UNIVERSITI TEKNIKAL MALAYSIA MELAKA

PRIORITIZING WEIGHTING CRITERIA IN ASEAN NCAP RATING ASSESSMENT BY USING THE ANALYTIC HIERARCHY PROCESS (AHP): INDUSTRY AND POLICY MAKER PERCEPTION

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DECLARATION

I declare that this report entitled Prioritizing Weighting Criteria in ASEAN NCAP Rating Assessment by Using The Analytic Hierarchy Process (AHP): Industry and Policy Maker Perception is the result of my own research except as cited in the references. Prioritizing Weighting Criteria in ASEAN NCAP Rating Assessment by Using The Analytic Hierarchy Process (AHP): Industry and Policy Maker Perception has not been accepted for any degree and is not concurrently submitted in the candidature of any other degree.

Signature : 

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APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Mechanical Engineering Technology (Automotive Technology) with Honours.

Signature : .....

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Date : 18/1/2023

DEDICATION

I dedicate my dissertation work to my family and many friends. A special feeling of gratitude to my loving parents, Shea Hu Ping and Liew Suck Cheang whose words of encouragement and push for tenacity ring in my ears. I also dedicate this dissertation to my many friends who have supported me throughout the process. I will always appreciate all they have done

ABSTRACT

Automotive Technology is improving every moment nowadays, but road accidents are still happening. Road accidents and fatalities in Malaysia are still high today. ASEAN NCAP is introduced to elevate vehicle safety standards, raise consumer awareness and encourage a market for safer vehicles in the ASEAN market. There are many testing protocols and tests created by ASEAN NCAP to achieve their objectives. However, the weightage of each item and each pillar in the ASEAN NCAP rating assessment is incompatible with the data on road accidents shown. According to the Ministry of Transport of Malaysia, Motorcyclist has the highest fatalities rate in road accidents. Besides, according to World Health Organisation (WHO), children are more vulnerable to road accidents. There is a lack of study on the priority weighting criteria for safety technology in assessment protocol for ASEAN NCAP rating. Hence, there is a need to design and develop a research instrument for weighting criteria for each pillar and item in the ASEAN NCAP rating assessment. The weighting for each pillar in the ASEAN NCAP rating needed to be determined by using Analytic Hierarchy Process (AHP). There is also a need to determine the effectiveness of the current rating assessment protocol. At the beginning of this study, a survey will be distributed to policymakers makers and automotive industry workers to collect their preferences on each item in the ASEAN NCAP rating assessment for 2021 to 2025. Analytic Hierarchy Process (AHP) will analyse data collected from the questionnaire. The results obtained in this process can help in determining the weightage of each item and each pillar in the ASEAN NCAP. Simultaneously, the effectiveness of the current ASEAN NCAP rating assessment can be determined. Based on the preferences of the respondents, Child Occupant Protection (COP) was the most important criterion in the ASEAN NCAP rating assessment. The top 2 priority items from the standpoint of automotive industry worker were side (child) and vehicle-based assessment, while seatbelt reminder (front) and blind spot detection were perceived for that by the policymaker. Out of these items, two of them are under the pillar of Child Occupant Protection (COP) and Motorcyclist Safety (MS). The ASEAN NCAP should be prioritising the weightage of items in the pillar of COP and MS. By manipulating the weighting of the criteria in the ASEAN NCAP rating assessment based on the happening traffic data, it will encourage the vehicle manufacturer to introduce more safety technologies to their vehicles. At the same time, road accidents and fatalities can be reduced.

ABSTRAK

Teknologi Automotif bertambah baik setiap saat pada masa kini, tetapi kemalangan jalan raya masih berlaku. Kemalangan jalan raya dan kematian di Malaysia masih tinggi sehingga kini. ASEAN NCAP diperkenalkan untuk meningkatkan standard keselamatan kenderaan, meningkatkan kesedaran pengguna dan menggalakkan pasaran untuk menghasilkan kenderaan yang lebih selamat di pasaran ASEAN. Terdapat banyak protokol dan ujian-ujian yang dicipta oleh ASEAN NCAP untuk mencapai objektifnya. Walau bagaimanapun, wajaran setiap item dan setiap tunggak dalam penilaian penarafan ASEAN NCAP tidak serasi dengan data mengenai kemalangan jalan raya yang ditunjukkan. Menurut Kementerian Pengangkutan Malaysia, penunggang motosikal mempunyai kadar kematian tertinggi dalam kemalangan jalan raya. Selain itu, menurut Pertubuhan Kesihatan Sedunia (WHO), kanak-kanak lebih terdedah kepada kemalangan jalan raya. Terdapat kekurangan kajian mengenai kriteria pemberat keutamaan untuk teknologi keselamatan dalam protokol penilaian untuk penarafan ASEAN NCAP. Oleh itu, terdapat keperluan untuk mereka bentuk dan membangunkan instrumen penyelidikan untuk kriteria pemberat bagi setiap tunggak dan item dalam penilaian penarafan ASEAN NCAP. Wajaran bagi setiap tunggak dalam penarafan ASEAN NCAP perlu ditentukan dengan menggunakan Proses Hierarki Analitik (AHP). Terdapat juga keperluan untuk menentukan keberkesanan protokol penilaian penilaian semasa. Pada permulaan kajian ini, satu tinjauan akan diedarkan kepada pembuat dasar dan pekerja industri automotif untuk mengumpul keutamaan mereka pada setiap item dalam penilaian penarafan NCAP ASEAN untuk 2021 hingga 2025. Proses Hierarki Analitik (AHP) akan menganalisis data yang dikumpul daripada soal selidik . Keputusan yang diperolehi dalam proses ini boleh membantu dalam menentukan wajaran setiap item dan setiap tunggak dalam ASEAN NCAP. Pada masa yang sama, keberkesanan penilaian penarafan ASEAN NCAP semasa boleh ditentukan. Berdasarkan keutamaan responden, Perlindungan Penumpang Kanak-Kanak (COP) merupakan kriteria terpenting dalam penilaian penarafan ASEAN NCAP. 2 item keutamaan teratas dari sudut pandangan pekerja industri automotif ialah penilaian hentaman sisi (kanak-kanak) dan berasaskan kenderaan, manakala peringatan tali pinggang keledar (depan) dan pengesanan titik buta dilihat oleh pembuat dasar. Daripada barangan tersebut, dua daripadanya berada di bawah tonggak Perlindungan Penumpang Kanak-Kanak (COP) dan satu daripadanya di bawah tonggak Keselamatan Penunggang Motosikal (MS). ASEAN NCAP sepatutnya mengutamakan wajaran item dalam tonggak COP dan MS. Dengan memanipulasi wajaran kriteria dalam penilaian penarafan ASEAN NCAP berdasarkan data trafik yang berlaku, ia akan menggalakkan pengeluar kenderaan memperkenalkan lebih banyak teknologi keselamatan kepada kenderaan mereka. Pada masa yang sama, kemalangan jalan raya dan kematian dapat dikurangkan.

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LIST OF SYMBOLS AND ABBREVIATIONS

ADAS	-	Advanced Driver Assistance Systems
PCAM	-	Pedestrian Crash Avoidance and Mitigation System
LDW	-	Lane Departure Warning
AEB	-	Autonomous Emergency Braking
BSM	-	Blindspot Monitoring System
ASEAN	-	Association of Southeast Asia Nation
NCAP	-	New Car Assessment Program
MIROS	-	Malaysian Institute of Road Safety Research
MOT	-	Ministry of Transport
AOP	-	Adult Occupant Protection
WHO	-	World Health Organization
COP	-	Child Occupant Protection
AHP	-	Analytic Hierarchy Process
HPT	-	Head Protection Technology
FRS	-	Fitment Rating System
CRS	-	Child Restraint System
OEM	-	Original Equipment Manufacturer
ISOFIX	-	International Standard for child car seat fittings
SA	-	Safety Assist
ESC	-	Electronic Stability Control
SBR	-	Seatbelt Reminder
ABS	-	Anti-lock Braking System
SATs	-	Safety Assist Technologies
FCW	-	Front Collision Warning
LKA	-	Lane Keep Assist
MS	-	Motorcyclist Safety
BST	-	Blindspot Technology
ARV	-	Advance Rear Visualization
AHB	-	Auto High Beam

IIT	-	Industrial Information Technology
GPS	-	Global Positioning System
GSM	-	Global System for Mobile Communications
LCD	-	Liquid-crystal Displays
SMS	-	Short Message Service
CV	-	Connected vehicle technology
DA	-	Driving Assistance Technology
FCW	-	Front Collision Warning
BSW	-	Blind Sport Warning
LCW	-	Lane Change Warning
CMBS	-	Collision Mitigation Brake System
SAM	-	Statistical Analysis Methodology
FOT	-	Field Operation Test
SIM	-	Safety Impact Methodology
TTC	-	Time-to-Collision
V2V	-	Vehicle-to-vehicle
IOAS	-	Intelligent Overtaking Advice System
EGV	-	Ego vehicle
LVF	-	Lead vehicle – Front
LVO	-	Lead Vehicle – Opposite
VNet	-	Velocity Net
TTC-Net	-	Time-to-Collision Net
MST	-	Motorcyclist Safety Technology
λmax	-	Maximum Eigen value
CI	-	Consistency Index
n	-	Number of elements

CR	-	Consistency Ratio
RI	-	Index Random Consistency
WS	-	Weight of synthesis
BSD	-	Blindspot Detection

CHAPTER 1

INTRODUCTION

1.1 Background

Automotive technology is advancing every second nowadays. In the old days, the automobile is invented to enable people to travel and relocate more efficiently, reduce human workload, etc. It is a common transport for a family as it provides comfort and protection from sun and rain. According to CEIC data, there were 17,728,482 vehicles registered in December 2021 in Malaysia.(CEIC Data, 2021) As time goes by, automobile manufacturers prioritize the performance and efficiency of an automobile. As a result, the automobile's speed increases, and the duration of travelling from one spot to another is reduced. Due to the growing number of vehicles and increment in automobile speed, safety concerns are created.

Five hundred sixty-seven thousand five hundred sixteen road accidents were reported in 2019 in Malaysia. (Ministry of Transport Malaysia, 2020) This figure rose from four hundred fourteen thousand four hundred and twenty-one cases in 2010. In this period of time, fifty-nine per cent of road fatalities are coming from motorcyclists, whereas passenger cars are responsible for twenty-one per cent of fatalities among all other road users. (Ministry of Transport Malaysia, 2020) Few studies indicate that human error is the main factor in road accidents. Examples of drivers' behaviour are carelessness, reckless driving, and over speeding. (Musa MF et al., 2020) Distracted driving such as using a phone while driving, interacting with passengers, eating, drinking, and smoking can also lead to road accidents. More than fourty-three per cent of Malaysian drivers use their mobile phones while driving. These dangerous driving behaviours will put the driver and others in danger.

Automobile manufacturers have introduced some strategies to overcome this problem. This includes increasing chassis rigidity and introducing Advanced Driver Assistance Systems (ADAS) to reduce road accidents. The ADAS can reduce the severe impact of those that cannot be avoided during a road accident. The essential safety critical ADAS applications include Pedestrian Crash Avoidance and Mitigation System (PCAM), Lane Departure Warning (LDW), Autonomous Emergency Braking (AEB), and Blindspot Monitoring System (BSM). These technologies can be used to keep a vehicle in its lane or control its motion in various situations. To standardize and improve the vehicle safety systems, the systems should be tested and evaluated by a regulation or consumer-based approach intervention. It should refer to professional opinions from automotive researchers and perspectives from people in different regions.

In December 2011, New Car Assessment Program for Southeast Asia countries (ASEAN NCAP) is established by the effort of the Malaysian Institute of Road Safety (MIROS) and Global NCAP. The main objective of ASEAN NCAP is to elevate vehicle safety standards, raise consumer awareness and encourage a market for safer vehicles in the ASEAN market. There is a variety of testing protocols and tests created by ASEAN NCAP to check the safety of a vehicle. Up till now, ASEAN NCAP has successfully reduced the number of road accidents by elevating vehicle safety standards. In addition, it also provides a vehicle safety reference for consumers when making car purchase decisions.

However, the weightage of each item and each pillar in the ASEAN NCAP rating assessment is incompatible with the data on road accidents shown. According to MOT, the motorcyclist has the highest percentage of road fatalities, fifty-nine per cent.(Ministry of Transport Malaysia, 2020) In ASEAN NCAP rating assessment protocol for 2021 to 2025, Motorcyclist Safety only contributes twenty per cent of the overall rating. (*Assessment Protocol-Motorcyclist Safety*, 2020) It is twenty percent lower than the weighting of Adult Occupant

Protection (AOP). Besides, according to World Health Organization (WHO), young children are more vulnerable to road accident compared to adults. (World Health Organization (WHO), 2015) Children are limited by their physical, cognitive, and social development. Additionally, due to their softer heads, children are more likely to sustain catastrophic head injuries in car accidents. Nevertheless, Child Occupant Protection (COP) only contributes twenty percent of the overall rating. (*Assessment Protocol-Child Occupant Protection*, 2019) This shows there is a contradictory relationship between the weightage of the ASEAN NCAP rating assessment and the reality.

In conclusion, there is a need to ascertain the effectiveness of the current ASEAN NCAP rating assessment. This can be done by collecting the opinion of individual who has knowledge in the aspect of road and vehicle safety: automotive industry workers and policymakers. Then, the weighting for each pillar in the ASEAN NCAP rating assessment can be determined by using Analytic Hierarchy Process (AHP). AHP is a method of "measurement through pairwise comparisons and relies on the judgements of experts to derive priority scales.". Thomas L. Saaty created it in the 1970s.(Russo & Camanho, 2015) As a tool for multiple criteria decision-making, it has been one of the most popular. It is widely used by researchers and decision-makers due to its simplicity and ability. Hence, AHP will be the most suitable technique to be used in this paper to determine the weighting for each pillar in the ASEAN NCAP rating assessment.

1.2 Problem Statement

Automobile brings advantages and eases human in daily life. In the meantime, it may bring injury, in a worst-case scenario, resulting in fatalities when the driver and passenger are involved in a road accident. ASEAN NCAP is established in December 2011. To date, it has a history of 11 years. However, there is lack of study on the prioritiy weighting criteria for safety technology in assessment protocol for ASEAN NCAP rating. The weighting of each pillar for current ASEAN NCAP rating assessment is irreconcilable with the road accident index. Thus, There is a need to determine and evaluate the weighting for each item and each pillar in ASEAN NCAP. The effectiveness of the current assessment protocol for item in each pillar should be tested too.

1.3 Research Objective

The main objective of this research is to propose accurate, achievable, methodical, and effective methods of prioritzing the weighting criteria in an assessment protocol. Specifically, the objectives are as follows:

a) To design and develop a research instrument for weighting criteria for each pillar and item in the ASEAN NCAP rating assessment.
b) To determine the weighting for each pillar in the ASEAN NCAP rating by using Analytic Hierarchy Process (AHP).
c) To determine the effectiveness of the current assessment protocol for item in each pillar.

1.4 Scope of Research

The scopes of the research are as follows:

a) Respondent must be citizen of ASEAN countries.

b) Respondent must have considerable knowledge about road and vehicle safety.

c) Determination of weighting for each pillar is based on ASEAN NCAP rating scheme for 2021 to 2025.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A literature review is an academic writing that discusses the information from published articles in a particular subject area. It also demonstrates the knowledge and understanding of the published articles on a specific topic in a context. A literature review normally comes before a research proposal and the results of a project. Conducting a literature review can help in summarising and analysing previous research and studies. Information and knowledge that is useful for this project have been collected as a guide in completing this project.

For this project, statistics of road accidents, information about the pillars of ASEAN NCAP, innovative accident-avoidance technologies and analytic hierarchy process (AHP) is being collected need to be studied for quality project results. Thus, academic literature related to these topics will be collected and reviewed. All these efforts are to ensure the project can proceed smoothly.

2.2 Accident Statistic

2.2.1 Malaysia Road Accident 2010 to 2019

In October 2018, there is around 16,000,000 vehicles registered in Malaysia based on CEIC Data.(CEIC Data, 2021) When the number of vehicles increases, the number of road accidents will increase accordingly. According to the Department of Statistics Malaysia, transport accidents were ranked as the fourth principal cause of death in 2018.(*Department of Statistics Malaysia Official Portal*, 2020) Transport accidents can lead to economic losses and restrict a country's social development process.

For a growing country like Malaysia, transport infrastructure is important since it connects all the states in Malaysia and consequently brings up the economic sectors. Hence, the need for automobiles is growing every year. Road accident is the biggest risk in transport. As we can see, from Figure 2.1, the digit is rising constantly since 2010. There is an increment of 153095 road accidents from 2010 to 2019. For Malaysia Road Fatalities, the integer shown in Figure 2.2 is rising from 2010 to 2012 by 45. Then, it starts to drop from 2012 to 2014 by 213. The figure continues to increase from 2014 until 2016. It is worth noting that there is a sharp increment in 2016 which is 446 higher than that in 2015. After that Malaysia's road fatalities begin to drop until 2019. It is a good sign that the Malaysia road fatalities are reducing.

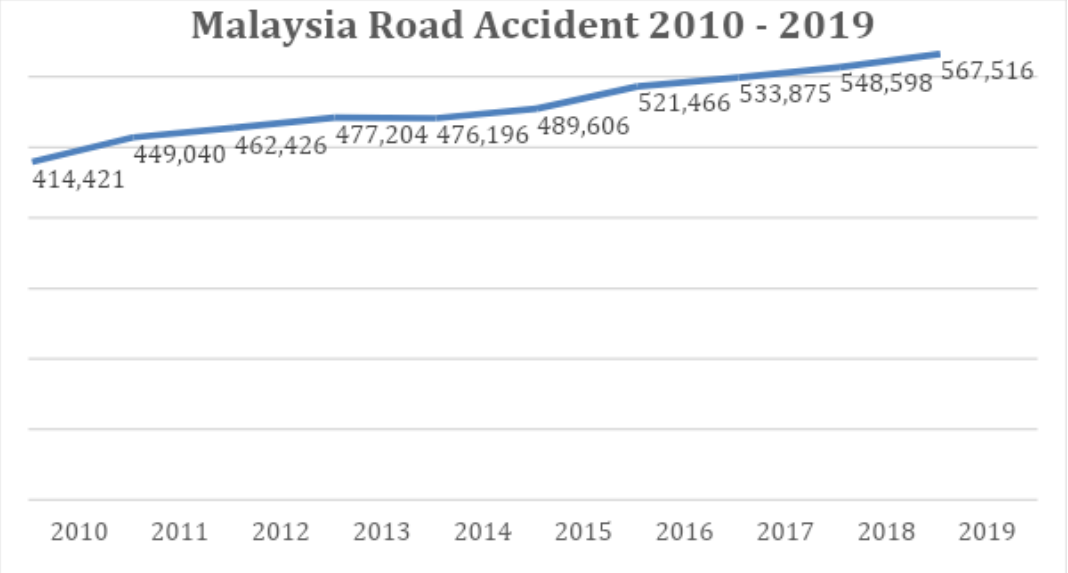

Figure 2.1: Malaysia Road Accident 2010 to 2019 (Ministry of Transport Malaysia, 2020)

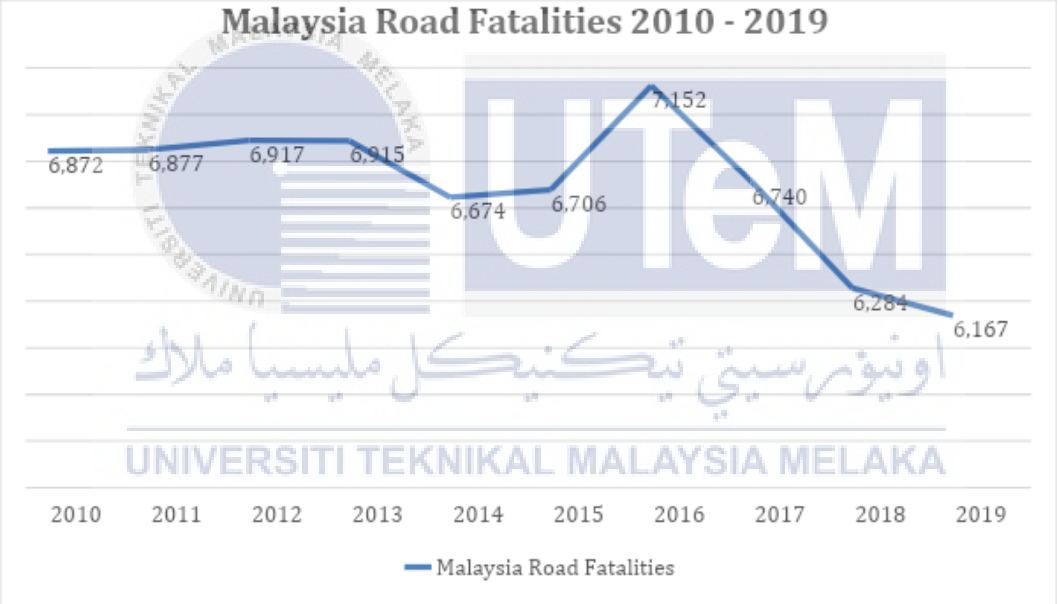

Figure 2.2: Malaysia Road Fatalities 2010 to 2019 (Ministry of Transport Malaysia, 2020)