413.00	1,504.00	1,593.00	1,697.38
Malaysia	9,441.91	9,985.31	10,589.82	11,087.88	11,629.26	12,094.79	12,677.22	13,173.07	13,725.95	14,322.23
Myanmar	1,881.00	1,934.00	3,153.20	3,419.00	4,162.00	4,505.00	5,122.70	5,640.07	5,997.52	6,069.30
Philippines	3,482.15	3,881.00	4,117.00	4,251.00	4,489.00	4,623.00	5,330.00	6,174.00	7,162.00	8,014.00
Singapore	148.00	147.00	144.00	144.00	144.00	143.00	143.00	142.00	137.00	141.00
Thailand	17,322.54	18,174.92	19,169.42	19,987.19	20,327.76	20,519.50	20,497.30	20,717.65	21,099.53	21,425.04
Viet Nam	31,155.00	33,774.00	36,894.00	38,643.00	41,197.00	44,128.00	47,131.00	54,063.00	58,169.43	62,035.00

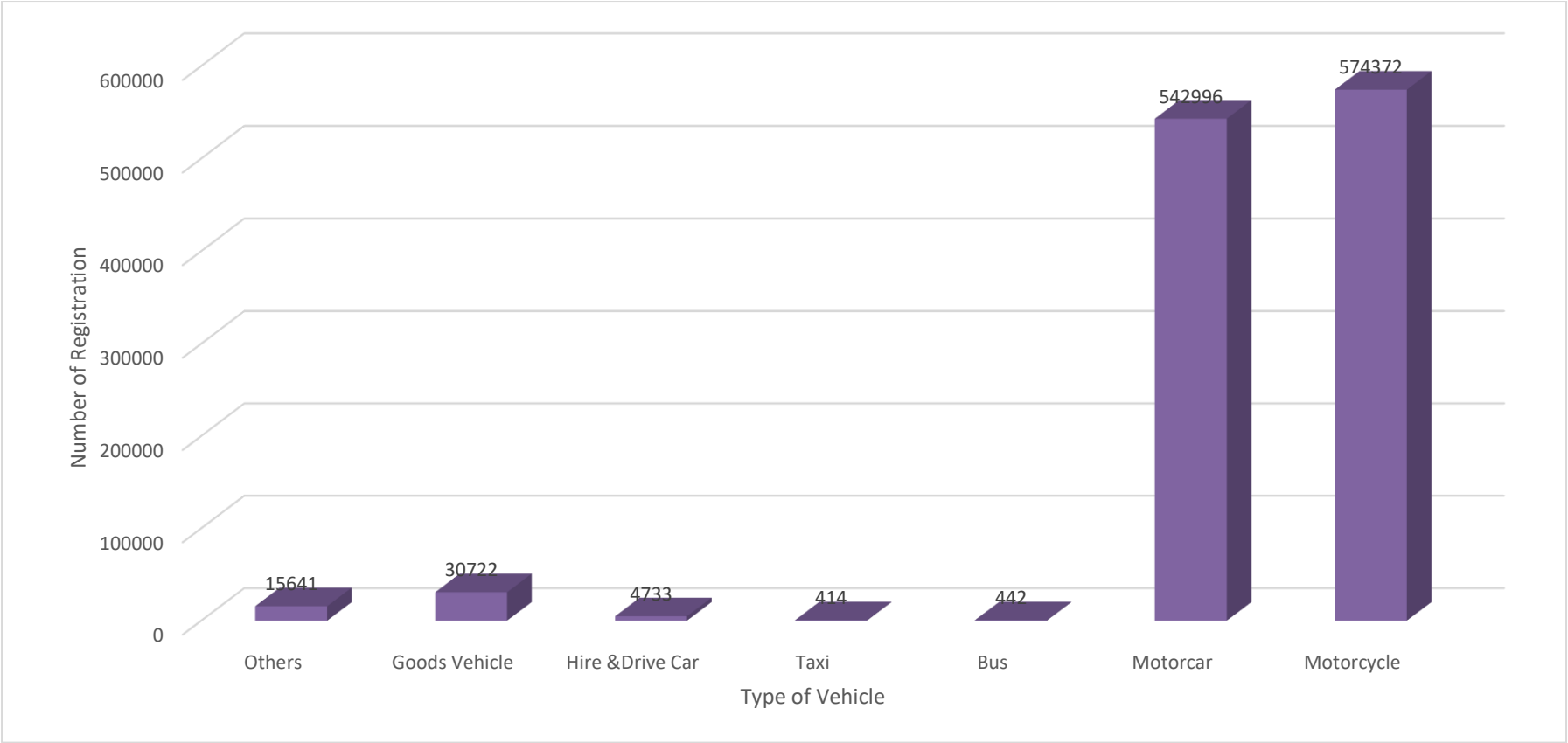


Figure 1.2: New Registered Motor Vehicles By Type, Malaysia, 2020 (Ministry of Transport Malaysia, 2021b)

1.2 Problem Statement

As a developing country, motorcycle has become an affordable mode of transport for Malaysian. Based on data obtained from "Two Wheeler Market was the best in ASEAN" (2021), Malaysia motorcycles two-wheelers market rebounds in June with sales up 24.5%. However, motorcycle is more likely to the caused accident as compared to other modes of transport. A total of 6,167 road accident deaths were recorded in 2019, with 64% of fatalities involving motorcyclists (Chung, 2020). There are many contributing reasons for road accidents, including vehicle, road, and human factors. But the most often factors contributing to the road accident is human behaviour or condition (Bucsuházy et al., 2020). However, most of the research is focusing on the typical or conventional T-junctions. Therefore, there is lacking the research on the motorcyclist's risky riding behaviour at unconventional three-legged stop-controlled junctions. As well as the comparison of the risky riding behaviours of the motorcyclists between conventional and unconventional T-junctions.

1.3 Objectives

The objectives of this study are:

1. To assess the risky riding behaviours of motorcyclists at typical three-legged-stop-controlled junction.
2. To compare the motorcyclist risky riding behaviour between typical or conventional and unconventional three-legged stop-controlled junctions.
3. To determine the risky riding behaviours of motorcyclists from major and minor roads at unconventional T-junctions.

1.4 Scope of study

The field study is carried out at two unconventional and one conventional three-legged stop-controlled junctions. There are eight risky riding behaviours of motorcyclists at different types of junctions will be observed through observational study. Video camera is installed and it will be extracted and analysed then we compared with other direction of travels and junctions.

1.5 Thesis organization

This dissertation contains 5 chapters. Chapter 1 is introduction which includes background of the study, problem statements, objectives, and scope of works. Chapter 2 is literature review which discusses more in-depth background of the study, usually citing other researchers' journals and research papers. Chapter 3 is research methodology, which discuss about the procedures that were taken out to achieve the listed objectives. A flow chart was illustrated to present the procedures more clearly. Chapter 4 is results and discussion which will records the results obtained and the discussion of the results will explain in detailed in this chapter. Lastly, chapter 5 is about conclusion which is to summarise everything that was mentioned in the previous chapters and draw conclusions on the research.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

Many studies have found out that drivers' risk behaviour would influence the possibility of motorcycle crash accidents at T-junction. Researches on the risk behaviours have been extensively conducted.

In this chapter, literature reviews on previous research studies that have any similarity or relationship with this study are carried out to understand this study's objectives. In section 2.2, risky behaviour has been discussed. Based on the study by Hirschberger et al. (2002), the value control of risk-taking behaviour is vital for human decision-making, which involves a degree of risk in terms of the outcomes and probability of those outcomes. In sections 2.3 and 2.4, peer and parental influence on motorcyclists' risky riding behaviours are reviewed. Law enforcement is discussed in section 2.5. Based on the study by Satiennam et al. (2020), the research concluded that the fatality rate of the motorcyclists decreases when the efficiency of law enforcement increases. In section 2.6, drivers' behaviour at the stop-controlled junction is presented. On-site behaviour observation is discussed in section 2.7.

2.2 Risky Behavior

Risky behaviour refers to one's purposive participation in some form of behaviour that involves potential negative consequences or losses as well as perceived positive consequences or gains. Indeed, many lives decisions entail striking a balance between expected gains and losses (Ben-Zur and Hasida Zeidner, 2009). Besides, risky behaviour can be explained as a mechanism in which a person decides that the potential benefits outweigh the risks. However, this process is always unnecessary, objective

assessment of gains and losses. Instead, the subjective utility value of risky behaviour is often determined by various individual and situational variables. This may lead people to participate in risky behaviours, underestimating the risk of adverse outcomes even though the danger is objectively serious (Hirschberger et al., 2002). Human decision-making also involves a degree of risk in terms of the effects and probability of those outcomes. All in all, the consequences of our decisions and behaviours are almost impossible to foresee with absolute certainty. In these circumstances, a decision-maker engages in risk-taking actions. Therefore, the value control of risk-taking behaviour is vital for human decision-making (Hirschberger et al., 2002).

Motorcycles are overrepresented in fatal and severe injury accidents for a variety of reasons, including susceptibility to injury, inexperience or lack of recent experience, driver inability to see motorcycles, instability and braking difficulties, as well as road surface and environmental hazards. For instance, risk-taking in motorcycling includes purposely not following the road rules, riding without a license, riding under the influence of drugs and alcohol, and riding unhelmet (Haworth et al., 2009). High-risk behaviours became the main factor of accidents. This can be explained by the risks' increasing characteristics of young or inexperienced riders and their tendency to perform overtly risky behaviours on their riding style, the excitement of motorcycling, and a desire for speed were found to be predictors of behavioural errors (Sexton et al., 2004)

2.2.1 Speeding

Speeding is one of the significant factors associated with road accidents. Excessive speeding is defined as a vehicle exceeding the applicable speed limit, but it varies from country to country. Some describe it as going 10% to 20% above the posted speed limit. Excessive speeding is categorized as inappropriate and risky driving

behaviour. A total of 18% of at-fault motorcycle accident fatalities are associated with speeding, based on the Malaysia police record (Abdul Manan et al., 2017). In Thailand, speeding was the most significant determinant of traffic collisions based on A 2015 World Health Organization (WHO) Report. Several types of research for this gender difference had been carried out. It shows that males are more likely to speed on the road than females (Stephens et al., 2017). This is because males are considered high-risk takers toward road safety issues, where a high-risk taker means a greater preference for risk-taking behaviours (Zhang et al., 2014).

2.2.2 Distracted riding

Distracted riding, including mobile phone usage, is a significant concern that affects road traffic safety all over the world. Driver distraction can be defined as ‘‘the diversion of attention away from activities critical for safe driving/riding toward a competing activity”. Distraction occurs when a driver or rider engages, willingly or unwillingly, in a secondary activity that interferes with the performance of the primary driving task. The human brain has a limited supply of attention. Humans can perform two functions simultaneously without one degrading understanding of the other and only if the functions demand no more than the limited supply of attention. In addition, they must be as dissimilar as possible. Riding a motorcycle and having a chat with a passenger are different tasks. So, provided the traffic is light, and the conversation is simple, the two tasks can be combined with relative ease. If an unexpected traffic event occurs, however, the driver will usually stop talking because the combined demands of the tasks are too high (Fernández et al., 2016).

Similarly, if the conversation becomes too complex, driving performance will suffer. Hence, it is showed that distracted riding is the primary cause of road accidents.

According to the findings of a study by a group of Vietnamese university students, nearly 81 percent of university students in Hanoi and Ho Chi Minh City admitted to using a phone while riding a motorcycle (Truong et al., 2017). The more mobile phones use while riding a bike, the higher than chances or opportunities to get involved in a road accident (Truong et al., 2019).

2.2.3 Motorcycle Helmet

Motorcycle helmet is an essential gadget that helps to reduce the head injury of motorcyclists during an accident. The death rate of motorcyclists during an accident was dominated by the non-usage of helmets (Abbas et al., 2012). However, wearing a helmet that does not met the safety requirement or standard will not reduce morbidity and mortality in motorcycle accidents. It will cause tragedy for those non-usage helmet motorcyclists. Hence, enforcement of motorcycle helmet laws should be tightened for the motorcyclists and those motorcycle helmet suppliers. Furthermore, the development of closed-circuit television (CCTV) applications can help the authority in many ways, especially law enforcement. It can capture the motorcyclists without a helmet and send the image of the violating motorcyclist to authority to take necessary actions (Wonghabut et al., 2018).

2.2.4 Turn signal

Turn signal is one of the main contributing factors to road accidents. Most drivers or motorcyclists know that using a turn signal when making a turn at a junction is essential, but most neglected it. Putting a turn signal can alert other drivers of motorcyclists about your intention to change direction or make a turning. Failure to make

a turn signal before making a turn or changing lanes is crucial. It not only breaks the traffic rule but will also put other drivers of motorcyclists into a dangerous spot because they cannot predict or guess your movement. Based on Nguyen-phuoc et al. (2020), the findings showed that 17.54% of the motorcyclists were involved at least once in a road accident due to failure to put turn signal. Besides, the turn signal usage is different under the different traffic conditions. When there is an oncoming vehicle at the junction, the use of turn signal is 63% and 43.7% when there are no oncoming vehicles (Lebbon et al., 2010). Furthermore, road type and turn direction are the leading indicators to determine turn signal usage rate (Sullivan et al., 2014). Moreover, perceived risk, beliefs, and environmental characteristics correlate with the usage of turn signals among motorcyclists at junctions (Nguyen-phuoc et al., 2020).

2.2.5 Wrong way of riding

Wrong way of riding indicates that the motorcyclist rode in the opposite direction of the road. It has the very high opportunity to cause a road tragedy especially head on collision between 2 vehicles. Normally, it happens in rural area, suburban area or highly congested area. Besides, wrong way of riding occurred mainly due to the time saving factor and short distance traveller. Based on the research by Umniyatun et al. (2021), the finding showed that more than 50% of motorcyclists in Jakarta metropolitan area, Indonesia had have at least once involved in wrong way of riding.

2.3 Peer Influence on Motorcyclists' Risky Riding Behaviours

Adolescents are known for their impulsive risky behaviour, particularly when they are around their peers. Adolescence is marked by novelty seeking and impulsive

risky behaviour, as well as a greater desire for social recognition than children and adults. As a result, as shown by reckless driving, teenage risk-taking is much more likely to occur in the presence of peers. Adolescents showed increased activation in reward-related brain regions during peer observation, and this behaviour predicted future risk taking (Kwon et al., 2014). Peer influence is described as direct peer pressure, as well as other social processes involving peers and involving peer influence on the adolescent. It's not shocking that teenager are influenced by their peers, considering how enjoyable it is for them to spend time with their peers. After all, as children grow older, they gain more freedom from their parents and their peer group becomes more essential. Adolescents, particularly during middle adolescence, are more likely to conform to their peer group and follow the styles, beliefs, and desires of their peers due to the increased importance of peers. As a result, adolescence is an important time for others to shape one's self-concept, especially peers. Peer influences can be direct, such as encouraging adolescents to engage in risky behaviours by inciting them to do so, or indirect, such as encouraging adolescents to engage in risky behaviours because they believe their peers would find them attractive and anticipated. The mere presence of teen passengers, for example, can alter teenage driving behaviour by causing distraction by acts in the car, such as talking, changing the radio channel, moving about, and etc. Furthermore, direct encouragement of reckless driving behaviour by motivating the driver to drive quickly or overtake another vehicle is one example of peer influence. Besides, peer pressure may have an indirect effect on a teen's driving style; for example, a teenager may be pushed to drive in a more or less reckless manner because he or she believes that the teen passengers may find such behaviour attractive or seductive (Smorti et al., 2014).

2.4 Parental influence on Motorcyclists' Risky Riding Behaviours

Numerous studies indicate that parental influence play a significant role in the driving behaviour of their adolescent children. Teens who report high levels of parental control and driving restrictions are less likely to participate in unsafe driving activities, as well as report traffic violations and accidents, than those who report less restrictions and less monitoring. Furthermore, teenage children of parents who often supervise their teen's driving and limit access to a car record less speeding and higher awareness of road safety such as more seat belts use (Orit Taubman and Liat Katz, 2012). Positive relationship between parent and child as well as high levels of obedience to authority were linked to greater support for the cautious driving style, while family noncommitment to protection, higher peer pressure, and lower obedience to authority were linked to greater support for the reckless driving style. Furthermore, more personal dedication to safe driving and a lower preference for unsafe driving were linked to positive aspects of the family environment for road safety and a lower perceived popularity of reckless driving among friends. The discussion emphasises the importance of examining the complex collection of antecedents of reckless driving among young drivers, as well as the findings' practical implications for road safety (Orit Taubman, 2011).

2.5 Law enforcement

Law enforcement plays a vital role in road safety as well as road accident. For example, the rate of helmet use in many countries in the Association of Southeast Asian Nations region has increased where efficiency of helmet law enforcement has increased over the last 10 years. Directly or indirectly, it shows decreased fatality rate among motorcycle users when the efficiency of helmet law enforcement is increased (Satiennam

et al., 2020). The most efficient speed feedback sign was one that was accompanied by periodic law enforcement. Furthermore, it was shown that by combining periodic law enforcement with the speed feedback symbol, the decrease in average speed and the proportion of vehicles exceeding the speed limit could last long after the speed control strategy was implemented. To put it another way, the presence of regular law enforcement could theoretically change drivers' attitudes and improve the spatial efficiency of speed feedback signs (Karimpour et al., 2021). Based on the research by Rolison et al. (2018), It reveals possible underreporting of causes in current accident reports, as well as inadequacies in law enforcement procedures for investigating driver distraction, drug and alcohol impairment, and uncorrected or impaired eyesight. Besides, the research also mentioned that it is important to check and revise the accident report forms on a regular basis to ensure that contributing factor lists represent the full spectrum of factors that lead to road accidents. The major obstacle to general traffic-law enforcement is a lack of public support. However, no driver wants to be in a road accident, yet almost all drivers disobey traffic laws at some time, such as by speeding. According to the findings by Redelmeier et al. (2003), over 10 million people for more than a decade and found that convicting drivers for traffic violations lowers the incidence of fatal accidents. Each conviction reduces the relative risk of death for drivers and other road users by 35% over the next month. Each conviction that is not released, on the other hand, increases the risk. It also implies that raising the level of traffic enforcement will minimize overall fatalities even more, that emphasizing moderate punishment is beneficial, and that previous procedures resulted in certain deaths that would not have occurred otherwise.

2.6 Drivers' Behaviour at Stop-controlled Junction

At intersections, the most common motorcycle accident happens when another road user violates an oncoming motorcyclist. Normally, it is a car that is pulling out into the junction and the car driver often claims being careful and attentive with their visual checks but nonetheless having failed to see the approaching motorcycle. This is commonly termed the 'Look But Fail To See' error. While it's likely that the driver in these situations failed to see an approaching motorcycle, it's also possible that they're alleging a lack of visual attention when another factor is to blame. One explanation is that the car driver does not want to confess to committing a wilful driving violation, such as acknowledging a potentially dangerous gap in traffic (Robbins et al., 2018).

Most of incidents typically involve another vehicle failing to give way to a motorcycle at a junction. Such accidents may not be the motorcyclist's fault, but they may face serious injuries (Crundall et al., 2017). Intersections have been classified as the most dangerous locations in urban traffic due to the higher situation awareness requirement caused by the complex traffic environment. In European countries, roughly 60% of severe injuries in traffic accidents occurred at intersections. In United States, 47% of road accidents happened at intersections and these intersection crashes contributed to over 50% of crash injuries (Li et al., 2019). Based on the result from Talbot et al. (2020), when fatalities of all road user types are considered, one third occurred at junctions. When the focus is on riders only, roughly about 44% of the road fatalities occurred at junctions. The most common cause is the other vehicle driver not seeing the rider or misjudging the speed/distance of the rider.

Furthermore, conflict area is also one of the major factors which lead to road fatalities, such as road intersection which is a critical road network element, where two or more roads meet. Stop-controlled T-junction or unsignalized intersection is often a

major crash-prone spot. There are many conflicting points at the unsignalized intersection and there is no any indicator like traffic light to command the vehicles movement from crossing the junctions and merging into the traffic flow. Hence, the behaviour at the stop-controlled junctions is totally dependent on the drivers' risk behaviour and decision taken. Figure 2.1 shows all the conflicting points and possible movement of a T-junction.

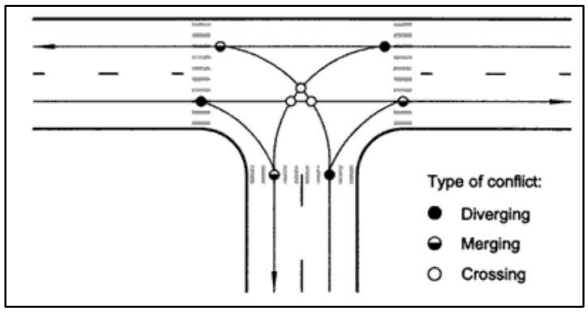


Figure 2.1: Conflicting points and possible movements of T-junction

2.6.1 Stop line

At the stop junction, motorcyclists are required to stop completely before the stop line before leaving the junction. This is because it will give more time to the motorcyclists to glance for the traffic and wait for their opportunity to cross or turn out of the junction. However, there are motorcyclists showed that they want to do whatever they can to avoid their foot on ground when approaching the stop junction. Besides, weave technique is used by the motorcyclists to lower their speed at the same time remains erect (Muttart et al., 2011). Based on Abdul Manan and Várhelyi (2015), the researchers showed that there are less inclined of the motorcyclists to obey the stop line rule, 97% of the studied motorcyclists did not stop at the stop line.

2.6.2 Right of way

One of the most common collision or accident involving motorcyclists are due to right of way. This is because motorcyclists have a very limited judgment on the space and speed of the approaching vehicle (Pai, 2011). Hence, most of the victims claimed that they did not see the approaching vehicle until the accident happened. Motorcycles are the group of vehicles that is commonly neglected but other type of vehicle like car due to the it' size. However, motorcycles have the same right like other type of vehicle. If the right of rule of motorcyclists is not followed by the road user, an accident will occur (Sager et al., 2014).

2.6.3 Conflicting movement

Based on the internationally accepted definition by Amundson and Hyden (1977), they defined traffic conflict is "an observable situation in which two or more road users approach each other in space and time for such an extent that there is a risk of collision if their movements remain unchanged". Based on the findings from Leong et al. (2020), it showed that the presence of a short right-turn exit lane at T-junction can reduce the conflict between right-turn movement from the minor road with through movement of the major road. Therefore, outcomes from this study are important as they can contribute to improving the design approach of T-junction.

By referring to the Highway Capacity Manual 2000 with the aid of Figure 2.2 and 2.3, right of way of the two way stop-controlled intersection is assigned based on the hierarchy. Rank 1 indicates all conflicting movement yield the right of way to any through movement vehicle and right-turning vehicle (left-turning in Malaysia) on the major road approaches (Traffic Streams 2, 3, 5, and 6). It has the highest priority among

the movement at the intersection. Vehicle from the other approach have to stop their vehicle to let the vehicle from the major approach to move straight or turn right (left turning in Malaysia).

Rank 2 allows the vehicles from the major road turning left (right-turning in Malaysia) into minor road yield only to the through and right-turning vehicles (left-turning in Malaysia) on the major road conflicting movement. Vehicles which make a right-turning movement (left-turning in Malaysia) from minor road only yield to the through movement from the major road (Traffic Streams 1, 4, 9, and 12).

Rank 3 represents the vehicles from minor approach moving straight (Traffic Streams 8 and 11), but required to yield to all conflicting movement from major road.

Rank 4 illustrate the left-turning movement (right-turning in Malaysia) (Traffic Streams 8 and 11) yield to all conflicting movement from the main road as well as the conflicting movement from minor approach including through and right-urning vehicles (left-turning in Malaysia).

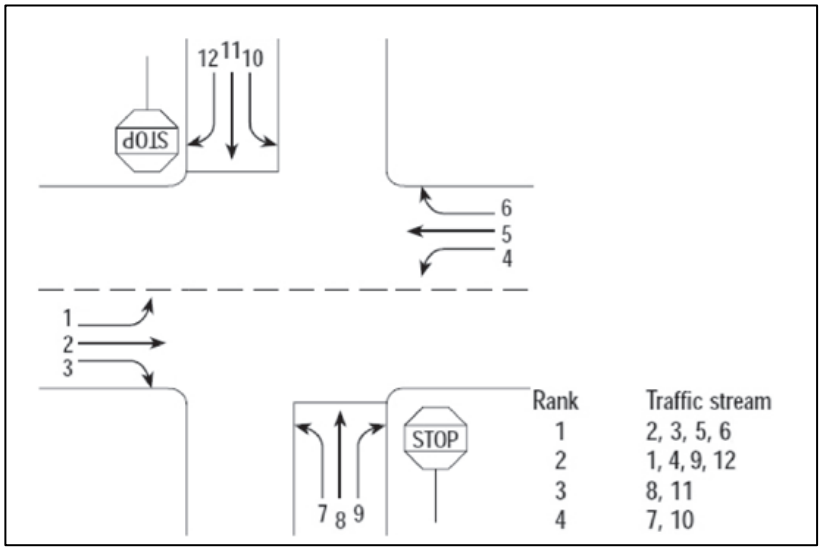


Figure 2.2: Traffic streams and ranks at standard four-legged two-way stop-controlled intersection

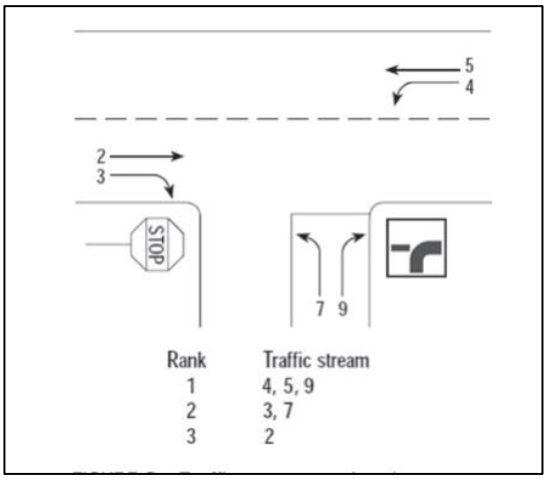


Figure 2.3: Traffic streams and ranks at standard four-legged two-way stop-controlled intersection

2.7 On-site Behavioral Observations

Self-reported studies such as questionnaire, survey, and interviews may have validity issues. This is because survey respondents may not know the seriousness and frequency of risky behaviour or exaggerate symptoms. Besides, the validity issues of the studies depend on the maturity and responsibility of the respondents. Furthermore, the dominant disadvantage of self-report studies might be the possibility of providing invalid answers. While responding to the items, respondents may not answer truthfully, especially on sensitive questions. Acquiescence bias (the tendency to provide positive answers to questions when in doubt) and social desirability bias (the tendency to react in a way that respondents feel would be perceived favourably) are both possible sources of bias in self-report, and both forms of bias may be more prevalent among socially disadvantaged groups (Lofters et al., 2015). Self-report studies are that they are subjective in nature. Furthermore, survey instruments are ideally structured to measure attitudes and values, so attitudes frequently seep into responses even when respondents are directly asked to disclose their actions. Others have proposed that, rather than objective actions, self-reports represent individuals' interpretations of their behaviour , behavioural motivations or other negative values and attitudes (Kormos and Gifford,

2014). Based on the previous studies, it shows that self-report studies have tons of limitation. Hence, observational study is applied.

Observational studies collect naturalistic data on riders' behaviours without influencing traffic conditions. This analysis focuses solely on behavioural observation studies in which the road user is not aware of their involvement in the research project either before or after the study. This is a major different because natural settings in which road users are unaware that they are being monitored minimize prejudice created by modifying one's actions when they are aware that they are being observed and increase the probability of seeing the full range of activities, including dangerous and violent driving. While it is impossible to guarantee that road users going through the observation site are unaware that their behaviour is being observed, it is unlikely that they will have enough time to adjust their behaviour if they intend once the observing equipment has been identified. Furthermore, behavioural observation studies record the actions of all road users travelling by the observation site, while naturalistic driving studies track the behaviour of a small group of participants over time (vanHaperen et al., 2019). Based on the previous studies by Abdul Manan and Várhelyi (2015a), in order to reduce serious traffic conflicts, there is a need to establish the relationship between the behavioural variables and the resulting serious traffic conflict and it would give the information on what behaviour and attributes to influence.

Furthermore, based on the recent observational study by Varhelyi (2018), it shows the potential risk factors attributed by the rider and motorcycle and it has a high possibility of the conflict occurrence and it illustrate list of potential variables as risk factors via the table below.

Table 2.1: Different type of potential risk factor variables that could be observed onsite (Varhelyi, 2018)

Category	Coding
Age	young / middle-aged / old
Gender	male / female
Protective clothing	helmet: not worn / worn securely fastened / worn loosely foot protection: considerable foot protection / no foot protection sun glare protection: yes / no
Visibility of the rider	clothing: striking / dark / light motorcycle appearance: striking / not striking headlight: on / off
Motorcycle condition	good / fair / poor
Approach behaviour	fast approach / slow approach
Turning signal usage	activated / not activated
Stopping behaviour	passing without slowing down / slowing down and creeping / full stop
Position of stopping	at the stop line / after the stop line
Head movement	none / only to the right / only to the left / in both directions
Eagerness to enter	eager / calm
Gap on major road	limited / ample
Entering angle	sharp / right-angle
Behaviour during entry	hesitancy: hesitant / non-hesitant cautiousness: cautious / not cautious eye contact with approaching vehicle: yes / no
Manner of entry into the flow on major road	enters after a passing vehicle / enters in front of a passing vehicle / squeezes in-between two consecutive vehicles / opposite indirect right turn
In case of traffic conflict	evasive action by subject rider: yes / no evasive action by vehicle on major road: yes / no

A video camera is set up at the site to assist the data collection process because it provides better data than a human observer. This is because it records behavioural variables permanently for data analysis. Since video footage can be revised as compared with eyes observation on-site. Video camera has clearly showed his capability of being a better data analysis tool. When the traffic flow is at its peak, the on-site observer is prone to making wrong decisions, which may result in data errors. Hence, video camera is essential for observational study.

CHAPTER 3

METHODOLOGY

3.1 Overview

This chapter discusses and presents the research methods used to perform the study on Malaysian motorcyclists' dangerous riding behaviours. First of all, the field study is carried out at two unconventional and one conventional stop-controlled junction. For the preliminary site survey, suitable T-junctions are chosen based on certain parameters, such as suburban location, geometry, motorcycle volume, and so on. The "Street View" function in Google Earth is used to view the actual situation of junctions to ensure that the selected stop-controlled junction meet the criteria before carrying out preliminary site survey. Besides, half an hour of the video recording was taken for preliminary site survey. It is carried out in order to ensure there is sufficient motorcycle volume and to identify the risky behaviours that could occur at the junctions. After the site has been confirmed, video cameras are used to record the riders' behaviours at the area during the data collection stage. Then, observation of the risky behaviour of the motorcyclist were conducted via the video recording. Furthermore, the risky behaviours of motorcyclists were extracted and analysed. Lastly, we discussed and compared the risky riding behaviour of motorcyclists at conventional and unconventional T-junctions. Figure 3.1 shows the flowchart of the research methodology that has been adopted in this study.

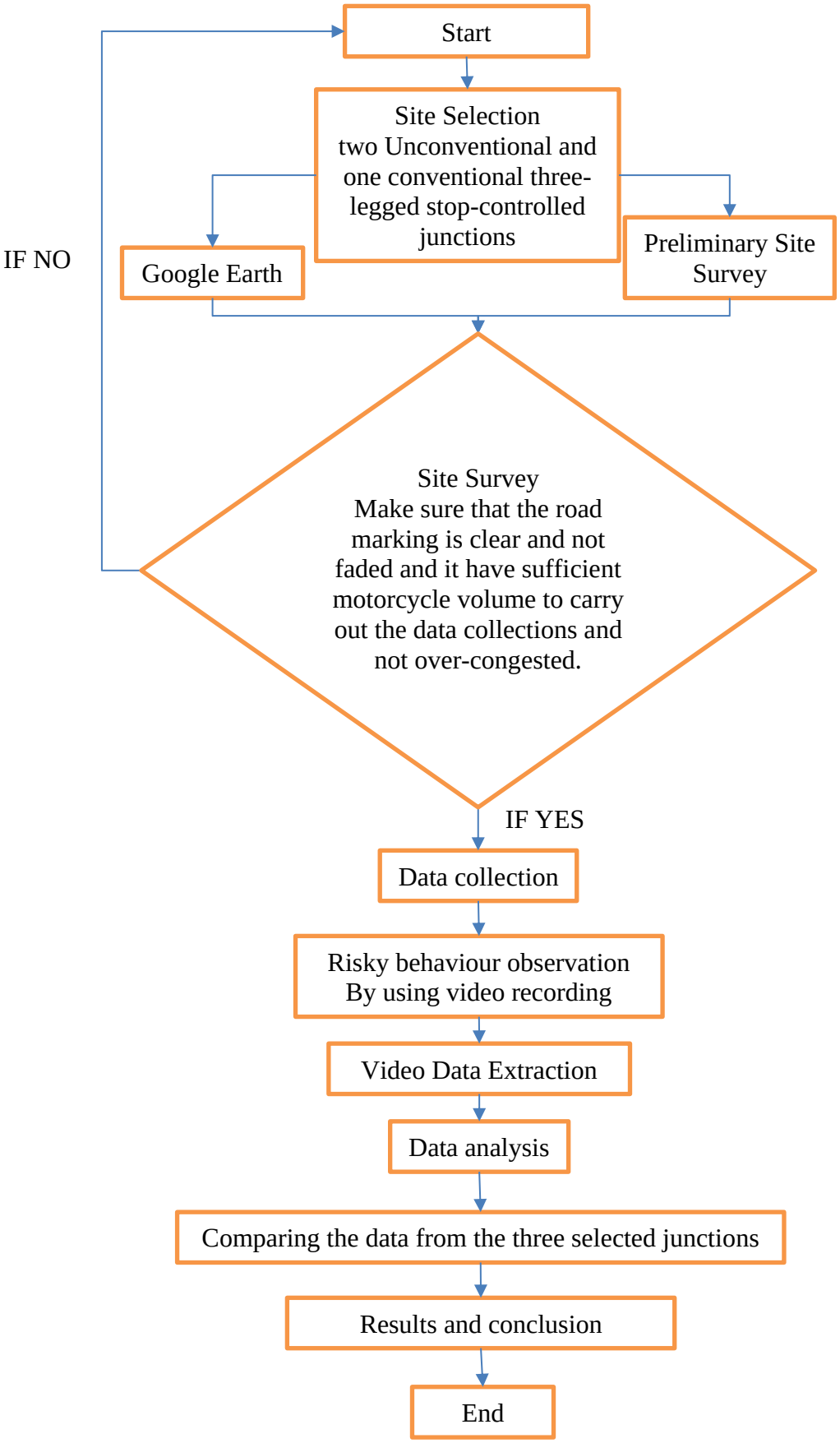


Figure 3.1: Flowchart of the research methodology