INVESTIGATION ON THE RELATIONSHIP BETWEEN SAFETY FEATURES AND SAFETY RATING: A CASE STUDY ON MALAYSIAN NATIONAL CAR

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This report is submitted
In fulfillment of the requirement for the degree of
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DECLARATION

I declare that this project report entitled “Investigation On The Relationship Between Safety Features And Safety Rating: A Case Study On Malaysian National Car” is the result of my own work except as cited in the references

Signature : .....

Name : .....

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APPROVAL

I hereby declare that I have read this project report and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering.

Signature :

Name of Supervisor:

Date :

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Date :

DEDICATION

To my beloved mother and late father

ABSTRACT

ASEAN NCAP is an organization that evaluate the safety rating of the car. There are two protocol system used by ASEAN NCAP which are 2012-2016 protocol system and 2017-2020 protocol system. The difference between both protocol are the used of single rating for 2012-2016 protocol system and overall rating for 2017-2020 protocol system. Safety rating is being given by ASEAN NCAP based on crash test of the car. Safety features of the car is divided into two categories which are active safety and passive safety. This rephrase focused on passive safety only (airbag and seatbelt). This research is focused on Malaysian national car only. Three selected models of national car that have used 2012-2016 protocol system have been used in this research for calculation in the first objective. As mentioned, there is no calculation has been done before on the three selected models using the 2017-2020 protocol system. In Malaysia, there is no study about the effectiveness of safety features on national car and awareness of safety in passenger vehicles. The correlation between safety features and safety rating of the Malaysian national car will be proved. The first objective was to calculate a new safety rating point for three selected models of national car using 2017-2020 protocol system of ASEAN NCAP. The second objective was to evaluate the effectiveness of safety features on Malaysian national car and awareness on safety in passenger vehicles based on regulation body, safety features and safety rating. The final objective was to analyze the relationship between safety features and safety rating of national car. Therefore, to correlate the actual and new safety protocol by ASEAN NCAP, analytical method was used based on the Offset Deformable Barrier (ODB) values obtained from actual crash test on the selected car models. Then, to measure the effectiveness and awareness of safety on Malaysian national car, a customer survey was developed and have been sent to 515 respondents. The overall results obtained, vehicles safety rating based on new protocol increase for Model 3 and same for Model 1 and 2. The safety features equip in the vehicle models influence the safety rating of the car. Based on the customer survey, shows that male and young drivers tend to know about the regulation body compared to female and old drivers. The survey also shows that female and young drivers have more knowledge and awareness on safety features and safety rating rather than male and old drivers. In conclusion, the relationship between safety features and safety rating have correlation based on the calculation and equip features in the car.

ABSTRAK

ASEAN NCAP adalah organisasi yang menilai penarafan keselamatan kereta. Terdapat dua sistem protokol yang digunakan oleh ASEAN NCAP iaitu sistem protokol 2012-2016 dan sistem protokol 2017-2020. Perbezaan antara kedua-dua protokol adalah penggunaan penarafan tunggal untuk sistem protokol 2012-2016 dan penilaian keseluruhan untuk sistem protokol 2017-2020. Penarafan keselamatan disediakan oleh ASEAN NCAP berdasarkan ujian kemalangan kereta. Ciri-ciri keselamatan kereta terbahagi kepada dua kategori iaitu keselamatan aktif dan keselamatan pasif. Penulisan ini memberi tumpuan kepada keselamatan pasif sahaja (beg udara dan tali pinggang keledar). Kajian ini hanya tertumpu kepada kereta kebangsaan Malaysia sahaja. Tiga model kereta nasional Malaysia yang telah menggunakan sistem protokol 2012-2016 telah digunakan dalam penyelidikan ini untuk tujuan pengiraan dalam matlamat pertama. Seperti yang dinyatakan, tidak ada perhitungan yang dilakukan sebelum ini pada tiga model terpilih yang menggunakan sistem protokol 2017-2020. Di Malaysia, tiada kajian mengenai keberkesanan ciri keselamatan pada kereta kebangsaan dan kesedaran mengenai keselamatan kenderaan penumpang. Hubungan antara ciri keselamatan dan penarafan keselamatan kereta kebangsaan akan dibuktikan. Objektif pertama adalah untuk mengira titik penarafan keselamatan baru bagi tiga model kereta nasional terpilih yang menggunakan sistem protokol 2017-2020 ASEAN NCAP. Objektif kedua adalah untuk menilai keberkesanan ciri keselamatan kereta kebangsaan Malaysia dan kesedaran tentang keselamatan kenderaan penumpang berdasarkan badan organisasi, ciri keselamatan dan penarafan keselamatan. Objektif akhir adalah menganalisis hubungan antara ciri keselamatan dan penarafan keselamatan kereta kebangsaan. Oleh itu, untuk mengaitkan protokol keselamatan sebenar dan baru oleh ASEAN NCAP, kaedah analisis telah digunakan berdasarkan nilai Offset Deformable Barrier (ODB) yang diperolehi daripada ujian kemalangan sebenar pada model kereta terpilih. Kemudian, untuk mengukur keberkesanan dan kesedaran mengenai keselamatan kereta kebangsaan Malaysia, tinjauan pelanggan telah dibangunkan dan telah dihantar kepada 515 responden. Keputusan keseluruhan diperolehi, penarafan keselamatan kenderaan berdasarkan peningkatan protokol baru untuk Model 3 dan sama untuk Model 1 dan 2. Ciri-ciri keselamatan melengkapkan dalam model kenderaan mempengaruhi penarafan keselamatan kereta. Berdasarkan kaji selidik pelanggan, menunjukkan bahawa pemandu lelaki dan muda cenderung mengetahui tentang badan organisasi berbanding pemandu wanita dan tua. Tinjauan ini juga menunjukkan bahawa pemandu wanita dan muda mempunyai lebih banyak pengetahuan dan kesedaran mengenai ciri keselamatan dan penilaian keselamatan daripada lelaki dan pemandu lama. Kesimpulannya, hubungan antara ciri keselamatan dan penarafan keselamatan mempunyai korelasi berdasarkan pengiraan dan melengkapkan ciri-ciri dalam kereta.

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LIST OF ABBREVIATIONS

FIGURE	TITLE
ABS	Antilock Breaking System
AOP	Adult Occupant Protection
ASEAN NCAP	New Car Assessment Program For Southeast Asean
BST	Blind Spot Technology
COP	Children Occupant Protection
CRS	Children Restraint System
ESC	Emergensy Stability Control
EuroRAP	The European Road Assessment Program
FIA	Federation International Automobile
GLOBAL NCAP	Global New Car Assessment Program
HIC	Head Impact Criteria
HPT	Head Protection Technology
MIROS	Malaysian Institute Of Road Safety Research
MoU	Memorandum Of Understanding
ODB	Offset Deformable Barrier

PC3	Provisional Crase Crash Centre
SATs	Safety Assissts Technologies
SBR	Seatbelts Reminder
WHO	World Health Organization
ANOVA	Analysis of Variance

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CHAPTER 1

INTRODUCTION

1.1 Background

Malaysia is the third largest vehicles market nation in the Southeast Asia (Focus2Move, 2015). Due to the high use of vehicles, the rate of accidents also increases from day to day (Beh, 2016). To overcome the problem of road accidents from happening and also to reduce the risk of death and serious injury, The New Car Assessment Program for Southeast Asia or known as ASEAN NCAP has been established. ASEAN NCAP jointly established by the Malaysian Institute of Road Safety Research (MIROS) and Global New Car Assessment Program (Global NCAP) in New Delhi, India on 7 December 2011 (Abu Kassim, 2018).

The objective of ASEAN NCAP to raise motor vehicle safety standards in the region and encourage a market for safer vehicles (Abu Kassim et al., 2017). It is an organization that evaluates the crashworthiness of a certain car variant. The crash test was held at the MIROS Provisional CRASE Crash Centre (PC3), Japan Automobile Research Institute (JARI), Australian CRASHLAB (ANCAP) and Korean KATRI (KNCAP). ASEAN NCAP has conducted the first crash test in 2011. There were seven (7) cars were tested and three (3) of them were Malaysian National Cars.

During the first crash test of ASEAN NCAP, the Malaysian national cars have received a relatively low star rating compared to other cars. However, the rating of Malaysian national car ratings has increased from generation to generation. This has shown a positive improvement by Malaysian manufacturing. In this research, three latest car models of Malaysian national car have been used to investigate the improvement of star rating. This study is to identify the safety features that have been added to the model's car causing the safety rating of the car's model increase.

Safety features can be divided into two categories which are active safety and passive safety. This rephrase focused only on passive safety features which help to reduce injuries when a crash cannot be avoided. Passive safety features are important as to keep the driver and passengers protected within the vehicle from various crash forces which a body structure absorb crash kinetic energy. Airbags and seatbelts are the most importance things of passive safety in car system (DekraOnTheSafeSide, 2018).

ASEAN NCAP has produced 2011-2016 Protocol System which separate rating for Adult Occupant Protection (AOP) and Child Occupant Protection (COP). The star rating will be given based on point scoring of AOP and COP. Meanwhile, in the year 2017, a new protocol system, 2017-2020 Protocol System has been introduced and it is a single rating system. The new protocol system is more severe than the old one since it has includes 50% overall rating for AOP (Ahmad et al., 2010).

1.2 Problem Statement

The car is a wheeled motor vehicle used for transportation. Along with time, many cars have been used in Malaysia whether locally-made or car imported from abroad. Most of the cars that have been manufactured have been equipped with safety features to make sure that the cars are safe to use. Back then, safety features are not really concern by Malaysian. But, after the establishment of the New Car Assessment Programme for Southeast Asian Country (ASEAN NCAP), peoples get more concern about the safety features (Eusofe & Evdorides, 2017).

The ASEAN NCAP have two protocol system which is 2012-2016 Protocol System and 2017-2020 Protocol System. All the three latest Malaysian National Cars Model have used 2012-2016 Protocol System and have shown a positive improvement of the safety rating. In Malaysia, the calculation has never been done on Malaysian national car using 2017-2020 protocol system. Therefore, the researcher wants to calculate the new safety rating of the three models using the 2017-2020 Protocol System since the new protocol is more severe than the old one (Ahmad et al., 2010).

Safety features is one of the most important things in vehicle system (Hung & Yazdanifard, 2015). In an article published by the Monash University Accident Research Center, Safety features are emphasized especially for newly released cars (Koppel et al, 2013). The study shows how important safety features are related to consumer's car purchasing. However, in Malaysia, there has been no study made yet on the Malaysian national car model and awareness of safety. The researcher will reviewed about the effectiveness of safety features on Malaysian national car and awareness of safety based on regulation bodies, safety features and safety rating. This study also assess Malaysian national car user experience by safety features.

The study on the relationship between safety features and safety rating ASEAN NCAP has been studied in Malaysia (Md. Isa et al., 2016). The study was conducted on all of the vehicles user in the Klang Valley area and not specific to one model. Furthermore, the study is not limited to specific age and more focus on those aged 25 to 30 years only. Therefore, this study will be focused on young drivers of Malaysian national car users.

1.3 Objectives

The main objectives of this research are:

i. To calculate a new Safety Rating point for three selected models of Malaysian National Car using 2017-2020 protocol system of ASEAN NCAP.

ii. To evaluate the effectiveness of safety features on Malaysian National Car and awareness of safety in passenger vehicles based on regulation body, safety features and safety rating.

iii. To analyze the relationship between Safety Features and Safety Rating of Malaysian National Car.

1.4 Research Scope

This project focused on the passive safety system of Malaysian national car models. The safety rating of the Malaysian national car will be calculated based on a new protocol system. This study will focus on a new protocol system which calculate 50% overall rating of AOP point. The value of AOP points includes a frontal impact test and side impact test. Frontal impact test has four section which contributes the maximum four (4) point four each division that is Neck, Chest, Head and, Knee. This study will be used on chest deflection value only which can calculate manually. The value of chest deflection from old protocol system will be used to insert in new protocol system. Old protocol system used 22mm to 50mm while the new protocol system used 22mm-42mm which is more severe. Then, in this study also will be formulated questionnaire and analyze the data. This study will focused on young drivers of Malaysian national car user that aged between 18 to 25 years old. All the data will be evaluated based on user feedback.

1.5 Significant of Study

For this study, the researcher hope the safety rating point value is still the same or increase if using the new protocol system and shows a positive improvement. In addition, researcher also hope to prove that the safety features will affect safety rating. With this study, researcher hope that Malaysians will be more concern of safety features and can choose a safer vehicle in the future. Furthermore, user feedback is crucial to improve the Malaysian national car for the future. Last but not least, the NCAPs emphasizes safety features important for all vehicles since it can reduce the road accidents and also can give users the opportunity to choose a safer car by having the safety rating of the car.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In Malaysia, there are many categories of industry existed. Meanwhile, the automotive industry is one of the most important industry that bring a lot of advantages to country (MITI, 2014). The automotive industry is divided into three scopes which is production, research and development and design. Research and development are classified into five scope which are aerodynamic, material, safety, structure, and control system. Safety is divided into two categories namely safety features and safety rating. Under safety features, there are two parts where they are active system and passive system. The overview of research on safety in automotive industry is shown in Figure 2.1.

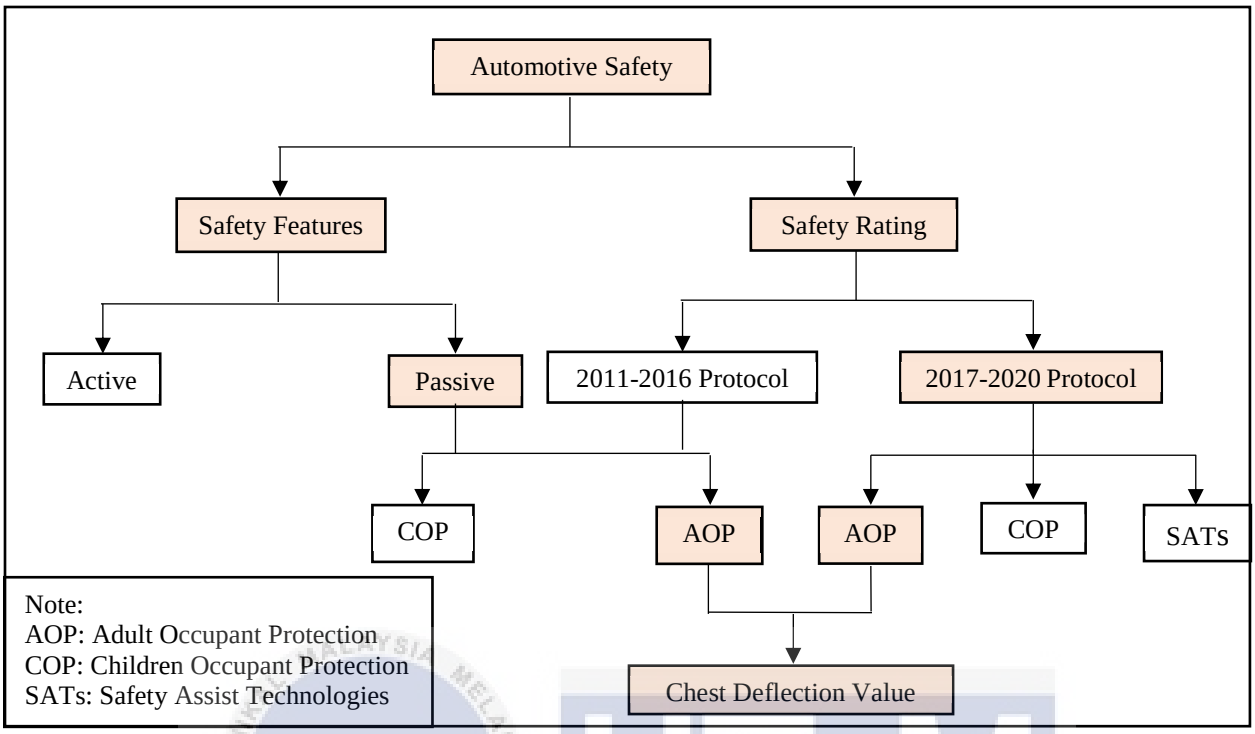


Figure 2.1 Overview of research on safety in automotive industry

2.2 Safety Rating

New Car Assessment Program for Southeast Asia or known as ASEAN NCAP is an automobile safety rating programme jointly established Malaysian Institute of Road Safety Research (MIROS) and Global New Car Assessment Programme (Global NCAP) during the Federation International Automobile (FIA) in New Delhi, India on 7 December 2011 (Abu Kassim, 2018). Establishment of ASEAN NCAP is to raise safety standard towards the vehicles among Asian country (Abu Kassim et al., 2017).

During earlier establishment, ASEAN NCAP had introduced the 2012-2016 protocol system which single rating for both Adult Occupant Protection (AOP) and Children Occupant Protection (COP). In the year 2016, a new protocol system had been released which is 2017-2020

protocol system. The 2017-2020 protocol system used 50 percent overall rating for AOP and 25 percent overall rating for COP and also included the Safety Assist Technologies (SATs) which contributes 25 percent overall rating with maximum to 18 points.

2.2.1 Adult Occupant Protection (AOP)

During used of 2012-2016 protocol system, for the AOP only used offset frontal test and side impact test which is single rating. The new protocol system is more severe than the old protocol system which used 50% overall rating for AOP with maximum 36 points include three assessment which is offset frontal test, side impact and head protection technology. The similarities assessment for AOP point of 2011-2016 protocol system and 2017-2020 protocol system is offset frontal test which both scored the maximum point to 16 points.

There are four sections in offset frontal test which are head and neck assessment, chest assessment, knee, femur and, pelvis assessment, and lower leg, foot and ankle assessment. Each assessment will score maximum to 4 points. One of the criteria from head and neck assessment is Head Impact Criteria (HIC). The old protocol system used HIC36 and new protocol system used HIC15 which is more severe. The research indicates that only HIC intervals of 15 m/s or less are relevant to cerebral concussion (Hodgson and Thomas 1972). The overall changing of AOP will shows in Figure 2.2.

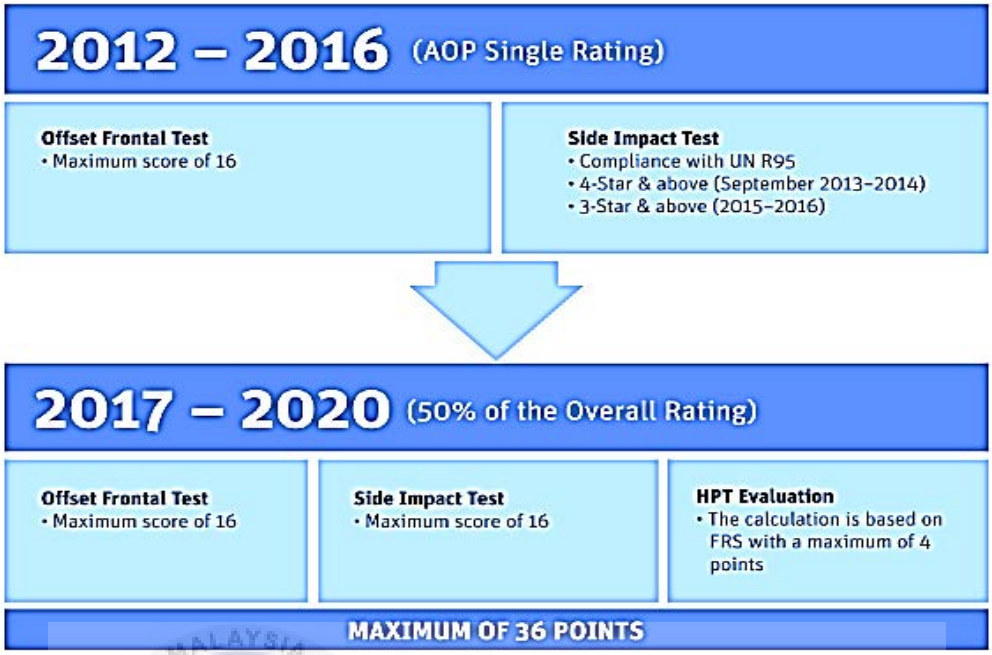
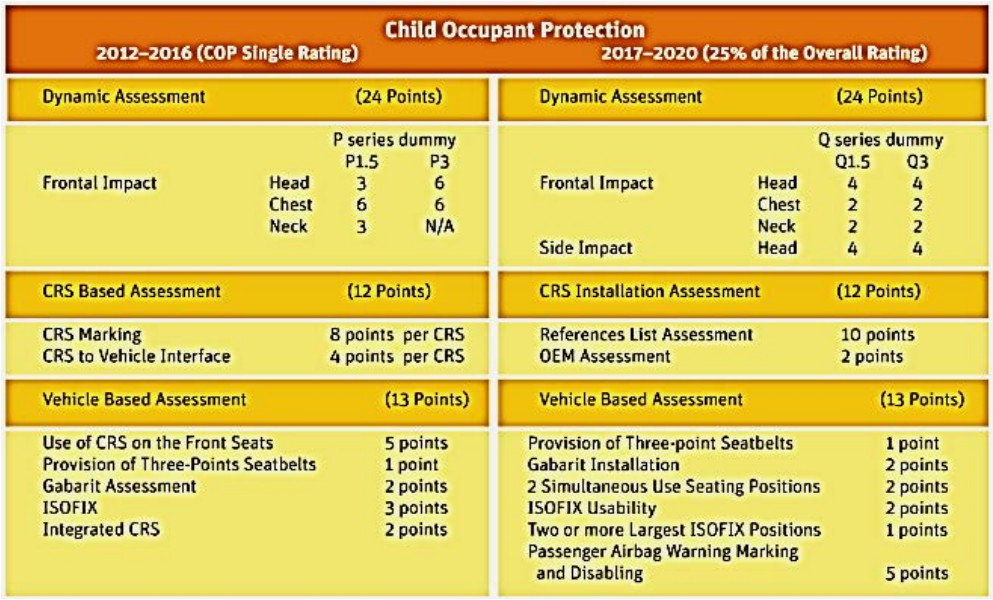


Figure 2.2 Adult Occupant Protection Assessment (ASEAN NCAP, 2017b)

2.2.2 Children Occupant Protection (COP)

The COP is used 25% overall rating with maximum to 49 points. There are three parts in COP which are the dynamic assessment which score 24 points, the CRS assessment which score 12 points and the vehicle based assessment which give total score 13 points. The overall changing of COP is shown in Figure 2.3.



Child Occupant Protection							
2012–2016 (COP Single Rating)				2017–2020 (25% of the Overall Rating)			
Dynamic Assessment			(24 Points)	Dynamic Assessment			(24 Points)
		P series dummy				Q series dummy	
		P1.5	P3			Q1.5	Q3
Frontal Impact	Head	3	6	Frontal Impact	Head	4	4
	Chest	6	6		Chest	2	2
	Neck	3	N/A		Neck	2	2
				Side Impact	Head	4	4
CRS Based Assessment			(12 Points)	CRS Installation Assessment			(12 Points)
CRS Marking		8 points per CRS		References List Assessment		10 points	
CRS to Vehicle Interface		4 points per CRS		OEM Assessment		2 points	
Vehicle Based Assessment			(13 Points)	Vehicle Based Assessment			(13 Points)
Use of CRS on the Front Seats			5 points	Provision of Three-point Seatbelts			1 point
Provision of Three-Points Seatbelts			1 point	Gabarit Installation			2 points
Gabarit Assessment			2 points	2 Simultaneous Use Seating Positions			2 points
ISOFIX			3 points	ISOFIX Usability			2 points
Integrated CRS			2 points	Two or more Largest ISOFIX Positions			1 points
				Passenger Airbag Warning Marking and Disabling			5 points

Figure 2.3 Children Occupant Protection Assessment (ASEAN NCAP, 2017b)

2.2.3 Chest Deflection Value

The 2012-2016 Protocol system have used the value of chest deflection is between 22mm - 50mm which is 50% risk to injured during crash event (Mertz et al., 1991) while the 2017-2020 protocol system is 22mm - 42mm which only 30% risk to injured (Ahmad et al., 2010). Based on the chest deflection value, the new safety rating will be calculated. Furthermore, a new formula for AOP point will be generated as to ignore the HPT evaluation since the Malaysian National car did not include yet the SATs. The chest deflection was influenced by the seatbelt path.

2.2.4 Overview of Research on Safety Rating

In countries like Europe, United States, and Australia have used the same road safety rating systems for motorcycles and cars. The aim study conducted by Daniello et al. (2010), is to highlighted the unique of the road safety rating system for motorcycles. As motorcycles are the most dangerous of all vehicles. The European Road Assessment Program (EuroRAP) has introduced three different protocols for road safety in year 2001. In addition, EuroRAP has also introduced the same four-star-rating system with car-crash-rating to motorcycles. The rating calculation system for motorcycles is the same as the rating calculation system for the car. The study also shown that the percentage of hazard for motorcycles is higher than the percentage of cars. Based on the research, safety rating for vehicles is also needed to ensure the reduction of road traffic rate. Table 2.1 are shows the risk factor by road.

Table 2.1 Risk Factor by Road User at New Jersey (Daniello et al., 2010)

Road Name	Road Length (mi)	% Higher Risk Factor for Motorcycles	% Higher Risk Factor for Cars
US-1	64.88	0.0	46.2
US-9	130.7	34.7	7.7
US-22	46.35	21.6	21.6
NJ-23	52.63	81.0	0.0
NJ-27	38.53	0.0	51.9
US-30	58.26	51.5	17.2
NJ-33	37.43	14.4	0.0
NJ-35	58.07	65.4	0.0
US-46	72.09	42.3	13.9
NJ-47	75.2	56.6	0.0
NJ-70	59.77	11.2	16.7
US-130	73.16	21.7	17.7
US-202	80.31	9.6	17.2
US-206	120.9	35.3	29.2
US-322	50.2	38.8	0.0
CR-579	34.83	26.8	0.0
Average		31.9	15.0

Safety rating is very important to the individual in determining the purchase of a car. In a study conducted by Koppel et al. (2007), it has been stated that safety rating is one of the most important factors in car purchases. The purpose of their study is to investigate the ranked factors affecting the purchase of vehicles. To prove the safety rating factor is important in the purchase of the car, NCAP has issued a statement on safety rating on the Euro NCAP website. Each decision is based on standard base vehicles. After analyze, there were three important factors during the purchase of cars which is safety rating of 16 percent, vehicles reliability 15 percent and price 10 percent. The study proves that safety rating is the most important priority in determining car purchases.

2.3 Safety Features

Safety engineering is associated with accident prevention, reducing the rate of injury caused by human error itself and safety also associated with obtaining security benefits based on a product design system (Safeopedia, 2018). Safety also can be referred to product safety. Features can be defined as process attempts to add some features from existing raw features (Brownlee, 2014). In the selection of product, features is highly emphasized to get the best one. Every new product released, the features should be inserted in order to get a better product. Generally, safety features mean the good characteristics of a product. Safety features are important because it will determine whether a product is good or not.

As mentioned before, the safety features is important. Aven (2014) said that safety science can be defined as obtaining the knowledge that related to phenomena, processes, events and etc. safety science also can be viewed as the discipline of safety science and totally covered of relevant educational programme, journals, papers and others. Hence, safety features in terms of engineering can be defined as all those conditions that can cause losses of equipment or property, the damaging of environment, injuries, death or occupational illness (Gloss & Wardle, 1984).

GlobalCarsBrands (2015) explained that the important of vehicles for people and many reforms have been done by manufacturers day by day to compete for each other. In-vehicle system, the safety features is one of the important systems that need to include in their system (HowSafeIsYourCar, 2018).

2.3.1 Passive Safety

Safety features include airbags, seatbelts, crumple zones and all protection that helps people to reduce injuries during a crash event or it called passive safety (Abu Kassim, 2018). The calculation for passive safety is based on AOP point and COP point. There are two passive system under the AOP which are Offset Frontal Test or Offset Deformable Barrier (ODB) and Side Impact. Every each contribute 16 points. Every car that has been crash test will be provided Star Rating based on the calculation of point received.

2.3.2 Active Safety

Active safety is the system that has been added to the vehicle system to prevent people from involving in a crash event (Abu Kassim, 2018). As shown in Figure 2.4, there are five active system in the new car production which are Anti-lock Braking System (ABS), Electronic Stability Control (ESC), Seatbelt Reminder (SBR), Blind Spot Technology (BST) and Safety Assist Technologies (SATs) (NCAP, 2016).

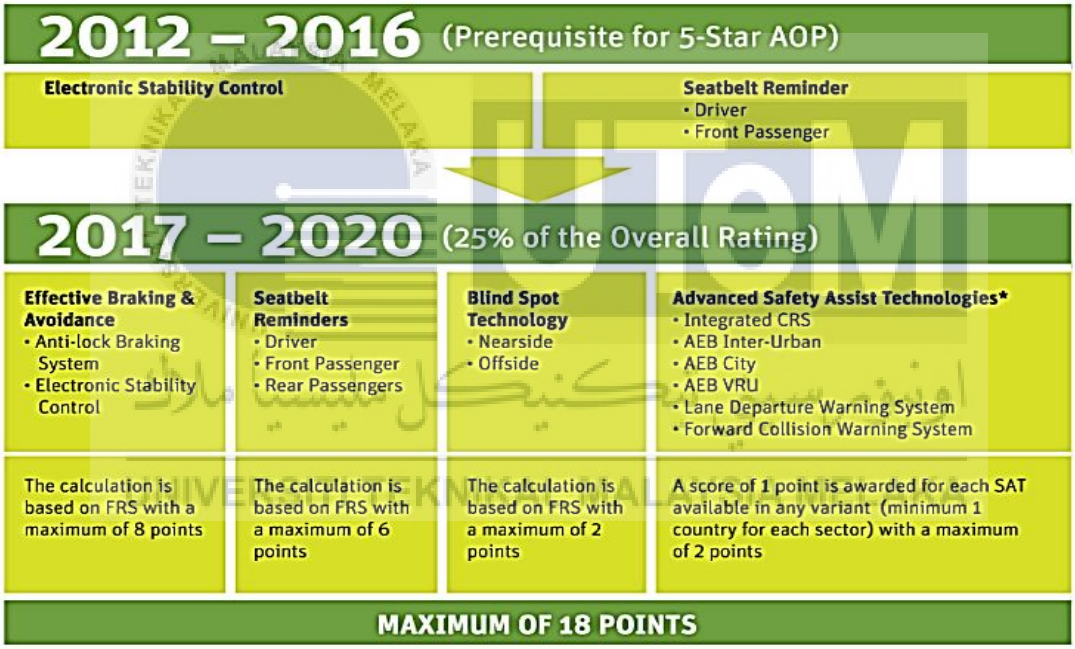


Figure 2.4 Advanced SATs in ASEAN NCAP (NCAP, 2016b)

2.3.3 Overview of Research on Safety Features

In Malaysia, road accidents increased from day to day. This accident involves vehicles. In 2004, the World Health Organization, WHO (2013) has proved that deaths due to road accidents are the highest in the world, ninth ranking. In 2030 it is likely that road accidents will be the fifth cause of death. The Malaysian Institute of Road and Safety Research (MIROS) in a study conducted by Rohayu et al (2012) has presented some facts involving road accidents. Their study showed that Malaysian is a developing country that highly need a safe vehicles. Their research have point out that at mortality rates have increased from year to year so that a safety vehicles is important to avoid the accident.

As mentioned previously, vehicle safety is very important to ensure that accidents can be avoided and also can reduced death rates in the event of an accident. Study by Koppel et al (2013) showed that people from Spain emphasized on safety features in buying cars. Through questionnaire given to participants of Sweden and Spain has proved that 90 percent of Spain focused on safety features during purchasing a new vehicle instead of other system on the vehicle. Different with Sweden population with 67 percent more likely to choose other systems such as navigation on the car. In addition, standard safety features such as seatbelts, airbags and antilock brakes are the most important features when purchasing a car by Canadian older drivers (Koppel et al., (2007).

2.4 Malaysian National Car

Malaysia have produced two brands of Malaysian National cars which are Proton and Perodua. Starting from 2011, all the new Malaysian National car tested their car at ASEAN NCAP as to prove that their car is safe to use. Some of the vehicles model have included the safety assist like Seatbelt Reminder (SBR), Anti-Braking System (ABS) and Electronic Stability Control (ESC). The differences between all the results for vehicles that have carried out crash test at ASEAN NCAP shown the Table 2.2.

Proton cars began to be released in 1985 and the first model was Proton Saga (Rosli, 2006). There are eight edition of Proton Saga series that have been released. Since early in the car establishment, no party is responsible for handling car safety. However, starting in 2010, the ASEAN NCAP has implemented a crash test to ensure that the car is safer. Proton Saga is one of the models that have done the first phase of crash test. Proton Saga model that was first tested on the test was Proton Saga FL and obtain one star rating only (ASEAN NCAP, 2012). This is because the Proton Saga is equipped with some basic safety features such as only seatbelts and one airbag. However, the model of Proton Saga has produced a new model in 2013 and obtain three stars (ASEAN NCAP, 2013). This positive improvement is good as the Proton Saga has added some other safety features such as adding airbags to two. The most recent Proton Saga was released in 2016 and obtain four stars (ASEAN NCAP, 2016). This convinced many parties that National cars are good and standing with others brands.

The second National car, the Perodua was released in 1994 (Rumadi, 2016). One of the models that have shown a positive improvement is Perodua Myvi. This is because the Perodua Myvi has produced three edition that have been equipped with high safety features. Perodua Myvi

has also been tested on the first phase of the ASEAN NCAP, and has scored 3-stars (ASEAN NCAP, 2012). At the second release in 2015, Perodua Myvi has earned 4-stars and is equipped with two airbags for passive safety (ASEAN NCAP, 2015). Then in 2017, once again has released the latest model and got 5-stars rating and equipped with 4 airbags (ASEAN NCAP, 2017). Perodua Myvi 2017 has been equipped with anti-collision feature as Safety Assist Technologies. Malaysia is capable of producing better cars in the future.

Table 2.2 Crash test safety rating results of Malaysian National cars (ASEAN NCAP, 2011)

Models of Car	Years of Production	Safety Features		Safety Rating for AOP
		Active	**Passive**	
Proton Saga	2008	• SBR for Driver only	• 1 Airbags	• 1-Star • 4.3 Points
Proton Saga FLX	2011	• SBR for Driver only	• 2 Airbags	• 3-Stars • 10.23 Points
Proton Saga	2016	• SBR for Driver only	• 2 Airbags • Seatbelts Retractor Pre-tensioner & Load Limiter for Driver and Passenger	• 4-Stars • 13.33 Points
Perodua Myvi	2011	• SBR for Driver only	• 2 Airbags	• 3-Stars • 8.71 Points
Perodua Myvi	2015	• SBR for Driver and Passenger	• 2 Airbags • Seatbelts Retractor Pre-tensioner & Load Limiter for Driver and Passenger	• 4-Stars • 11.55 Points
Perodua Myvi	2017	• SBR for Driver and Passenger • ABS • ESC • SATs	• 4 Airbags • Seatbelts Retractor Pre-tensioner & Load Limiter for Driver and Passenger	• 5-Stars • 14.79 Points
Proton Preve	2012	• SBR for Driver and Passenger • ABS • ESC	• 6 Airbags • Seatbelts Double Pre-Tensioner & Load Limiter for Driver and Passenger	• 5-Stars • 15.38 Points
Perodua Alza	2013	• SBR for Driver only	• 2 Airbags • Seatbelts Retractor Pre-tensioner & Load Limiter for Driver and Passenger	• 4-Stars • 12.86 Points
Perodua Axia	2014	• SBR for Driver only	• 2 Airbags • Seatbelts Retractor Pre-tensioner & Load Limiter for Driver and Passenger	• 4-Stars • 12.91 Points
Proton Iriz	2014	• SBR available for Driver and Passenger • ABS • ESC	• 7 Airbags • Seatbelts Double Pre-Tensioner & Load Limiter for Driver and Passenger	• 5-Stars • 14.07 Points
Perodua Bezza	2016	• SBR for Driver and Passenger • ESC • ABS	• 2 Airbags • Seatbelts Retractor Pre-tensioner & Load Limiter for Driver and Passenger	• 5-Stars • 15.38 Points
Proton Ertiga	2016	• SBR available for Driver only	• 2 Airbags • Seatbelts Retractor Pre-tensioner & Load Limiter for Driver and Passenger	• 4-Stars • 12.39 Points
Proton X70	2018	• SBR for Driver and Passenger • ESC • SATs	• 6 Airbags • Seatbelts Retractor Pre-tensioner & Load Limiter for Driver and Passenger	• 5-Stars • 15.27 Points

CHAPTER 3

METHODOLOGY

3.1 Introduction

In general, the overall research methodologies are divided into three phases. The first and second phases are calculation of safety rating and customer survey. Then the relationship between the safety rating and the safety features are analyzed. Figure 3.1 shows the overall project flow. The new formula generated is used to calculate new safety rating using scale rating of chest deflection value. Furthermore, there were four section in customer survey which including demographic, ASEAN NCAP, safety rating and safety features. There were 515 respondents that have answered the questionnaire.

As mentioned before, the objective of this study is to analyse the relationship between safety features and safety rating. Based on the questionnaire, the researcher prepared some questions of safety rating and safety features to achieve the objectives two (2) and three (3). The question is based on bloom's taxonomy method. As mentioned previously, the objective one (1) is to calculate new safety rating of Malaysian National Car. The researcher have shown the generated formula in this chapter.

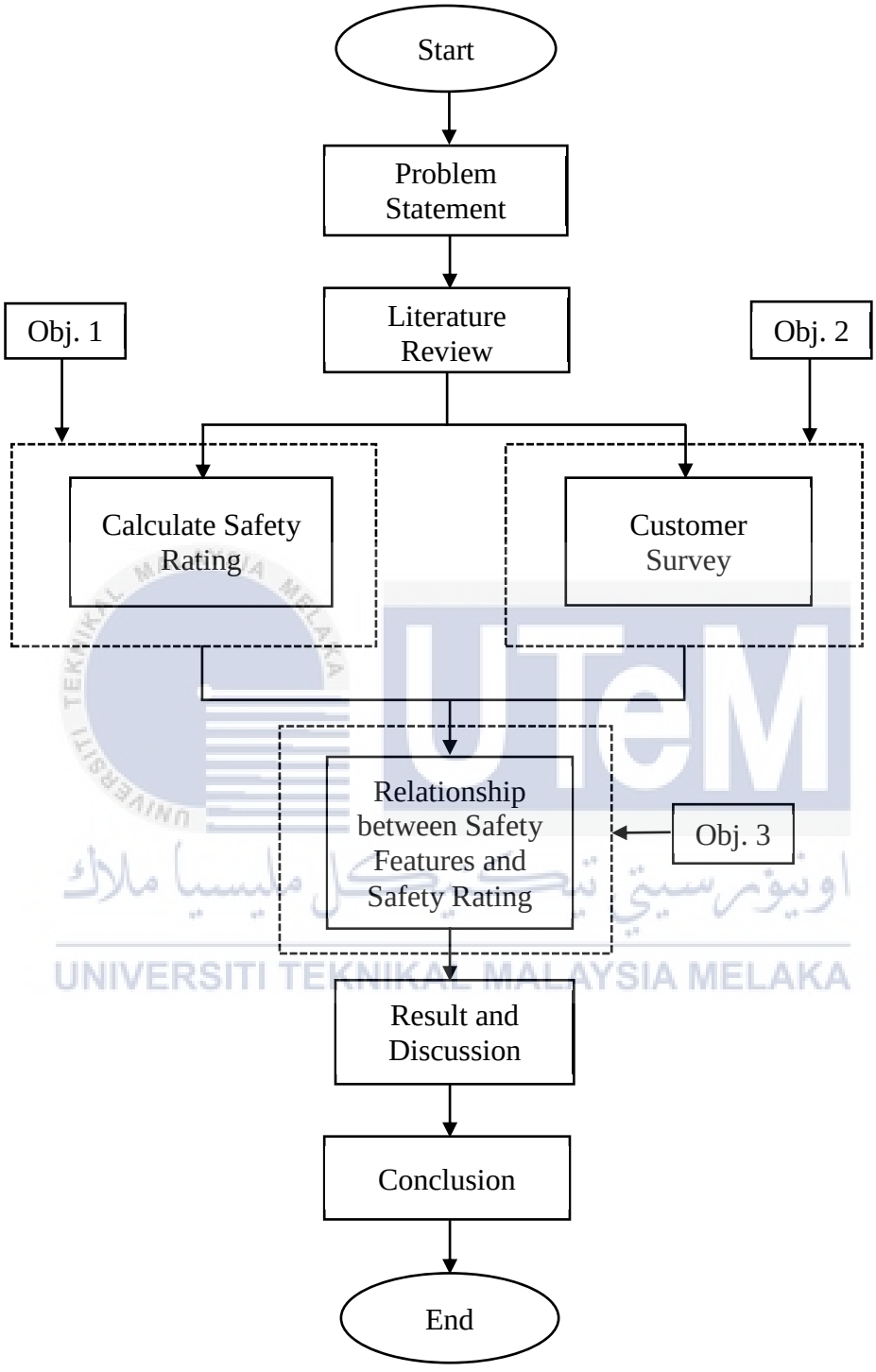


Figure 3.1 Overall Research Flow Chart

3.2 Calculation for New Safety Rating

The new protocol system, 2017-2020 protocol system have been used to calculate the new rating point of Malaysian national car. As the 2012-2016 protocol system, the Adult Occupant Protection (AOP) point used separate rating system. So the point collected only based on frontal impact test and side impact test. The 2017-2020 protocol system used the single rating system which contribute 50% of overall rating point for AOP, 25% each for Children Occupant Protection (COP) and Safety Assists Technology (ASEAN NCAP, 2017). In this study, a new formula of new protocol system is generated as to consider the information that had in 2012-2016 protocol system.

3.2.1 Calculation to Obtain the New Offset Deformable Barrier

First and foremost, to get the new safety rating, the researcher need to calculate the new chest deflection value so that it can be used in Offset Deformable Barrier (ODB). Table 3.1 shown that the range scale of chest deflection value.

Table 3.1 Range scale of chest deflection value

Protocol System	2012-2016	2017-2020
Compression (mm)	22 – 50	22 – 42
Chest Points	0 – 4	0 – 4

Using the interpolation method, the chest point were calculated. The value of compression chest deflection value (CCDV) was get from ASEAN NCAP data. Firstly, the actual chest point (ACP) is calculated using the 2012-2016 protocol system using the Equation 3.1.

$$\frac{CCDV-22}{50-22} = \frac{ACP-4}{0-4} \quad \text{Eq. (3.1)}$$

Then using the same value of compression chest deflection, the new chest point (NCP) is calculated using the 2017-2020 protocol system as shown in Equation 3.2.

$$\frac{CCDV-22}{42-22} = \frac{NCP-4}{0-4} \quad \text{Eq. (3.2)}$$

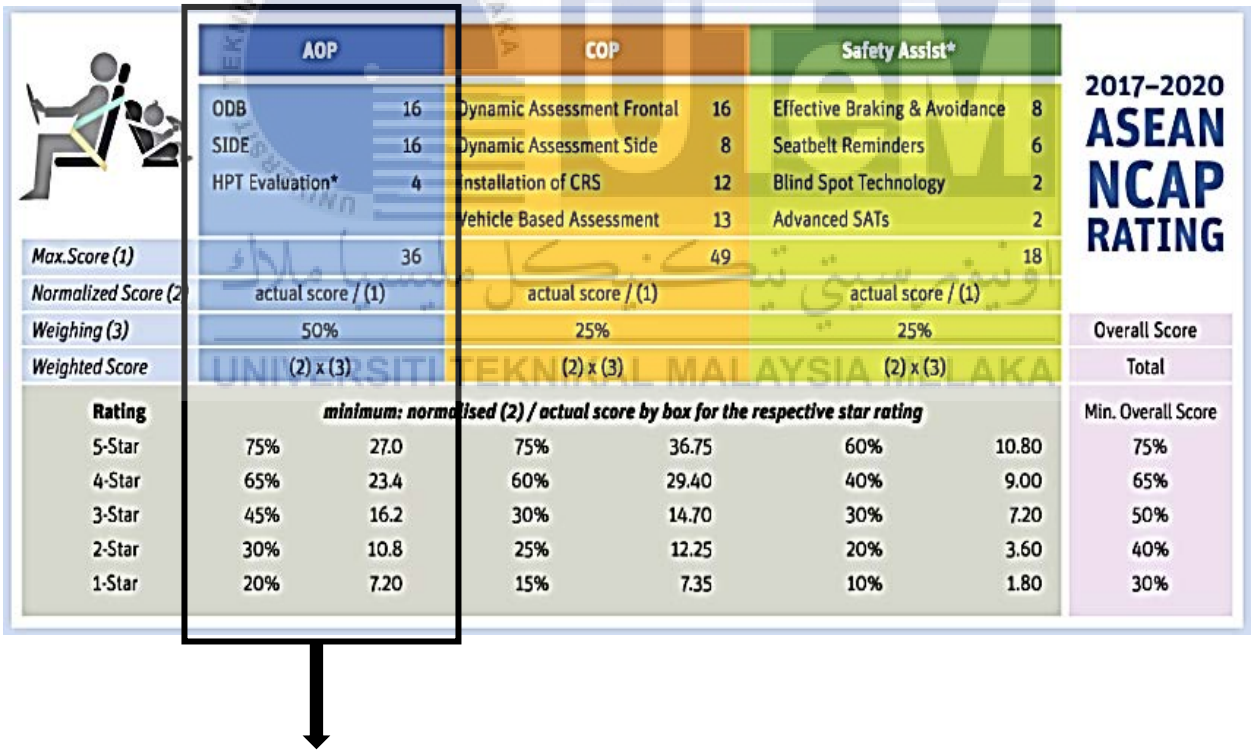
The following step, the value of Actual Offset Deformable Barrier (AODB) was minus with ACP so that the value of safety rating without value of chest assessment was obtained. As mentioned before, the value of AODB is included the value of head and neck assessment, chest assessment, knee, femur and, pelvis assessment, and lower leg, foot and ankle assessment. Each assessment. Then, NCP was added in the ODB obtained before to get the New Offset Deformable Barrier (NODB). The equation is shown in Equation 3.3.

$$NODB = AODB - ACP + NCP \quad \text{Eq. (3.3)}$$

3.2.2 Method to Obtain the New Safety Rating

To obtain the new safety rating, the researcher need to reshuffle the table of 2017-2020 protocol system as to fit the information from 2012-2016 protocol system. The method is shown from Table 3.3 to 3.4. The table 3.3 is actual calculation ASEAN NCAP for 2017-2020 protocol system. As mentioned before, the safety rating of the models in this study are using 2012-2016 protocol system. Using the 2017-2020 protocol system, researcher has generated the new calculation to get the safety rating of the models using the 2017-2020 protocol system.

Table 3.2 The ASEAN NCAP Rating, 2017-2020 (ASEAN NCAP, 2016b)



	AOP		COP		Safety Assist*		2017–2020 ASEAN NCAP RATING
	ODB	16	Dynamic Assessment Frontal	16	Effective Braking & Avoidance	8	
	SIDE	16	Dynamic Assessment Side	8	Seatbelt Reminders	6	
	HPT Evaluation*	4	Installation of CRS	12	Blind Spot Technology	2	
			Vehicle Based Assessment	13	Advanced SATs	2	
Max.Score (1)		36		49		18	
Normalized Score (2	actual score / (1)		actual score / (1)		actual score / (1)		
Weighing (3)	50%		25%		25%		Overall Score
Weighted Score	(2) x (3)		(2) x (3)		(2) x (3)		Total
Rating	***minimum: normalised (2) / actual score by box for the respective star rating***						Min. Overall Score
5-Star	75%	27.0	75%	36.75	60%	10.80	75%
4-Star	65%	23.4	60%	29.40	40%	9.00	65%
3-Star	45%	16.2	30%	14.70	30%	7.20	50%
2-Star	30%	10.8	25%	12.25	20%	3.60	40%
1-Star	20%	7.20	15%	7.35	10%	1.80	30%

The method to change the framework

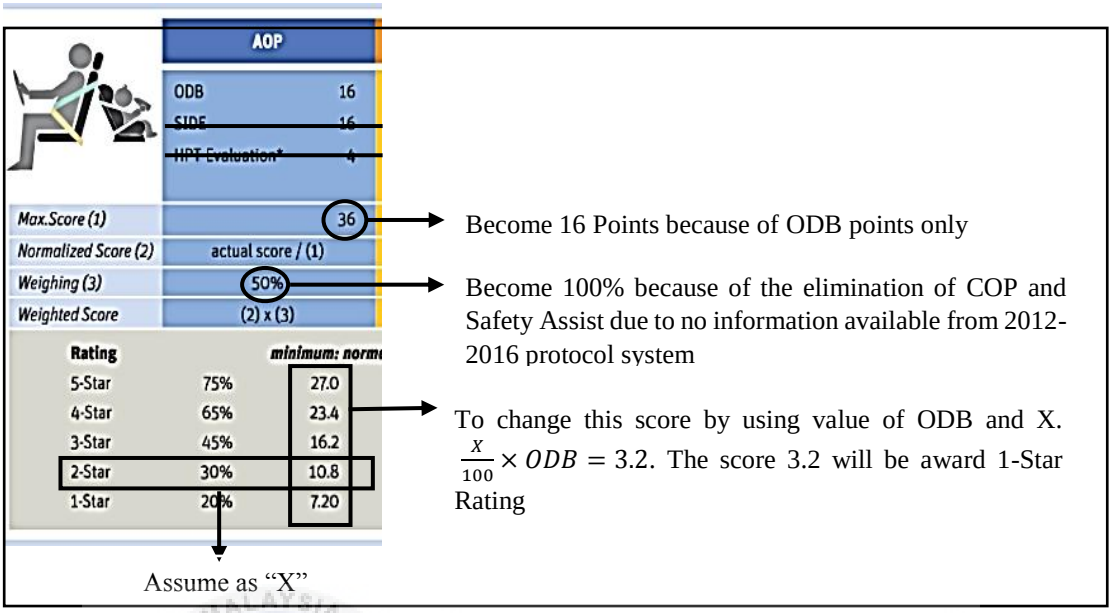


Table 3.4 New protocol system as to fit the information from 2012-2016 Protocol System

	Adult Occupant Protection		
	NODB	16	
Maximum Score (1)		16	
Normalized Score (2)	Actual / (1)		
Weighing (3)	100%		Overall Score
Weighted Score	(2) x (3)		Total
Rating-Star	Min: Normalised (2) / actual score		Min Overall Score
5	75%	12	75%
4	65%	10.4	65%
3	45%	7.2	50%
2	30%	4.8	40%
1	20%	3.2	30%

3.3 Data Collection

Data collection is the process of preparing and collecting data for the research. The purpose of collecting data is to reach the information for keeping as record, to make decision about the important issues, and pass the information to others. In this study, the researcher focused on surveying. By using the questionnaire, the data is analysed.

In this study, the survey was given to the random people in area Melaka and Kuala Lumpur, students in Universiti Teknologi Malaysia (UTM), students in Universiti Tenaga Nasional (UNITEN), International Islamic University Malaysia (IIUM) and students of Universiti Tun Hussein Onn Malaysia (UTHM). The range of aged user feedback between 18 and above. The question were divided into three section which are the knowledge about ASEAN NCAP, the perception of safety rating and the awareness of safety features. This survey is conducted to 515 respondents that used car.

The questionnaire given are divided into five (5) sections. The five sections includes demographic, ASEAN NCAP, safety rating, safety features and for the last section is the relationship between safety rating and safety features. Each section showed the details needed to support the objective of the analysis in getting the customer (car user) feedback on passive safety of Malaysian National Car.

The demographic information described about general aspect such as gender, ages, faculty, social status and driving experience. All this general aspects are important because it can affect the behaviour of someone's driving.

Not only that, the questionnaire also asked about ASEAN NCAP which was to know the knowledge of driver about the existence of ASEAN NCAP. Besides that, the third section about

perception of safety rating is created to know about the perception of driver. The fourth section is about safety features in which to evaluate the effectiveness of safety features on Malaysian National Car based on user experience. Last but not least, the final section concern on the user perception about safety features and safety rating.

The researcher used Bloom's taxonomy method to create the question as to give more understanding for person (ForGreatTeaching, 2018). The table of Bloom's taxonomy is shown in Table 3.2. The online survey question created using Google form is shown in Appendix A.

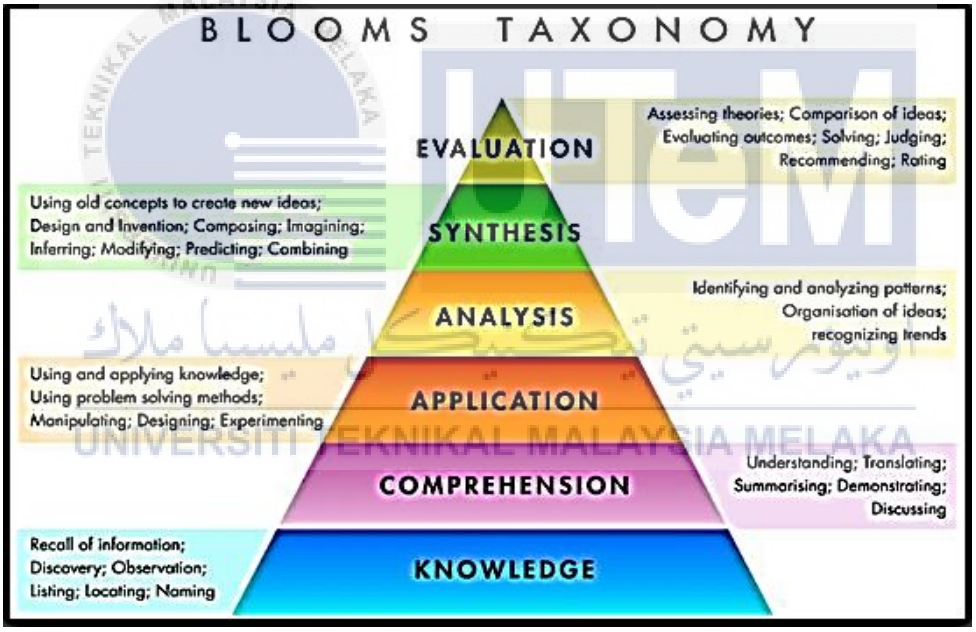


Figure 3.2 Bloom's taxonomy method (ForGreatTeaching, 2018)

3.4 Analyzing

For the analyse process, the researcher analysed the data from Google form using Microsoft Excel. The researcher used this software to avoid any mistake during interpreting the result data. The software can help researcher to get the exact value of respondents. The data is tabulated using table so that it easier to understand. The table is divided into five sections as there were five sections of the questionnaire.

3.5 Gant Chart

Overall schedule for completing the Projek Sarjana Muda 1 and 2 are shown in Table 3.3 and Table 3.4.

Table 3.5 Overall Schedule Gant Chart for PSM 1 and 2

Task \ Month	September				October				November				December				Feb		March				April				Mei				June	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Discussion with Supervisor																																
Decided the title of PSM																																
Find the sources of LR																																
Discussion on Chapter 1																																
Overall schedule Gant Chart																																
Overall research flow chart																																
General Methodology																																
Progress report submission																																
Literature Review																																
Construct questionnaire																																
Overall Methodology																																
Report writing																																
Final report submission																																
PSM 1 presentation																																
Seminar assessment																																
Calculate the new safety rating																																
Collect all survey data																																
Tabulate data																																
Conclude and analyze all data																																
Results and discussion																																
Conclusion																																
Submission draft report																																
Submission final report																																
PSM 2 presentation																																

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

Generally, this chapter describes the new safety rating of three selected models, effectiveness of safety features encountered by Malaysian National Car User and last one was an discussion the relationship between safety features and safety rating. The first section presents the calculation of safety rating. The safety rating were being calculated using chest deflection value and steps mentioned id chapter three. The results of the safety rating briefly explained in this chapter. For the second section, the evaluation of customer survey was being tabulated using table and graph. The consumer perception and the effectiveness of Malaysian national car were explained details. Lastly, the relationship between safety rating and safety features was discussed details for this chapter.

4.2 New Safety Rating

As mentioned before, several data is needed to calculate the new safety rating. The raw data for calculation is shown in Table 4.1 that included the data from ASEAN NCAP. The compression chest deflection value for the three selected models are 34.45mm, 32.97mm and 33.54mm.

Table 4.1 Parameter related to new safety rating

Raw Data for AOP Calculation for 3 Different Models of Malaysian National Car				
Parameter		**Model 1**	**Model 2**	**Model 3**
ASEAN NCAP	Compression Chest Deflection Value (mm)	34.45	32.97	33.54
Appendix	AODB Value	4.30	10.23	13.33
	Safety Rating (Star)	1	3	4
Calculation	Actual Chest Deflection Point (2012-2016 Protocol)	2.22	2.43	2.35
	New Chest Deflection Point (2017-2020 Protocol)	1.51	1.81	1.69

Based on the method explained, the new safety rating were being calculated. The results of the three models are shown in Table 4.2, 4.3 and 4.4. The value of actual chest deflection is highest than new chest deflection due to the severity of compression value. As mentioned in methodology, the 2012-2016 protocol system used the 22mm to 50mm while the range scale of compression value for 2017-2020 protocol system is 22mm to 42mm. The smaller range scale of compression value, the more severity of the system (El-jawahri, Ruan, Rouhana, & Barbat, 2017).

4.2.1 Model 1

Based on the calculation the new value of chest deflection is 1.51 over 4 point as shown in Table 4.2. The value has been used for Offset Deformable Barrier (ODB) and the overall score for new ODB is 3.59. The new ODB value is lowest than the actual ODB due to the value of chest deflection range. Since the 2017-2020 protocol system used 50 percent overall rating for AOP, the value of ODB is being calculated for weighted score and the results obtained 22.44 and it below 30 percent. So it obtained as 1 star rating same as the actual safety rating.

Table 4.2 Result of Model 1

MODEL	**1**
Parameter	**Value Score**
AODB	**4.3**
NODB	**3.59**
Max. Score (1)	3.59
Normalize Score (2)	0.2244
Weighing (3)	100
Weighted Score (2)x(3)	22.44
Actual Safety Rating	**1**
New Safety Rating	**1**

4.2.2 Model 2

The results obtained for new chest deflection value for model 2 is 1.81 points as shown in Table 4.3. After being inserted to ODB, the value scored is 9.58 over 16 points. The value of the new ODB is lowest than actual ODB because the chest deflection value. Even though the new ODB is lower than actual ODB, the safety rating of this model is still maintained as 3 star rating. The value of new ODB is being calculated in weighing scale and scored as 59.88 percent. The percentage is highest than 45 percent so that it obtained as 3 star rating.

Table. 4.3 Result of Model 2

MODEL	**2**
Parameter	**Value Score**
AODB	**10.23**
NODB	**9.58**
Max. Score (1)	9.58
Normalize Score (2)	0.5988
Weighing (3)	100
Weighted Score (2)x(3)	59.88
Actual Safety Rating	**3**
New Safety Rating	**3**

4.2.3 Model 3

Model 3 have shown that the new safety rating is difference with the actual safety rating from 4 star to 5 star as highlighted in Table 4.4. As explained in chapter 2, 2017-2020 protocol system used the 50% overall rating while the 2012-2016 protocol system used overall rating which is safety rating is based on the ODB value. While, the value ODB for 2017-2020 protocol system is being calculated using weighing scale. The value of new ODB is 12.76 point and the actual ODB is 13.33 point which highest than new ODB. After being calculated in weighing scale for new ODB, the weighted scored is 79.19 percent which is highest than 75 percent. So the safety rating obtained is 5 star.

Table 4.4 Result of Model 3

MODEL	**3**
Parameter	**Value Score**
AODB	**13.33**
NODB	**12.67**
Max. Score (1)	12.67
Normalize Score (2)	0.7919
Weighing (3)	100
Weighted Score (2)x(3)	79.19
Actual Safety Rating	**4**
New Safety Rating	**5**

4.3 Results on Customer Survey

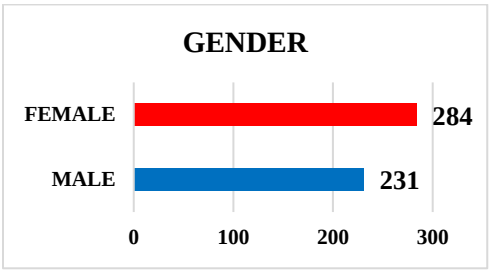
Overall, there were 515 respondents participated in the survey, which consists of 285 female respondents and 231 male respondents. The 515 respondents represent 5682 users of car in Malaysia at confidence level of 99 percent at margin error 5 percent (Dessel, 2013). After screening process from 515 respondents, only 451 respondents were accepted in this survey as the user of national car. The 451 respondents have represent 3099 user of Malaysian national car. 224 of the respondents were Proton users and 227 were Perodua users.

The survey was divided into two states which are Melaka and Kuala Lumpur. The students respondents earn from Universiti Teknikal Malaysia Melaka (UTeM), Universiti Teknologi Malaysia (UTM), Universiti Tenaga Nasional (UNITEN), International Islamic University Malaysia (IIUM) and Universiti Tun Hussein Onn Malaysia (UTHM). The survey was spread-out using Google form to all the respondents. For Melaka, the survey have also been given to teachers at primary and secondary school in Ayer Keroh area and 8 random service center for Proton and Perodua.

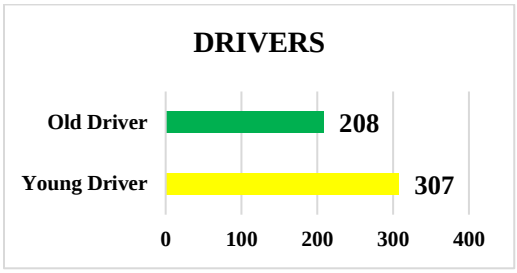
The main target for this research is based on the gender and young drivers. There are five section categories of age which are 18-21, 22-25, 26-30, 31-35 and above 35. The young drivers were referred to respondents age between 18 to 25 (Brake, 2014). The objective of this survey is to evaluate the effectiveness of the Malaysian national car especially from the viewpoint of young drivers and to find out the awareness on vehicle safety based on regulation body, safety features and safety rating.

The survey also included other demographics sections such as driving experience, social status and academic qualification. The results of the survey is shown in Figure 4.1 using the section

of ASEAN NCAP, safety features and safety rating. The percentage of overall results obtained is shown in Appendix C.



(a)



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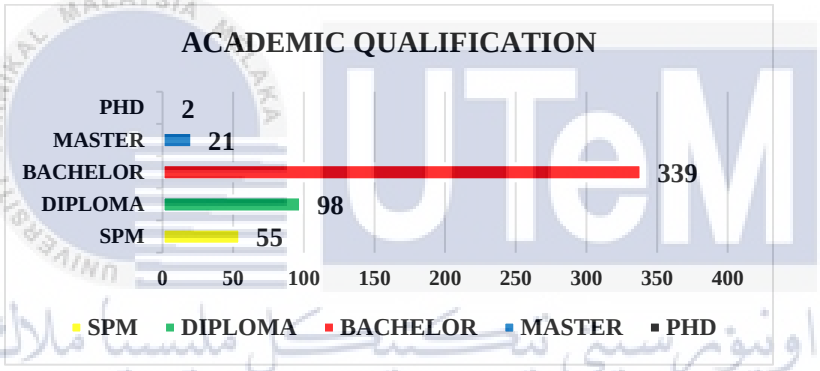

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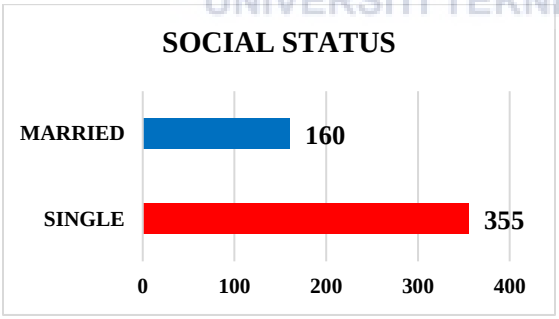

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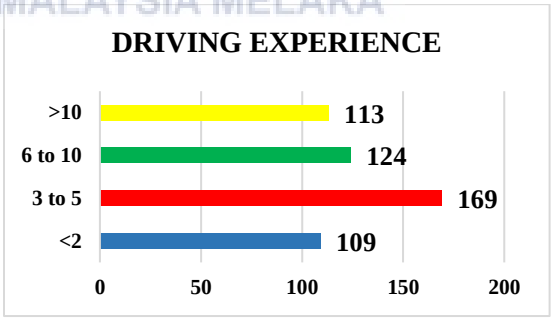


(e)

Figure 4.1 The Number of Respondents Based on Demographic; (a) gender; (b) driver's age; (c) academic qualification; (d) social status; (e) driving experience.

4.3.1 Respondent feedback about ASEAN NCAP

There are five questions on knowledge and awareness about ASEAN NCAP included in the survey. The results of the gender male-female and young-old drivers of the respondents was compared. The overall results obtained from ASEAN NCAP section shows that the awareness and knowledge of male and young drivers are wider than female and old drivers.

Question 1: Awareness on the responsible regulation body for safer vehicles

There are about 316 respondents whom are aware of the regulation body for safer vehicles. Figure 4.2 shows that female driver is more aware compared to male driver (which are 159 over 316 of the respondents). The percentage between male and female slightly difference which is 0.64 percent only. The awareness among the young drivers are better than old drivers since 176 from 316 respondents. It shows that young drivers are heading to be a better drivers for the future.

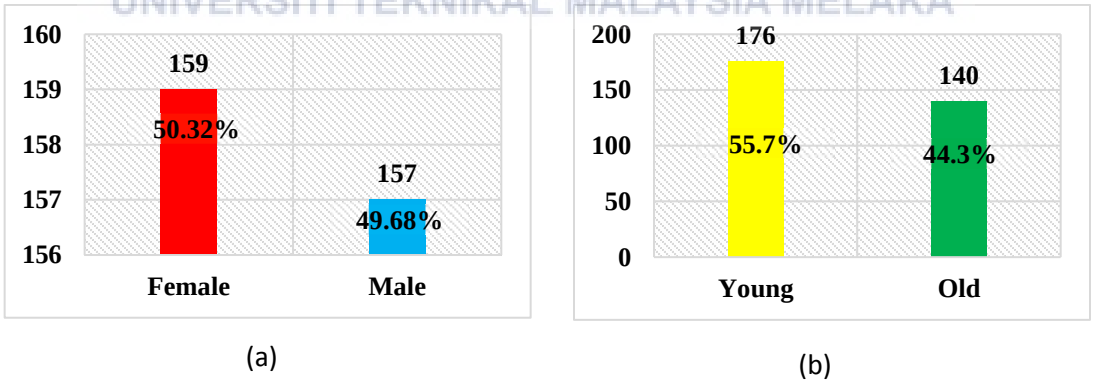


Figure 4.2 Respondent response about awareness on regulation body for safer vehicles; (a) based on gender; (b) based on young-old category.

Question 2: Respondent surrounding that ever talked about ASEAN NCAP issues

There are 151 from 451 respondents who usually talked about ASEAN NCAP issues. Figure 4.3 shows that the number of male respondents are often talked about ASEAN NCAP issues rather than female. The figure also showed that the number of old driver are highest than young drivers which 86 out of 151 respondents. It shows that male and old drivers talked more frequently about current issues.

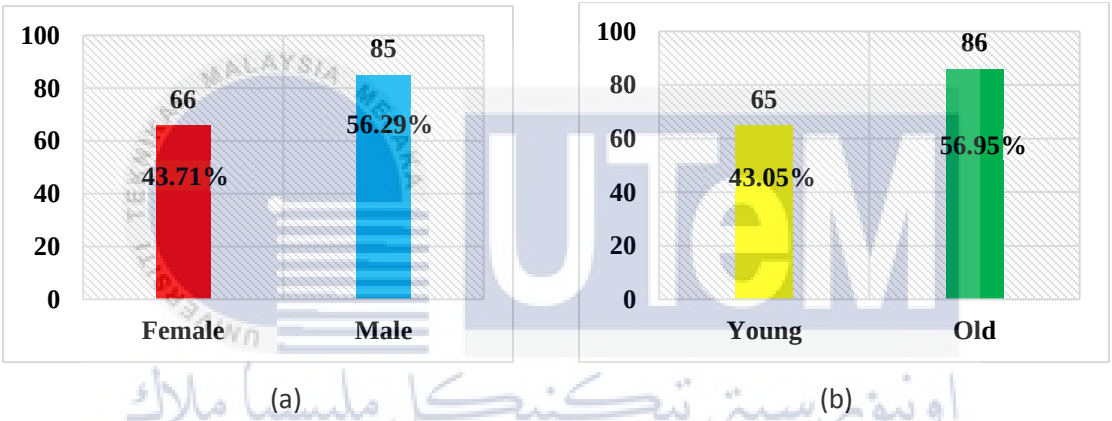


Figure 4.3 Respondent response about their surrounding that talked about ASEAN NCAP issues; (a) based on gender; (b) based on young-old category.

Question 3: Awareness on the ASEAN NCAP as regulation body that conduct crash test

Based on the survey that have been done, there are 205 respondents that knew the ASEAN NCAP is an organization that conduct crash test. Figure 4.4 shows that 109 over 205 are male and 86 of female respondents. From the results obtained, it is observed that female respondents less aware than male. It shows that the knowledge of male were better than female about the regulation body. There is no much different between young and old drivers since the percentage shows that 50.24 percent of young drivers and 49.76 percent of old drivers.

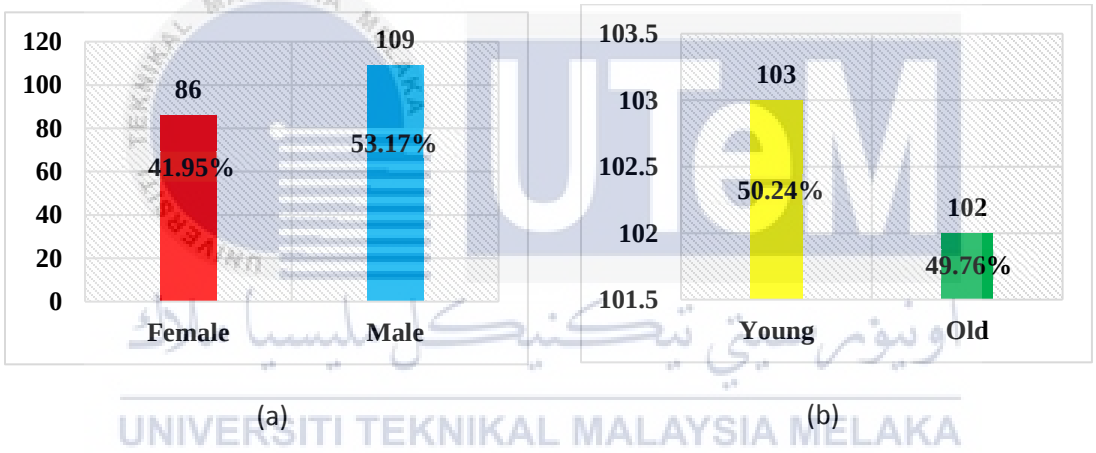


Figure 4.4 Respondent response about awareness on regulation body which conduct crash test; (a) based on gender; (b) based on young-old category.

Question 4: Respondent that referred ASEAN NCAP safety rating to buy Malaysian national car

Figure 4.5 shows that 212 of 451 respondents who have referred ASEAN NCAP safety rating before they bought the Malaysian national car. Only 99 female out of 212 respondents who have referred ASEAN NCAP safety rating while the number of male were 113 which are more concern about the safety rating of ASEAN NCAP. The number of drivers in old categories are 96 respondents lower than young drivers. The figure shows that young drivers more aware than old drivers about the safety rating before buying a car.

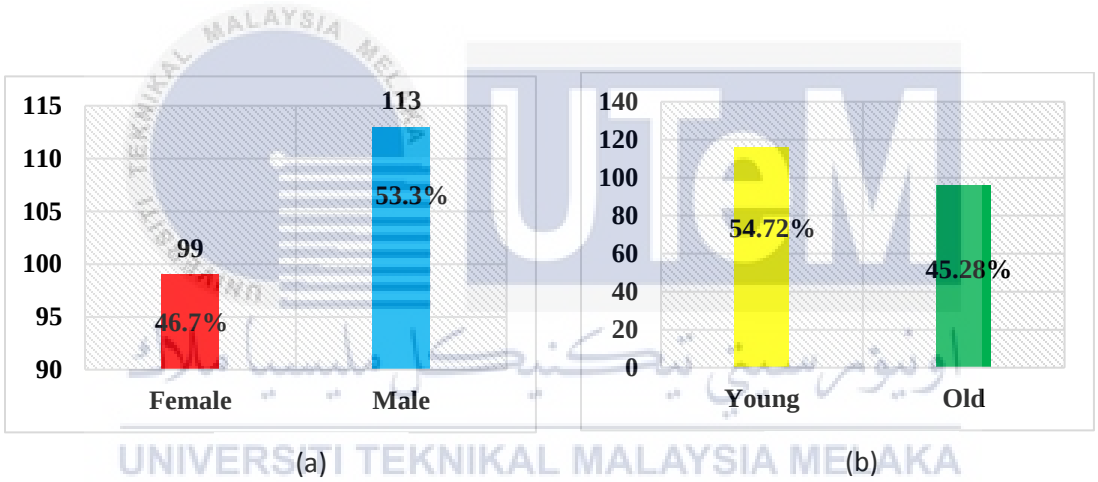


Figure 4.5 Respondent response about them referring to ASEAN NCAP safety rating to buy Malaysian national car; (a) based on gender; (b) based on young-old category

Question 5: Awareness about the crash test made on Malaysian national car before release to market sale

There are 225 out of 451 respondents who have knew that Malaysian national car will having a crash test before release to market sales. Based on 225 respondent, 118 of them are male while only 107 of them are female. There are 122 young driver have knew about the crash test of Malaysian national car while 103 respondents only for old drivers. Figure 4.6 shows that 54.22 percent of young drivers who knew about the crash test.

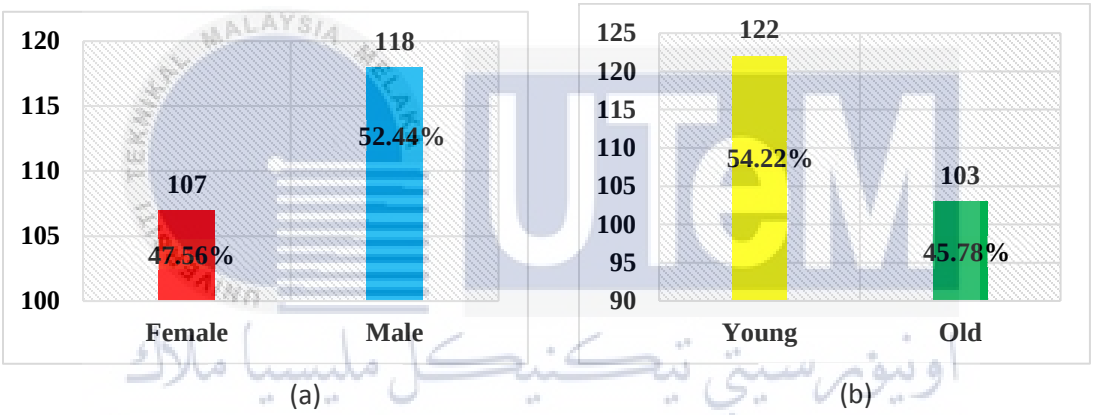


Figure 4.6 Respondent response about crash test awareness made on Malaysian national car; (a) based on gender; (b) based on young-old category.

4.3.2 Respondents feedback about Safety Features

There are six questions in this section. Safety features is the most common knowledge that every person need to know before buying a car. But, there are some people did not concern about the safety features. The questions in this section mostly about the effectiveness of safety features on Malaysian national car. The overall results showed that the safety features on Malaysian national car more effective to female and young drivers. The results is being discussed.

Question 1: Awareness on safety features in the car

This question have been asked about the safety features in the car. There are 439 over 451 respondents have noticed the safety features in their car. Most of them are female which 248 out of 439. It showed that female more aware about the safety features rather than male. Figure 4.7 shows that the number of young drivers are highest than old drivers. It shows a good results since the number of young drivers is highest than old drivers. For future, young drivers could buy a car that equip with more safety features.

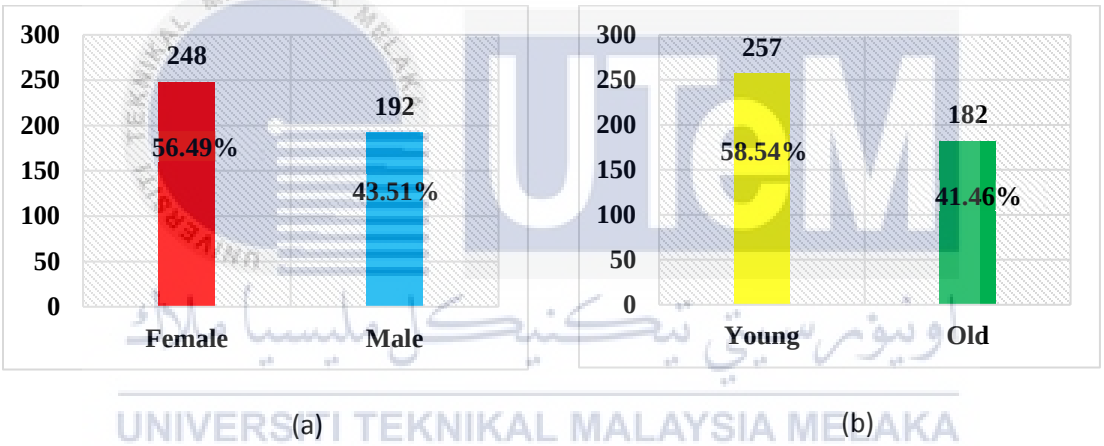


Figure 4.7: Respondent response about safety features awareness in the car; (a) based on gender; (b) based on young-old category.

Question 2: Consideration about the safety features before buy the Malaysian national car

Figure 4.8 shows that the number of respondents that considered the safety features before they bought the Malaysian national car. All 451 respondents who have used the Malaysian national car, 413 of them have considered the safety features before buying the car. Similar figure also shows that the percentage of female is highest than male respondents. On top of that, the number of young drivers who have considered the safety features are better than old drivers since the number respondents of young drivers are 240 while the old drivers are 173 only. The young drivers have made a right decision since it effected the safety (Jeff S. & Jen, 2019).

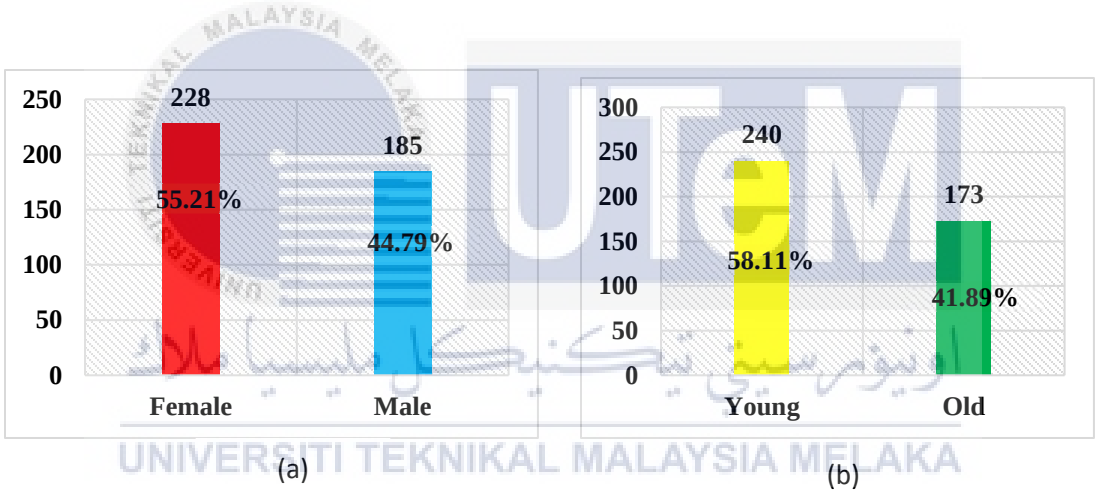


Figure 4.8 Respondent response about their consideration on the safety features before buying Malaysian national car; (a) based on gender; (b) based on young-old category.

Question 3: Respondent who ever involved or nearly involved in accident

Figure 4.9 shows that 250 respondents over 451 have ever involved or nearly involved in accident. Based on the 250 respondents, 132 of them are female while 118 of them are male. It shows that female respondents negligent compared to male. Similar figure also shows that young drivers are highest in getting accident than old driver. It was true that young drivers does not really care about the safety and they are causing the highest number of accidents (Henry, 2017).

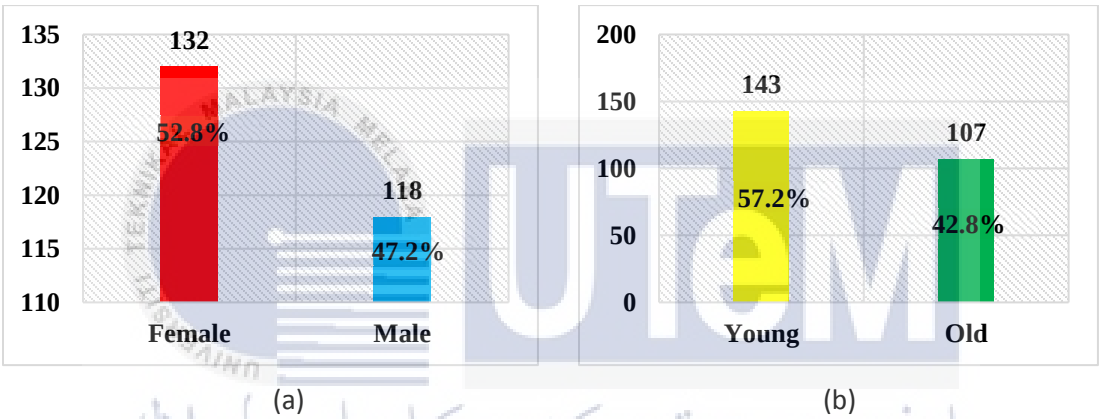


Figure 4.9 Respondent response about their direct involvement or near involvement in car accident; (a) based on gender; (b) based on young-old category.

Question 4: Effectiveness safety features on Malaysian national car

Based on the number of respondents that involved or nearly involved in accident, the effectiveness of the safety features on Malaysian national car have been issued. 218 over 250 respondents have agreed that safety features of the national car have helped them during the accident. The airbags and seatbelts have fully function and it helped to reduce injuries. There are 115 female and 103 male have agreed that statement. Figure 4.10 shows that the percentage of young drivers are much difference with old drivers.

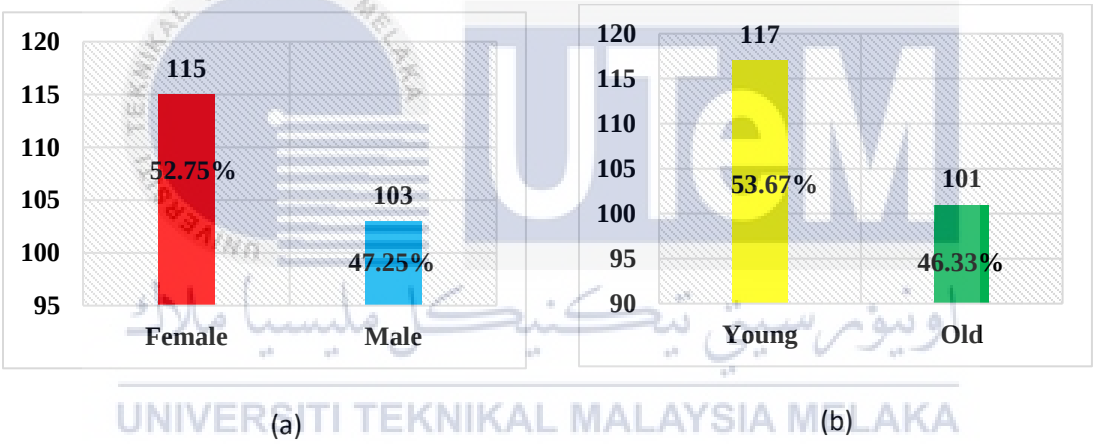
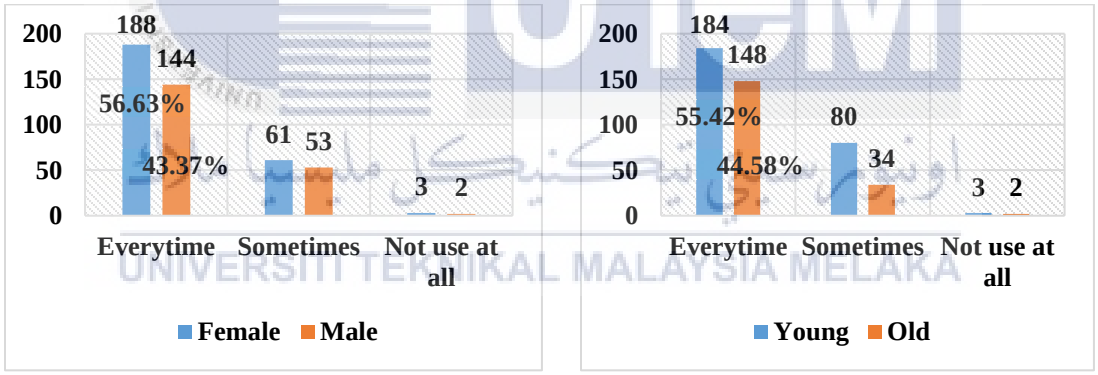


Figure 4.10 Respondent response about the safety features effectiveness on Malaysian national car; (a) based on gender; (b) based on young-old category.

Question 5: Respondent who frequently used seatbelt

For this section, there are three choices of answers which are every time, sometimes and not use at all. Average of the respondents chose every time as they used the seatbelts every time they drive the car. Figure 4.11 shows that there are 332 from 451 respondents used seatbelts every time they used the car. The numbers of female used seatbelts every time use the car are 188 while male 144. Moreover, young drivers also showed the positive attitude since there are 184 respondents who have used seatbelts every time use the car. There are less respondents who did not used the seatbelts at all during used the car which the results shown that only 3 female and 2 male did not used at all.



(a) (b)

Figure 4.11 Respondent response about the frequency of using seatbelt; (a) based on gender; (b) based on young-old category.

Question 6: Malaysian national car give the best safety features to respondents

After all the question, the last question is about the effectiveness of Malaysian national car. There are 209 respondents have agreed that Malaysian national car gave the best safety features. However, most of young drivers agreed that Malaysian national car gave the natural range since they not really satisfied with the Malaysian national car safety features. Figure 4.12 shows there are 9 respondents of young drivers and male who did not agreed with safety features of Malaysian national car.

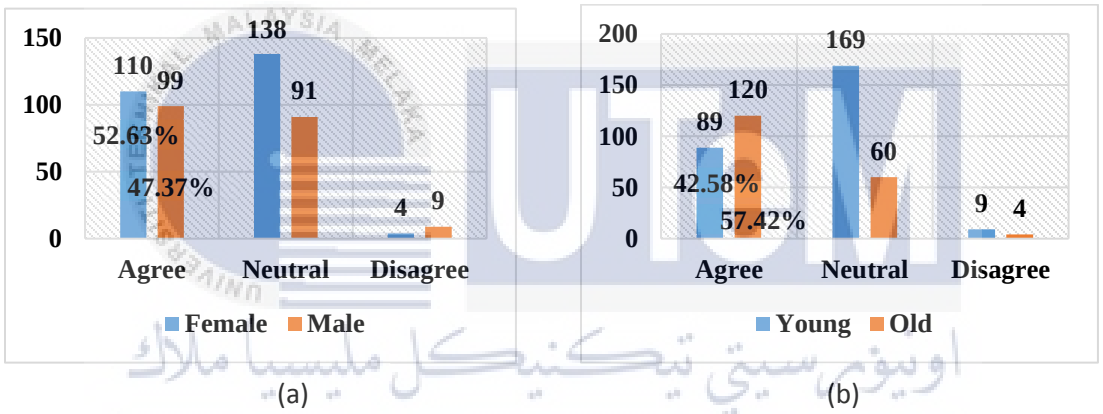


Figure 4.12 Respondent response about safety feature performance of Malaysian national car; (a) based on gender; (b) based on young-old category.

4.3.3 Respondent feedback about Safety Rating

In the first place, the researcher have included four simple question in this survey related to safety rating. The questions are about the awareness and knowledge of the respondents about the safety rating. The results obtained shows that there slightly difference between female-male and young drivers-old drivers. For question 1, 3 and 4, female and young drivers have more understanding about safety rating. The overall results are described as below.

Question 1: Awareness on the meaning of safety rating

From the results obtained, there are 332 respondents who have knew about the meaning of safety rating. Most of them are female and young drivers. Figure 4.13 shows that there are 56.93 percent of the young drivers who have knew the meaning of safety rating. The number of young drivers are 189 respondents. It shows that young respondents more concern than old respondents about the safety rating.

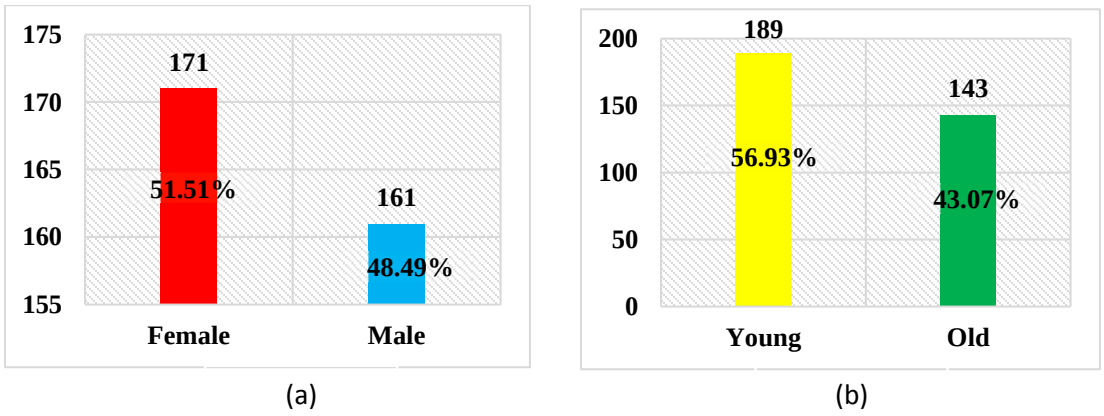


Figure 4.13 Respondent response about their awareness on the meaning of safety rating; (a) based on gender; (b) based on young-old category

Question 2: Respondent who aware on the ASEAN NCAP that evaluating the safety rating

From last discussion, female respondents are comprehensive than male respondents. But they only knew the meaning of safety rating. Based on the results obtained, some of the female respondents did not know the body regulation that evaluating the safety rating. Majority of the male respondents knew that ASEAN NCAP is the regulation body that evaluating the safety rating. 128 from 227 respondents who have knew the body regulation involved. On the other side, there is no much difference between young drivers and old drivers about the knowledge of body regulation involved to safety rating. 116 respondents for old rivers while young drivers were 111 respondents. The results is shown in Figure 4.14.

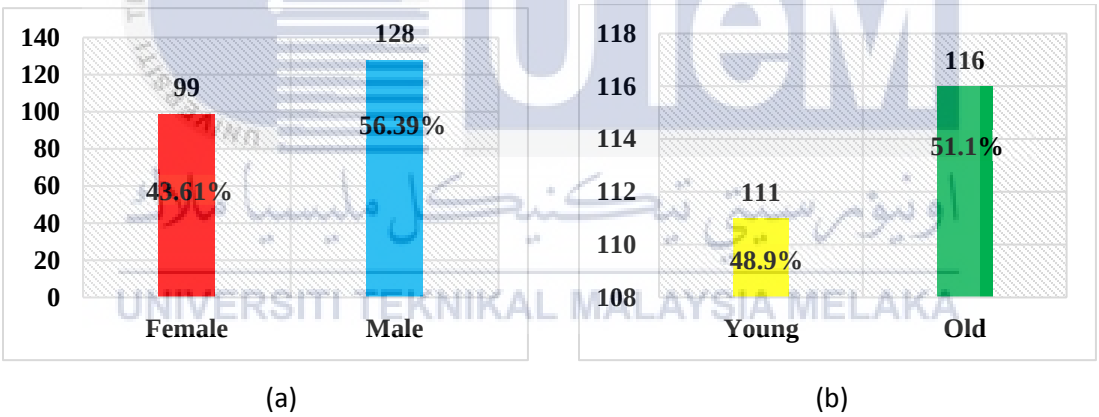


Figure 4.14 Respondent response about awareness on safety rating evaluation by ASEAN NCAP; (a) based on gender; (b) based on young-old category.

Question 3: Respondent who referred safety rating before buy the car

Figure 4.15 showed that the number of respondents who have referred safety rating before buying a car. The total number of respondents who have referred safety rating first were 306 from 451 respondents. The number of young drivers were 177 which higher than old drivers. Besides, the number of female were 160 while male were 146 only.

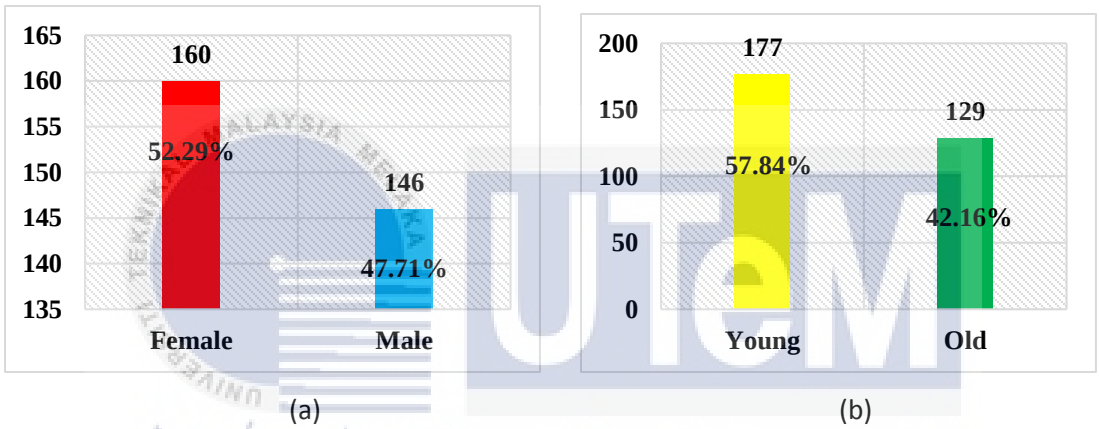


Figure 4.15 Respondent response about them referring to safety rating before buying any car; (a) based on gender; (b) based on young-old category

Question 4: Respondent who think safety rating is important for car

For the last question of safety rating, is about the important of safety rating. There are 295 respondents who thought that safety rating is important to any vehicles especially for Malaysian national car. Female and young driver's respondents mostly agreed that safety rating is important to car. Both are 152 respondents for female and 169 respondents for young drivers.

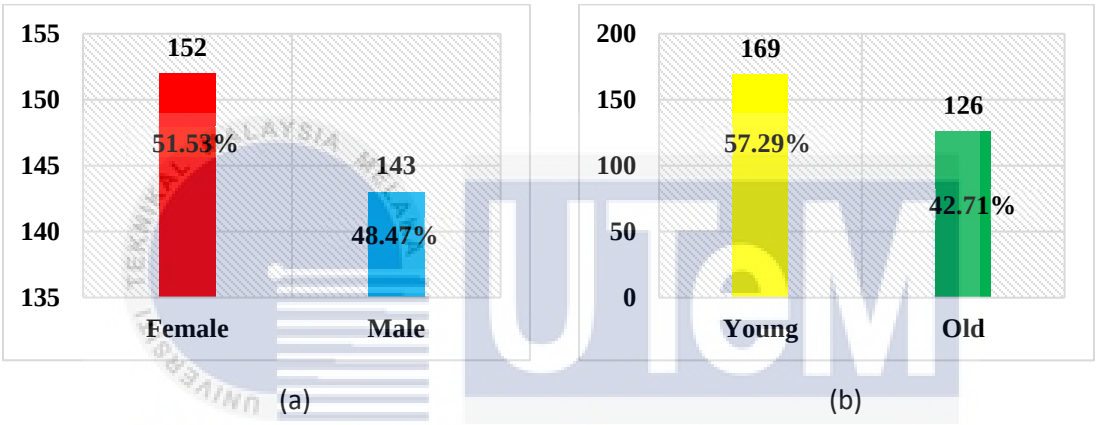


Figure 4.16 Respondent response about the important of safety rating for a car; (a) based on gender; (b) based on young-old category

4.4 Relationship between Safety Features and Safety Rating

Based on the calculation, it shows that safety features and safety rating have their correlation. A better safety features could give a good assumption to consumer during choosing a car. Safety rating were obtained based on some calculation. A car that includes the safety features like air bag and seatbelt give better safety rating since it could give less injuries to dummies during crash test. Besides, the value of chest deflection also give impact on safety rating since less compression chest deflection value range could give a best severity. The safety features and safety rating for 3 types of national car model selected in this project is shown in Table 4.5.

Table 4.5 The Correlation between Safety Rating and Safety Features

MODEL		1	2	3
SAFETY FEATURES	Airbags	1	2	2
	Seatbelts	Three-point seatbelt	Pre tensioner	Retractor Pre-tensioner & Load Limiter
SAFETY RATING	Actual Rating (2012-2016 protocol)	1	3	4
	New Rating (2017-2020 protocol)	1	3	5

CHAPTER 5

CONCLUSION AND RECOMMENDATION FOR FUTURE WORKS

5.1 Conclusion

In this study, the calculation of new safety rating point for Malaysian national car using 2017-2020 protocol system of ASEAN NCAP was performed. The safety rating for model 1 and model 2 are still the same as using 2012-2016 protocol system. While the model 3 showed increment of safety rating from 4 star to 5 star rating. Safety rating of model 3 only performed difference rating because Malaysian national car has improved the car safety features. The safety rating of 2017-2020 protocol system is based on weighing scale while 2012-2016 protocol system is directly based on Offset Deformable Barrier (ODB). The range scale of chest deflection value could give impact to the safety rating. The smaller the range scale of chest deflection, the more severe of the calculation. The fact that, safety rating not just depend on safety features but also others factor such as the strength of the frame (Caldwell, 2018).

The effectiveness of safety features on Malaysian national car and awareness safety in passenger vehicles based on regulation body, safety features and safety rating had been evaluated. From 451 respondents, half of the them agreed that safety features of national car could help them during the crash event. Based on the overall results obtained, young drivers more aware and have a wide knowledge about the regulation body compared to old drivers. Besides that, the female drivers is more concern than male driver about the safety features and safety rating. The safety

features could reduce the risk of death or significant injury. The safety rating of the car is given based on safety features and some others equipment safety assists. Most of the respondents from survey stated that the safety rating was affected by safety features.

The relationship between safety features and safety rating of Malaysian national car had been analyzed. Better safety features, give high safety rating of the car (ConsumerReport, 2014). Malaysian national car have improved a lot from model one until model three as it included the more safety features. Malaysian national car have improved the safety features in the latest edition. It prove that safety features give impact on the safety rating.

5.3 Recommendations for Future Works

Several recommendation for future works based on the obtained results are listed as below:

i. Expand the method to include other section to get accurate Offset Deformable Barrier (ODB). This study only covered the calculation on chest deflection value. For the next research, other section of head and neck assessment, knee, femur and, pelvis assessment, and lower leg, foot and ankle assessment could be covered.

ii. The calculation to all models of Malaysian national car can be done for the future research. There are others of national car that have used 2012-2016 protocol system. Using the same method, the safety rating of the car can be calculated to make comparison.

iii. Expand the number of respondents to all IPT's in Malaysia. This research only spread to five universities only. For the next research, the researcher can spread the survey to all IPTS and IPTA in Malaysia so that the accuracy of young drivers are more accurate.

iv. Study about the comparison safety features and safety rating of Malaysian national car and imported car. This research only covered about the Malaysian national car. For future, the comparison can be done between national car and imported car as in Malaysia since many consumer used imported car.

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APPENDIX A

The Online Survey Question.

INVESTIGATION ON THE RELATIONSHIP BETWEEN SAFETY FEATURES AND SAFETY RATING: A CASE STUDY ON MALAYSIAN NATIONAL CAR

1.0 INTRODUCTION

This research is conducted by Nik Watikah Nik Hassan for Final Year Project and supervised by Dr. Ridzuan Mansor, Faculty of Mechanical Engineering and Ir. Dr. Khairil Anwar Abu Kassim, Secretary General of ASEAN NCAP as Co-Supervisor. The objective of this research is to analyze the relationship between Safety Features and Safety Rating of Malaysian National Car. Respondents selected in this study are Malaysian National car users.

2.0 GUIDELINES TO ANSWER THE QUESTIONNAIRE

2.1 The participation in this study is strictly voluntary. The responses collected from this survey will be treated as highly confidential and individual identity will not be disclosed in the research findings.
2.2 The time required to answer this questionnaire is around 5 minutes only.

For any inquiries, please contact me via e-mail: nikwatikah96@gmail.com

Thanks in advance for your cooperation.

NIK WATIKAH NIK HASSAN
B041510146
Faculty of Mechanical Engineering
Universiti Teknikal Malaysia Melaka
75450, Ayer Keroh Melaka.

* Required

PART A : Demography of Respondents

Please tick for the related answer.

1. **Gender** *
   Mark only one oval.
   - ◯ Male
   - ◯ Female

2. **Age (Years)** *
   Mark only one oval.
   - ◯ 18 - 21
   - ◯ 22 - 25
   - ◯ 26 - 30
   - ◯ 31 - 35
   - ◯ Above 35

3. **Academic Qualification** *

Mark only one oval.

- ◯ SPM
- ◯ Diploma
- ◯ Bachelor
- ◯ Master
- ◯ Doctor of Philosophy

4. **Social Status** *

Mark only one oval.

- ◯ Single
- ◯ Married

5. **Driving Experience (Years)** *

Mark only one oval.

- ◯ <2
- ◯ 3 - 5
- ◯ 6 - 10
- ◯ >10

6. **Are you a user of Malaysian National Car?** *

Mark only one oval.

- ◯ Yes
- ◯ No

7. **If yes, what type of model?**

Mark only one oval.

- ◯ Proton
- ◯ Perodua

PART B : ASEAN NCAP

New Car Assessment Program for Southeast Asian Countries (ASEAN NCAP), is targeted to evaluate vehicle safety standards, raise consumer awareness and thus encourage a market for safer vehicles in the region.

8. **Please tick the answer on the box given.** *

Check all that apply.

	Yes	No
Do you aware on the organization that responsible for safer vehicle?	☐	☐
Did your surrounding ever talk about ASEAN NCAP issue?	☐	☐
Do you know ASEAN NCAP is one of the organization that will done a crash test before release?	☐	☐
Do you refer the ASEAN NCAP rating safety before buying the car?	☐	☐
Do you know the Malaysian National Car will having crash test at ASEAN NCAP before release market sales?	☐	☐

PART C : Safety Features

Vehicle safety features have come a long way over the years. Features such as crumple zones, seat belts and airbags all provide protection of you have a crash, however active safety assist technologies which can prevent a crash from occurring are now a significant point of differentiation. In other word, safety features is features in the car that helps you to avoid crash event.

This rephrase focused only on passive safety features which help to reduce injuries when a crash cannot be avoided.

Here are some question about safety features. Please tick the answer on the box given.

9. **Do you notice any safety features in your car?** *

Mark only one oval.

- ◯ Yes
- ◯ No

10. **Before buying the Malaysian National Car, do you consider about the safety features of the car?** *

Mark only one oval.

- ◯ Yes
- ◯ No

11. **Have you ever involve or nearly involve in any crash event?** *

Mark only one oval.

- ◯ Yes
- ◯ No

12. **If yes, does the safety features help you?**

Mark only one oval.

- ◯ Yes
- ◯ No

13. How many times you use seatbelt in a day? *

Mark only one oval.

- ◯ Everytime use the car
- ◯ Sometimes
- ◯ Not use at all

14. Do you agree that Malaysian National Car give the best safety features for you? *

Mark only one oval.

- ◯ Agree
- ◯ Neutral
- ◯ Disagree

PART D : Safety Rating

Safety rating is a grade given by a testing organisation (New Car Assessment Program, NCAP) to vehicles indicating the safety occupants in the event of crash.

15. Here are some question about safety rating. Please tick the answer on the box given *

Mark only one oval per row.

	Yes	No
Do you know what is meant by safety rating?	◯	◯
Have you noticed that Malaysia has an organisation (ASEAN NCAP) in evaluating the safety rating of the cars?	◯	◯
Do you refer the safety rating before buying the car?	◯	◯
Do you think safety rating is important for cars?	◯	◯

PART E : The Relationship Between Safety Features and Safety Rating

This section is only to know the perception of drivers about the relationship of safety features and safety rating after answer the previous section.

16. Do you think safety features will give effect to safety rating? *

Mark only one oval.

- ◯ Yes
- ◯ No

17. I'm so glad if you could give a comment about the relationship between safety features and safety rating.

_____

_____

_____

_____

APPENDIX B

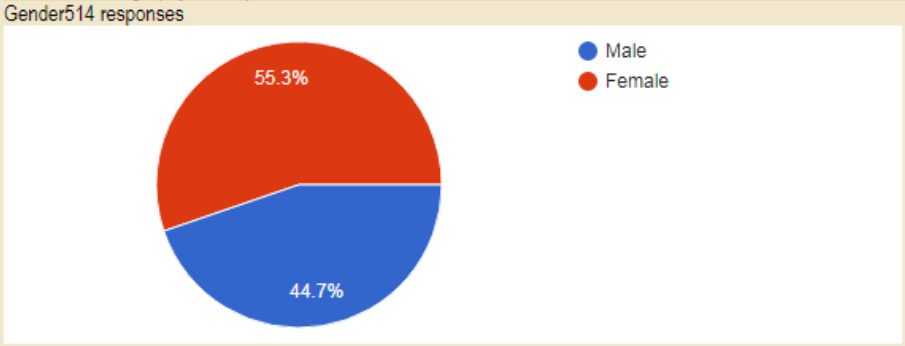
INVESTIGATION ON THE RELATIONSHIP BETWEEN SAFETY FEATURES AND SAFETY RATING: A CASE STUDY ON MALAYSIAN NATIONAL CAR

515 responses

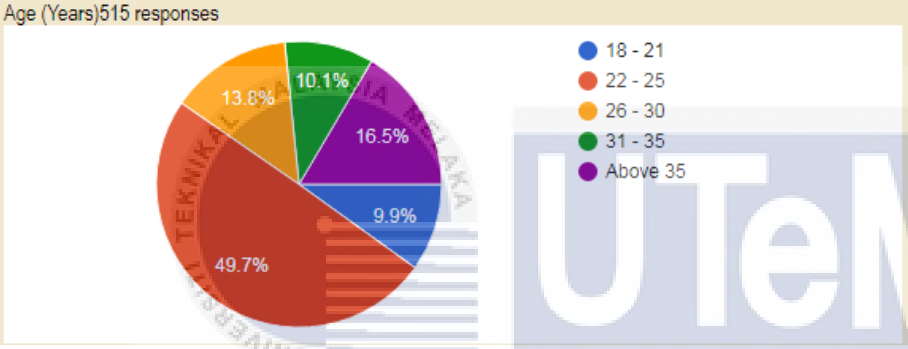
Publish analytics

PART A : Demography of Respondents

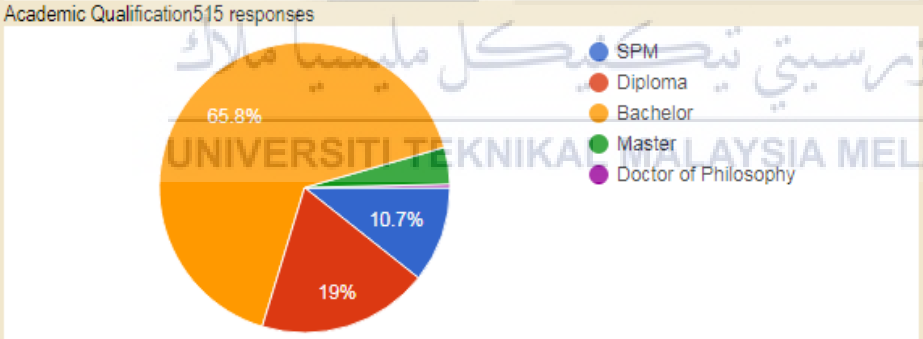
Gender514 responses



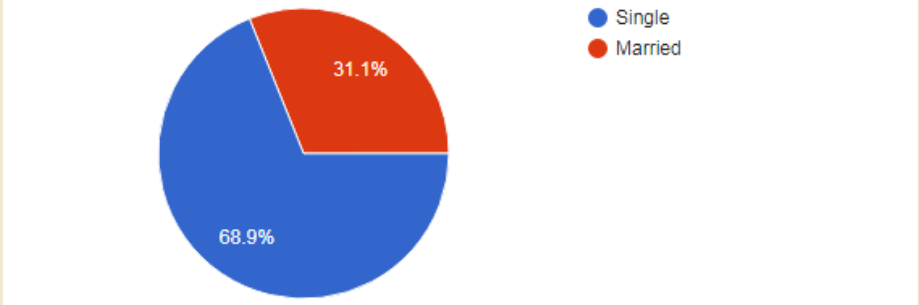
Age (Years)515 responses



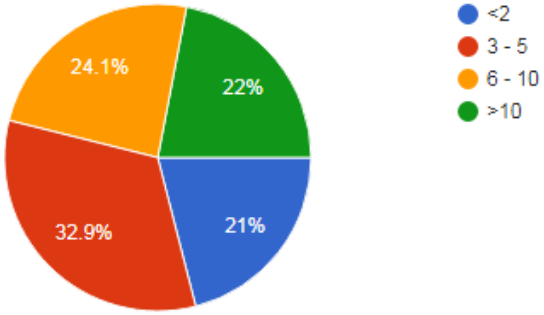
Academic Qualification515 responses



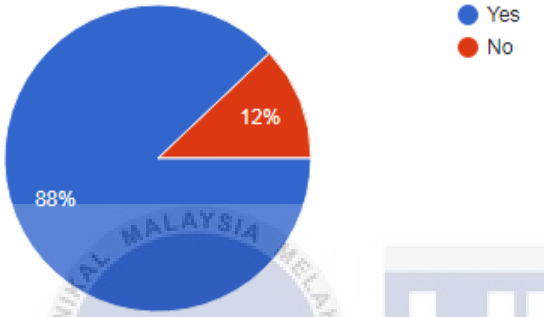
Social Status515 responses



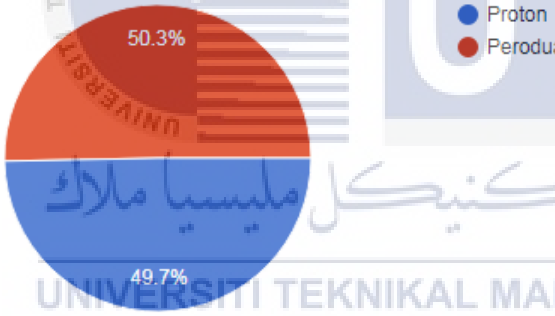
Driving Experience (Years)514 responses



Are you a user of Malaysian National Car?515 responses

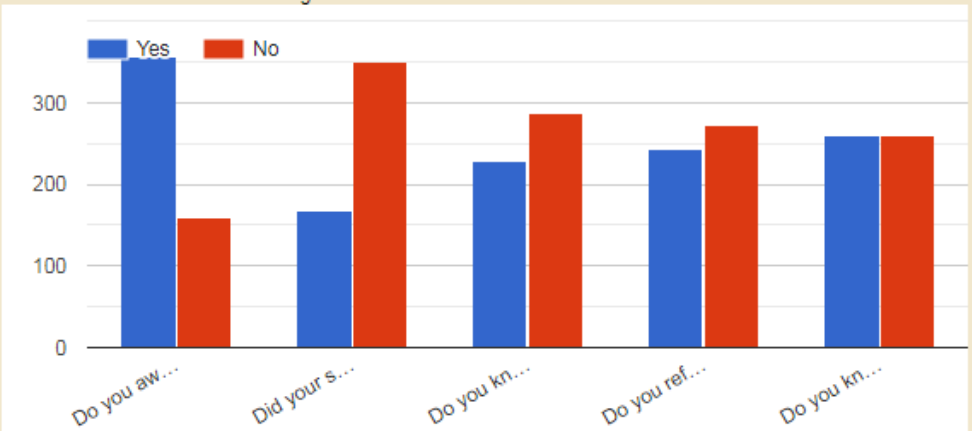


If yes, what type of model?469 responses



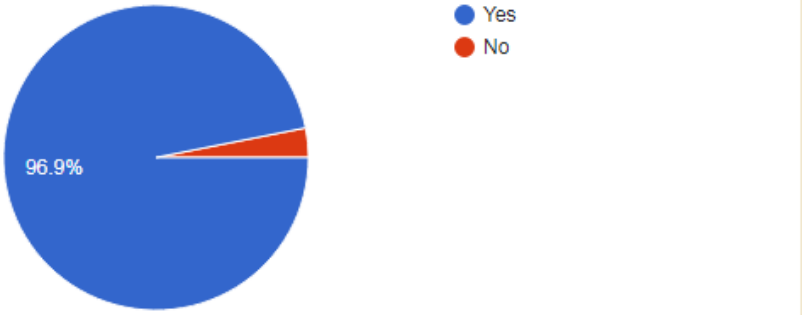
PART B : ASEAN NCAP

Please tick the answer on the box given.

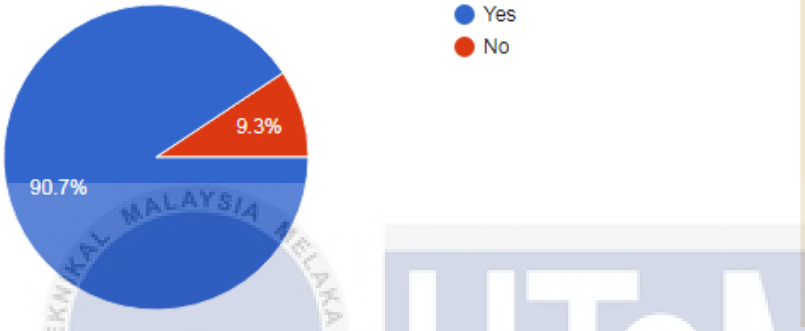


PART C : Safety Features

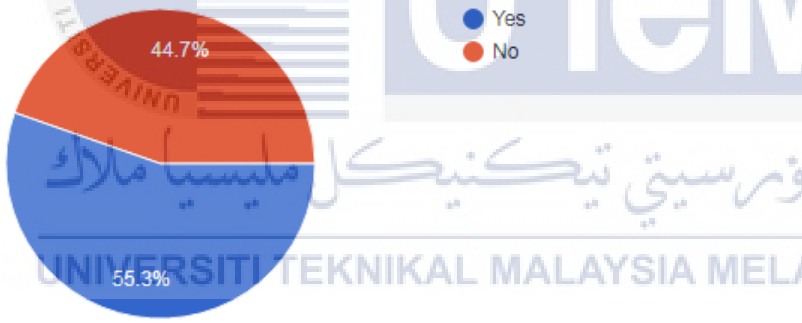
Do you notice any safety features in your car?515 responses



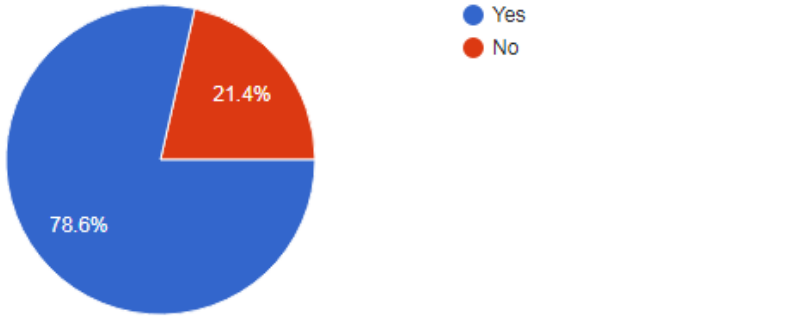
Before buying the Malaysian National Car, do you consider about the safety features of the car?515 responses



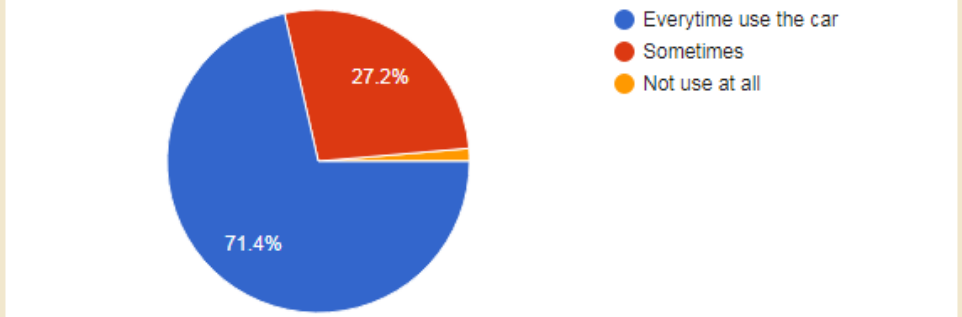
Have you ever involve or nearly involve in any crash event?515 responses



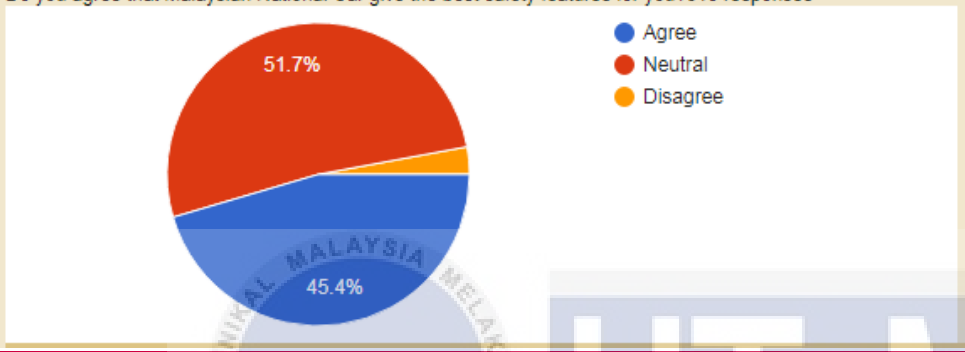
If yes, does the safety features help you?420 responses



How many times you use seatbelt in a day?514 responses

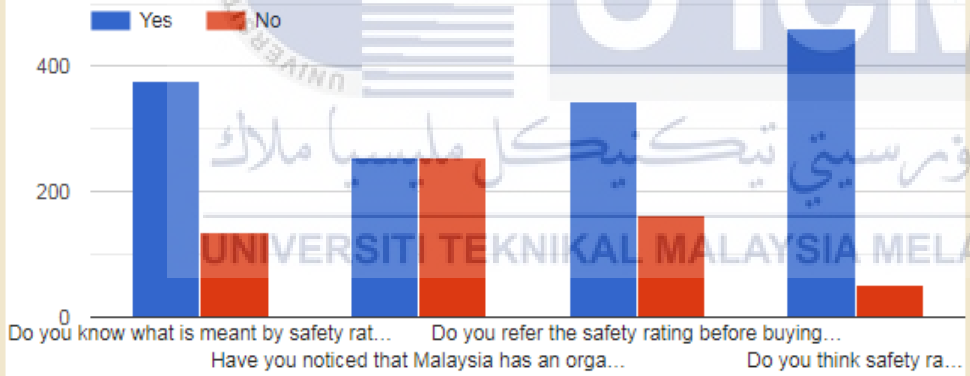


Do you agree that Malaysian National Car give the best safety features for you?515 responses



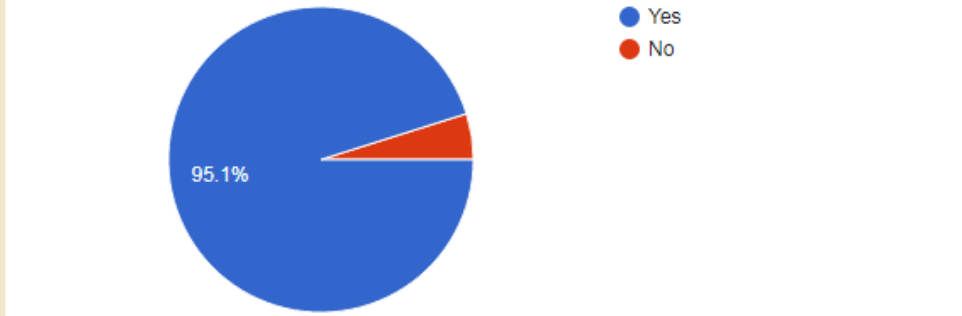
PART D : Safety Rating

Here are some question about safety rating. Please tick the answer on the box given



PART E : The Relationship Between Safety Features and Safety Rating

Do you think safety features will give effect to safety rating?515 responses



APPENDIX C

The Percentage of Overall Results

	Agreed Respondents	Female	Male	Young	Old
ASEAN NCAP					
Q1	316	50.32	49.68	55.7	44.3
Q2	151	43.71	56.29	43.05	56.95
Q3	205	41.95	53.17	50.24	49.76
Q4	212	46.7	53.3	54.72	45.28
Q5	225	47.56	52.44	54.22	45.78
Safety Features					
Q1	439	55.21	44.79	58.11	41.89
Q2	413	56.49	43.51	58.54	41.89
Q3	250	52.8	47.2	57.2	42.8
Q4	218	52.75	47.25	53.67	46.33
Q5	332	56.63	43.37	55.42	44.58
Q6	209	52.63	47.37	42.58	57.42
Safety Rating					
Q1	332	51.51	48.49	56.93	43.07
Q2	227	43.61	56.39	48.9	51.1
Q3	316	52.29	47.71	57.84	42.16
Q4	295	51.53	48.47	57.29	42.71