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PERSPECTIVES ON THE IMPLEMENTATION OF RTSMS ISO 39001:2013 IN CHANGING THE COGNITIVE AND BEHAVIOUR OF INSTITUTIONAL ROAD USERS: A CASE STUDY IN NIOSH MALAYSIA

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MSc

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Thesis submitted in fulfilment
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CONFIRMATION BY PANEL OF EXAMINERS

I certify that a Panel of Examiners has met on 12 September 2025 to conduct the final examination of Azizie Bin Hamid on his Masters of Science thesis entitled "Perspectives On The Implementation Of RTSMS ISO 39001:2013 In Changing The Cognitive And Behaviour Of Institutional Road Users: A Case Study In NIOSH Malaysia" in accordance with Universiti Teknologi MARA Act 1976 (Akta 173). The Panel of Examiners recommends that the student be awarded the relevant degree. The Panel of Examiners was as follows:

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ABSTRACT

Despite official statistics from the Royal Malaysia Police (PDRM) indicating reductions in road-traffic fatalities and serious injuries, the overall number of crashes in Malaysia continues to rise. The consistent annual increase of approximately 1.5 million newly registered vehicles contributes to higher traffic density, thereby elevating the probability of road accidents. This trend underscores the need for more adaptive and systemic preventive strategies that reshape the cognitive orientation and behavioural patterns of Malaysian road users in addressing Road Traffic Safety (RTS) risks. This study investigates the cognitive and behavioural transformation of road users within an institutional setting through the effective implementation of the Road Traffic Safety Management System (RTSMS) known as MS ISO 39001 and its influence on road-safety outcomes. The research focuses on the changes of meta-cognitive processes which underlying aspect of behavioural change fostering safer driving culture and reducing incident rates. The implementation of RTSMS MS ISO 39001:2013 is posited to facilitate a cognitive shift in managing RTS risk both at the organizational and individual levels. A total of fifty-seven (57) respondents that have direct impact with RTSMS has been identified as respondents in the institutional landscape from NIOSH Malaysia that's have participated in this study. NIOSH has implemented RTSMS MS ISO 39001 through an accredited certification body, supporting its strategic objective of achieving zero road-traffic accidents. Respondents represented all seventeen (17) regional offices across Malaysia, providing a comprehensive perspective on diverse traffic contexts. Quantitative analysis was conducted using Structural Equation Modelling (SEM) to test three hypotheses (H1, H2, H3) derived from the conceptual framework. Data were obtained using the validated Driver Behaviour Questionnaire (DBQ) and Driver Skill Inventory (DSI). The results revealed strong and significant relationships: H1 ($R^2 = 0.713$, $\beta = 0.848$, $p < 0.000$), H2 ($R^2 = 0.373$, $\beta = 0.621$, $p < 0.000$), and H3 ($R^2 = 0.910$, $\beta = 0.955$, $p < 0.000$). These findings confirm that RTSMS ISO 39001:2013 exerts a substantial influence on the cognitive and behavioural dimensions of road users, thereby reinforcing its role as an effective mechanism for enhancing Malaysia's road-traffic safety culture.

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This research contributes to road safety by developing and validating a Road Traffic Safety Management System (RTSMS) that integrates data-driven risk assessment, real-time monitoring, evidence-based intervention planning and impact on cognition and behaviour within institutional settings. The system has the potential to reduce traffic-related injuries and fatalities by enabling proactive management of high-risk corridors, intersections, and times of day.

The RTSMS implementation influences individual cognitive by shaping risk perception, decision-making, and situational awareness among road safety personnel. Real-time data visualization, standardized protocols, and feedback mechanisms foster more consistent interpretation of risk signals and evidence-based prioritization. Behavioural changes include increased adherence to standardized procedures, proactive communication, and collaborative decision-making across units (operations, maintenance, emergency response). This leads to faster recognition of hazards, more timely interventions, and improved response coordination.

To all who contributed directly or indirectly to this work, your support has been a crucial part of this journey, and I am sincerely thankful.

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LIST OF SYMBOLS

Symbols

COM -B	An Acronym for A Psychological Framework Used to Understand and Change Human Behavior. It Suggests That for Any Behaviour (B) To Occur, Three Essential Conditions Must Be Met Capability, Opportunity and Motivation.
Aze+	Aze+ Concepts RTA Causation and Control Framework Based on The Theory Related.

LIST OF ABBREVIATIONS

Abbreviations

DBQ	Driver Behaviour Questionnaire
DIS	Driver Skill Inventory
EWCS	European Working Condition Survey
ISO	International Organization for Standardization
JKJR	Jabatan Keselamatan Jalan Raya
JPJ	Jabatan Pengangkutan Jalan Malaysia
KOSB	KOTAMAS Oil Sdn. Bhd
MIROS	Malaysian Institute of Road Safety Research
MKJR	Majlis Keselamatan Jalan Raya Malaysia
NIOSH	National Institute of Occupational Safety and Health
NTP	National Transport Policy
OHS	Occupational Health and Safety
PDRM	Polis Diraja Malaysia
RTA	Road Traffic Accident
RTS	Road Traffic Safety
RTSMS	Road Traffic Safety Management System
SEM	Structural Equation Modelling
VKT	Vehicle Kilometres Travelled
WHO	World Health Organization

CHAPTER 1
INTRODUCTION

1.1 Introduction

Road traffic accidents remain one of the most critical public health and safety challenges in Malaysia. Despite continuous efforts by government agencies such as the Polis Diraja Malaysia (PDRM), Malaysian Institute of Road Safety Research (MIROS) and Jabatan Pengangkutan Jalan (JPJ) or Road Transport Department, which have recorded and tabulated the statistic on reductions in road fatalities and serious injuries. The overall number of traffic crashes continues to increase. Each year, approximately

1.5 million new vehicles are registered in Malaysia, contributing to higher traffic density and increased exposure to risk of road traffic incidents. This steady growth in road users increases the likelihood of road traffic incidents, thereby requiring more adaptive and integrated preventive strategies that address the root behavioural and cognitive causes of unsafe driving practices (Anstey et al., 2005).

In the past, most road safety initiatives have focused on enforcement, education, and infrastructure improvement. However, such approaches often overlook the importance of human cognitive and behavioural factors, which are essential determinants of road user safety. The cognitive mindset of drivers, their awareness, decision-making, and perception of risk, play a significant role in shaping driving behaviour. Therefore, achieving a sustainable reduction in road traffic incidents requires not only regulatory enforcement but also a systematic approach to transforming road users' cognitive behaviour.

To address this need, the International Organisation for Standardisation (ISO) introduced the Road Traffic Safety Management System (RTSMS) ISO 39001:2013, a management framework that enables organisations to systematically identify, assess, and control road traffic safety risks. The implementation of RTSMS aims to instil a culture of safety within organisations by integrating cognitive awareness, operational procedures, and behavioural practices toward achieving the ultimate goal of Zero Road Traffic Accidents. Furthermore, under the umbrella ISO 39001 standard the guide for controlling commuting scope have been published under ISO 39002. The ISO committee have taken an extra millage to establish guide of implementation for institutional having issues in commuting. The ISO 39002:2020 is subset in managing risk of road traffic safety in the commuting scope, which focuses on commuting safety management, provides additional guidance on managing risks associated with work-related travel. The essence of the standard focuses on road behaviour changes and setting norm to driver and rider for commuting to workplaces.

This study focuses on the effectiveness of RTSMS ISO 39001:2013 in reshaping the cognitive and behavioural dimensions of road users within an organisational context. The researcher is comparing the elements in the two road traffic management systems, namely the Sunflower method and ISO RTSMS 39001. The Road Traffic Safety Management System ISO 39001 is an important standard for identifying and managing risks related to road traffic safety and road traffic for enterprises (Stoma, 2021).

The National Institute of Occupational Safety and Health (NIOSH) Malaysia, as a certified organisation under RTSMS ISO 39001, provides an appropriate case study for examining the system’s implementation and outcomes. The study analyses how the adoption of RTSMS influences cognitive restructuring, behavioural change, and the overall road safety culture among NIOSH employees which used and implement the RTSMS ISO 39001 across all seventeen (17) regional offices in Malaysia. The respondents in the study must be NIOSH staff who have implemented the system on-site. The fifty-seven (57) respondents, from the manager to the driver, have been given an explanation and access to the link in the Google form to answer the instruments.

Using a quantitative approach based on Structural Equation Modelling (SEM) (Hair et al., 2022a), the research investigates the relationships among cognitive factors, driver behaviour, and RTSMS implementation. The findings of this study provide empirical evidence on how RTSMS contributes to road safety improvements by enhancing road users' cognitive understanding and behavioural responsibility. Ultimately, this research aims to support Malaysia’s strategic vision of reducing road traffic accidents and to strengthen the global body of knowledge on the role of management systems in promoting road traffic safety in the institutional landscape in Malaysia.

1.2 Research Background

The phrases “Drive Safely” and “Biar Lambat Asalkan Selamat” have long served as moral reminders and guiding principles to promote safer driving behaviour. Such expressions reflect the belief that individual values and cognitive awareness have a profound influence on behavioural change on the road. In the Malaysian context, spiritual practices, such as reciting the supplication سُبْحَانَ الَّذِي سَخَّرَ لَنَا هَذَا وَمَا كُنَّا لَهُ مُقْرِنِيْنَ وَإِنَّا إِلَى رَبِّنَا لَمُنْقَلِبُوْنَ before beginning a journey, as taught in Islamic tradition, symbolise an internalised cognitive mechanism of self-awareness and responsibility before engaging in road activities. These practices serve as cognitive triggers that enhance mental alertness and promote safety-oriented behaviour among road users.

Such behavioural preparedness increases cognitive alertness and risk awareness, both of which are essential for mitigating potential hazards in road traffic environments. Human beings continually seek to identify and develop strategies to enhance their safety and well-being, including managing the uncertainties inherent in daily mobility. The study aimed to improve road traffic safety, which involves not only technological or regulatory advancements but also psychological and cognitive adaptations to the uncertainty and risk of road traffic.

Uncertainty has always been a fundamental aspect of human existence. The conceptualisation of risk emerged from humanity’s early reflections on mortality and the desire to avoid harm. The development of probability theory, which serves as the foundation for modern risk assessment, preceded the emergence of systematic risk analysis in technical and social systems. The institutionalisation of risk research and the professionalisation of risk management practices are relatively recent developments. Several scholars, including (Kates, 1985), have identified seminal work on risk perception and voluntariness, published in 1968, as a pivotal starting point for contemporary risk studies. The researcher has identified the cognitive and behavioural factors impacting novice young drivers (Marinova et al., 2022; Meng & Siren, 2012). Factors such as hazard perception, lack of driving skills, poor situational awareness, and crash history affect cognitive and behavioural skills among novice young drivers.

Hazards encountered on the road introduce both probabilistic and severity-based risks that can significantly influence the overall level of road traffic safety. Within organisational contexts, the absence of structured systems to manage and mitigate these risks can lead to substantial operational consequences. A lack of driver awareness of road hazards increases the likelihood of road traffic accidents, which can result in the loss of skilled personnel, reputational damage, reduce operational performance, reduce production, service disruptions, and a decline in client confidence. Globally, road traffic safety has become a pressing concern as road fatalities are among the top ten leading causes of death. According to the International Organisation for Standardisation (ISO), approximately 1.35 million fatalities occur annually due to road accidents, with an additional 20 to 50 million individuals sustaining non-fatal injuries that contribute to significant economic losses. Vulnerable road users, particularly motorcyclists, pedestrians, and cyclists, constitute the majority of victims. Alarmingly, individuals aged 5 to 29 years, who represent the future socio-economic foundation of nations, are disproportionately affected by road traffic injuries and fatalities.

Before delving further into the issue of Road Traffic Accidents (RTAs), it is necessary to examine the situation from a micro perspective, particularly the risks and opportunities faced by road users in Malaysia during the post-COVID-19 period in 2019. During the global COVID-19 pandemic, road usage in Malaysia declined by approximately 3% of normal activity levels. In response to the outbreak, the Malaysian government implemented unprecedented public health measures through the Movement Control Order (MCO), which lasted for nearly four months. This measure aimed to limit the spread of the virus through a comprehensive public health system, including disinfection protocols, social distancing, home confinement, and the mandatory use of personal protective equipment (PPE).

Public compliance with these Standard Operating Procedures (SOPs) was notably high, reinforced by strict enforcement and continuous government supervision. However, when compared with compliance to road traffic regulations such as the Road Transport Act 1987 and the Occupational Safety and Health Industry Code of Practice for Road Transport Activities 2010, the level of adherence and awareness among organisations and the public remains considerably lower.

The MCO period provided an unintended yet significant example of how risk reduction operates under the Hierarchy of Control principle. According to Occupational Health and Safety (OHS) theory, eliminating risk at its source is the most effective control measure. By restricting road usage and thereby eliminating exposure to road hazards, the number of vehicles on the road was reduced by approximately 70%, resulting in a proportional reduction in road traffic safety risks.

Data from the Royal Malaysia Police (PDRM) indicated that during the first phase of MCO (18–31 March 2020), a total of 5,498 accidents were recorded, averaging 392.7 cases per day, with 58 fatalities. During the second phase (MCO 2), the figures decreased to 4,693 accidents and 56 fatalities, demonstrating a downward trend. However, subsequent phases showed an upward trajectory: MCO 3 recorded 6,011 accidents and 65 fatalities, while MCO 6 reached 25,251 accidents and 231 fatalities, as reported by then-Prime Minister of Malaysia, Tan Sri Muhyiddin Yassin.

These statistics, verified by PDRM and analysed by MIROS, gained wide public attention through social media. Many commentators observed the paradox of Malaysian road users possessing a "third-class mentality with first-class road infrastructure." This phenomenon underscores the cognitive and behavioural gap that persists among Malaysian road users. Hence, it reinforces the need to strengthen cognitive awareness and reshape behavioural attitudes toward road safety within Malaysia's road traffic ecosystem.

Table 1.1
Data retrieved from PDRM and MIROS indicated the accident cases during the MCO period

MCO Series	**Date FY 2020**	**Accidents**	**Rate Accident/Day**	**Fatalities Cases**
MCO 1	18th March until 31st March (14 days)	5,498	392.7	58
MCO 2	1st April until 14th April (14 days)	4,693	335.2	56
MCO 3	15th April until 28th April (14 days)	6,011	599.7	65
MCO 4	29th April until 4th May (7 days)	3,174	453.4	29
MCO 5	5th May until 12th May (8 Days)	5,904	738.0	68
MCO 6	13th May until 9th May (29 days)	25,251	870.7	231
	Total	50,531		507

Source: Webinar by MIROS and MITRANS dated 11th June 2020 and "Jabatan Siasatan & Penguatkuasaan Trafik Bukit Aman, PDRM

However, a deeper analysis of the major accident cases resulting in fatalities during the MCO and EMCO (PKP1–PKPB6) periods reveals a substantial increase, rising from 58 fatalities during the first MCO to 231 fatalities by MCO 6. To better understand the underlying causes, it is important to review several key cases recorded during these phases.

During the initial MCO period, one case involved the tragic death of a nurse and her daughter in Kelantan, when an ambulance lost control and overturned by the roadside while transporting a frontliner to a hospital. Another incident involved a police officer who was killed, and two others seriously injured, when their patrol vehicle overturned during a pursuit of suspected drug offenders. In a third case, a police officer was killed instantly when a four-wheel drive vehicle, driven by an intoxicated motorist under the influence of alcohol (DUI), rammed into a police roadblock. In a separate incident, another road user was killed when their vehicle was struck by a drunk driver travelling in the opposite direction.

These incidents illustrate an emerging pattern of new risk norms among Malaysian road users. Without prompt and systematic interventions, such risks are likely to escalate, posing even greater threats to road traffic safety.

Public concern has therefore turned toward the effectiveness of existing legal frameworks, particularly the Road Transport Act 1987 (Act 333), in influencing compliance and regulating road user behaviour. The act, while essential, appears to provide only temporary remedies, addressing the symptoms rather than the root causes of unsafe behaviour. Sustainable change requires a permanent transformation in cognition and behaviour that promotes safety as a habitual mindset.

A systematic framework, such as the Road Traffic Safety Management System (RTSMS), MS ISO 39001:2013, is necessary to reconstruct and sustain safety-oriented cognitive and behavioural patterns among road users. Supporting this direction, the National Transport Policy (NTP) 2019–2030, launched by the former Prime Minister Tun Dr Mahathir Mohamad, emphasises the importance of a structured approach to enhance transport safety and efficiency. Tun Dr Mahathir stated; “I truly believe that a developed nation is not just about having a strong economy but also providing accessible and affordable transport services that will make real differences to people’s lives.” The NTP 2019 – 2030 outlines five policy thrusts, with Thrust 3, “Enhance safety, integration, connectivity, and accessibility for a seamless journey", serving as a core focus for this study's analytical framework.

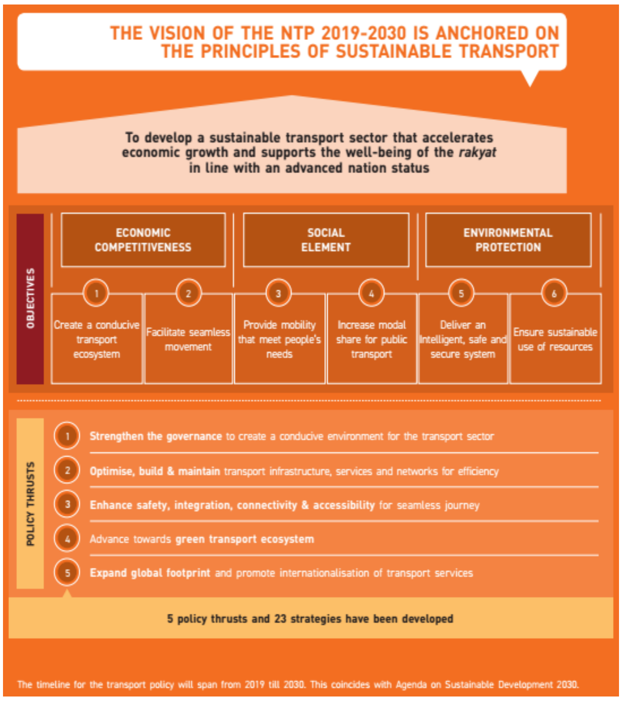

Figure 1.1 National Transport Policy Framework

Based on strategy 3.2 illustrated in Figure 1.1 and Figure 1.2 focuses on adopting a Safe System Approach that promotes safer road users, infrastructure, and vehicles. Meanwhile, Strategy 3.3 aims to ensure that the safety and security standards of Malaysia's transport sector are aligned with international best practices and regulations.

Policy Thrust 3: Enhance safety, integration, connectivity and accessibility for seamless journey for passenger and goods

S3.1: Strengthen enforcement to ensure adherence to rules and regulations to improve safety, service quality and reliability

S3.2: Adopt a safe system approach that advocates safer road, rail, maritime and aviation users, infrastructure and vehicles

S3.3: Ensure that Malaysia's transport sector's safety and security are in accordance to international standards

S3.4: Strengthen transport infrastructure and intensify the use of digitalisation to enhance connectivity

Figure 1.2 Policy Thrust 3 Under NTP

Malaysia records one of the highest road fatality risks among ASEAN countries, at 24 deaths per 100,000 population. In 2017, the number of fatalities increased to 6,740 cases, with motorcyclists accounting for approximately 63% of the total. On average, more than 4,000 motorcyclists lose their lives each year due to road traffic accidents. The estimated economic loss in 2017 alone amounted to RM8.8 billion, reflecting the profound socio-economic impact of road traffic incidents on the nation. These figures underscore the pressing need to enhance road safety frameworks through systematic and structured approaches, particularly by implementing the Road Traffic Safety Management System (RTSMS) as outlined in MS ISO 39001:2013. These standards aim to improve safety performance through effective risk management, organisational commitment, and continuous improvement.

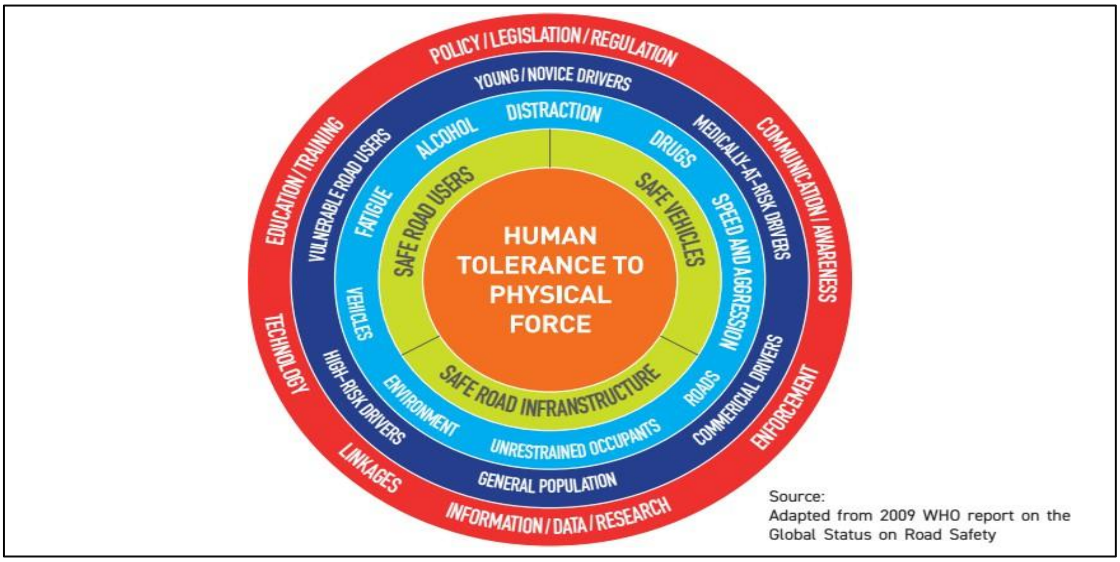

Figure 1.3 Linkages Of Human Connectivity With System In Places

Table 1.2
Comparison Data: Road Traffic Crashes With COVID-19 Death Cases Within 85 Days

Road Traffic Crashes	Figures
World population	7,800,000,000
World's road traffic death	1,300,000
World's road traffic death rate per 100,000 population	17
Malaysia population	31,000,000
Malaysia's road traffic deaths in 2019	6,167
Malaysia's road traffic death rate in 2019 per 100,000 population	20
Malaysia's road traffic deaths (2019) per day	

Source: MIROS Report June 2020

Table 1.3
Comparison Data: Road Traffic Crashes With COVID-19 Death Cases Within 85 Days

Road Traffic Crashes	Figures
World's COVID-19 death	413,816,00
World's COVID-19 death rate per 100,000 population	5.3
Malaysia's COVID-19 deaths	118
Malaysia's COVID-19 death rate per 100,000 population	0.4
COVID-19 deaths per day (85 days)	1.4

Source: MIROS Report June 2020

According to the World Health Organisation (WHO), Malaysia records one of the highest global statistics for road-related fatalities, with 0.025% of deaths occurring per 100,000 population, compared to the localised national rate of 0.0179% per 100,000. These figures reflect an unfavourable impact on both social and economic sectors, with national losses estimated in the billions of ringgits (Bliss et al., 2009). Moreover, recognition, participation, and achievements of responsible institutions in addressing road safety have been hampered by management challenges and poor institutional coordination, resulting in continued difficulties in reducing accident rates.

The WHO recommends that government authorities lead national road safety strategies through systematic structuring and strengthened management systems. These recommendations emphasise the importance of establishing the effectiveness of road safety management through a systematic, evidence-based approach that incorporates practical, enforceable methods. Additionally, three key components are emphasised: (1) the role of institutional management, (2) consistent stakeholder involvement, and (3) the achievement of measurable outcomes. Through effective coordination, legislative action, awareness promotion, monitoring, research, and information sharing, the WHO can evaluate the performance of institutions to determine their effectiveness in road safety management.

Such strategies in the Road Traffic Safety (RTS) Management Systems — Requirements with Guidance for Use, internationally recognised as ISO 39001:2012 (IDT). Accordingly, this research investigates the implementation of the Road Traffic Safety Management System (RTSMS) MS ISO 39001:2013, focusing on managing commuting risks within human organisations. The study aims to determine whether the RTSMS framework can influence and reshape the cognitive mindset of road users within the National Institute of Occupational Safety and Health (NIOSH) Malaysia. Furthermore, it examines whether implementing RTSMS has positive impacts on knowledge, skills, behaviours, and attitudes in managing road traffic safety risks.

The study also explores how changes in road traffic safety cognition and behaviour can proportionately reduce accident rates by minimising cognitive errors, such as stress, aggression, vengeance, and unsafe driving behaviours. Although only 30% of the NIOSH Malaysia population is sampled, the organisation represents a diverse cross-section of road users across the Malaysian states. NIOSH Malaysia, headquartered in Bandar Baru Bangi, Selangor, comprises 17 regional offices nationwide (Figure 1.4), with 57 respondents participating in this research. These respondents represent various geographical locations and road design contexts across Malaysia. The findings derived from this sample are expected to provide significant empirical evidence supporting the research hypothesis and to be cross-referenced with data from 161 countries under the ISO framework. Collectively, the results will validate the influence of RTSMS ISO 39001 in reshaping cognitive and behavioural patterns among Malaysian road users, thereby contributing to a reduction in accident risk.

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Table 1.4 List of respondent locations at NIOSH Malaysia

1.3 Problem Statement

Based on previous research, such as (Iwaro & Mwasha, 2012) in "The Effect of ISO Certification on Organisational Workmanship Performance," it demonstrated that implementing management systems within organisations can enhance human performance and behavioural outcomes. In this context, the Road Traffic Safety Management System (RTSMS) ISO 39001:2013 is expected to produce a similar impact by reducing road traffic crashes (RTCs) and improving the cognitive and behavioural performance of road users. This improvement, in turn, may contribute to safer driving behaviour and enhanced road traffic safety in Malaysia.

According to the Buku Statistik Keselamatan Jalan Raya (Road Safety Statistics Book) published by the Ministry of Transport (MOT), JKJR, JPJ, MIROS, PDRM, and the World Health Organisation (WHO), dated 12 February 2020, the annual number of fatalities due to Road Traffic Accidents (RTAs) in Malaysia has consistently remained above 6,000 deaths per year from 2012 to 2019. Data recorded by MIROS indicate that, in 2012, a total of 22,702,221 registered vehicles with 6,917 fatalities, resulting in an RTA index of 3.05. In 2019, despite an increase in registered vehicles to 31,214,842, the index decreased to 1.95. However, the total number of fatalities showed a slight downward trend, with 6,167 deaths recorded, reflecting a decremental trend after that year until now (refer to chapter 2 (RTA Index Table 2.1).

Further analysis by JKJR reveals that the average number of fatal cases increased from 15 deaths per day to 17 deaths per day in the year 2000. Despite various initiatives such as awareness programmes, campaigns, educational efforts, policy development, engineering interventions, and enforcement activities carried out by government agencies, including MIROS, JPJ, JKJR, MKJR, PDRM, NIOSH, and other related bodies, the overall number of road traffic fatalities has not shown a significant decline.

These findings suggest that existing initiatives have not yet achieved the intended behavioural transformation among road users. Awareness campaigns and competency programmes, although widespread, have not significantly altered drivers' and other road users' cognitive mindsets or behavioural patterns. Consequently, this raises the question of whether implementing the RTSMS MS ISO 39001:2013 could influence organisational behaviour and cognitive awareness in a manner that reduces road traffic risk. Moreover, it remains to be determined whether such implementation could improve organisational productivity, quality, and overall institution/organization performance.

1.4 Research Question

a. Why do Road Traffic Accidents (RTA) keep on increasing with the implementation of the act and sanctions by the enforcement parties?
b. How does RTA reduce when cognitive and behavioural aspects of road users in the institutional landscape are considered by implementing the RTSMS ISO 3900:2013?
c. To what extent does the RTSMS ISO 39001:2013 affect the cognitive and behavioural aspects of institutional road users, giving a positive impact on productivity and institution/organisation performance?

1.5 Research Objective

The primary objective of this study is to advance understanding and practice at the intersection of cognitive processes, organisational safety systems, and road safety outcomes. Building on established theories of safety culture, behaviour change, and system-level safety management, this study seeks to generate actionable insights that inform the design and implementation of safer road environments within institutional setups or organisational and national policy contexts.

a. To determine the cognitive impact of road users on behaviour change for the NIOSH Malaysia implementer of ISO 39001:2013.
b. To analyse the cognitive road user on the implementation of RTSMS in NIOSH Malaysia.
c. To assess RTSMS's significant influence on both cognitive and behavioural through synthesis theory Aze+ concepts RTA causation theory.

The three (3) objectives stipulated above are briefly as follows: 1st objective. This objective seeks to clarify how cognitive factors, such as perception, attention, memory, risk assessment, and decision-making, impact road-user behaviours. It will identify cognitive mediators and moderators that explain why similar individuals can show different safety behaviours in real-world situations. The study will incorporate theories from COM-B and other behavioural frameworks to link cognitive factors to observable behavioural outcomes on the road.

Second (2nd) objective: This objective explores how cognitive processes interact with the design, adoption, and functioning of Road Transport Safety Management Systems (RTSMS) within organisations. It will evaluate how RTSMS impacts cognitive load, situational awareness, and safety-related decision-making among road users, operators, and managers. The aim is to identify design principles for RTSMS that align with human cognition, minimise cognitive strain, and improve safety performance. Additionally, it recognises that the essence of cognitive change is to alter the behaviour of road traffic users.

The third (3rd) objective is to investigate the bidirectional relationships between RTSMS implementation and cognitive processes, and how these, in turn, drive road-user behaviours. It will quantify the extent to which robust RTSMS reduces cognitive biases, improves mental models of safety, and yields measurable behavioural improvements. The outcome will include a framework linking RTSMS maturity, cognitive outcomes, and behavioural safety indicators, enabling practitioners to tailor interventions by context.

1.6 Summary of Research Framework and Hypothesis

The research framework and hypotheses of this study are developed based on the study investigates the perspective of implementing a Road Traffic Safety Management System (RTSMS) aligned with ISO 39001:2013 within the institutional ecosystem of NIOSH Malaysia, aiming to illuminate how the integration of Heinrich's Domino and Multi-Causation theories, Bird and Germain's Loss Causation Model, Reason's System Safety framework, and Bandura's Social Cognitive Theory can transform the cognitive and behavioural patterns of road users in a corporate, public health, and inter-organizational context.

By situating these theories within an institutional framework, the research seeks to demonstrate how governance structures, risk management processes, and safety cultures can be engineered to shift attitudes, norms, and practices of road users from reactive, blame-oriented responses to proactive, system-wide safety behaviours, while ensuring compliance with ISO 39001:2013 requirements. Through a case study at NIOSH Malaysia, the thesis will examine (1) the extent to which ISO 39001:2013 implementation leverages multi-theoretical insights to create preventive barriers and resilience against road traffic incidents; (2) the mechanisms by which organizational policies, training, and leadership influence cognitive schemas, self-efficacy, and observed safety behaviour’s among staff, contractors, and visitors; and (3) the effectiveness, challenges, and implications of translating abstract safety concepts into concrete, measurable improvements in road user behaviours, incident causation reduction, and safety culture development within a Malaysian institutional setting.

The overarching argument is that a multi-theoretical, ISO 39001-aligned RTSMS implementation can produce sustainable behavioural change and cognitive adjustments among institutional road users by embedding systematic, layered defences, fostering psychological safety and continuous learning, and aligning safety governance with regulatory, ethical, and organisational performance imperatives. The study situates its research framework and hypotheses within the long-standing tradition of accident causation research. By drawing on established theories, Heinrich’s Multi-Causation Theory and Domino Theory (193), Bird and Germain’s Loss Causation Model (1985), Reason’s Model of System Safety (1997), and Bandura’s Social Cognitive Theory (1977), the work offers a composite lens through which road traffic incidents (RTAs) can be understood.

This integration is not merely a recital of theoretical precepts but a deliberate pedagogical strategy to illustrate how cognition, behaviours, and system design interact to shape safety outcomes. For workers in the institutional landscape, the material demonstrates the progression from simple, linear explanations of accidents to more sophisticated, systems-based analyses that accommodate human factors, organisational dynamics, and environmental context. In institutions, the content provides a concrete example of theory integration, model comparison, and the translation of theory into practical safety controls and risk mitigation strategies.

The theoretical bedrock of this study rests on a constellation of influential frameworks. Heinrich’s Multi-Causation Theory and Domino Theory, introduced in 1931, present a foundational, sequential view of accidents (Safety Institute of Australia, 2012). The model envisions an incident as the culmination of a chain of causal factors, each link connecting deterministically to the next. From a theoretical standpoint, this perspective introduces learners to the preventive logic that removing any single link in the chain can avert an accident. It anchors students in the intuitive causal sequence and establishes a baseline for understanding how early-stage risk factors propagate toward harm.

Bird and Germain's Loss Causation Model extend the conversation by incorporating latent conditions and loss precursors. This extension foregrounds the role of defences and their failures, urging students to contemplate why protective barriers may falter. The educational takeaway here is systemic thinking: safety is not achieved merely by addressing observable acts but by understanding how latent hazards and the integrity of defences interact within a broader system. The theory fosters an appreciation for defences, barriers, and the conditions under which they fail, as well as the interdependencies that sustain safety (Bird, n.d.; Shahab Hosseinian & Jabbarani Torghabeh, 2012a).

Reason's Model of System Safety reframes accidents as outcomes of complex interactions within socio-technical systems. It foregrounds organisational factors, culture, policies, and the interplay among people, technologies, and procedures. This holistic lens shifts analysis away from individual blame toward system design and safety culture. Pedagogically, it encourages learners to evaluate risks at multiple levels of the system and to consider how organisational practices shape safety outcomes. It also supports the development of competencies in systemic risk assessment, safety culture appraisal, and resilient system design.

Bandura's Social Cognitive Theory adds a cognitive-behavioural dimension, emphasising the roles of cognition, observational learning, self-efficacy, and the social context in which behaviour is enacted (Nabavi, 2011a). Educationally, this theory illuminates how individual actions are shaped by expectations, reinforcement, and modelling within organisations and environments. It invites road users or workers to consider how educational interventions, training, and organisational norms influence risk perception and safety-related behaviour.

Taken together, these theories illuminate the dynamic interplay between human cognition, behaviour, and system design. They offer complementary lenses for explaining why RTAs occur and how they can be prevented. The synthesis provides a robust scaffold for analysing not only what happened but why it happened and how prevention could be achieved across multiple dimensions of safety.

The synthesis theory produced a new framework for studying the cognitive and behavioural patterns of institutional road users, labelled the Aze+ concepts RTA causation and control framework, which illustrates theory-based relationships related to causation and control in road traffic incidents in Figure 2.19 in Chapter 2. The value of this figure lies in its capacity to help the users of RTSMS visualise how causal factors map onto control measures and defences, thereby bridging theoretical constructs with practical interventions. Based on the theoretical framework, the Hypothesis below is established to confirm the three (3) research objectives.

First Hypothesis - $\mathbf{H_1}$

$\mathbf{H_0}$: Implementation of Road Traffic Safety Management System (RTSMS) MS ISO 39001:2013, will not change the cognition of road users and behaviour of the road users in the organisation implementing ISO 39001.

$\mathbf{H_A}$: Implementation of the Road Traffic Safety Management System (RTSMS) MS ISO 39001:2013 has a significant impact on road user cognitive driving behaviour within the organisation implementing ISO 39001:2013.

Second Hypothesis - $\mathbf{H_2}$

$\mathbf{H_0}$: Change in the cognition of road users does not give a significant change to the road user behaviour.

$\mathbf{H_A}$: Changing the cognition of road users will lead to significant changes in road user behaviour.

Third Hypothesis – $\mathbf{H_3}$

$\mathbf{H_0}$: Change the cognition of road users towards the implementation of the Road Traffic Safety Management System (RTSMS). MS ISO 39001:2013 do not change the road user behaviour.

$\mathbf{H_A}$: Changing the cognition of road users will significantly influence the Road Traffic Safety Management System (RTSMS), MS ISO 39001:2013, and will significantly change road user behaviour.

1.7 Significance of the Study

The findings of this study are expected to enhance awareness, understanding, and implementation of road traffic safety practices among individuals within the organisation, from drivers to policymakers. These individuals are categorised into varying levels of functional risk within the organisation: operational risk, managerial risk, top management risk, and policymaker risk, all of which contribute to the broader business risk impact.

Although many employees are aware of the requirement for “FITness” as stipulated under Sections 15 and 24 of the Occupational Safety and Health Act (OSHA) 1994, most lack a comprehensive understanding of why and how road traffic accidents directly affect them and their organisations. Therefore, this research provides valuable insights for stakeholders by strengthening the application of appropriate knowledge, skills, behaviours, and attributes in managing Road Traffic Safety (RTS) risks. The expected outcomes include a reduction in the number of road accidents, minimisation of RTS risk, and the achievement of the intended objectives and scope of the RTS framework.

Broadly, this study will generate opportunities for both organisations and stakeholders by promoting a stronger safety culture and cognitive awareness of road risks. The findings will directly improve the cognitive and behavioural orientation of road users and affected individuals within organisations, thereby reducing road traffic risks and accident rates associated with commuting and work-related travel. In the long term, this research is expected to contribute to a safer, healthier, and more conducive road environment in Malaysia by promoting positive cognitive and behavioural changes aligned with the Road Transport Act 1987 (Act 333) and other national road safety initiatives.

It strengthens knowledge, skills, behaviours, and attributes for managing RTS risks among drivers, managers, system implementers, system auditor and policymakers; aims to reduce road accidents and RTS risk within organisations; promotes a stronger safety culture and cognitive awareness of road risks; and contributes to a safer road environment in Malaysia in line with national road safety legislation and initiatives. No study had previously been conducted due to cognitive and behavioural changes resulting from the organisation's or institutional setup's implementation of the road traffic system.

For context and framing, see peer-reviewed work on safety culture and RTS risk in organisational settings, and on behavioural change theories applied to road safety (Anstey et al., 2005).

1.8 Summary

This thesis comprises five (5) chapters, structured to fulfil the requirements of a scientific academic study aimed at discovering new understanding in the form of hypotheses, models, and theoretical development based on prior research conducted by the researcher.

Chapter 1 presents an overview of the study, including the background of the research, the four (4) foundational theories, the research problem, framework, objectives, problem statements, and research questions. It also outlines the study’s limitations, significance, and provides a summary of the chapter.

Chapter 2 deepens the discussion through a systematic literature review, highlighting the methods used to collect, compile, and analyse previous studies on road traffic safety, road user cognition, and road user behaviour. The review draws upon major databases, including ProQuest, Web of Science/Elsevier, Google Scholar, the National Library of Medicine (NIH), Springer Books, and ISO/IEC standards. The study analyses the previous study with the same keywords and objective, and identifies a gap in the previous study regarding Road Traffic Safety and Cognitive and Behaviour change within the institutional or organisational framework. Based on the literature review, the researcher identifies key studies, articles, and journals that have contributed to understanding how the implementation of management systems can influence cognitive change and behaviour among road users, as well as the factors that directly or indirectly contribute to reducing road traffic crashes in Malaysia.

Chapter 3 focuses on the research design and methodology of this study, which will ensure compliance with academic writing standards and schools of thought, and will elaborate on the development of the research framework and hypotheses. It discusses the quantitative approach employed, including the survey methodology and data collection from respondents within NIOSH Malaysia as primary data. The secondary data on the study will be based on the RTSMS ISO 39001 audit findings from KOTAMAS Sdn.Bhd (KOSB), a company transporting oil and gas for PETRONAS and

Shell distribution for East Malaysia in Sabah and Sarawak. Thus, the productivity and performance of KOSB increase as a result of RTSMS ISO 39001 implementation in the institution, with positive changes in the cognitive and behavioural aspects of tanker drivers, also known as RKP (Rakan Perniaga).

Chapter 4 presents the data analysis process and discusses the quantitative survey results in relation to the three research objectives and outcomes. The data analysis will be based on the respondents' statistics and analysis using SEM based on the theme in the questionnaire (Refer to Appendix 3)

Finally, Chapter 5 provides the conclusion and recommendations derived from the research findings. The researcher offers guidelines and practical suggestions for implementing the Road Traffic Safety Management System (RTSMS) in accordance with MS ISO 39001:2013, aiming to influence changes in road users' cognitive and behavioural patterns. The chapter concludes with implications for Malaysian road users and stakeholders in their collective efforts to reduce road crashes nationwid

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

This chapter presents a comprehensive discussion of previous studies, journals, articles, and research papers relevant to the systematic literature review conducted for this research. The purpose of this review is to identify and analyse the predictors that have directly or indirectly contributed to changes in cognitive processes and behavioural patterns influencing road traffic accidents within the context of NIOSH Malaysia, as outlined in the research hypothesis.

The reviewed literature covers findings in the domains of road traffic safety, cognitive psychology, human behaviour, occupational safety and health, and management systems. These studies, sourced from globally recognised researchers, provide valuable insights into the factors that contribute to road traffic incidents and fatalities. The discussion in this chapter also emphasises the importance of identifying latent factors and effective interventions to further reduce road traffic accident statistics.

It is noteworthy that some research findings within this field are inconsistent with one another. Such inconsistencies often arise due to differences in the types of data collected, research methodologies adopted, or incompatibility of data sources, even within the same country (Eusofe & Evdorides, 2017). Despite these variations, studies across different regions provide necessary evidence highlighting the persistent issue of traffic-related fatalities. For instance, Malaysian statistics indicate that the number of road crashes increased by nearly 40%, from 215,632 cases in 1997 to 549,598 cases in 2018, as shown in Table 3.

This systematic literature review, has conducted through comprehensive search was undertaken for relevant research. The methodology for the review involved identifying appropriate databases and citation indexes such as Web of Science (WOS)/Elsevier, ProQuest, Google Scholar, the National Library of Medicine (NIH), and Springer Books. Titles and abstracts of retrieved studies were screened against pre-determined relevance criteria, based on the research problem defined in Chapter 1 and the key terms of this study. As noted by (Kaur, 2015) despite the implementation of traffic laws, technological advances, and improved traffic education systems, the number of traffic fatalities has not decreased substantially.

The implementation of the statutes indicates that although efforts are in the right direction, there is a lack of overall understanding of all the contributing factors and their interaction with each other. This observation highlights the importance of a comprehensive review, such as the one undertaken in this research.

According to (Shahab Hosseinian & Jabbarani Torghabeh, 2012a) a systematic literature review must include a detailed description of the methodology and procedures applied in identifying, analysing, and synthesising relevant studies. Accordingly, this thesis adopts a structured review process, beginning with the extraction of keywords related to road traffic fatalities, road accidents, road safety, Road Traffic Safety Management Systems (RTSMS), risk-based techniques, cognitive factors, human behaviour, hazard identification, cognitive restructuring, and ISO management systems. The researcher selected databases such as Web of Science (WOS) from Elsevier, ProQuest, Google Scholar, NIH, and Springer Books to identify the previous study with the same scope in articles, journal and thesis to find gaps in this study. The overall process and steps involved in the systematic literature review are illustrated in Figure 2.1.

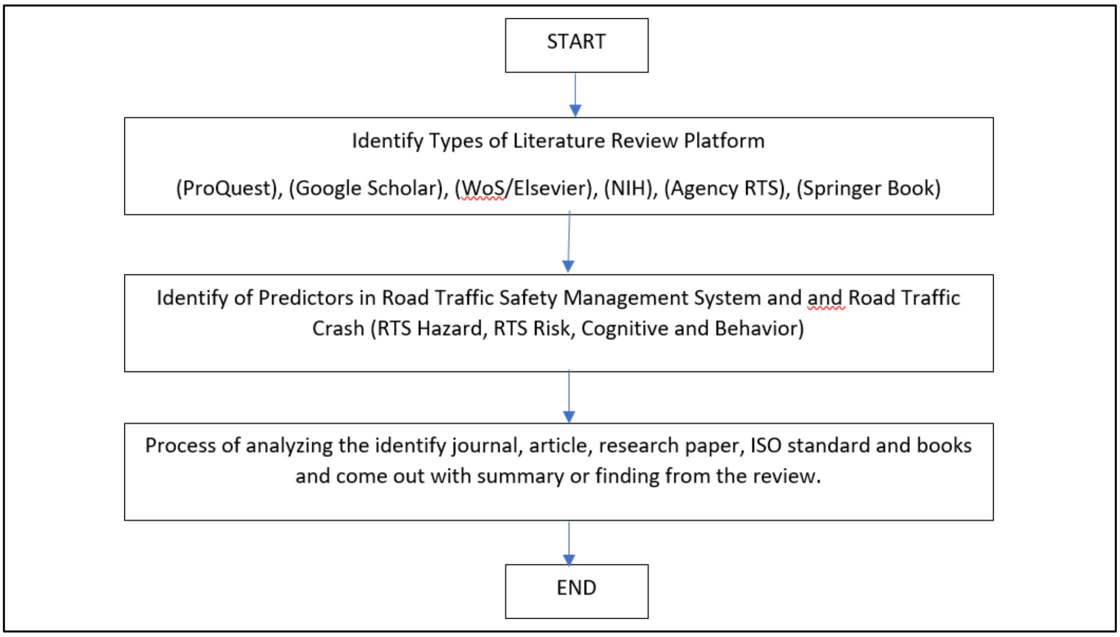


Figure 2.1 Flow Chart Literature Review Process

This section articulates the theoretical and conceptual underpinnings that guide the examination of RTSMS ISO 39001:2013 implementation and its potential impact on cognition and behaviour among institutional road users. A synthesis of management-system theory with behaviour-change frameworks is employed to explain how formal safety structures can translate into individual cognitions and practices within an organisational setting. The researcher detailing the process of changing the cognitive and behaviour of road traffic user in the RTSMS ISO 39001 standard as path of constructing the norm in the institutional process in the sub-chapter.

First, a management system perspective anchored in ISO 39001:2013 provides the structural components such as policy, leadership, risk assessment, planning, implementation, evaluation, and continual improvement that shape safety culture and operational practices. Second, behaviour-change theories, notably the theory Heinrich’s Domino and Multi-Causation theories, Bird and Germain’s Loss Causation Model, Reason’s System Safety framework, and Bandura’s Social Cognitive Theory, offer explanatory mechanisms for how knowledge, attitudes, perceived norms, perceived control, and risk perceptions influence safety-related behaviours. The integration of these perspectives allows one to trace a pathway from RTSMS inputs (policies, training, resources) through cognitive mediators (knowledge, attitudes, risk perception) to observable behaviours (compliance, safe practices, reporting). Additionally, moderators such as organisational culture, leadership commitment, communication quality, and resource availability are acknowledged as shaping the strength and direction of these relationships.

Key constructs and definitions are central to this study. The ISO 39001:2013 RTSMS constructs include policy and leadership, risk assessment and planning, implementation and operations, evaluation and corrective actions, and continual improvement, all supported by effective communication and training. Cognitive constructs include knowledge about road safety and RTSMS requirements, attitudes toward safety and risk, risk perception (perceived susceptibility and severity), and perceived behavioural control. Behavioural constructs encompass compliance with safety procedures, safe driving and operating practices within institutional premises, and reporting behaviours for incidents or near-misses. Moderating and mediating factors comprise organisational culture, leadership support, training quality, communication effectiveness, resource availability, and language or literacy factors that influence how information is understood and acted upon.

The theoretical framework in practice posits that the RTSMS provides the structural conditions necessary for safe behaviour, while Heinrich's Domino and Multi-Causation theories, Bird and Germain's Loss Causation Model, Reason's System Safety framework, and Bandura's Social Cognitive Theory and related theories explain how individuals internalise these conditions into cognitions and actions. The synthesis informs measurement approaches, surveys to capture cognitive constructs, observational checklists for behaviours, and quantitative strategies to triangulate data from documents, records, and findings from the instruments. In the context of NIOSH Malaysia, this framework supports an integrated assessment of how ISO 39001:2013 is interpreted, operationalised, and experienced by road users within an institutional setting, and how these processes relate to cognitive and behavioural changes. The secondary data and gap, form the industry implemented RTSMS ISO 39001 as process have been established from the audit finding.

2.2 RTA Index and Statistics

The statistical value for RTAs will be addressing the missing process of our current initiative. The Table 2.1 presents data on road traffic accidents (RTAs) in Malaysia from 1997 to 2018. Over this period, the number of registered vehicles increased steadily by approximately one million cars per year. Despite the consistent implementation of road safety laws and behavioural enforcement measures, the trend of road crashes continues to show a significant upward trajectory.

In 1997, authorities reported a total of 215,632 road crashes, resulting in 6,302 fatalities. By 2018, the number of reported road crashes had risen sharply to 548,598, representing an increase of more than 150% over two decades. This pattern indicates that Malaysia continues to face significant challenges in preventing road traffic accidents, despite substantial improvements in road safety awareness, education, and enforcement.

While the overall number of road deaths has shown some reduction, from 6,302 fatalities in 1997 to 4,634 fatalities in 2020, the number of registered vehicles increased dramatically from 8,550,469 to 32,375,174 during the same period. The total Vehicle

Kilometres Travelled (VKT) also showed a notable decline, from 33.57 billion VKT in 1997 to 12.98 billion VKT in 2020. This reduction may be attributed to several factors, including the rise of the gig economy, expansion of highway networks, and shifting mobility patterns during and after the COVID-19 pandemic.

The data further suggest that the introduction of various safety measures, such as the mandatory use of Personal Protective Equipment (PPE) (e.g., helmets and seatbelts) and the integration of advanced safety features in vehicles, has contributed positively to mitigating the severity of crashes. However, despite these improvements, the country continues to struggle with reducing the overall number of road crashes and incident rates.

According to a study by (Mohan, 2025a) road crashes are strongly associated with high traffic volumes and increasing vehicle ownership. Using the Fatality Analysis Reporting System (FARS) dataset, which examined traffic fatalities from 1994 to 2005, their research established a correlation between economic growth, automobile sales, and traffic fatalities. Their findings suggest that improvements in the national economy led to higher vehicle sales and, consequently, a greater number of new drivers on the road, which may elevate accident risk.

This phenomenon aligns with Malaysia's experience, where socio-economic growth and increased affordability of private vehicles have contributed to higher traffic density. These findings are consistent with the National Transport Policy 2019 – 2030, which emphasises the relationship between economic development, transport infrastructure, and safety management. Furthermore, Malaysia's road infrastructure has expanded substantially from 61,294 km in 1995 to 238,789 km in 2016, a 3.9-fold increase, with approximately 8.3% comprising federal road networks.

These statistics demonstrate that while Malaysia has made significant progress in improving road infrastructure and implementing safety measures, the continued growth in vehicle ownership and road usage remains an important factor contributing to road traffic accidents and fatalities. Higher numbers of vehicles in the road equal to higher likelihood of incidents risk in our road traffic society.

Table 2.1
Statistical Data Analysis: RTS Accident Index From Year 1997 – 2020

Year	Registered Vehicles	Population	Road Crashes	Road Deaths	Serious Injury	Slight Injury	Index Per 10,000 Vehicles	Index per 100,000 Population	Index Per Billion VKT
1997	8,550,469	21,655,600	215,632	6,302	14,105	36,167	7.37	29.10	33.57
1998	9,141,357	22,179,500	211,037	5,740	12,068	37,896	6.28	25.80	28.75
1999	9,929,951	22,711,900	223,166	5,794	10,366	36,777	5.83	25.50	26.79
2000	10,598,804	23,263,600	250,429	6,035	9,790	34,375	5.69	26.00	26.25
2001	11,302,545	23,795,300	265,175	5,849	8,680	35,944	5.17	25.10	23.93
2002	12,068,144	24,526,500	279,711	5,891	8,425	35,236	4.90	25.30	22.71
2003	12,819,248	25,048,300	298,653	6,286	9,040	37,415	4.90	25.10	22.77
2004	13,828,889	25,580,000	326,815	6,228	9,218	38,645	4.52	24.30	21.10
2005	15,026,660	26,130,000	328,264	6,200	9,395	31,417	4.18	23.70	19.58
2006	15,790,732	26,640,000	341,252	6,287	9,253	19,885	3.98	23.60	18.69

Year	Registered Vehicles	Population	Road Crashes	Road Deaths	Serious Injury	Slight Injury	Index Per 10,000 Vehicles	Index per 100,000 Population	Index Per Billion VKT
2007	16,813,943	27,170,000	363,319	6,282	9,273	18,444	3.74	23.10	17.60
2008	17,971,907	27,730,000	373,071	6,527	8,868	16,879	3.63	23.50	17.65
2009	19,016,782	28,310,000	397,330	6,745	8,849	15,823	3.55	23.80	17.27
2010	20,188,565	28,910,000	414,421	6,872	7,781	13,616	3.40	23.80	16.21
2011	21,401,269	29,000,000	449,040	6,877	6,328	12,365	3.21	23.70	14.68
2012	22,702,221	29,300,000	462,423	6,917	5,868	11,654	3.05	23.60	13.35
2013	23,819,256	29,947,600	477,204	6,915	4,597	8,388	2.90	23.10	12.19
2014	25,101,192	30,300,000	476,196	6,674	4,432	8,598	2.66	22.00	10.64
2015	26,301,952	31,190,000	489,606	6,706	4,120	7,432	2.55	21.50	9.60
2016	27,613,120	31,660,000e	521,466a	7,152	4,506	7,415	2.59	22.60	10.70a
2017	28,738,194	32,049,700e	533,875	6,740	3,310	6,539	2.34	21.06	11.24

Year	Registered Vehicles	Population	Road Crashes	Road Deaths	Serious Injury	Slight Injury	Index Per 10,000 Vehicles	Index per 100,000 Population	Index Per Billion VKT
2018	29,956,525	32,400,000e	548,598	6,284	2,964	5,377	2,097	19.39	11.79
2019	31,214,842	32,680,000e	567,516	6,167	3,022	5,855	1.97	18.87	12.37
2020	32,378,174	32,700,000e	418,237	4,634	2,840	9,762	1.43	14.17	12.98
2021	NA	NA	NA	NA	NA	NA	NA	NA	NA

Note:
e: Estimated value from Department of Statistic Malaysia a: Media statement
NA: Not Available (The official figures are not available yet)

Table 2.2

Macro Level Initiative

Year	Registered Vehicles	Road Crashes	Road Death	Prime Minister / Transport Minister	National Initiative
1997	8,550,469	215,632	6,302	Tun. Dr. Mahatir Ling Liong Sik	Road TranspoRTAAct 1987 (Act 333) Occupational Safety and Health Act 1994 (Act 514)
2007	16,813,943	363,319	6,282	Tun Abdullah Badawi Chan Kong Choy	"Kod Amalan Keselamatan, Kesihatan dan Persekitaran Untuk Sektor Pengangkutan 2007" "Occupational Safety and Health ICOP Road Transport Activities 2010" APAD 2010 (Akta 715)

Year	Registered Vehicles	Road Crashes	Road Death	Prime Minister / Transport Minister	National Initiative
2012	22,702,221	462,423	6,917	Dato'Seri Najib Tun Razak Kong Cho Ha	"Akta Institut Penyelidikan Keselamatan Jalan Raya Malaysia 2012 (Akta 748)" "SPAD ICOP – Keselamatan "Pengendali Berlesen Perkhidmatan Kenderaan Barangan 2013" 2MS ISO 39001:2013
2018	29,956,525	548,598	6,284	Tun. Dr. Mahatir Liow Tiong Lai Anthony Loke Siew Fook	Note: National Transport Policy 2019 -2030

The data presented in Table 2.1 shows that in 2019, Malaysia recorded 6,167 road traffic fatalities, with a Road Traffic Accident (RTA) index of 1.97, marking the lowest fatality rate in the past decade. RTA indicates some positive progress in nationwide road safety efforts. However, despite the gradual reduction in fatalities, road crashes continue to cause substantial social and economic losses. As noted by Kaur (2015), “Thousands of people are killed and injured on roads worldwide every year. People walking, driving, and biking on the roads do not have a guarantee that they will reach their destination safely, and their families might have to pay the price in terms of lost lives, medical expenses, lost wages and property damages.”

Research across various countries has highlighted several factors that influence road fatalities such as identified road infrastructure, population mobility, traffic density, and the proportion of paved roads, motorways, and expressways as key determinants of the Road Fatality Rate (RFR) (Stanley Murage San Diego, 2017; Ziarnick, n.d.). His study revealed that enhancements in road safety systems and infrastructure directly reduce the frequency and severity of crashes. Similarly, found that “a significant improvement in traffic safety was achieved in Singapore between 1990 and 2008 due to the implementation of a holistic approach” (Khan et al., 2015). Their findings emphasise that coordinated interventions involving engineering, enforcement, and education can substantially improve road safety outcomes (Stanley Murage San Diego, 2017)

In addition to infrastructure, road safety barriers play a crucial role in mitigating the severity of accidents. The study transition barrier systems and found that these structures not only provided directional control for vehicles but also improved occupant safety during and after impacts. Their research proposed enhanced barrier designs that could minimise severe injuries among vehicle occupants, reinforcing the importance of engineering controls in road safety management (Stoma et al., 2021).

Another significant infrastructural factor influencing road traffic safety is road furniture, including lighting, signage, and guardrails. evaluated the role of street lighting and found that improved illumination significantly reduced nighttime accidents and the severity of injuries. Their study found that the presence of sufficient lighting and well-maintained infrastructure enhances visibility, reduces uncertainty, and promotes safer driving behaviour (Khan et al., 2015). The results further suggested that weather conditions, accident types, and vehicle types also interact with lighting to influence crash outcomes.

Supporting these findings, Kaur (2015) emphasised that "proper and adequate infrastructure is crucial in keeping roads safe for all users (drivers and pedestrians)." Poor lighting, inadequate visibility, and inefficient traffic management systems often correlate with higher fatality rates. Countries with underdeveloped infrastructure tend to experience more severe accidents than those with advanced safety systems. Adverse weather conditions, unlit roads, and the absence of effective warning systems contribute to increased accident risks. Proper consideration of road design factors, such as lane width, number of lanes, curvature, medians, junction types, ramps, and speed limits, is crucial for enhancing traffic safety.

Additionally, implementing barrier systems, guardrails at intersections, properly timed traffic signals, pedestrian crossings, and clear road markings are proven measures that enhance the safety of both vehicular and non-vehicular road users. Effective road administration, maintenance, and enforcement also contribute to the overall safety performance of a transportation network.

To conceptualise these interrelated factors, the research framework of incidents and accidents in road traffic, as illustrated in Figure 4, is grounded in four theoretical foundations, such as Heinrich's Multi-Causation Theory (1931), Loss Causation Model by Bird and Germain (1985), Reason's Model of System Safety (1997) and Bandura's Social Cognitive Theory (1977).

The evolution of accident models, as described by Hollnagel (2010), can be traced through three distinct phases: simple linear models, complex linear models, and complex non-linear models. This study integrates insights from these theories into the Aze+ RTA Causation and Control Framework, which combines principles from safety management, human factors, and cognitive psychology.

This framework illustrates how implementing the Road Traffic Safety Management System (RTSMS), as outlined in MS ISO 39001:2013 and ISO 39002:2020, can influence and transform the cognitive mindset and behavioural patterns of road users in NIOSH Malaysia. By holistically addressing human, organisational, and environmental interactions, the framework supports the goal of reducing road traffic risks and enhancing safety culture in Malaysian organisations.

2.3 Factors Contributing to RTA

Before delving into an in-depth discussion of the two grounded theories by Herbert W. Heinrich (1931) and Albert Bandura (1977), it is essential to first examine the current state of implementation and the variables that influence road traffic accidents in the twenty-first century. The contributing factors to road incidents and accidents have been analysed based on road traffic crash investigations conducted by the Malaysian Institute of Road Safety Research (MIROS). According to the Buku Statistik Keselamatan Jalan Raya (Road Safety Statistics Book), revised as of 12 February 2020, and as illustrated in Figure 9, the data reveal that human factors remain the predominant contributor to road traffic crashes, accounting for 80.6% of total incidents. In comparison, road-related factors contribute 13.2%, while vehicle-related factors account for 6.2%.

This distribution clearly indicates that road crashes in Malaysia are primarily influenced by human behaviour and decision-making processes, underscoring the need for behaviour-based safety models such as those proposed by Heinrich(Moore et al., 2020) and Bandura (Nabavi, 2011a; Sosial et al., n.d.). These findings further justify the relevance of integrating psychological and cognitive-behavioural theories into the analysis of road traffic safety performance and accident prevention strategies.

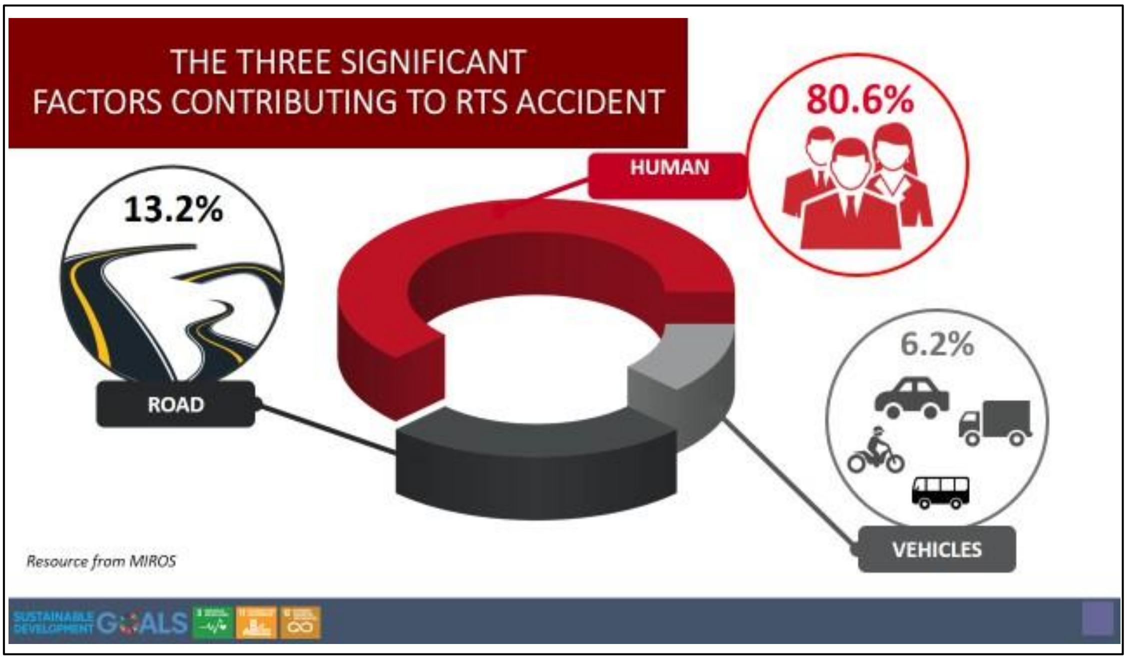


Figure 2.2 Factors Contributing to RTS Accidents (Source from MIROS)

Cited from (Islam Bin & Kanitpong, 2008; Moran et al., 2010) human errors are the most significant contributing factor to road accidents. The researcher argued that psychological and spiritual aspects largely influence negative driving attitudes. According to (Moran et al., 2010) findings, both education level and the number of traffic summonses were found to have significant associations with safe driving practices, as determined by a Chi-square test at a significance level of $p < 0.05$. Correlation analysis further demonstrated that drivers' attitudes toward safety driving are significantly related ($p < 0.05$) to psychological and spiritual factors. Using Structural Equation Modelling (SEM) to postulate the hypothesis, the structural model indicated that psychological and spiritual factors influence and enhance drivers' likelihood of practising safe driving behaviour, thereby potentially reducing the number of road accidents. This finding provides a valuable reference for relevant agencies, offering practical guidelines to improve road safety for drivers. Specifically, it underscores the importance of cognitive and behavioural transformation among road users through the implementation of the Road Traffic Safety Management System (RTSMS), as outlined in MS ISO 39001:2013 and ISO 39002:2002, particularly within the context of NIOSH Malaysia.

A study by (Ma et al., 2012; Zhang et al., 2026), examining traffic accidents in rural China found that the probability of traffic accidents increased with lower levels of traffic safety consciousness (TSC). The study also established that demographics and driving skills were key contributors to TSC. The authors reported that motor vehicle drivers were responsible for more than 90% of traffic accidents in China and recommended implementing a combination of traffic safety education and improved safety infrastructure to standardise safety management and reduce crashes and fatalities. Similarly, research focused on factors affecting two-wheeler accidents in China.

Both studies yielded consistent findings, indicating that gender, behavioural control, and perceptions of risk and utility were significant determinants of red-light violations and subsequent accidents (Yang et al., 2025). The researchers highlighted that driver behaviour and prevailing social norms increasingly influence trends in traffic fatalities. In the United States, Slaughter et al. (2014) investigated accidents involving vulnerable road users (pedestrians and cyclists) struck by motor vehicles in New York City between 2008 and 2011. Their analysis, which utilised accident data, interviews, and imaging, revealed that non-compliance with traffic laws and regulations was a significant cause of such accidents. They concluded that traffic safety interventions must place greater emphasis on promoting compliance behaviours among both motorists and vulnerable road users.

This body of literature reinforces the aims and objectives of the present research, which seeks to identify existing gaps in understanding, competency, and implementation of RTSMS ISO 39001:2013 within institutions to reduce road traffic accidents (RTAs). Furthermore, this study aims to develop and implement a new framework that incorporates cognitive knowledge, skills, behaviours, and attributes in managing road user safety. Such a framework is expected to reduce road traffic risks, minimise accidents, and help achieve NIOSH Malaysia's intended outcomes.

The literature reviewed supports the hypotheses (**H_1**, **H_2**, and **H_3**) that significant correlations exist among the contributing factors leading to increased road traffic crashes. In 2019 alone, Malaysia recorded 548,598 road crash cases, representing an increase of more than 150%. This alarming statistic underscores the urgent need for effective management frameworks to mitigate road and traffic hazards, which not only cause human casualties but also reduce productivity and quality within organisations. The findings of this study will provide valuable input to complement the National Transport Policy (NTP) and serve as evidence-based recommendations for enhancing cognitive and behavioural change among stakeholders in the transportation sector.

In this research, a deeper exploration and analysis of the ISO management system frameworks will be conducted to elucidate how ISO 39001:2013 can reshape the cognitive and behavioural attributes of road users. The Plan–Do–Check–Act (PDCA) cycle in the essence of central to ISO management systems, has evolved into the Observe–Plan–Do–Survey–Action (OPDSA) model, inspired by Sir Edward Deming’s modern management philosophy. Within the context of Road Traffic Safety (RTS) risk management, these international standards specify the requirements necessary for organisations to effectively engage with road users in reducing fatalities and serious injuries arising from traffic crashes. These standards also require organisations to establish appropriate RTS policies, objectives, and action plans, taking into account relevant legal and regulatory requirements.

The ISO 39001:2013 standards are not designed to dictate the technical or quality requirements of transportation products or services, such as road construction, signage, vehicle design, or emergency services, but rather to establish a management framework that fosters a culture of road safety within organisations with the capacity to manage road traffic risk within the institution itself. RTS management is a shared responsibility among employers, employees, and all internal and external stakeholders. While these standards do not exempt road users from their legal obligations, they provide organisations with structured guidance to promote compliance and responsible road behaviour. The standards are generic, allowing flexibility in implementation based on the organisation's type, size, and operations. Any exclusions made under these standards must be documented appropriately, ensuring they do not compromise the organisation's ability to establish, implement, maintain, or improve its RTS management system.

For decades, scholars and practitioners have recognised that all organisational activities inherently involve risk. According to (Paul Hopkin, 2010) effective risk management represents the foundation of sound decision-making, particularly in addressing the effects of uncertainty on organisational objectives. Transitioning toward a "culture of prevention" through systematic, comprehensive risk management is a gradual, evolutionary process. Success in risk management depends on adopting methods that best fit an organisation's specific context and understanding the challenges associated with implementing such systems (Henny et al., 2025; Leitch, 2010; Paul Hopkin, 2010; Zio, 2025). Stakeholders must clearly identify critical decisions that require risk considerations, evaluate their existing safety culture, and initiate appropriate steps toward an integrated risk management approach.

2.4 ISO and ISO Management System Principle

The International Organisation for Standardisation (ISO) develops voluntary standards that can become obligatory in practice through adoption by industry, regulators, or contractual requirements. ISO's approach to developing standards is grounded in broad-based consensus, achieved through committees that represent a transparent and participatory alternative to more exclusive arrangements, such as consortia or de facto standards (Jelani, 2019). Unlike other standard-setting mechanisms, ISO standards enjoy international recognition and authority as quasi-official benchmarks, primarily due to the technical expertise and broad consensus that underpin their development. Although ISO is widely known today, it was not the first international standardisation body. Its institutional framework and decision-making procedures were inspired by its sister organisation, the International Electrotechnical Commission (IEC), established in 1906 to oversee electrotechnical standards. ISO’s direct predecessor, the International Federation of National Standardising Associations (ISA), was founded in 1926 but faced significant challenges due to the division between countries using imperial and metric measurement systems. The organisation ceased operations during the Second World War but was reactivated in 1946 with renewed support from the United States and the United Kingdom. Based on (Mohan, 2025b) the International Organisation for Standardisation ISO (2021), defines governance as a “human-based system by which an organisation is directed, overseen and held accountable for achieving its defined purpose”. (Mohan, 2025a)

ISO's operational work is not carried out by its central secretariat in Geneva, which primarily coordinates the decentralised activities of expert working groups and technical committees (TCs). These committees encompass more than 200 technical fields and comprise approximately 3,093 subcommittees and working groups, which typically convene annually at various venues worldwide. ISO’s technical committees consist of experts nominated by national member organisations, including representatives from industry, academia, government agencies, and, in some cases, consumer and non-governmental organisations. Collectively, more than 50,000 experts worldwide contribute to ISO’s standardisation processes.

Structurally, ISO resembles an intergovernmental organisation, featuring a small central secretariat in Geneva responsible for day-to-day management and coordination. Its membership comprises national standards bodies that convene annually at the ISO General Assembly. The examples of prominent member bodies include the British Standards Institution (BSI), the Deutsches Institut für Normung (DIN), the American National Standards Institute (ANSI), and the Association Française de Normalisation (AFNOR). Many of these national institutions predate ISO and have evolved along distinct national trajectories, which continue to shape the organisation’s global standardisation landscape. ISO recognises only one national member per country, the entity deemed most representative of standardisation activities in that nation, which is responsible for aggregating and articulating a unified national position on matters discussed within ISO.

As a federation of national standards organisations, ISO's principal mandate is to harmonise existing national standards and develop new, universally recognised international standards. Over time, purely national standards have become increasingly rare, as most standards are now developed collaboratively at the international level and later adopted or adapted as national standards. As of 2020, ISO comprised 167 member countries, including 104 full members with voting rights and 63 corresponding or subscriber members with limited participation, primarily from Eastern Europe and developing nations such as Malaysia. This structure enables ISO to serve as a truly global platform for harmonising technical, safety, and quality management standards across sectors.

2.5 ISO 39001:2013 Road Safety Management System Landscape in Malaysia

In the landscape of road traffic safety management systems (RTSMS) in Malaysia, the country has played an active role in the international standardisation process under the International Organisation for Standardisation (ISO). Malaysia became a participating member of ISO/PC 241 following the establishment of the National Mirror Committee to ISO/PC 241, chaired by the Malaysian Institute of Road Safety Research (MIROS) on 17 June 2008. This committee was responsible for aligning national efforts with the international development of road traffic safety management standards. In mid-2012, ISO/PC 241 was upgraded to ISO/TC 241 by ISO, with an expanded scope that included road traffic safety (RTS)-specific auditing requirements for third-party certification, as well as implementation and guidance documents. Subsequently, on 16 May 2012, the National Mirror Committee to ISO/TC 241 undertook the development of the Malaysian Standard on Road Traffic Safety Management Systems (RTSMS), aligned with the broader objectives of ISO/TC 241.

To facilitate national implementation, the Malaysia Steering Committee for the Implementation of ISO 39001 was established, also chaired by MIROS. The primary roles of this steering committee include developing the national roadmap for RTSMS implementation, monitoring its progress, and ensuring effective capacity building through training and consultation. The committee is also responsible for preparing training modules, providing technical guidance to pilot organisations, and supporting the adoption of ISO 39001:2013 across sectors. Through these coordinated efforts, Malaysia has positioned itself as a proactive contributor to international standardisation while promoting safer road traffic management practices at the national level.

2.5.1 Scope of RTSMS MS ISO 39001:2013

According to the written statement in ISO 39001:2013, the world continues to struggle with the alarming rate of road traffic accidents (RTA), which have become a primary global concern. It is estimated that approximately 1.3 million people die and 20 to 50 million are injured on roads worldwide each year, with the numbers continuing to rise. The socio-economic and health impacts of these incidents are substantial, affecting both individuals and national economies. ISO 39001:2013 provides a systematic framework to help organisations reduce, and ultimately eliminate, the risk of death and serious injury associated with road traffic crashes. By applying this standard, organisations can achieve a more cost-effective and efficient use of the road traffic system (Iwaro & Mwasha, 2012; Jelani, 2019). The standard outlines key elements of good road traffic safety (RTS) management practices that enable organisations to achieve their desired RTS outcomes.

ISO 39001:2013 applies to both public and private organisations that interact with the road traffic system, and it can be utilised by internal and external parties, including certification bodies, to evaluate an organisation's compliance with RTS requirements. Global experience demonstrates that significant reductions in road deaths and serious injuries can be achieved through the adoption of a holistic "safe system" approach. This approach emphasises a clear focus on RTS outcomes, evidence-based interventions, and strong organisational management capacity to sustain improvements in road safety performance.

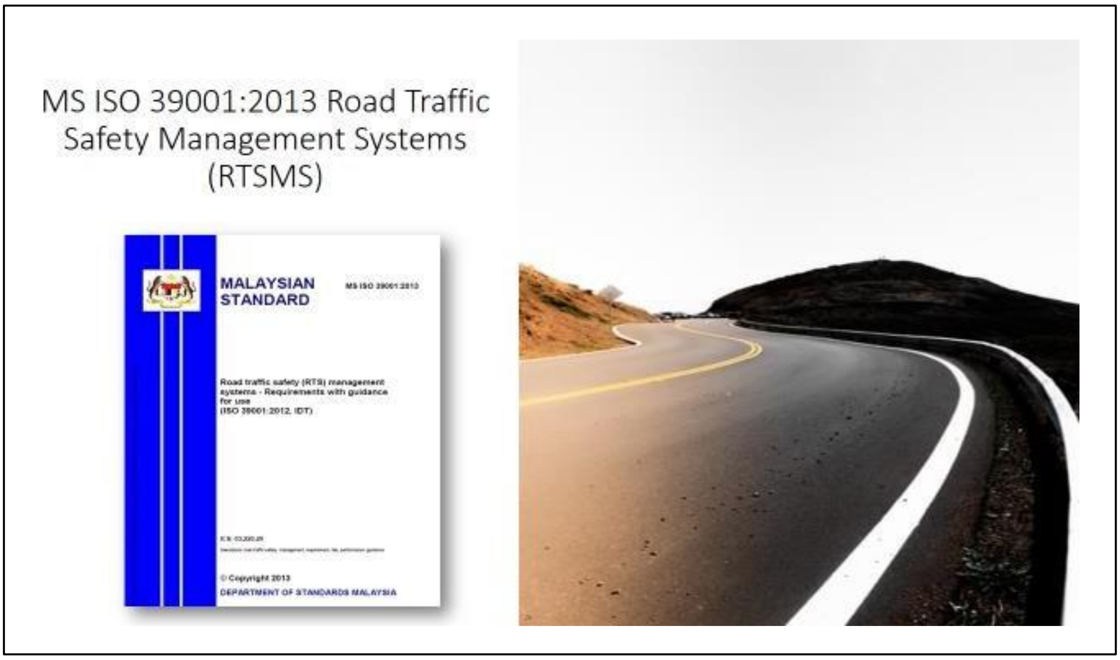


Figure 2.3 Illustration Of The ISO 39001 Standard Front Page

Supporting this perspective, research conducted by (Iwaro & Mwasha, 2012; Jelani, 2019) on the impact of ISO management system certification, it was found that ISO certification can enhance organisational performance by improving quality factors. Their findings revealed that organisations certified under ISO standards reported significant improvements in quality performance, particularly in communication, documentation, supervision, worker performance, and management practices. In contrast, non-certified organisations demonstrated weaker performance, citing issues such as poor systems, ineffective methodologies, and inadequate planning. Similarly, Joseph Iwaro's (2012) earlier study confirmed a strong correlation between ISO certification and improvements in quality performance. The research highlighted that ISO certification not only strengthens the management system but also influences improvements in factors that typically contribute to poor quality. Consequently, ISO certification can be considered a key enabler of organisational effectiveness, consistency, and safety performance, especially in the context of road traffic safety management.

2.5.2 HLS (High Level Structure) and P.D.C.A Concepts

In research conducted by various scholars, cognitive elements influencing behavioural change among road users have been integrated into the Road Traffic Safety Management System (RTSMS) ISO 39001:2013 through the application of the Plan-Do-Check-Act (PDCA) concept (Tor-Olav Naevestad et al., 2025), embedded within the High-Level Structure (HLS) framework. This integration enables ISO 39001 to address cognitive transformation, behavioural adaptation, and human-factor improvement in managing road traffic safety (RTS) risks within organisations. The HLS provides a standardised structure of clauses, core text, and common terminology across all ISO management system standards. Its framework is organised into ten clauses: Clause 1 (Scope), Clause 2 (Normative References), Clause 3 (Terms and Definitions), Clause 4 (Context of the Organization), Clause 5 (Leadership), Clause 6 (Planning), Clause 7 (Support), Clause 8 (Operation), Clause 9 (Performance Evaluation), and Clause 10 (Improvement).

Within this framework, the PDCA cycle is systematically embedded across these ten clauses to ensure continual improvement. The implementation process begins with the “Plan” phase, which encompasses Clauses 4, 5, 6, and 7. In this stage, the organisation is required to establish, implement, maintain, and continually improve the RTS management system. It involves identifying both internal and external interested parties, understanding their expectations, and defining the scope of the RTSMS. Clauses 5.1, 5.2, and 5.3 emphasise the roles, responsibilities, and authorities required to manage system effectiveness, guided by policy statements that provide strategic direction and accountability across multiple organisational levels. Clause 6 serves as the core of the management system, guiding risk and opportunity assessment while defining relevant RTS performance factors, including Risk Exposure Factors, Final Safety Outcome Factors, and Intermediate Safety Outcome Factors (Clause 6.3). Clause 7 addresses resource coordination, ensuring that road users possess the necessary competency, awareness, and support to perform effectively within the RTSMS framework.

The “Do” phase (Clause 8) focuses on operational planning and control, including preparedness for responding to RTS incidents and emergencies. The “Check” phase (Clause 9) involves monitoring, measurement, analysis, and evaluation to assess the effectiveness of the implemented processes. Finally, the “Act” phase (Clause 10) emphasises continual improvement through corrective actions and performance review. The interrelationships among these clauses form a closed-loop process system, similar to a process engineering block diagram, in which inputs, processes, outputs, and feedback loops interact dynamically. As illustrated in Figure 2.4, integrating the PDCA methodology into the HLS structure ensures a continuous, systematic approach to enhancing road user cognition, behaviour, and safety performance in accordance with ISO 39001:2013 requirements.

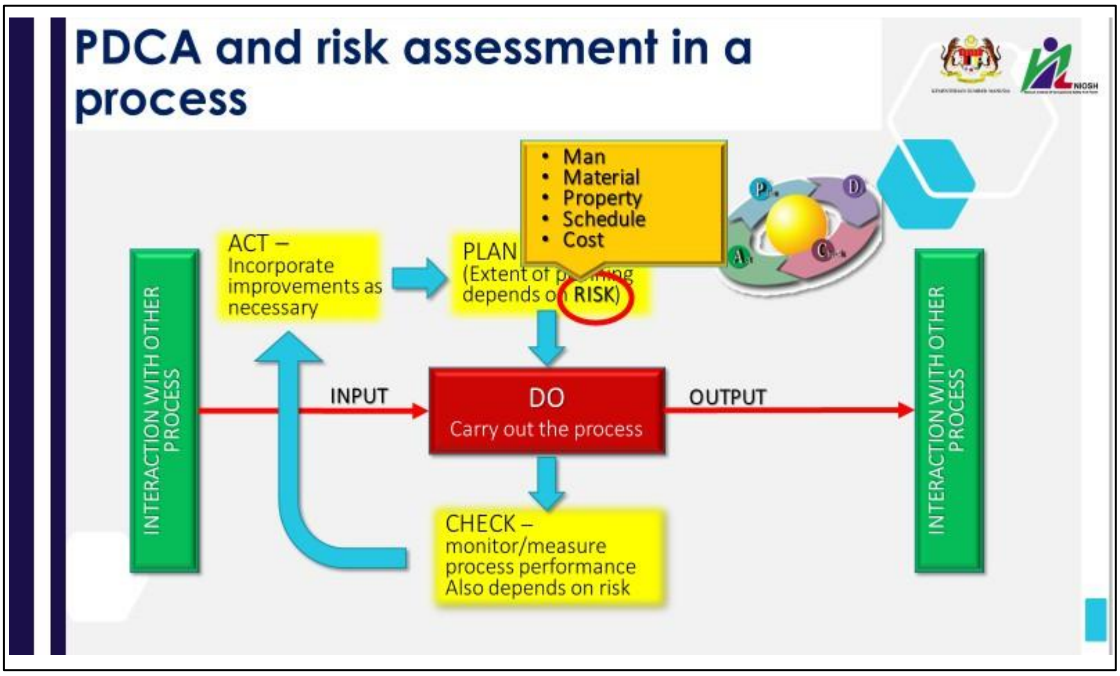


Figure 2.4 P.D.C.A Concept By “Shewart Cycle” (1930), Referring To Edward Deming

The philosophy of W. Edwards Deming has long been recognised as a cornerstone of modern quality and management systems (Yu, 2025). When appropriate management principles are adopted, organisations can simultaneously increase quality and reduce costs by eliminating waste, rework, staff attrition, and litigation, while fostering customer loyalty and long-term sustainability. The essence of Deming’s approach lies in the practice of continual improvement and in viewing manufacturing and organisational management as an integrated system rather than isolated components.

According to William Edwards Deming (1930), as illustrated in Figure 2.4, “The first step is the transformation of the individual. This transformation is discontinuous.

It comes from understanding the system of profound knowledge. The individual, once transformed, will perceive new meaning in life, events, numbers, and interactions between people". Deming emphasised that once an individual understands this system of profound knowledge, they will naturally apply its principles in all relationships and contexts, forming a basis for sound judgment and enabling the transformation of organisations to which they belong (Lin, 2025; Yu, 2025).

The appreciation of a system, one of the four components of Deming's profound knowledge, involves understanding how interactions and feedback loops among system elements can create internal constraints that cause the system to behave as a unified entity striving for equilibrium. This steady state ultimately determines the overall system performance rather than the efforts of individual elements in isolation. Therefore, it is the organisation's structure, not merely employees' behaviour, that holds the key to improving risk management, safety performance, and the intended outcomes of a management system. This concept is illustrated in Figure 12, which demonstrates how systemic interaction governs stability, performance, and continuous improvement within organisational processes.

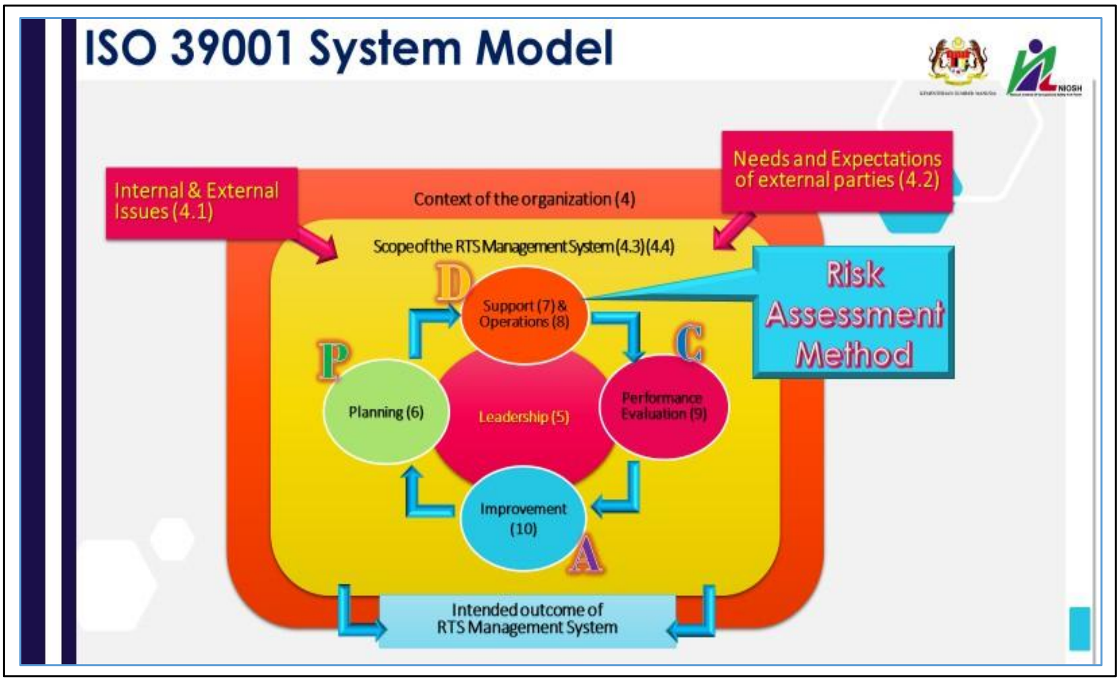


Figure 2.5 HLS Interaction with The PDCA Cycle

2.6 ISO 39002 – RTS Good Practices for Implementing Commuting Safety Management

ISO 39002:2019(E) was approved as a guideline by Technical Committee TC 241 and scheduled for publication in 2020. The inclusion of this standard in this research demonstrates the linkages between ISO 39001 and ISO 39002, where the latter serves not as a certifiable scheme but as a supporting subset of the implementation requirements outlined in Clause 8 of ISO 39001. The requirements in ISO 39002 are structured across Clauses 1 to 6: Clause 1 provides the generic ISO framework; Clause 2 addresses factors affecting commuting crashes; Clause 3 outlines roles and responsibilities; and Clause 6 details good practices and recommendations.

The scope of ISO 39002 provides guidelines for good practices that organisations worldwide can adopt to systematically and flexibly manage commuting safety, while ensuring the continual improvement of their safety practices and systems. It emphasises proactive measures and initiatives to mitigate commuting risks. Organisations are encouraged to adopt as many good practices as possible from this standard, as the high proportion of road traffic crashes involving commuting has become a global concern. To address this, organisations should take proactive steps to enhance safe commuting practices, particularly in protecting all commuters, including vulnerable road users (VRUs).

By applying ISO guidelines, organisations can play a pivotal role in cultivating a road-safety culture among employees and students. They can reduce commuting crashes by developing and implementing comprehensive policies, procedures, and training programs on road safety, encouraging the use of safer modes of transport and vehicles, and ensuring effective journey planning. A systematic assessment framework should also be established to evaluate the effectiveness of commuting crash prevention strategies and related initiatives. Furthermore, organisations should emphasise extensive outreach programs to strengthen commuting safety management. The successful implementation of this standard requires a strong organisational commitment to fostering a “safety-first” culture, which will, in turn, promote the prevention of commuting crashes.

The implementation of ISO 39002 is recognised for delivering not only safety benefits but also societal, environmental, and economic advantages to organisations.

This research is closely related to Clause 4 of ISO 39002, which addresses factors that contribute to commuting crashes. It supports Hypothesis H1, stating that cognitive understanding of road traffic safety (RTS) hazards has a significant positive impact on behaviour and RTS risk management. Under this clause, ISO TC 241 identifies three primary factors contributing to commuting crashes: Clause 4.1, road users; Clause 4.2, vehicles; and Clause 4.3, roads and environment.

2.7 ISO 31000 – Risk Management Guideline

ISO Guide 73 was developed to establish a common terminology for use across all ISO standards. This international guide defines risk as the "effect of uncertainty on objectives," emphasising that such effects may be positive, negative, or represent a deviation from the expected outcome (Leitch, 2010). These three types of events correspond to risks categorised as opportunity, hazard, or uncertainty, which can be illustrated through examples such as motor vehicle ownership, where both benefits and potential losses coexist. The guide also notes that risk is often described in terms of events, changes in circumstances, consequences, or a combination of these factors, each of which may influence the achievement of an organisation's objectives.

Managing risk is an integral component of all organisational activities and involves continuous interaction with both internal and external stakeholders. It requires consideration of the organisation's external and internal contexts, including human behaviour, cultural influences, and other contextual factors. Regardless of their type or size, all organisations are subject to various external and internal conditions that may introduce uncertainty in achieving objectives. As explained by Paul Hopkin (Paul Hopkin, 2010) maintaining a car in good mechanical condition can reduce the likelihood of breakdowns, but cannot eliminate the risk entirely. Such risks, characterised by high uncertainty, are often referred to as control risks. Similarly, shared by other researcher (Iosif, 2012) highlighted that modern risk management provides a structured framework for organisations to anticipate, respond to, and manage uncertainty, acknowledging that complete certainty is unattainable. Contemporary risk management, therefore, adopts a systematic and comprehensive approach, employing transferable tools and techniques to address these uncertainties effectively.

The risk management process cannot occur in isolation; it must be embedded within a broader organisational framework. Across various standards and publications, successful risk management frameworks share three critical components: the risk architecture, which defines communication and reporting structures; the strategy, which outlines the organisation's overarching approach to risk; and the protocols, which establish formal guidelines and procedures. Collectively, these elements are referred to as Risk Architecture, Strategy, and Protocols (RASP), and they form the foundation of an effective risk management framework.

The international standard ISO 31000:2018 provides the principles, framework, and process for managing risk. These components may already exist partially or fully within an organisation, but often require adaptation or enhancement to ensure that risk management practices are efficient, effective, and consistent. ISO 31000:2018 is structured across several key clauses. Clause 1 (Scope) defines the standard's applicability to generic risk management, introducing its principles and dual-process structure. This structure comprises one process addressing long-term organisational risk development and another focusing on the management of specific risks. Clause 2 (Normative References) and Clause 3 (Terms and Definitions) provide foundational terminology, the latter referencing ISO Guide 73:2009 as its glossary source. Clause 4 (Principles) outlines eight fundamental principles of risk management, each explained in detail, while Clause 5 (Framework) describes a cyclical process for embedding risk management within an organisation through six core elements. Finally, Clause 6 (Process) presents a cyclical approach to managing specific risks, emphasising the ongoing, iterative nature of effective risk management.

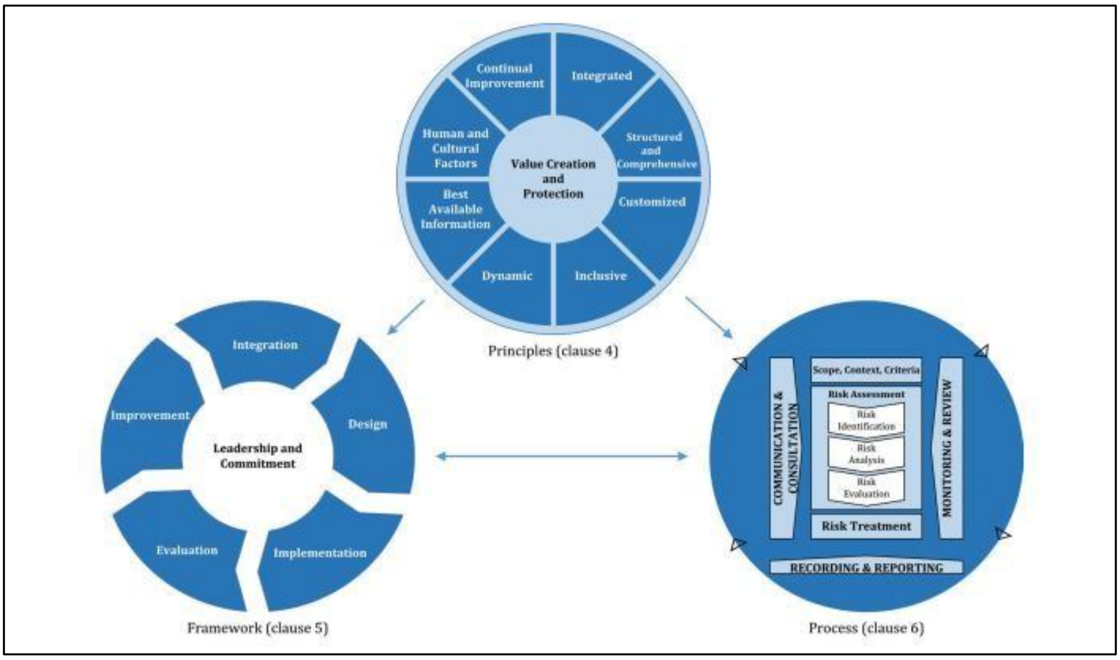


Figure 2.6 ISO 31000 – Risk Assessment Principles, Framework And Process

The combination of risk management processes and the supporting organisational framework together form what is known as a risk management standard. Over the years, several such standards have been developed to guide organisations in establishing systematic and consistent approaches to identifying, assessing, and managing risks. Among the most notable are the IRM Risk Management Standard and the British Standard BS 31100, both of which provide comprehensive guidance on risk governance and integration into organisational structures. In addition, the Committee of Sponsoring Organisations of the Treadway Commission (COSO) developed the Enterprise Risk Management (ERM) Framework, which has become a widely recognised model, particularly in the United States, for embedding risk management into strategic and operational decision-making.

The most recent and internationally recognised standard is ISO 31000, first published in 2009, which has since become the global benchmark for risk management. Its introduction led to the withdrawal of the well-established Australian Standard AS 4360 (2004), which had served as a foundational model for many years. Initially published in 1995, AS 4360 laid the groundwork for a structured, process-driven approach to managing risks across all organisational types and sectors. ISO 31000 was built upon the strengths of AS 4360, incorporating many of its principles and methodologies while expanding its applicability to a broader international context. The result is a unified and adaptable framework that emphasises continuous improvement, integration, and alignment with organisational objectives, ensuring that risk management remains an essential component of sustainable and effective governance (Jelani, 2019; Leitch, 2010).

2.8 ISO 31010 – Risk Management and Risk Techniques

The ISO 31010:2019 standard provides comprehensive guidance on the selection and application of risk assessment techniques to enhance organisations' identification, analysis, and evaluation of uncertainty. These techniques support the overall risk management process as outlined in ISO 31000, particularly in the key stages of risk identification, risk analysis, and risk evaluation. The purpose of ISO 31010 is to help organisations develop a deeper understanding of uncertainty and its potential effects on objectives, thereby enabling more informed and effective decision-making. Although many of the techniques described in this standard originated within technical and engineering domains, their applicability has broadened significantly. Over time, these methods have evolved and been adapted across diverse sectors, reflecting differences in terminology, methodology, and purpose. As a result, organisations can tailor, combine, and extend these techniques to meet contemporary and emerging needs in risk management.

The structure of ISO 31010:2019 comprises seven clauses, with the first three—Clause 1 (Scope), Clause 2 (Normative References), and Clause 3 (Terms and Definitions) providing general information common to ISO standards. The implementation aspect begins with Clause 4 (Core Concepts), which elaborates on the fundamental ideas of uncertainty and risk. This is followed by Clause 5 (Uses of Risk Assessment Techniques), explaining how different techniques can support risk-related decisions; Clause 6 (Implementing Risk Assessment), which outlines the process for integrating these techniques into organisational practices; and Clause 7 (Selecting Risk Assessment Techniques), which guides on choosing appropriate methods based on context and objectives.

Among the many techniques referenced in ISO 31010, several are particularly effective for identifying, analysing, and evaluating risks, including Bow-Tie Analysis, Cause-Consequence Analysis, Failure Modes and Effects and Criticality Analysis

(FMECA), F–N Diagrams, Human Reliability Analysis, Privacy Impact Assessment (PIA)/Data Protection Impact Assessment (DPIA), Reliability-Centered Maintenance, and Scenario Analysis. Selecting the proper technique is critical, as it shapes an organisation's cognitive understanding and perception of risk. In this research, the Bow-Tie Analysis, a graphical method, is chosen as the primary approach, providing a clear visual representation of the relationships among potential causes, preventive controls, and consequences. This approach is preferred over the commonly used HIRARC (Hazard Identification, Risk Assessment, and Risk Control) technique, which relies on a statement-based method. The Bow-Tie technique offers a more intuitive and systematic approach to understanding risk pathways, supporting more effective decision-making in road traffic safety management.

Table 2.3
Risk Assessment Technique

Tools and Technique	**Risk Assessment Process (A: Applicable; SA: Strongly Applicable; NA: Not Applicable)**					**Sub-Clause**
	Risk Identification	**Risk Analysis**			**Risk Evaluation**	
		Consequences	**Likelihood**	**Level of Risk**		
ALARP, ALARA and SFAIRP	NA	NA	NA	NA	SA	B.8.2
Bayesian analysis	NA	NA	SA	NA	NA	B.5.2
Bayesian networks	NA	NA	SA	NA	SA	B.5.3
Bow tie analysis	A	SA	A	A	A	B.4.2
Brainstorming	SA	A	NA	NA	NA	B.1.2
Business impact analysis	A	SA	NA	NA	NA	B.5.4
Causal mapping	A	A	NA	NA	NA	B.6.1
Cause-consequence analysis	A	SA	SA	A	A	B.5.5
Checklists, classifications and taxonomies	SA	NA	NA	NA	NA	B.2.2
Cindynic approach	SA	NA	NA	NA	NA	B.3.2
Consequence/likelihood matrix	NA	A	A	SA	A	B.10.3
Cost/benefit analysis	NA	SA	NA	NA	SA	B.9.2
Cross impact analysis	NA	NA	SA	NA	NA	B.6.2
Decision tree analysis	NA	SA	SA	A	A	B.9.3
Delphi technique	SA	NA	NA	NA	NA	B.1.3

Event tree analysis	NA	SA	A	A	A	B.5.6
Failure modes and effects analysis	SA	SA	NA	NA	NA	B.2.3
Failure modes and effects and criticality analysis	SA	SA	SA	SA	SA	B.2.3
Fault tree analysis	A	NA	SA	A	A	B.5.7
F-N diagrams	A	SA	SA	A	SA	B.8.3
Game theory	A	SA	NA	NA	SA	B.9.4
Hazard and operability studies (HAZOP)	SA	A	NA	NA	NA	B.2.4
Hazard analysis and critical control points (HACCP)	SA	SA	NA	NA	SA	B.4.3
Human reliability analysis	SA	SA	SA	SA	A	B.5.8
Ishikawa (fishbone)	SA	A	NA	NA	NA	B.3.3
Layer protection analysis (LOPA)	A	SA	A	A	NA	B.4.4
Markov analysis	A	A	SA	NA	NA	B.5.9
Monte Carlo simulation	NA	A	A	A	SA	B.5.10
Multi-criteria analysis (MCA)	A	NA	NA	NA	SA	B.9.5
Nominal group technique	SA	A	A	NA	NA	B.1.4
Pareto charts	NA	A	A	A	SA	B.8.4
Privacy impact analysis/ data privacy impact assessment (PIA/DPIA)	A	SA	A	A	SA	B.5.11
Reliability centered maintenance	A	A	A	A	SA	B.8.5
Risk indices	NA	SA	SA	A	SA	B.8.6
S-curves	NA	A	A	SA	SA	B.10.4
Scenario analysis	SA	SA	A	A	A	B.2.5

2.8.1 Risk

The understanding of risk levels within an organisation can be explained based on three main layers of business risk, as illustrated in Figure 2.7 below. These layers represent the hierarchical structure through which risk manifests and is managed. The first and most significant layer originates from the foundation of risk, commonly identified by most risk management practitioners as the operational process. This level encompasses day to day activities, procedures, and systems where risks are most likely to emerge due to human error, process inefficiency, or system failures. The second layer involves managerial risks arising from decision-making, supervision, and resource coordination within the organisation. The third and most critical layer pertains to the policy-making level, where strategic decisions and regulatory frameworks determine the overall direction of risk governance.

According to several researchers (Engineering Risk Management, n.d.; Henny et al., 2025; Iversen & Rundmo, n.d.; Paul Hopkin, 2010; Simons-Morton et al., 2011), there is remains significant confusion regarding the true potential and interpretation of risk assessment and risk management. In the context of road traffic crash control, particularly when analysing the cognitive and behavioural aspects of road users, it becomes crucial to explore what individuals and society can do to reduce such risks. This involves understanding how road users perceive, interpret, and act on the concept of risk.

The term “risk”, as defined by the Oxford English Dictionary, refers to “a chance or possibility of danger, loss, injury, or other adverse consequences,” while “at risk” is defined as being “exposed to danger.” Within the landscape of road crashes in Malaysia, this understanding of risk becomes particularly vital, as it shapes how individuals, organisations, and policymakers conceptualise safety and implement preventive measures. Recognising the layers of business and operational risk, alongside societal perceptions of risk, enables a more holistic and practical approach to reducing traffic-related incidents and enhancing overall road traffic safety (RTS) management.

Figure 2.7 Organizational Risk layer

Effective control of road traffic risk must extend from within the organisation to its external environment, emphasising that the management system serves as the central mechanism for governing risk. Organisations inherently face a broad spectrum of risks that can influence the outcomes of their operations. The overarching objective of any organisation, often articulated as its mission or corporate goals, may be affected in three distinct ways. Hindered by hazard risks, enhanced by opportunity risks, or rendered uncertain by control risks. Therefore, a comprehensive and integrated approach to risk management is essential to ensure consistent evaluation, control, and monitoring of these three dimensions. Importantly, the risk management process cannot operate in isolation; it must be supported by an internal organisational framework that ensures coherence and alignment with strategic objectives.

Historically, the concept of “risk” is relatively recent and uncertain (Henny et al., 2025; Iversen & Rundmo, n.d.; Paul Hopkin, 2010). Although risk has always been intrinsic to human existence, systematic reflection on the nature of danger and uncertainty only emerged as humans began contemplating mortality and ways to avoid harm. The mathematical foundations of probability theory, developed centuries ago, provided the tools that humans later applied to assess risks in technical systems. However, the institutionalisation of risk research and the formalisation of risk management as a professional field are comparatively modern developments (Henny et al., 2025; Leitch, 2010; Org, 2020; Paul Hopkin, 2010).

Risk can be understood through various conceptualisations as an expected value, a probability distribution, uncertainty, or an event. Several definitions converge on this multi-dimensional view, risk as expected disutility, as the probability of adverse outcomes as the probability-severity combination of adverse effects or as a triplet of scenarios, probabilities, and consequences (Diego & Lavillotti, 2013; Khan et al., 2015; Org, 2020; Zhang et al., 2026) further emphasised risk as a two-dimensional construct comprising consequence and uncertainty, encompassing both likelihood of occurrence and potential impact.

This perspective is often illustrated through predictive applications, such as estimating the number of fatalities from car crashes in a given year using historical data. Such an approach, however, assumes two key conditions: that sufficient data exist and that causal mechanisms remain stable over time. Traditional risk assessments often adopt a reductionist stance, narrowly defining hazards and uncertainties in probabilistic terms. While this methodological precision offers clarity and analytical rigour, it also overlooks the complex, non-linear factors that influence real-world risk phenomena, including behavioural, cultural, and organisational dimensions.

(Khan et al., 2015) argue that the traditional or "technical" approach to risk assessment suffers from significant limitations, particularly its lack of precision and its failure to represent uncertainty. Probability-based models often rely on historical averages that obscure context-specific factors such as human behaviour, social influences, and system interdependencies. Moreover, through the concept of the "black swan," reliance on past data renders such model's incapable of predicting rare yet high-impact events. Outliers, by definition, fall outside the scope of conventional probability models and defy extrapolation from historical records.

Statistical modelling further complicates this issue. The fitting of data to theoretical distributions, such as the normal distribution, assumes homogeneity and stability that may not exist. When historical data lack extreme observations, it creates a false sense of predictability, even though such extremes may emerge in the future. Consequently, effective risk management requires transcending purely data-driven approaches by integrating qualitative understanding, contextual interpretation, and value-based judgment.

A quantitative assessment of risk necessitates the establishment of clear acceptance criteria. However, these thresholds, such as tolerable levels of human life loss, cannot be empirically derived from data alone; they must instead be informed by ethical reasoning and societal consensus. The process of defining "acceptable risk" thus moves beyond scientific inquiry into moral deliberation, where regulators and policymakers negotiate between societal benefit and human safety (Paul Hopkin, 2010). Technical perspectives on risk spanning statistical, environmental, and technological approaches share the common goal of anticipating and mitigating potential physical harm to individuals, assets, and ecosystems. Through probabilistic and expectation-based frameworks, they enable the identification of threats, the formulation of preventive measures, and the enhancement of system reliability. Risk assessments thereby serve as foundational tools for cost–benefit analyses, the formulation of safety standards, and risk reduction strategies.

The strength of traditional risk assessment lies in its ability to systematise knowledge and uncertainty about processes, phenomena, and activities. (Hammer et al., n.d.; Iosif, 2012; Paul Hopkin, 2010), such assessments have been instrumental in improving the safety performance of complex technical systems, including chemical plants, power facilities, and road traffic networks. While their focus on quantifiable outcomes such as the number of traffic accidents or fatalities limits scope, it simultaneously allows for methodological rigour, objective comparison, and informed policy-making.

In this research, the comparative techniques presented in Table 2.3 illustrate the diverse methods available for identifying and managing organisational risk levels. The techniques outlined in ISO 31010 are particularly relevant, as they address the limitations inherent in traditional statement-based assessment methods widely used by practitioners. This study employs these advanced techniques to assess whether changes in cognitive understanding among respondents from the National Institute of Occupational Safety and Health (NIOSH) Malaysia can influence behavioural adaptation and road safety outcomes. These insights support the study's research hypotheses (H1, H2, H3) and inform the methodological framework presented in Chapter 3, which focuses on evaluating how ISO 39001:2013 implementations can shape road user cognition and behaviour.

The integration of these risk management processes, together with the supporting frameworks, forms the foundation of modern risk management standards. Several such standards exist globally, including the Institute of Risk Management (IRM) Standard, the British Standard BS 31100, and the American COSO Enterprise Risk Management (ERM) framework. Among these, the international standard ISO 31000, first published in 2009, represents the most comprehensive and globally accepted framework. Its introduction led to the withdrawal of the Australian Standard AS 4360, which served as a precursor. The ISO 31000 retains many of the conceptual features of AS 4360 but refines them to promote consistency, integration, and effectiveness in managing risk across diverse organisational contexts (Leitch, 2010).

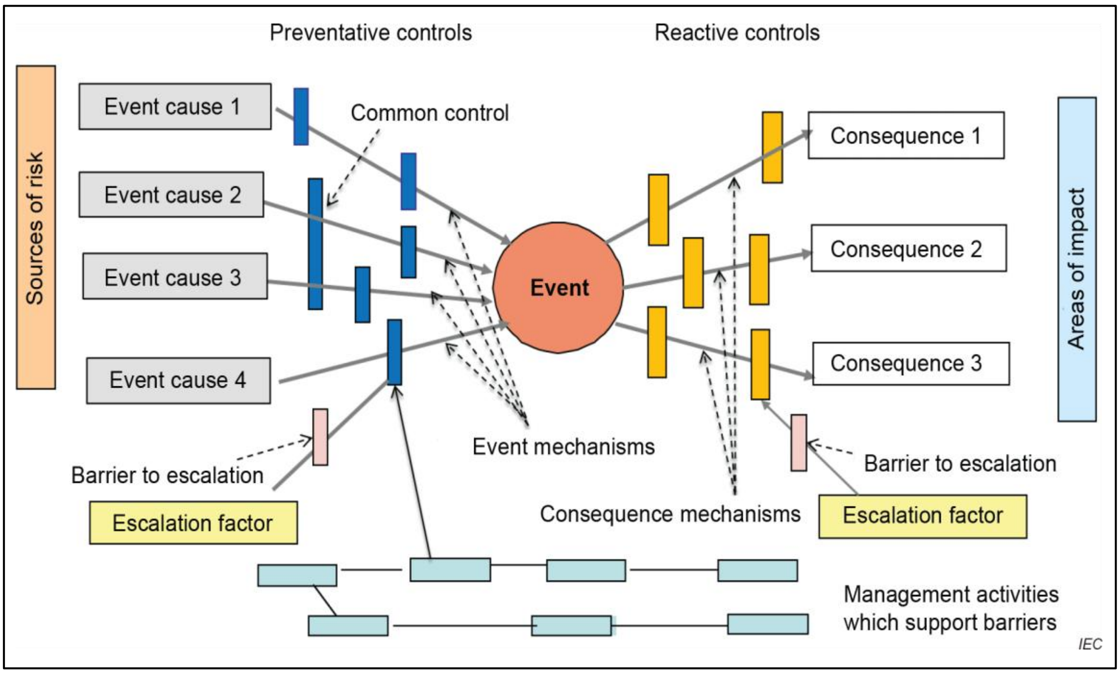


Figure 2.8 Bow-Tie Technique (Source: ISO 31010)

Using the Bow-Tie method, illustrations and graphical representations enhance readers' focus and facilitate a clearer understanding of the risk management process. The barriers depicted in Figure 2.8 are prominently highlighted, providing a clear visualisation of how risks can be effectively prevented. The diagram clearly separates the prevention and consequence stages, allowing for a structured understanding of the cause-and-effect relationships within the risk framework (Stockel, 2023). This visual segregation also supports the development of cognitive understanding, perception, and behavioural change among readers, thereby strengthening their awareness of how risks can be managed and mitigated.

HIRARC RESULT

Work process: CONSTRUCTION OF SOIL INVESTIGATION								Conducted by: MOHAMAD ARIFFIN BIN SAMSURI	
Hazard identification				Risk analysis				Risk control	
No	Work activity	Hazard	Effect	Existing control	L	S	Risk	recommendation	Legal requirement
1	Temporary traffic control	Accident due to mobilization of machineries (crash by heavy machinery) (safety)	Serious or minor Injury, bone fracture, traffic congestion	Toolbox meeting, daily workplace inspection, provide complete set of ppe	3	3	9 medium	**ELIMINATION: N/A** **SUBSTITUTION: N/A** **ISOLATION: N/A** **ENGINEERING CONTROL: N/A** **ADMINISTRATIVE CONTROL:** provide general workers to direct traffic, competent operator and driver with valid driving license, implement traffic management as per approved by management, Provide clear & working space and access with enough flagmen to control the traffic. **PERSONAL PROTECTIVE EQUIPMENT:** provide hazard warning blinker light	FMA1987 (building operation and works of engineering construction) (runways and ramps) FMA 1987 (person in charge)(machinery required to be in charge of persons holding certificates of competency)(section 13, assessment of drivers)

Figure 2.9 HIRARC Techniques (Source: DOSH HIRARC Guideline)

The linear and classical methods of risk assessment, such as HIRARC (Hazard Identification, Risk Assessment, and Risk Control), are often difficult for the general public to comprehend, particularly for individuals without formal safety training (Henny et al., 2025). These traditional approaches adopt a direct and procedural format that may inadvertently overlook critical steps in the hazard identification phase, thereby increasing the potential for unrecognised risks, as illustrated in Figure 2.9. Furthermore, the reliance on lengthy textual descriptions can hinder comprehension, especially among practitioners or drivers who may struggle to interpret complex written instructions. As illustrated in Figure 2.9, the HIRARC example applied to road transportation shows that preventive measures are not explicitly emphasised, thereby reducing the method's effectiveness in conveying risk-prevention strategies. Consequently, this limitation highlights the need for a more intuitive and cognitively engaging approach, such as the Bow-Tie analysis, which provides a clearer, visual representation of risk pathways and preventive barriers, thereby enhancing understanding and facilitating behavioural change toward risk management.

2.9 Driver Operation (Human Factor and Human Behaviour in Driving)

The interaction between human sensory inputs such as vision, hearing, touch, and instinct plays a critical role in driving behaviour. These sensory systems continuously transmit impulses to the brain, enabling the cognitive processing necessary for decision-making and initiating appropriate motor responses. This cognitive chain of perception, interpretation, and action underpins a driver's ability to respond to hazards and manage risks on the road. In this context, the relationship between cognition, metacognition, psychology, and physiology becomes essential in understanding how drivers perceive and react to dynamic and potentially hazardous driving environments (Kyung et al., 2008; Stanley Murage San Diego, 2017).

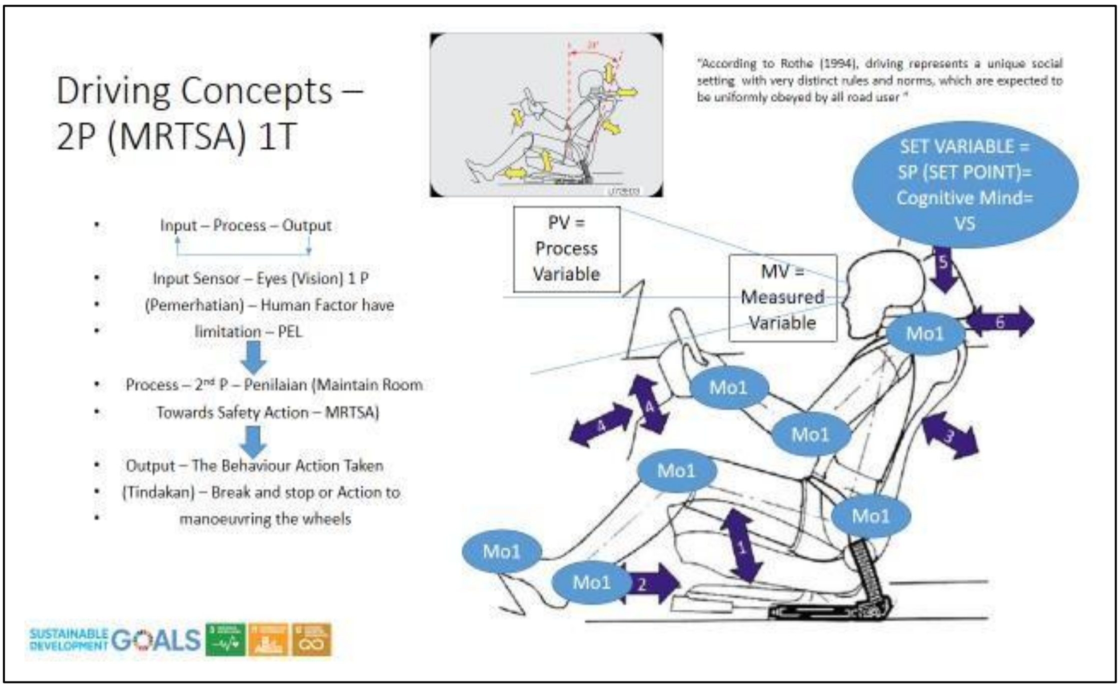


Figure 2.10 The Driving Process Of Cognitive Mind

Driving is fundamentally defined as a unique social setting governed by distinct rules and norms that require uniform adherence by all road users by Rothe, in the 1994 (Roth, 2011; Rothe John Peter1948, 1994). To understand the driver's role within this system and the interaction between the driver cognitive and driver behaviour, the model in the Figure 2.10 employs an Input-Process-Output (IPO) cycle, categorized as 2P (Pemerhatian & Penilaian) and 1T (Tindakan).

Because traffic arises from the interaction between people, he argues that traffic safety is a social process, one that is created, formed, and changed by human interaction. Beyond Traffic Safety presents controversial critiques and provocative positions. It stimulates insight into the question of why traffic safety issues have become so important today. Based on Rothe explores new social boundaries and crosses old ones. He demonstrates that interlinking social factors in a motorist's behaviour reveal traffic safety as a significant facet of social behaviour worthy of in-depth exploration. This may well be the first work of fundamental theory in an area thus far dominated by crude empiricism. Beyond Traffic Safety describes drivers' responsibilities and examines how basic trust in traffic routines sustains an orderly flow. It shows how physical risks are negotiated to accommodate social expectations. Part of the text is devoted to the role of the driver's license as a form of social control, emphasising how various images of licensing convey different ideas about traffic safety.

Therefore, this research study emphasises that social expectations are operationalised through a systematic Input-Process-Output (IPO) cycle, which the current framework categorises as the 2P (MRTSA) 1T model. The cycle begins with the first "P," representing Pemerhatian (Observation), in which the driver serves as an input sensor primarily through vision. This stage is heavily influenced by human factor limitations, specifically categorised under the acronym PEL (Permisseble, Exposure, and Limit) in occupational safety and health, but in the sociological field, PEL was measured from PEL (Perception, Experience and Learning), which determines the accuracy with which a driver gathers data from the surrounding environment. The first stage of the driving cycle is the input sensor, primarily driven by human vision (Eyes). In this framework, the first "P" stands for Pemerhatian (Observation). The driver observes the Measured Variable (MV), the actual state of the road environment, and compares it against the Process Variable (PV). The driver’s cognitive process involves several interrelated variables, including goals, situational awareness, and external uncertainties. For example, a driver’s intention to reach a destination within a specific timeframe may influence risk-related decision-making processes (Marinova et al., 2022; Meng & Siren, 2012). Such cognitive variables interact with situational factors such as traffic congestion, adverse road conditions, accidents, aggression, or driving under the influence of alcohol or drugs (DUI). These factors collectively constitute significant hazards contributing to road traffic risk, as illustrated in Figure 2.10.

Based on the Process Assessment on MRTSA concepts of driving the second "P" represents Penilaian, the cognitive processing phase. During this stage, the driver's Cognitive Mind acts as the Set Point (SP), or the desired safe state. The core of this process is the MRTSA acronym: Maintain Room Towards Safety Action. The driver assesses the gap between the current environment (MV) and the safe goal (SP). The cognitive mind must constantly evaluate spatial "room" to ensure safety margins are maintained before moving to the execution phase. The output or action in the final stage, 1T, refers to Tindakan (The Behavioural Action Taken). This is the physical manifestation of the cognitive assessment. According to the illustration, this includes an action of braking and stopping to avoid hazards or manoeuvring the steering wheel to maintain lane position or change direction.

The illustration in Figure 2.10 further integrates control theory with cognitive and road user behaviour, including ergonomics, to explain the driver-vehicle interface. Based on the Control Loop, the system defines the Cognitive Mind as the controller. The driver monitors the difference between the Measured Variable (what is seen) and the Set Point (the desired safety standard). The Physical Interaction (Mo1), based on the points labelled Mo1, represents the ergonomic interaction between the driver and the vehicle's interior (the seat, steering wheel, and pedals). At such kinematics and movement, based on the numbered arrows (M1–M6), represent the multi-directional forces and movements a driver undergoes. These include vertical vibrations (M1), longitudinal movements (M2), and seat-back support (M3, M5, M6), all of which impact the driver's ability to process information and execute actions effectively.

Studies on human factors and cognitive behaviour in driving, both in Malaysia and internationally, have consistently emphasised the importance of understanding driver cognition in mitigating road risks (Khan et al., 2015). However, despite the growing body of research, the integration of cognitive restructuring principles into national driver education or legal enforcement remains limited. Current legislation, such as the Road Transport Act 1987, does not yet mandate cognitive-based training or rehabilitation programs for offenders, particularly those who are non-compliant or have repeated traffic violations.

Empirical evidence suggests that cognitive interventions can modify risky driving behaviours. A study by Papadakaki et al. (2020), titled Testing the Effectiveness of a Mixed-Method Pilot Intervention in Reducing Risky Driving Due to Aggression and Stress, conducted at the Laboratory of Health and Road Safety, School of Health Sciences, Hellenic Mediterranean University, demonstrated this relationship. Using a mixed-method approach involving driving simulators and stress-based driving scenarios, the study examined the effect of cognitive restructuring on aggressive and risky driving behaviours among 40 participants. The findings revealed measurable improvements in hazard perception, situational awareness, and road safety behaviour following the intervention, highlighting the importance of cognitive and behavioural training in enhancing driver safety performance.

2.9.1 Road Traffic Hazard

A road traffic hazard refers to any condition, situation, or object located on or near the roadway that has the potential to cause accidents, injuries, or damage to vehicles, pedestrians, or infrastructure. Such hazards may be natural, environmental, or human-made, and they collectively contribute to elevated risks within the road transport system (Henny et al., 2025; Venter, 2019). Effective hazard identification and mitigation, therefore, constitute fundamental components of road safety management, serving as preventive mechanisms to protect all categories of road users. By recognising and assessing potential hazards, both drivers and relevant authorities can implement preventive measures such as improved road design, appropriate signage, and strict enforcement to reduce the likelihood and severity of road crashes, thereby minimising injuries and fatalities.

Based on a comprehensive literature review encompassing academic articles, journals, and standards, hazard has been identified as the core element of a risk management system, particularly within the Road Traffic Safety Management System (RTSMS). To enhance understanding, Figure 2.18, in this study illustrates the detailed interaction between hazards and their associated risks in road traffic, demonstrating how these interactions can generate varying levels of danger that may compromise organisational productivity and road user safety. The figure conceptualises an interactive framework designed to break the chain of events that typically lead to road traffic accidents through improved cognitive understanding of the concept of hazard. In essence, a hazard is defined as a source with the potential to cause harm and is intrinsically related to the concept of danger.

The term danger, in turn, is a relative measure that can be quantified through variables such as concentration (Cn), duration of exposure (Tn), and spatial range (Dn) (Khan et al., 2015). Consequently, by identifying and managing hazards, organisations can proactively prevent accidents by aligning their practices with minimum safety, health, and environmental standards, including the Occupational Safety and Health Act 1994 (Act 514), the Factories and Machinery Act 1967 (Act 139), and the Environmental Quality Act 1974 (Act 127), as well as best practices outlined in the Industrial Code of Practice (ICOP) and the Occupational Health and Safety Management System (OHSMS).

The chronology of the Bhopal Disaster (1984), (Khan et al., 2015; Moran et al., 2010; Slaughter et al., 2014) provides a critical example of how inadequate hazard identification and risk management can lead to catastrophic consequences. The figure delineates the direct, indirect, and root causes that culminated in the release of methyl isocyanate (MIC) vapour, which formed a toxic cloud over Bhopal, resulting in widespread exposure and fatalities. This incident is used in the present study as a case example within the cognitive mind-map analysis to examine the psychological and cognitive dimensions of hazard perception and the failure of preventive systems.

2.9.2 Behaviour of Road Traffic Users

Road traffic behaviour encompasses the actions, attitudes, and conduct of all individuals engaged in road transportation activities, including drivers, pedestrians, cyclists, and passengers (Khan et al., 2015; Moran et al., 2010). It reflects how people interact in the traffic environment, particularly in terms of compliance with traffic regulations, adherence to safety practices, and alignment with social and cultural norms governing road use. Essentially, road traffic behaviour represents the collective manifestation of human responses within complex transportation systems, influenced by cognitive, environmental, and organisational factors.

According to ISO 39002:2002, unsafe road traffic behaviour refers to actions by road users that are inappropriate or hazardous, such as speeding, tailgating, weaving through traffic, and running red lights, all of which are significant contributors to road crashes. Distractions arising from secondary activities such as eating, drinking, smoking, texting, or making phone calls while driving further impair a driver’s focus and decision-making ability. Moreover, organisational pressures, such as expectations for employees to remain ‘reachable’ during commutes, can inadvertently promote unsafe driving behaviours by diverting attention from the primary driving task.

In addition, road users who are passengers in public transport systems have a responsibility to maintain safe conduct throughout their journey. This includes behaving appropriately while waiting at designated stops to minimise disruption to other road users, as well as boarding and alighting only at authorised locations. Passengers and pedestrians alike are expected to comply with traffic regulations, use designated crossings or pedestrian channels, and avoid obstructing traffic flow, thereby contributing to overall road safety and operational efficiency.

In essence, road traffic behaviour is an interdisciplinary construct that examines how individual attitudes, perceptions, and social conditioning influence actions on the road. It integrates psychological, sociological, and engineering perspectives to explain and predict human interaction within traffic systems (Lin, 2025; Roth, 2011). Promoting safer road behaviour through targeted interventions in education, enforcement, and engineering remains a fundamental strategy for reducing crashes and enhancing the overall safety performance of transportation networks.

2.9.3 Cognitive Mind of Road Traffic User

The definition of cognitive, based on findings by (Perestian Ares Sandi, 2025), which agreed with Albert Bandura’s Social Cognitive Theory (2004), human behaviour is influenced by reciprocal interactions between internal factors (knowledge), the environment, and behaviour itself. Thus, knowledge of road traffic rules and ethics constitutes an essential foundation for fostering orderly behaviour in public spaces such as road traffic areas.

The cognitive mind of a road traffic user encompasses the mental processes that enable individuals to perceive, interpret, evaluate, and respond effectively to stimuli within complex traffic environments. Enhancing cognitive awareness through education, training, and behavioural interventions is therefore crucial for cultivating safer driving practices and reducing accident rates. Cognitive skills and knowledge involve the acquisition and application of factual information that can often be measured or tested. As such, cognition is distinct from emotional, social, and creative development, although these dimensions interact dynamically to influence human behaviour on the road.

Cognitive science, a rapidly expanding interdisciplinary field, examines human perception, memory, reasoning, and learning. Developments in cognitive psychology throughout the twentieth century have greatly advanced understanding of how individuals perceive their surroundings, form memories, and engage in complex thought processes. These advances, enabled by technological progress and the contributions of numerous cognitive psychologists, have deepened our understanding of how neurophysiological activities underpin cognitive functions such as perception, information processing, and decision-making.

According to (Meng & Siren, 2012) in his research work, driving represents an intricate interplay of cognitive processes that engage perception, attention, learning, memory, decision-making, and motor control simultaneously. The arguments that understanding driving as a complex cognitive task provides a valuable framework for integrating laboratory-based findings with real-world applications. Through this integration, researchers gain deeper insight into how fundamental cognitive mechanisms combine to support performance in everyday activities, such as driving.

Further evidence from (Eyyam Ramadan et al., 2025; M. Miller Sally, 2015) underscores the role of cognitive and metacognitive processes in enhancing alertness and operational performance. The research explored optimal strategies for developing critical skills among operators in high-stakes environments (e.g., aviation), investigating whether training should replicate entire target tasks or focus on subcomponents. His findings indicate that resource training, targeting specific mental resources involved in a task, can improve performance when alternated with complex target tasks. This alternating design facilitates skill transfer by maintaining a high cognitive workload throughout training sessions. Interestingly, providing explicit metacognitive instructions about task similarities was found to be counterproductive, suggesting that implicit learning processes play a vital role in sustaining cognitive efficiency. Expert participants, such as experienced video game players, demonstrated sustained levels of critical workload and superior performance, highlighting how prolonged engagement in cognitively demanding activities enhances executive control and situational awareness, both of which are crucial attributes for safe driving behaviour.

Complementing this, Anstey et al. (2005), Eyyam Ramadan et al. (2025), and M. Miller Sally (2015) examined the influence of visual cognitive workload, eccentricity, and luminance on the detection of peripheral events, revealing that peripheral attention operates automatically and covertly. While increased workload typically reduces peripheral detection due to tunnel vision, certain peripheral events can still capture attention even under high cognitive load. Eye-tracking data showed participants maintained consistent focus on central tasks across all conditions, yet acknowledged nearly all peripheral events without direct gaze fixation. These findings underscore the significance of understanding cognitive load distribution and attentional resource allocation in driving contexts, where the simultaneous monitoring of central and peripheral stimuli is essential for hazard perception.

The relationship between hazards and hazard control can thus be conceptualised within a systematic framework that links cognitive performance to safety outcomes. Hazard identification and control involve structured processes for measuring and mitigating risks that pose potential harm to humans, machinery, and the environment. This framework provides a structured approach to breaking the causal chain of hazard escalation, preventing it from escalating into significant risks, incidents, or accidents. By integrating cognitive science principles with hazard management frameworks, organisations can enhance human reliability, optimise decision-making, and improve safety performance within road transport systems (Crundall et al., 2002; Marinova et al., 2022; Meng & Siren, 2012).

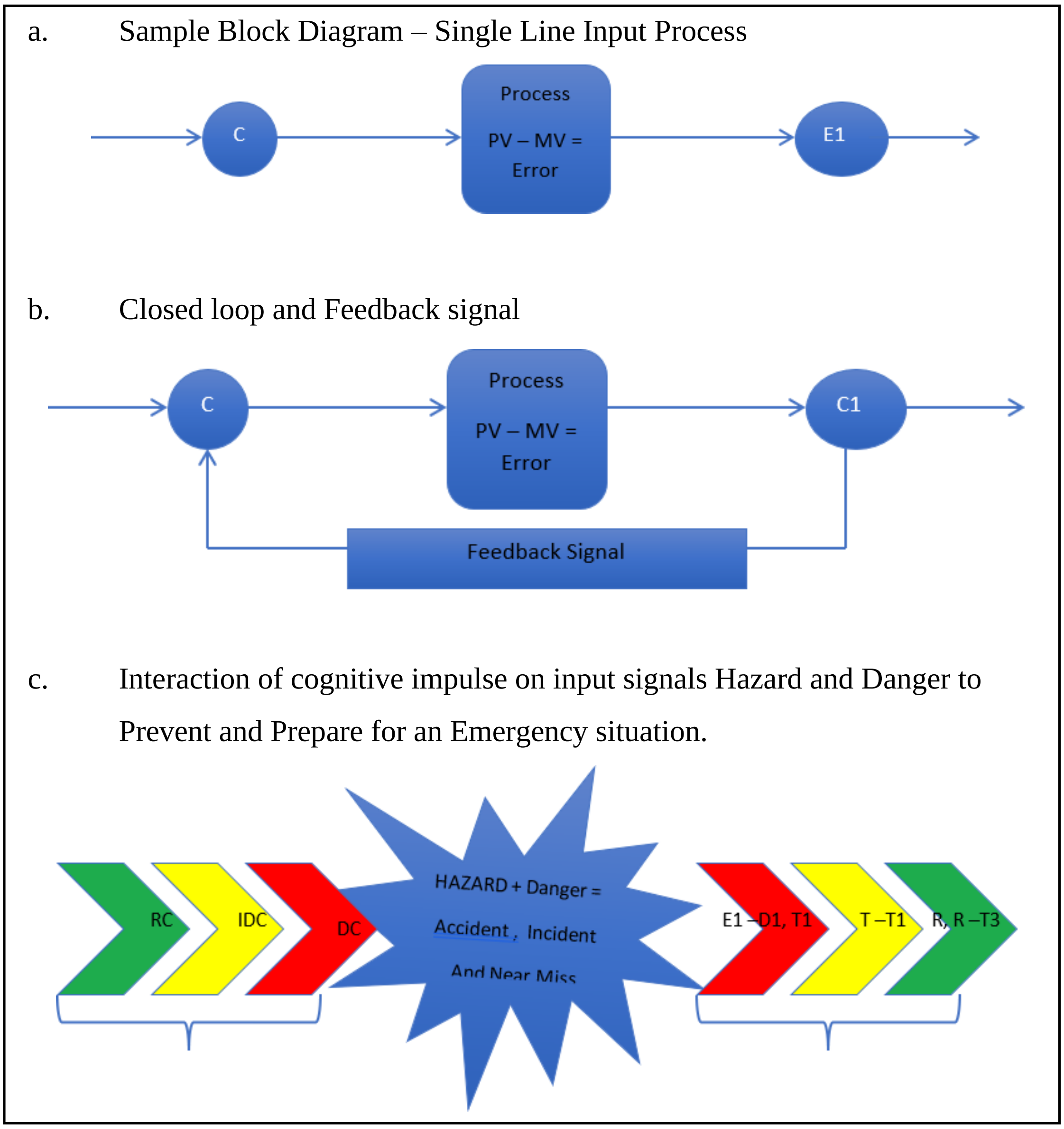


Figure 2.11 Single Loop Of Prevention

Intact cognitive abilities play a crucial role in driving performance, as they enable individuals to process multiple environmental cues simultaneously, making rapid, accurate, and safe driving decisions (Eyyam Ramadan et al., 2025; Marinova et al., 2022; Meng & Siren, 2012). Impairments in cognitive functioning, therefore, can adversely affect driving performance. Driving is an inherently complex activity that requires integrating diverse visual, motor, and cognitive skills. Empirical evidence indicates that crash rates and overall driving performance are influenced by a range of visual impairments (e.g., untreated cataracts, reduced visual acuity, diminished contrast sensitivity, and visual field loss), as well as medical conditions such as cardiovascular disease and diabetes. Furthermore, neurological disorders and the intentional consumption of drugs or alcohol beyond physiological tolerance levels can significantly impair metacognitive processing and decision-making while driving.

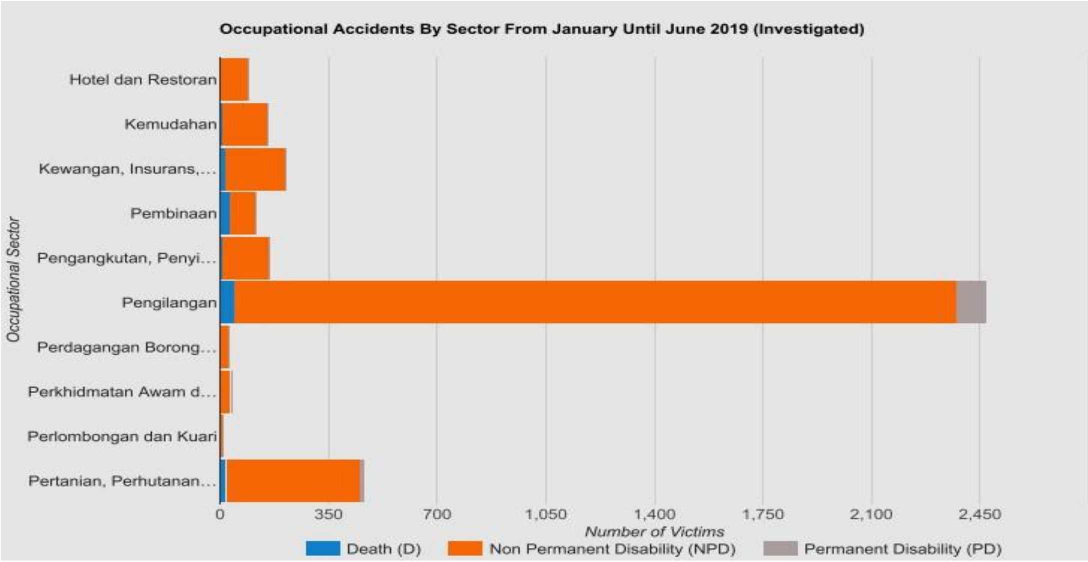
A study conducted in China found that, in rural Areas, the probability of traffic accidents increases as traffic safety consciousness decreases. The study revealed that demographic factors and driving skills contribute to variations in traffic safety consciousness, and that motor vehicle drivers were responsible for over 90% of traffic accidents in China. The authors recommended implementing a combination of enhanced traffic safety education and improved safety infrastructure to standardise traffic safety management and mitigate crash and fatality rates (Yu, 2025; Zhang et al., 2026).

A similar finding resulted from a comparative analysis of the fatality rates among vulnerable road users, such as pedestrians and two-wheel vehicle operators, in China and developed countries. The study concluded that elevated fatality rates in China are primarily associated with unsafe driver behaviour. In contrast, developed nations demonstrate stricter enforcement of traffic regulations, discouraging rule violations and risk-taking behaviour. The researcher established a direct correlation between traffic management practices, enforcement of regulations, and overall fatality rates, suggesting that stringent law enforcement could substantially reduce traffic-related deaths. However, the study acknowledged its limitations, as it did not account for other contributing variables, including traffic volume, infrastructure quality, and emergency response systems (Zhang et al., 2026).

The cognitive mind of a road user encompasses the mental processes involved in perceiving, interpreting, evaluating, and making decisions in traffic environments. It reflects how individuals process information, anticipate risks, and respond to dynamic stimuli while engaging in road transportation activities.

2.10 RTSMS Audit Finding Secondary Data RTSMS ISO 39001:2013 – KOSB Audit Finding.

The researcher selected a single case from the organisation's audit findings, namely Kotamas Oil Sdn., which is certified under the Road Traffic Safety Management System (RTSMS) ISO 39001:2013. Bhd. (KOSB), to examine best practices in transforming cognitive awareness and behavioural change toward road safety. KOSB, established in 2012, operates as a transporter company specialising in the distribution of oil and gas products, classified as dangerous goods (DG). Based on the audit results, one key issue among the five major findings was selected for a detailed improvement process and analysis. The detailed analysis of whether the audit evidence from the KOSB audit finding supported the three (3) objectives and three (3) hypotheses, H1, H2, and H3, within the research framework, will be discussed in Chapter 4. Before delving into the specific audit findings, it is essential to contextualise the safety performance of the Malaysian transport industry relative to European benchmarks. A comparative statistical analysis for the years 2019 and 2020, as presented in Figure 2.12 highlights a noticeable increase in workplace accidents in the service sector. This trend underscores the need to identify and address the underlying factors driving the significant increase in incidents in this sector.



SECTOR	PD	DEATH	NPD	TOTAL
Hotel and Restaurant		1	90	91
Utilities (Electricity, Gas, Water and Sanitary Service)	3	6	146	155
Finance, Insurance, Real Estate and Business Services	2	13	196	211
Construction	5	33	80	118
Transport, Storage and Communication	2	9	150	161
Manufacturing	98	43	2328	2469
Wholesale and Retail Trade			31	31
Public Services and Statutory Authorities	2	3	32	37
Mining and Quarrying	2	1	7	10
Agriculture, Forestry and Fishery	17	18	431	466
TOTAL	**131**	**127**	**3491**	**3749**

Figure 2.12 Accidents In The Industrial Sector

When examining the international and global landscape of occupational health and safety (OHS), statistics from the Bureau of Labour Statistics (BLS) and the Fifth European Working Conditions Survey (EWCS) offer significant insights into accident trends across various industrial sectors. In the United States, the BLS (2019) recorded the ten sectors with the highest numbers of workplace accidents. According to the BLS Survey of Occupational Injuries and Illnesses, job-related injuries are considerably more common than occupational illnesses. Moreover, occupations with the highest number of injuries typically overlap with those with the highest number of illnesses. Based on risk exposure and contributing factors across industrial sectors, the transportation and warehousing sector ranked fifth, underscoring a strong correlation with similar trends observed in Malaysia. Below is the list of the 10 most dangerous jobs. The first industry is health care and social assistance (544,800 workplace injuries and 32,700 workplace illnesses). The second industry in the row is retail trade (401,100 workplace injuries and 8,800 workplace illnesses). The third place is industry in manufacturing (395,300 workplace injuries and 35,000 workplace illnesses). The fourth place is the accommodation and food services industry (271,000 workplace injuries and 7,600 workplace illnesses). The Transportation and warehousing industry ranked as the fifth-largest industry in the world, contributing to global industry incidents (213,100 workplace injuries and 8,300 workplace illnesses). The sixth-largest industry contributing to the highest number of incidents is Construction (195,600 workplace injuries and 3,600 workplace illnesses). The number seven place most contributing to the world's incidents is wholesale trade (157,100 workplace injuries and 3,700 workplace illnesses). The number eight is administrative and waste services (112,800 workplace injuries and 5,800 workplace illnesses). Placing numbers nine and ten is other services (except public administration) (70,800 workplace injuries and 1,900 workplace illnesses), and professional and technical services (66,100 workplace injuries and 4,400 workplace illnesses)

Complementing these findings, data from the Fifth EWCS highlight the service sector's significant role in OHS risks. The diversity of sub-sectors within the service industry exposes employees to a wide range of working conditions and psychosocial hazards. The EWCS findings reveal that, despite differences across service industries, consistent patterns of psychosocial issues emerge, particularly those linked to customer interaction. Service industry employees are often required to maintain high standards of customer service, demonstrating politeness, attentiveness, and subordination to client expectations, which can result in psychological strain and vulnerability to harassment or abuse.

For instance, Guerrier and Adib describe cases where service workers faced punitive outcomes after responding defensively to harassment, reflecting managerial reluctance to challenge high-value customers. The EWCS further indicates that a significant proportion of service-sector employees report having to suppress their emotions to interact effectively with clients. Between 24 - 41% of men and 31 - 37% of women in the service sector reported emotional suppression, compared with 12 - 23% of men and 9 - 31% of women in non-service sectors. In addition, adverse social behaviours such as verbal abuse, unwanted sexual attention, threats, humiliation, and physical violence were more prevalent in the in-service sectors (14 - 29% of men; 16 - 22% of women) than the EU-27 average (14% men; 15% women). In particular, workers in transport (2.5%) and public administration (4.4%) reported higher incidences of workplace violence than the EU-27 average (1.9%). Bullying and harassment were also reported at higher rates in transport (5.6%), financial (4.3%), wholesale and retail (4.1%), and public administration (4.9%) sectors.

While these sectors share common psychosocial challenges, variations also exist in role clarity and career prospects. For example, 8.1% of financial workers reported uncertainty about work expectations, compared to 4.2 - 6.2% in other service sub-sectors such as transport, healthcare, and public administration. Similarly, perceived employability and career advancement opportunities varied widely from 22% in public administration to 42% in healthcare and 51% in financial services.

Among the ten sectors listed, transportation ranks as a major contributor to OHS-related incidents, particularly in terms of road traffic safety. Drawing on various scholarly works and RTSMS literature, this research begins its discussion of audit findings by focusing on the central focus of all management systems: hazard identification, hazard assessment, and hazard control as core mechanisms for managing road traffic risk. To develop a deeper understanding of HAZARD and HAZARD Control, Figure 5 presents a systematic approach to measuring and controlling risks that could harm humans, equipment, and the environment, thereby preventing productivity losses and accidents. The framework provides an analytical lens to "break the chain" of accident chronology by developing a cognitive understanding of HAZARD definition and risk pathways.

Drawing upon Heinrich's Accident Causation Framework (1931) and Reason's Model of System Safety (1997), road traffic accidents are understood as the consequence of identifiable and controllable hazards (Bliss et al., 2009; Jelani, 2019). Risks can be quantified using indices of severity and probability, and accidents can thus be prevented by addressing Direct Causes (DC), Indirect Causes (IDC), and Root Causes (RC) in accordance with the multi-causation theory. From a human factor's perspective, drivers and road users must remain cognitively FIT, that is, Flexible, Intense, and Timely, to mitigate behavioural risks, particularly when operating over long distances or extended durations. As identified in Figure 2.18, five key categories of hazards commonly affecting drivers and road users in the transportation service sector are psychosocial risk (Human Behaviour, Cognitive), ergonomic (body fatigue – prolonged driving), physical slip and falls from the tanker, vehicle condition or vehicle, FITness - Failure to conduct proper walkarounds and Road condition – Environment Changing conditions

The psychosocial risk category, particularly its link to cognitive distraction and human behaviour, is a critical factor in road safety. When driver attention decreases, the likelihood of accidents rises significantly. The Virginia Tech Transportation Institute reports that distracted drivers are nearly three times more likely to be involved in collisions than attentive drivers. Multitasking while driving, such as using mobile phones, conversing, or even engaging in internal thought, diverts attention from essential tasks like steering, monitoring speed, and hazard detection. Experienced drivers, though often confident, are prone to “autopilot” behaviour, reacting automatically without full cognitive awareness, which diminishes their ability to respond to sudden hazards.

Figure 2.13 illustrates the metacognitive process in which core beliefs influence driver cognition and behavioural response. Automatic thoughts derived from prior knowledge and experience shape intermediate beliefs, which in turn generate internal rules and attitudes, either aggressive or adaptive, leading to observable behaviour. These cognitive processes directly affect physical outcomes, such as fatigue from prolonged driving, which constitutes an ergonomic hazard. This will be discussed further in the subsequent Figure 2.14, focusing on ergonomic issues and body fatigue among transportation workers.

The impact of ergonomic hazards, such as prolonged driving-related fatigue, is among the most critical and hazardous conditions affecting drivers in the transportation sector. Although often dismissed as a manageable or routine experience, fatigue is far from a simple state of tiredness; it is a physiological and cognitive impairment that significantly compromises driving performance and safety. When fatigue sets in, drivers experience a marked decline in reaction time, situational awareness, attention span, and decision-making capacity. Physical exhaustion, combined with mental strain, leads to slower cognitive processing, reduced hazard perception, and an increased likelihood of driving errors.

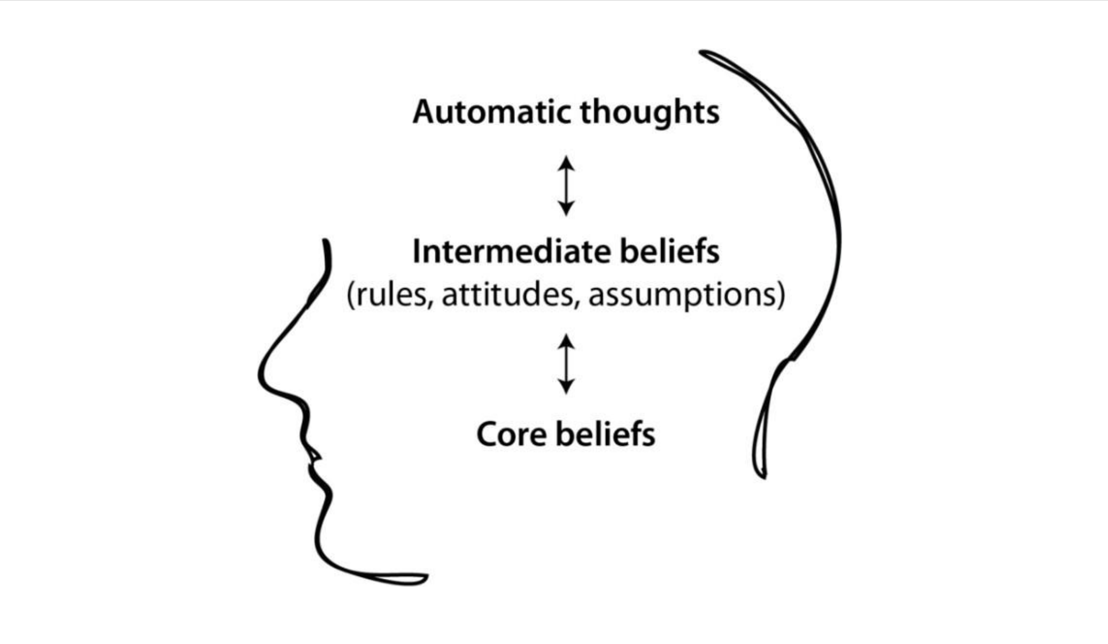


Figure 2.13 Illustration Of The Cognitive Driving Process

Fatigued drivers are also more prone to distraction, irritability, and emotional stress, which exacerbate unsafe driving behaviours such as inattention, lane deviation, and delayed braking responses (Di Milia et al., 2011; Kee et al., 2010a, 2010b). Empirical findings indicate that the effects of fatigue on psychomotor performance are comparable to those of alcohol impairment. According to WorkSafeBC (2019), remaining awake for 17 consecutive hours is equivalent to a Blood Alcohol Concentration (BAC) of 0.05, while 21 hours of wakefulness equates to a BAC of 0.08, the legal intoxication threshold in many North American jurisdictions. These findings highlight the severe cognitive and physiological deterioration associated with fatigue and its direct implications for road safety.

Addressing driver fatigue requires a systematic and multi-layered approach that integrates organisational, behavioural, and ergonomic interventions. Management's commitment is essential, as there are no simple, one-size-fits-all solutions to this problem. One effective strategy is implementing human factors safety training, which equips drivers with the cognitive tools and situational awareness needed to identify and mitigate unsafe mental states. Such training enhances drivers’ ability to regulate alertness, manage stress, and make sound decisions under prolonged operational conditions.

In parallel, organisational scheduling practices can be optimised to reduce fatigue by minimising extended driving hours, limiting overnight shifts, and ensuring sufficient rest intervals. However, while scheduling adjustments are beneficial, they cannot substitute the value of structured, classroom-based driver safety and cognitive awareness programs, which have proven effective in reducing accidents linked to fatigue and human error.

Figure 2.14 illustrates the physiological mechanisms of fatigue associated with prolonged sitting and continuous driving. This ergonomic hazard, interconnected with the psychosocial and cognitive risks discussed earlier in Figure 2.13, requires targeted mitigation measures through the Road Traffic Safety Management System (RTSMS) in accordance with MS ISO 39001:2013. The integration of ergonomic hazard management into RTSMS ensures that fatigue-related risks are systematically identified, monitored, and controlled, thereby reinforcing the organisation's commitment to continuous safety improvement.

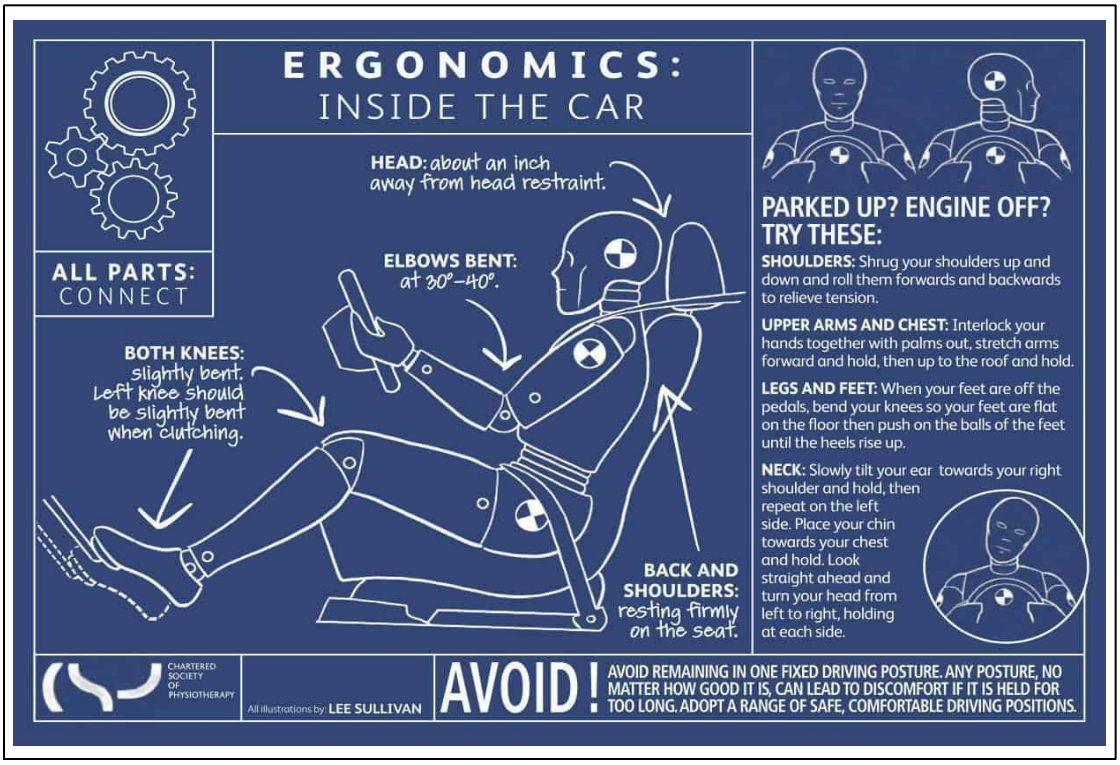


Figure 2.14 Ergonomic Hazard – Body Fatigue Due To Prolonged Driving

Physical hazards, particularly slips and falls, represent a significant safety concern within the road transportation industry. These incidents are especially prevalent during rainy seasons, when increased surface moisture from precipitation accumulates on roads, vehicle steps, and loading platforms, thereby elevating the risk of slips and loss of balance. Although considered routine activities, tasks such as entering or exiting vehicles remain among the most frequent contributors to occupational injuries in transportation operations.

Drivers are advised to employ the three-point contact method, maintaining two hands and one foot, or two feet and one hand in contact with the vehicle, to ensure stability when climbing into or descending from the vehicle. However, consistent application of this practice is often undermined by behavioural and environmental factors. For instance, time pressure, fatigue, or complacency may lead drivers to bypass established safety protocols. Even experienced drivers are not immune; familiarity with routine movements can foster overconfidence and reduced situational awareness, thereby increasing susceptibility to slips and falls.

Although modern transport fleets are commonly equipped with anti-slip steps, handrails, and textured surfaces, these engineering controls alone cannot eliminate the hazard. Slips, trips, and falls typically result from a combination of physical conditions and human factors such as haste, distraction, or diminished vigilance. This highlights the importance of adopting a comprehensive safety management approach that integrates both physical safeguards and behavioural reinforcement strategies.

Based on the most researchers the effective method for reinforcing safe behaviour is through toolbox talks and targeted safety briefings, which serve as continuous reminders of the risks associated with routine tasks. Regular communication sessions that focus on “slips and falls” not only refresh procedural memory but also promote a culture of mindfulness and accountability among drivers and maintenance personnel (Colling, 2010; Mustazar Mansur & Ho Shu Peng, 2009; Venter, 2019).

Within the Road Traffic Safety Management System (RTSMS) framework, as outlined in MS ISO 39001:2013, slips and falls are categorised as a physical hazard that requires systematic identification, risk assessment, and control. The implementation of preventive measures, such as surface maintenance, ergonomic vehicle design, and continuous safety education, helps mitigate physical injury risks and supports the organisation’s overarching objective of zero harm and continuous improvement in transport safety performance.

A vehicle hazard arises when a vehicle's condition or fitness for operation is compromised. Such hazards often result from a failure to conduct thorough pre-trip inspections, commonly referred to as "walk-arounds." Adverse weather conditions or time pressures may tempt drivers to rush through these inspections. However, walk-arounds are essential, as they allow drivers to identify potential hazards that could otherwise go unnoticed. While most trucking companies mandate walk-arounds, not all actively monitor compliance or provide the supervision and support necessary to cultivate consistent inspection habits. Positive reinforcement and fostering a culture of personal responsibility can encourage drivers to take pride in performing their duties safely and effectively. Consequently, drivers are more likely to assume greater responsibility for their vehicles, their own safety, and the well-being of their colleagues.

Figure 2.15 Physical Slip And Falls

Even when walk-arounds are performed, and potential issues are identified, practical constraints such as time, cost, or complacency may delay necessary repairs until the next trip, by which point the risks may have escalated (Yang et al., 2025). Deferred maintenance issues can also be easily overlooked if not properly documented or communicated. Implementing structured systems and checklists, with shared responsibility for completion and review, can help mitigate these risks.

Road hazards are often associated with changing environmental conditions. Failure to recognise alterations in road and weather conditions, such as sudden rainfall, reduced visibility, or elevated temperatures, can result from driver inattention or complacency (DigitalCommons et al., 2013; Islam Bin & Kanitpong, 2008; Jones et al., 2013; Mohan, 2025b). Drivers must adjust their behaviour in response to these changes, taking into account factors such as speed, following distance, braking distance, signalling, and lane positioning. Additionally, drivers should recognise when conditions necessitate pulling over or taking an alternative route.

Enhancing drivers' ability to respond effectively to evolving road conditions requires training them to detect and respond to environmental cues. Even minor changes, such as shifting light conditions, approaching clouds, or the setting sun, can serve as prompts for drivers to conduct quick vehicle checks and assess their personal state of alertness. Drivers should routinely ask themselves whether they are experiencing fatigue, exceeding speed limits, or need a break. Recognising environmental changes can also help drivers become aware of shifts in their own behaviour. For example, repeated contact with rumble strips may indicate inattention or fatigue, signalling the need to pull over before the risk of an accident escalates (Anlimah & Ackah, 2019; Gopalakrishnan, 2012; Mohan, 2025b).

Figure 2.16 Uncertainty Of Safe Roadworthy Design In Malaysian Road Condition

Therefore, based on the five (5) identified road traffic hazards, a clear relationship can be observed between these hazards and their impact on road traffic accidents. Among these, cognitive and behaviours of road user, ergonomic issues, specifically body fatigue resulting from prolonged driving, have been identified as contributing factors to psychosocial risks, particularly in terms of human behaviour and cognitive performance (Arif et al., 2025; Gopalakrishnan, 2012; Islam Bin & Kanitpong, 2008; Ma et al., 2012; Stoma et al., 2021). These issues have been selected for improvement through the implementation of the Road Traffic Safety Management System (RTSMS), in accordance with the RTSMS MS ISO 39001:2013 standards (Kravchenko et al., 2018; Stoma et al., 2021; Tor-Olav Naevestad et al., 2025)

For the purpose of gathering secondary data for this research, the researcher will use audit data from KOSB. KOSB is a transportation company specialising in oil and gas products, commonly classified as dangerous goods (DG). The company commenced operations in 2012 in collaboration with Petronas Dagangan Berhad (PDB) as part of PDB's transporter rationalisation program. KOSB was subsequently appointed as a transporter for Shell Timur Sdn. Bhd. in Sabah. As a wholly-owned Bumiputera enterprise incorporated as a private limited company on 3 February 2005, KOSB was established with the primary objective of providing efficient, fast, and hassle-free petroleum transportation services. To date, KOSB has expanded its transportation services to include biodiesel, condensate, and marine fuel oil (MFO) operations.

Figure 2.17 Corporate Information

KOSB operates by providing transportation services for its clients, delivering dangerous goods (DG) products. As a DG transporter, KOSB currently operates 47 road tankers transporting petroleum products, including petrol, diesel, marine fuel oil (MFO), Jet A1, bitumen, and LPG for PETRONAS Dagangan Berhad (PDB). The company holds approximately 70% of the market share in Sabah for biodiesel products from Genting Plantation Berhad, utilising six road tankers. For PETRONAS Carigali condensate distribution across Sabah, KOSB achieves 40% market utilisation with six tankers. Additionally, two tankers operate at full capacity in the Sepitang area, distributing petrol, diesel, and Jet A1 for SHELL Malaysia Timur. The remaining 31 road tankers serve Sabah and Labuan for GEOSB (GREEN Edible Oil Sdn. Bhd.), transporting biodiesel products with approximately 30% market utilisation, covering locations such as Sandakan, Tawau, Kota Kinabalu, and Labuan.

Within the transportation sector, road tanker safety and road traffic risks represent significant operational hazards. Based on KOSB’s operational processes, the most critical hazards involve the transportation of highly hazardous chemicals from collection centres to distribution centres, as described above. These hazards have been identified, analysed, assessed, and controlled using the HIRARC methodology (Hazard Identification, Risk Assessment, and Risk Control). Prolonged journeys exceeding 45 minutes pose ergonomic risks, primarily due to sustained static seating postures. Such postures can reduce drivers’ focus on the road, creating hazards for both drivers and other road users. The seating position, particularly when static, contributes to fatigue as the body is unable to maintain a relaxed and neutral posture.

Based on illustrates the connection between driver seating mechanisms and loss of focus, highlighting both ideal and commonly observed seating positions within truck cockpits. Analysis of body posture reveals that most lorry tankers lack headrests or ergonomic support, unlike designs show. The illustration demonstrates enhanced relaxation and body mechanics, with components such as Mo1 allowing greater adjustment for eye alignment, hand and steering positioning, and foot and pedal coordination. These adjustments mirror ergonomic principles applied in professional racing vehicle seating, which have been extensively studied and implemented by manufacturers to optimise driver comfort, posture, and performance.

Based on the Figure 2.18 illustrated the linkage between human sensory inputs, such as vision, hearing, and instinct, and the brain generates impulses that are processed to guide bodily responses. These cognitive and meta-cognitive processes influence human psychology, physiology, and anatomy, particularly in reaction to hazards and risks encountered on the road. The interaction of cognitive variables, such as anticipated arrival time at a destination, with unpredictable process variables, traffic congestion, road conditions, accidents, driver aggression, and driver impairment (due to drugs or alcohol) constitutes significant risk factors affecting road safety.

The study of cognitive processes in relation to human behaviour has been extensively researched both in Malaysia and internationally. Despite this, there remain gaps in the practical enforcement of training requirements under the Road Transport

Act 1987, particularly regarding cognitive restructuring for all road users. investigated the effectiveness of a mixed-method pilot intervention aimed at reducing risky driving associated with aggression and stress. Using a driving simulator and scenario-based training, the study involved 40 participants, of whom 30 demonstrated significant improvements in hazard monitoring, underscoring the potential of cognitive-focused interventions to enhance driver behaviour.

In this context, the Road Traffic Safety Management System (RTSMS) framework, aligned with ISO 39001:2013 and structured around the Plan-Do-Check-Act (PDCA) cycle, provides a systematic approach to addressing ergonomic risks such as body fatigue from prolonged driving, which can contribute to psychosocial risks, impaired cognitive function, road traffic accidents, and adverse health outcomes. The RTSMS framework embodies Deming's continuous improvement model (Deming, 1993) and aligns with Six Sigma principles to ensure effective and structured problem-solving (Jelani, 2019).

The theoretical underpinnings of RTSMS development have been proposed highlighting its role as a business improvement strategy to enhance operational efficiency, reduce costs, and exceed customer expectations (Diego & Lavillotti, 2013). In practice, the first step in implementing RTSMS is the "DEFINE" phase, where projects are selected based on their potential to address company issues and improve outcomes for customers, including financial savings (Mohan, 2025b). This aligns with the Voice of the Customer (VOC) principle, emphasising the identification of areas requiring improvement to meet customer expectations.

KOSB adopts a risk-based approach to management, applying structured frameworks from ISO management systems including ISO 45001 (Occupational Health and Safety), ISO 19600 (Compliance Management), and ISO 14001 (Environmental Management) to assess and control operational, managerial, and policy-related risks. Through the High-Level Structure (HLS), Clause 4, KOSB evaluates risks by considering the expectations of internal and external stakeholders. The risk maturity model illustrates how the organisation can achieve business optimisation by reducing risk, improving quality, enhancing revenue, and embedding a risk-aware culture into its organisational values. The overall project aims to improve ergonomic and cognitive-related risks, thereby enhancing driver safety, operational efficiency, and organisational performance.

Table 2.4
KOSB Summary RTSMS Hazard Analysis

Project Title	Ergonomic - Body fatigue due to Prolong Driving can cause Psychosocial risk – Human Behaviour, Cognitive and cause the road traffic accident and health illness to the driver
Background and reasons for selecting the project	High number of absenteeism and presenteeism due to OHS issue and high number of accidents when it relates with the long journey transportation and distribution by the tanker. It creates the negatively affects to organization’s image.
Project Goal	To eliminate the accident due to prolong driving and journey management to increase the 100% of the internal process control in journey management to all HQ and base by applying RTSMS into the distribution process.
Voice of the Customer (VOC)	Oil and Gas product distribution.
Team members:	Operation manager, Distribution Manager, Safety and Health Officer and RKP (Driver)
Expected Financial Benefits:	A considerable cost saving due to the no road traffic accident and no MC due to prolong driving.
Expected Customer Benefits:	Receiving the product with the expected quality, and time.

Sources: RTSMS Certification Audit Finding

A project summary is a tool used to document the objectives, scope, and parameters of a project at its outset. It provides a structured presentation of the project’s information, including the Voice of the Customer (VOC), goals, and the roles of the research team. The summary of this project is presented in the table above. In the RTSMS MS ISO 39001:2013 problem-solving methodology, the ‘Measure’ phase involves establishing reliable metrics to monitor progress toward project goals (Jelani, 2019; Kravchenko et al., 2018; Stoma et al., 2021) For this research, the metrics included reducing the number of hazards or risk registers, as well as minimising fatalities, lost-time injuries (LTI), and lost-time accidents (LTA) in the transportation process. Specifically, the ‘Measure’ phase required defining and selecting effective indicators to identify significant issues and root causes that needed to be addressed (Bliss & Breen, n.d.; Stoma et al., 2021).

KOSB utilised a series of indicators to compare the ‘before’ and ‘after’ states of the distribution and transportation processes during Six Sigma projects. Following the identification of the total number of consequences, the Sigma level of the process was calculated. For this study, the Kota Kinabalu distribution process was selected as the pilot project, which commenced in January 2019. Based on the analysis of recorded data, a combination of pie charts and Pareto analysis was used to identify the most frequently occurring defects and prioritise critical problems that require intervention. The data, illustrated in Chapter 4, indicate that the highest rate of accidents is attributable to ergonomic factors, specifically, body fatigue resulting from prolonged driving, which contributes to psychosocial risks affecting human behaviour and cognition. This factor alone accounted for over 25% of all recorded accidents.

The statistics further highlight that journey management practices, particularly regarding time spent on the road, were not adequately addressed under the ICOP 2010 Occupational Safety and Health Industry Code of Practice for Road Transport Activities. The ICOP 2010, enacted under Section 37 of the Occupational Safety and Health Act 1994 [Act 514], establishes legal obligations for drivers and employers. Specifically, Element 3 of ICOP 2010 mandates that employers control driver management, including adherence to element 3.5, which regulates driving and working hours. The Department of Safety and Health (DOSH) is empowered to enforce these limits to ensure driver safety.

Employers are required to implement driver management programs to maintain optimal safety, health, and environmental conditions. Sighted KOSB, implemented RTSMS ISO 39001:2013 in involvement of improving road traffic safety in journey management and hazard mapping along routes, with a focus on reducing ergonomic issues, fatigue, psychosocial risks, and associated traffic accidents or health complications (Jelani, 2019). This involves analysing data, identifying root causes, and determining strategies to close performance gaps between current operations and desired outcomes

Research has demonstrated that specific occupational groups are at greater risk of injury or illness due to psychosocial stressors. For example, found that younger and Hispanic workers, particularly those in service or transportation roles, were more likely to experience occupational injuries and assaults (Brandau et al., 2011; Lajunen et al., 2022; Ulleberg & Rundmo, 2002). Similarly, as an example in U.S. long-haul truck drivers (LHTDs) subjected to unrealistically tight delivery schedules exhibited unsafe driving behaviours and low compliance with safety regulations. Analysis of a national survey of 1,265 LHTDs revealed that drivers frequently pressured by tight schedules were more likely to exceed speed limits, violate safety regulations, continue driving despite fatigue or adverse conditions, and perceive their work as inadequately rewarded. Among eleven potential safety strategies, 95.4% of respondents indicated that building additional truck stops or rest areas would most improve driver safety.

In response, KOSB has implemented risk assessments considering prolonged driving due to the geographical challenges of Borneo and limited route accessibility. These assessments aim to control tight delivery schedules, determine appropriate driving hours, and identify suitable rest areas. One illustrative example involves the journey of a KOSB tanker driver, also known as a Rakan Perniagaan (RKP), from the Supply Point at Supply Base Sepanggar to a customer in Kudat. Covering a total distance of 167 kilometres, this journey typically requires four hours, as documented in the "Delivery Route Hazard Assessment Checklist." This risk assessment informs measures to mitigate ergonomic, psychosocial, and road safety risks along the route.

The primary strength of the RTSMS MS ISO 39001:2013 framework lies in the Control step. Despite extensive efforts by project teams to improve processes and outcomes, implementation of these improvements often faces challenges. Time pressures, insufficient focus on smooth transitions, and limited stakeholder buy-in can hinder the successful adoption of enhanced procedures, making it difficult to sustain the improvements achieved during the Improve phase. The purpose of the Control step is to ensure that the team's recommendations are effectively implemented and maintained, securing long-term success.

Once improvements are implemented, the revised processes are documented in flowcharts, and the new methods are adopted as standard operating procedures. Key performance factors and indicators, aligned with HSSE Performance 2020, are established to monitor the effectiveness of these initiatives. These include metrics such as total working hours per day, maximum driving hours per day, minimum rest hours per day, and journey risk management. The data collected from hazard mapping attached at reference 3, (refer attachment 3) illustrates the control process as applied by KOSB in the implementation of RTSMS MS ISO 39001:2013.

According to data from the Fifth European Working Conditions Survey (EWCS), the service sector significantly contributes to road traffic risks. In response, KOSB must manage these risks in accordance with stakeholder expectations, particularly regarding liability, to ensure the safety and health of workers and other interested parties, including clients. This is achieved through the implementation of improvement processes under the RTSMS MS ISO 39001:2013 framework, focusing on the enhancement of journey management systems.

For example, when KOSB transports petroleum products classified as highly hazardous chemicals due to their flammability, explosive potential, and high toxicity the company implements a comprehensive journey management plan. This includes identifying and assessing risks associated with each distribution route prior to dispatch. Effective risk management protects stakeholders and mitigates potential impacts, which could otherwise include lost business opportunities, reduced revenue, elevated accident rates (LTA and LTI), and reputational damage, as reflected in health and safety statistics.

2.11 Theory And Research Gap (Aze+ Concepts RTA Causation Theory)

The most significant contributor to road crashes is human error. While many of these errors are minor and quickly forgotten, their cumulative impact remains substantial. The relatively small immediate consequences of most human errors often lead to a lack of focused attention on the behaviour and cognition of road users.

Modern error theory posits that within complex systems; operator errors are not isolated incidents but the logical outcomes of systemic antecedents or precursors embedded within those systems. Earlier theories, however, tended to attribute errors primarily to individual failings, overlooking the critical role of system-level factors in influencing human behaviour and performance (Barry Strauch, 2017; Kyung et al., 2008; Stanley Murage San Diego, 2017).

In this context, the research gap identified in this study, summarised in Table 2.5 centres on the limited exploration of cognitive and behavioural change among road users in Malaysia. Specifically, there remains a lack of empirical research on how the implementation of the Road Traffic Safety Management System (RTSMS) in accordance with MS ISO 39001:2013 and ISO 39002:2002 can influence and improve the cognitive awareness, decision-making, and behavioural patterns of road users. Addressing this gap will provide a deeper understanding of how systematic approaches, such as RTSMS, can reduce human error and enhance overall road traffic safety performance.

Based on the Figure 2.2 this research is grounded in several established accident causation theories that form the foundation of the research framework and hypotheses. This Aze+ conceptual framework for Road Traffic Safety (RTS) adopts a multi-causational perspective to examine how cognitive human behaviour, specifically psychological triggers such as cognitive and behaviours (aggression, vengeance, and violence), serves as the primary driver of road incidents during the pre-event phase. By focusing on root, direct, and indirect causes, the framework integrates performance factors involving the road user, vehicle (VKT), and infrastructure (ISOF/FSOF) to establish the conditions under which an accident occurs. The central event is conceptualized as a failure to prevent physical or emotional contact between human, environmental, and mechanical variables, resulting in an accident, incident, or near miss. In the post-event phase, the framework addresses emergency management and trauma through the application of ISO 31010 and ISO 22320 standards, utilizing risk matrices to measure the severity and probability of disaster impacts over a temporal scale from to. This stage specifically accounts for contemporary hazards, such as the emergence of unskilled drivers post-MCO (Covid-19) and individuals exposed to "Vengeance Syndrome." Ultimately, the framework synthesizes human psychology with industrial safety standards and legislative mandates—such as the OSH Act and RTA to provide a holistic, integrated approach to understanding and managing road crashes as disasters.

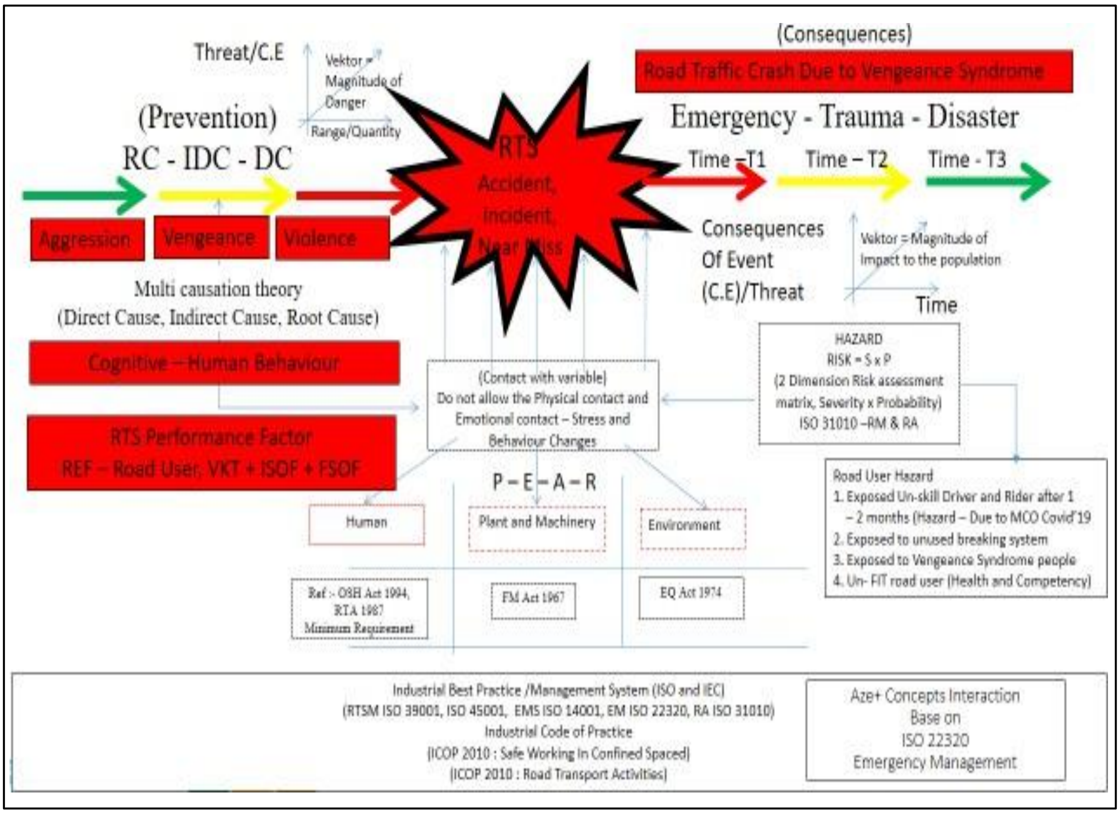


Figure 2.18 Aze+ Concepts RTA Causation And Control Framework Based On The Theory Related

The diagram presents a three-phase conceptual framework for Road Traffic Safety (RTS) that foregrounds a psychosocial construct I refer to as “Cognitive towards Behaviours (Vengeance Syndrome)” illustrating how such psychological factors interact with vehicle, human, and environmental elements to precipitate road incidents and their subsequent consequences. The framework is organized into the Pre-Event Phase (Prevention & Causation), the Event Phase (Accident/Incident/Near Miss), and the Post-Event Phase (Consequences & Emergency Management), with each phase embedding theoretical foundations, measurable performance factors, and policy-aligned standards to support prevention, rapid response, and disaster management.

In the Pre-Event Phase, Prevention & Causation, the model identifies behavioural triggers the Aggression, Vengeance, and Violence as primary threats that can precipitate road incidents when they manifest during driving. This phase adopts a multi-causation perspective, distinguishing direct, indirect, and root causes, while positioning Cognitive Human Behaviour as the core driver of risk-related decisions, including emotion- and motive-driven actions that disrupt safe driving norms. RTS performance is operationalized across three domains: the Road User (encompassing behaviour and risk perception), the Vehicle (captured by Vehicle Kilometres Travelled, VKT, as well as vehicle condition and safety features), and infrastructure (addressing safety standards, fault tolerance, and system reliability relevant to ISO/FSOF (risk performance factors) considerations). The integration of these elements supports a preventive orientation grounded in cognitive-behavioural theories of risk taking, empirical work on road rage and vengeance-related driving behaviours, and safety management system concepts that emphasize root-cause analysis and prevention. This phase thus sets the stage for understanding how psychological triggers interact with material and environmental factors to create conditions favourable to an RTS event.

In the Event Phase, the RTS Accident, the central “explosion” in the diagram represents the actual accident, incident, or near miss that arises when preventive controls fail to avert harmful contact among key variables. The event unfolds from a failure to prevent physical or emotional contact among Human, Plant/Machinery, and Environment elements, underscoring the interaction of driver state, vehicle/plant integrity, and road and environmental conditions. From an analytical standpoint, this phase is suited to systems thinking and human factors engineering, enabling causation analysis that traces how psychosocial triggers propagate through human–machine–environment interfaces to produce a damaging incident. The literature can draw on crash causation models, fault-tree analyses, and layered defence concepts to elucidate how triggers overcome safeguards and lead to loss of control, collision, or near-miss outcomes.

In the Post-Event Phase, Consequences & Emergency Management, the framework assesses outcomes through an Emergency–Trauma–Disaster lens, examining how impact evolves over time and how response capacity modulates consequences. Risk assessment within this phase employs ISO 31010 (risk assessment techniques) and ISO 22320 (emergency management) to characterize the magnitude of impact on populations, typically via severity and likelihood/probability matrices that guide prioritization of response and resource allocation. The model highlights context-specific hazards, such as unskilled drivers emerging after disruptions like COVID-19 lockdowns and populations exposed to Vengeance Syndrome, thereby emphasizing vulnerabilities that vary with time and circumstance as examples of the hazard of the process. Finally, the post-event phase connects RTS incidents to broader governance through standards-based risk management and disaster response, linking road safety incidents to legislative acts and organizational safety mandates. Taken together, the framework articulates a coherent chain in which cognitive and psychosocial factors drive driving behaviour, interact with vehicle and infrastructure conditions to produce an RTS event, and trigger emergency management and disaster-response processes governed by international standards and national acts.

Furthermore, in this chapter, the researcher provides a more detailed review of these theories and explains how each contributes to the conceptual basis of this study. One of the earliest and most influential theories in accident causation is Heinrich's Domino Theory (Manuele, 2011; Moore et al., 2020), presented in his seminal work Industrial Accident Prevention: A Scientific Approach. Heinrich, a pioneering occupational safety researcher, analysed large datasets collected by industrial employers through insurance companies. His study, which spanned more than a decade, identified key causal factors of industrial accidents, including unsafe acts by people (such as road users) and unsafe mechanical or physical conditions, including vehicle condition, road design, and road furniture.

Heinrich developed a sequential accident model that represented the chain of causation as a series of "dominoes" that topple one after another, symbolising the sequence of events leading to an accident. His model proposed that accidents result from a causal chain of events, and that removing one of the contributing factors in this sequence can interrupt the chain and prevent the accident from occurring. Over time, however, the idea of attributing workplace or road user behaviour to ancestry, personality, or ingrained personal faults was found to be overly simplistic. Modern interpretations of Heinrich's model have evolved to emphasise organisational, managerial, and systemic factors such as planning, leadership, and management control, which play a crucial role in accident prevention and safety performance.

Heinrich's theory posits that accidents arise from a sequence of interacting events that occur sequentially and linearly. Therefore, if one cause in the sequence is eliminated, the accident can be prevented. This assumption gave rise to the development of simple linear models, which view accidents as predictable outcomes of discrete, identifiable failures. Later developments introduced more complex linear models, which expanded on Heinrich's framework by recognising that accidents often arise from a combination of unsafe acts and latent conditions within the system. In these models, organisational and environmental factors are seen as upstream contributors, while human actions are the downstream and immediate causes. These models imply that strengthening barriers, defences, and safety systems can break the causal chain and prevent accidents

Contemporary researchers such as (Bird, n.d.; Safety Institute of Australia, 2012; Shahab Hosseinian & Jabbarani Torghabeh, 2012b) have argued that accident causation cannot always be explained through linear sequences. Real-world environments involve non-linear interactions among multiple variables, technological, human, and organisational, which interact dynamically. Therefore, accidents are not simply the result of one failure triggering another; instead, they result from complex interdependencies and mutual interactions within socio-technical systems. According to Surry (1969), early sequential models described accidents as a temporal sequence of events, decisions, and situations culminating in injury or damage. This concept forms the foundation of Heinrich’s Domino Theory, which posits that five sequential factors contribute to an accident: ancestry and social environment, the person's fault, an unsafe act or mechanical or physical hazard, the accident, and the injury.

Heinrich proposed that unsafe acts and mechanical hazards were the central factors in the chain, and that removing them could prevent accidents. Based on his actuarial analysis of 75,000 insurance claims, Heinrich concluded that 88% of preventable accidents were caused by unsafe acts of people, 10% by unsafe mechanical or physical conditions, and 2% were unpreventable due to unforeseen circumstances (Moore et al., 2020). These findings formed the foundation of his chart of direct and proximate causes, serving as a cornerstone of modern safety management thinking. The Domino Theory remains a key conceptual framework in occupational and road safety, offering valuable insight into how the interaction of human behaviour, mechanical conditions, and environmental factors leads to preventable incidents.

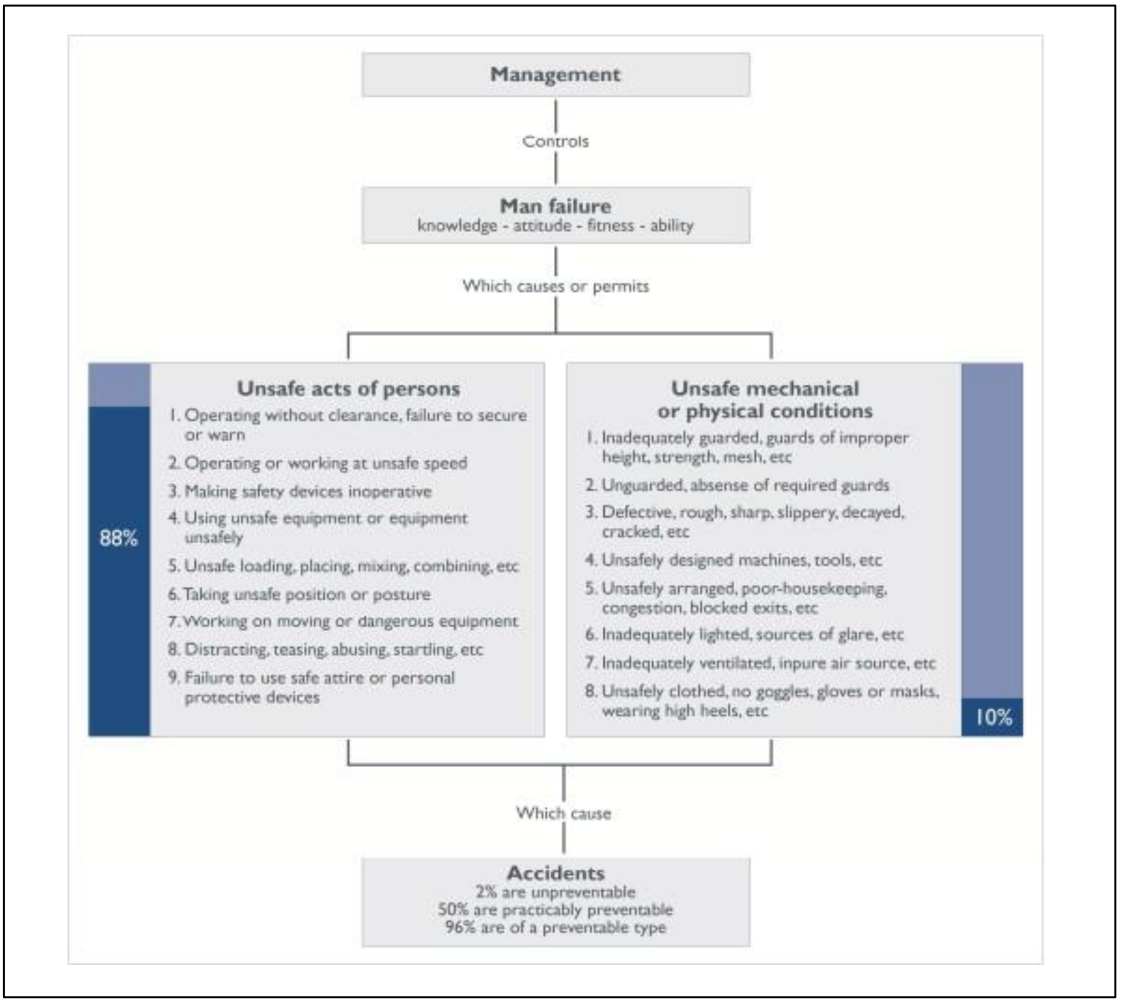


Figure 2.19 Accident Framework According To Heinrich (1931)

The study of sequential accident causation models was further advanced by Bird and Germain (1985), who built upon Heinrich's foundational Domino Theory. They acknowledged that Heinrich's model had significantly influenced safety thinking for more than three decades but noted that the industrial and organisational environments of the 1980s had become increasingly complex due to rapid technological advancements and evolving management systems. Recognising the limitations of Heinrich's model in explaining modern accident causation, Bird and Germain emphasised the crucial role of management in preventing and controlling accidents within such dynamic contexts. They introduced an updated framework known as the Loss Causation Model, which maintained the sequential representation of causes and effects but integrated a stronger focus on management's responsibility in accident prevention.

The Loss Causation Model, often depicted as a sequence of five interconnected dominoes, illustrates how accidents result from a chain of management system failures leading to loss events. These dominos typically represent lack of control, basic causes, immediate causes, incidents, and losses. Bird and Germain expanded the concept by incorporating arrows and feedback loops into the model, indicating the multi-linear and interactive nature of cause-and-effect relationships within an organisational safety system. This reflected their belief that accidents rarely stem from a single cause but rather from the interaction of multiple contributing factors such as technical, organisational, and human. Their model emphasised that effective safety management necessitates proactive control measures, a systematic identification of root causes, and the continuous improvement of safety processes. In essence, Bird and Germain's Loss Causation Model provided a more comprehensive and management-oriented approach to accident prevention, bridging the gap between human behaviour, system failures, and organisational responsibility in ensuring safety performance.

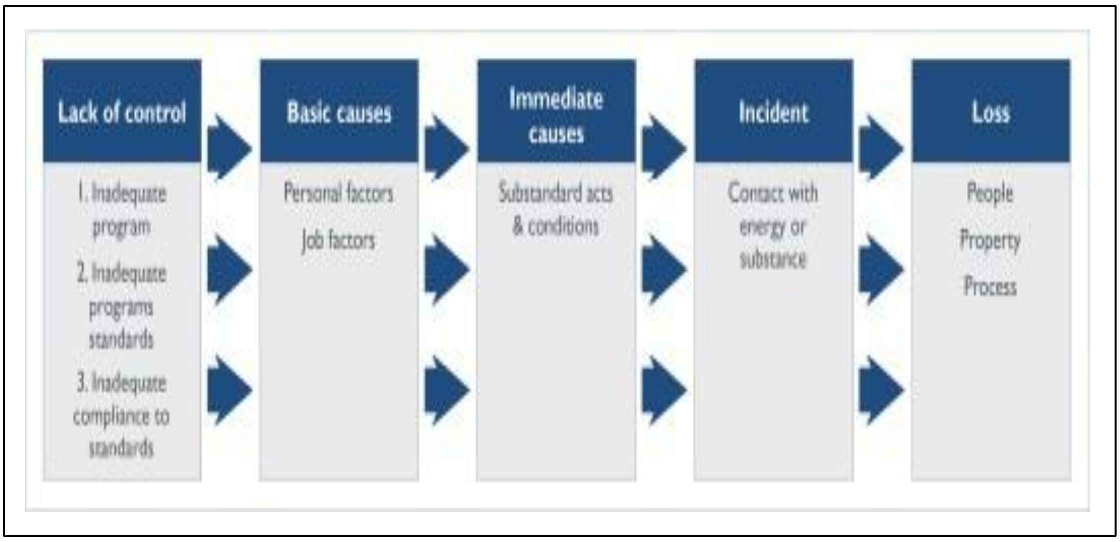


Figure 2.20 Loss Causation Model, Bird and Germaine, 1985

Sequential models gained prominence because they encouraged structured thinking about causal relationships in accident occurrence. These models are based on the premise that accidents follow a linear sequence of events where factor A leads to B, which subsequently leads to C, allowing researchers and practitioners to trace the progression from underlying causes to outcomes. Within this framework, accident prevention strategies are primarily aimed at identifying root causes and either eliminating them or introducing barriers to interrupt the causal chain. Although the foundational concepts of sequential accident models were developed earlier, the 1970s saw significant advancements that incorporated multiple interacting events within the linear sequence. Key developments during this period included the emergence of energy-damage models, time-sequence models, epidemiological models, and systemic models, each offering a more nuanced understanding of accident causation.

Systemic accident models, in particular, expanded the perspective by emphasising that system failures rather than solely human errors were often the predominant contributors to accidents (Barry Strauch, 2017; Di Milia et al., 2011; Islam Bin & Kanitpong, 2008). These models began addressing the complexity of accident causation by recognising that events occur within, and are influenced by, broader systemic environments. Parallel to this development, research into human error advanced the understanding of human contribution to accidents. The skill–rule–knowledge framework of human error, first proposed by Rasmussen and Jensen (1974), has become a foundational model for analysing how human behaviour and cognitive processes influence safety performance. Building on this, Rouse (1981) contributed to the study of human memory, particularly its coding, storage, and retrieval processes, which further enriched the cognitive perspective in safety research.

Cognitive science subsequently became central to accident research, with (Anstey et al., 2005; Gupta et al., 2018; Marinova et al., 2022; Mathias & Lucas, 2009) refining and popularising the distinctions between skill-based, rule-based, and knowledge-based behaviours in operational contexts. This conceptual triad remains integral to understanding human reliability and forms a core element of the theoretical foundation for this research, as outlined in subchapter 2.11. The detailed discussion of these theoretical underpinnings will be further elaborated in Chapter 2. As Benner (1984) aptly observed, "one element of realism was non-linearity models had to accommodate non-linear events". Therefore, a realistic accident model must integrate both sequential and concurrent non-linear processes and account for the dynamic interactions of events over time (see Figure 2.20).

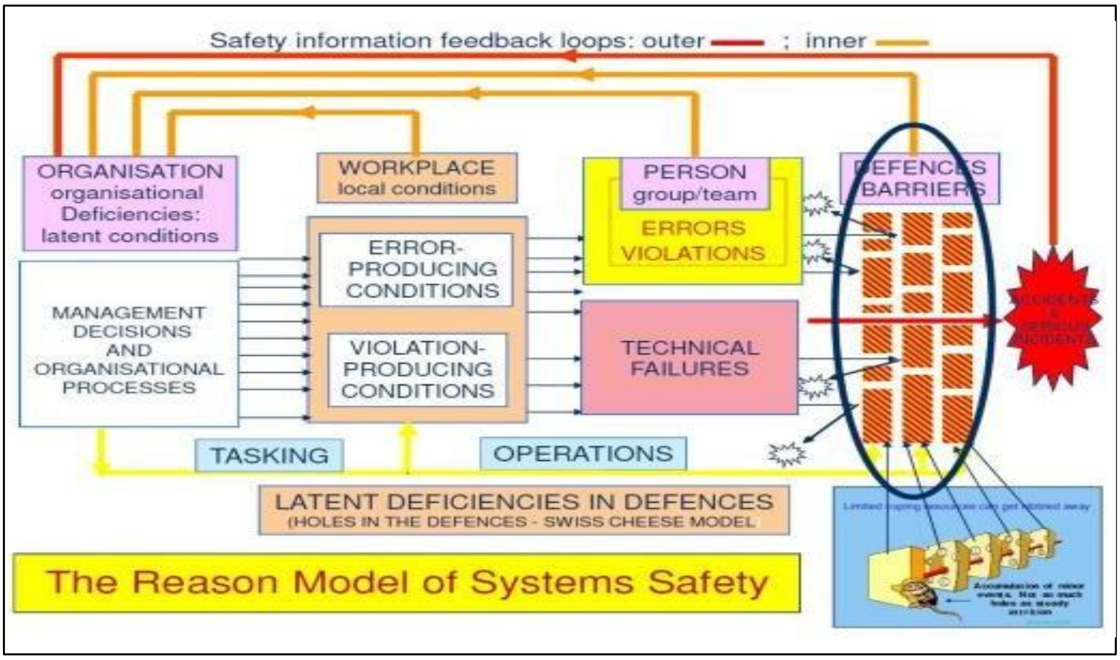


Figure 2.21 Reason Model of System Safety (Reason, 1997)

The Social Cognitive Theory (SCT), developed by Albert Bandura (1977), was later re-synthesised and expanded in his seminal work Social Foundations of Thought and Action, A Social Cognitive Theory (1986), which introduced the triadic reciprocal causation model. Bandura renamed his earlier framework to Social Cognitive Theory to highlight the central role of cognition in understanding, encoding, and performing human behaviours. According to SCT, human behaviour results from the dynamic and reciprocal interaction among three core determinants: personal factors (cognitive, affective, and biological events), behavioural patterns, and environmental influences (Eyyam Ramadan et al., 2025; Nabavi, 2011b).

Initially rooted in psychology, SCT has been widely applied and empirically tested across a range of fields, including health promotion, consumer behaviour, education, and physical activity. Its adaptability has made it a dominant framework for understanding behaviour modification and learning in social contexts. A more recent application of SCT, published in May 2011, examined its influence on public health and population behaviour in relation to global climate change, demonstrating the theory’s continued relevance to contemporary societal challenges.

Bandura further emphasised a paradigm shift from the disease model, which focuses on treating individuals with problems, to the health model, which promotes proactive well-being and resilience. Within this perspective, SCT provides a comprehensive foundation for fostering positive behavioural change and collective efficacy. Applied to the context of road traffic safety, SCT offers valuable insights into how cognitive processes, environmental conditions, and individual behaviours interact to shape safer road user practices and attitudes.

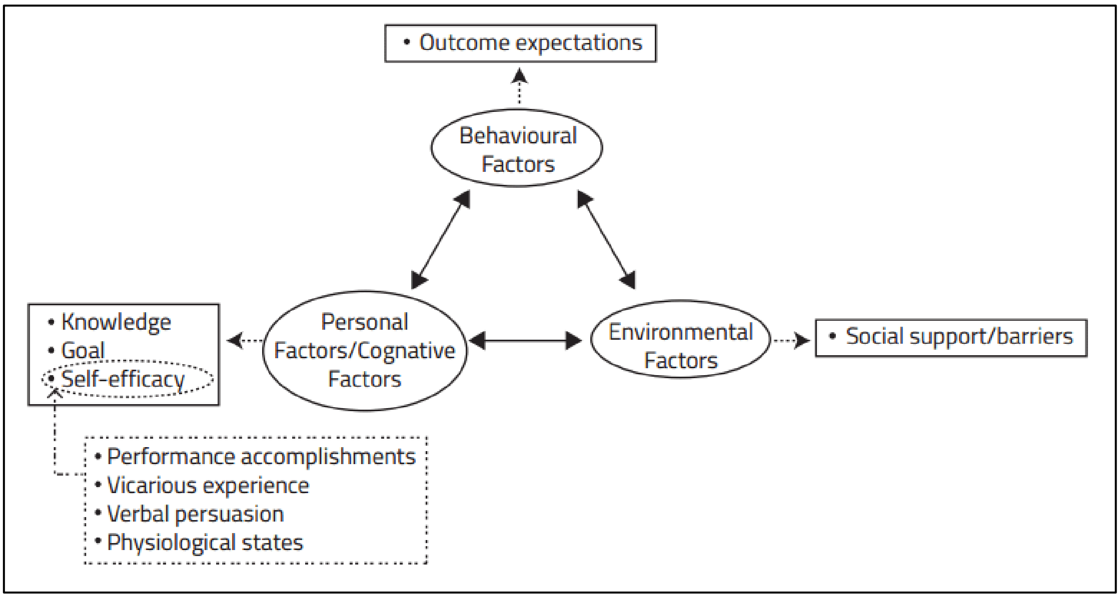


Figure 2.22 Social Cognitive Theory (SCT), by Albert Bandura (1970)

Referring to the illustration of triadic reciprocal causation in Figure 2.23, the Social Cognitive Theory (SCT) posits that learning occurs through the dynamic interaction between personal cognitive factors, behavioural patterns, and environmental influences. It is grounded in the assumption that the environment contributes to behaviour, while individual cognition, comprising beliefs, attitudes, and self-efficacy, shapes and regulates that behaviour. In the context of this study, road users learn by observing others, whereby their environment, behaviour, and cognition interact reciprocally to influence their development as safe or unsafe road users. Each individual's behavioural choice on the road reflects a personal assessment of risk, and over time, this transforms cognitive awareness, leading to improved attitudes and safer driving behaviour.

The core concept of SCT in this research is the interaction among three variables personal (driver cognition), behavioural (driver behaviour), and environmental implementation of Road Traffic Safety Management Systems, RTSMS, as specified in ISO 39001:2013 within organisational settings. This triadic framework encapsulates how both internal and external factors shape safety-related learning and behavioural change. As Bandura (1977) highlighted, learning occurs through both direct experience and observational learning. Individuals are not merely products of their environment; rather, a continuous interplay exists in which personal cognition, behavioural responses, and environmental factors mutually influence one another. The triadic causation model illustrates that the reproduction of observed behaviour is strongly influenced by an individual's belief in their own capability (competency and level of awareness) to perform the behaviour successfully, a construct referred to as self-efficacy.

To deepen the understanding of the research framework and the hypotheses of this study, it is essential to further define the concept of behavioural response. In this context, behaviour refers to the observable actions or reactions of an individual following exposure to environmental stimuli or learning experiences. For instance, a learner's opportunity to practice and successfully perform safe driving behaviours reinforces their learning outcome through positive feedback. Within the environmental dimension of this study, factors such as road conditions, design, structure, and road furniture represent external elements that influence an individual's ability to perform safely. Hence, a supportive, well-structured road environment enhances self-efficacy and facilitates the adoption of safer road user behaviours by improving awareness, capability, and confidence.

Table 2.5
List of Research Publication

Tittle	Authors	Years	Findings
Accidents Causation Theory	Henrich	(1931,1941)	The research discusses the confusion between the potential of risk assessment and risk management, and how to apply them to achieve the greatest impact within the organisation.
Freud's theory	Freud	(1931,1941)	This research examines the effect of driver attitude on psychological and spiritual factors, which influence driving behaviour and reduce the number of road traffic accidents.
Cognitive and motor errors	Norman	(1981, 1988)	Research on ISO certification could be used by an organisation to improve workmanship performance by improving workmanship factors.
Three levels of operator performance and three types of associated errors: skill, knowledge, and rule-based.	Jens Rasmussen	(1983)	The states of research have identified six potential factors that play an important role in decreasing traffic fatalities, either directly or indirectly.
The distinguished Slips, Lapses, Mistakes and Violations.	James Reason	(1990)	The research involved cognitive testing and cognitive restructuring using a driving simulator and scenarios (stress, aggression and risk)
Social Cognitive Theory	Albert Bandura	1977	The research is about testing the basic assessment of DBQ by reporting the descriptive findings, reliability as well as developing the factor model of the instrument.

Tittle	Authors	Years	Findings
Risk Management and Governance Concepts	Terjen Aven and Ortwin Renn	(2010),	The research discusses the confusion between the potential of risk assessment and risk management, and how to apply them to achieve the greatest impact within the organisation.
Structural Equation Modelling in Road Safety Behaviour Integration with Psychological and Spiritual Factors	Mohd Tarmizi Mohamad Ghous	2019	This research examines the effect of driver attitude on psychological and spiritual factors; these factors influence driving behaviour and reduce the number of road traffic accidents.
The Effects of ISO Certification on an Organization Workmanship Performance	Joseph Iwaro & Abrahams Mwasha	2012	Research on ISO certification could be used by an organization to improve workmanship performance by improving workmanship factors.
Identification of factors contributing to traffic fatalities in the United States	Dharminder Kaur	2015	The states of research have identified 6 potential factors that played an important role in reducing traffic fatalities, directly or indirectly.
Testing the Effectiveness of a Mixed-Method Pilot Intervention in Reducing Risky Driving Due to Aggression and Stress	Maria Papadakaki, Nikolaos Stamou, Stefanos Bessas, Stavroula Liolius and Jooannes Chliaoutakis	14th February 2020	The research involved cognitive testing and cognitive restructuring using a driving simulator and scenarios (stress, aggression and risk)

Tittle	Authors	Years	Findings
Testing the Driving Behaviour Questionnaire (DBQ) on Malaysian Drivers	Nur Shazwani Rosli, Jasmani Mohd Yunus, Suhaila Abdul Hanan	2017	The research tests the basic DBQ assessment by reporting descriptive findings and reliability, and by developing the instrument's factor model.
Managing the human error: A cognitive systems approach to safety.	Reason, J. (1997).	1997	Argues that accidents arise from latent conditions in systems; emphasises the design of resilient organisations and safety systems.
Safety culture and road traffic safety in corporate settings: A cross-sectional study.	Gibbons, J., et al. (2017).	2017	Demonstrates that formal safety processes and leadership commitment reduce RTS risk through shared norms.

2.12 Research Framework

According to Creswell, a conceptual framework serves as an argument that establishes the importance of a study and demonstrates the appropriateness of the research through a systematic and controlled process (Creswell John W & Creswell J. David, 2018). Supporting this view, it is asserted that the perspective is remarkably accurate, as a conceptual framework not only guides the formulation of research questions but also helps develop hypotheses, collect and analyse data, and interpret research findings. A conceptual framework is described as a graphical or narrative representation that outlines the key constructs or variables and their interrelationships. These relationships are explained in a manner that is theory-driven, descriptive, and relational, providing a clear understanding of the study's direction by (Creswell John W & Creswell J. David, 2018; Marinova et al., 2022; Planek et al., 2015)

Based on the variables identified in the theoretical review and findings of previous research, the conceptual framework model for this study is presented in Figure 2.3. This model consists of three variables: two dependent variables, cognitive change and behavioural change, and one independent variable, the ISO 39001:2013 Road Traffic Safety Management System (RTSMS). The selection of these variables is grounded in the premise that the implementation of ISO 39001:2013 within an organisation can significantly influence road users' cognitive processes and behavioural adaptations.

The development of this conceptual framework is informed by several theoretical foundations, including Heinrich's Multi-Causation Theory, the Loss Causation Model by Bird and Germain (1985), the Reason Model of System Safety (Reason, 1997), and Bandura's Social Cognitive Theory (1977). Collectively, these theories support the notion that systematic management interventions such as the application of RTSMS ISO 39001:2013 can initiate cognitive transformation in road users, which subsequently leads to behavioural modification, thereby enhancing road safety performance.

Furthermore, this study's conceptual framework is designed based on the theoretical principles of road traffic accident prevention, industrial safety and health risk control, and human factor management. It emphasises the interaction between organisational safety systems and individual psychological responses. To measure these relationships, this study employs the Driver Behaviour Questionnaire (DBQ) and the Driver Behaviour Inventory (DBI) (Martinussen et al., 2013), to assess cognitive and behavioural changes among individuals following the implementation of RTSMS ISO 39001:2013 within organisations such as NIOSH Malaysia.

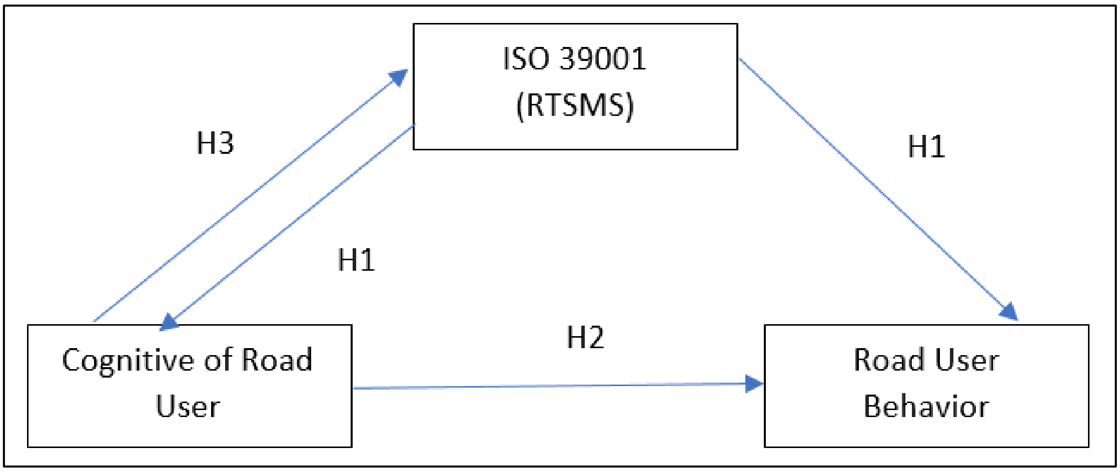


Figure 2.23 The Research Framework and Hypothesis

As illustrated in the conceptual framework, the study examines the dual influence of organizational systems and human psychology on road safety. Hypothesis H1and H3 focus on the efficacy of ISO 39001 in shaping the Cognitive of the Road User, while Hypothesis H2, addresses the direct relationship between the user’s mental state and their resulting Road User Behaviour. By analysing these pathways, the research identifies how negative cognitive implications with such as Vengeance Syndrome serving as a primary example can be systematically managed to produce a positive Behavioural Impact and reduce traffic accidents.

2.13 Research Hypothesis

According to several researcher to evaluate the significance of each research question, scholars often express it in the form of a hypothesis. A hypothesis represents a tentative and testable explanation that predicts the existence of a relationship or difference between two or more variables (Chen et al., 2009; Rashidirad et al., 2013). In line with this, emphasises that hypotheses serve as directional statements derived from research objectives and questions, guiding the analytical process and interpretation of findings. Building upon these scholarly perspectives, this study formulates its hypotheses based on issues related to road traffic accidents, changes in cognitive mindset and behavioural patterns among road users, and the effectiveness of implementing the Road Traffic Safety Management System (RTSMS) standards, ISO 39001:2013 and ISO 39002:2002, in mitigating road traffic risks. The data gathered from NIOSH Malaysia (Headquarters and Regional Offices), and audit findings data from KOTAMAS Sdn. Bhd., as well as gaps from insights journalists, scholars, and researchers in the field of occupational safety and road transport, ISO management system, road traffic safety, cognitive, behaviour, RTSMS ISO 39001 to support the formulation of these hypotheses.

In scientific research, a hypothesis functions as a tool to verify whether a proposed relationship between variables exists. The null hypothesis (H_0) represents a statement that assumes no significant relationship or effect between the variables, whereas the alternative hypothesis (H_a) suggests that a significant relationship or effect exists (Chen et al., 2009). In the context of this study, the initial null hypothesis (H_0) posits that the implementation of RTSMS ISO 39001:2013 does not significantly influence cognitive and behavioural changes among road users within organisations and therefore does not contribute to reducing road traffic crashes in Malaysia. Conversely, the alternative hypothesis (H_a) asserts that the application and experience of RTSMS ISO 39001:2013 within organisations significantly enhance road users' cognitive awareness and behavioural discipline, thereby improving overall road safety outcomes. The testing and acceptance or rejection of these hypotheses will be based on empirical data obtained through survey responses, which will be analysed statistically to determine the strength and significance of the relationships between variables (Rashidirad et al., 2013).

The general model of the research hypothesis can be expressed as $Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$, where Y represents road traffic accident reduction as the dependent variable, X_1 represents cognitive change of road users, X_2 represents behavioural change of road users, and X_3 represents the implementation of RTSMS ISO 39001:2013. The constant α reflects the intercept, β_1, β_2, and β_3 indicate the strength and direction of relationships, while ε denotes the error term. This model reflects the assumption that improvements in cognitive understanding and behavioural attitudes among road users, influenced by the implementation of RTSMS ISO 39001:2013 and ISO 39002:2002, will collectively contribute to reducing the number of road traffic accidents in Malaysia.

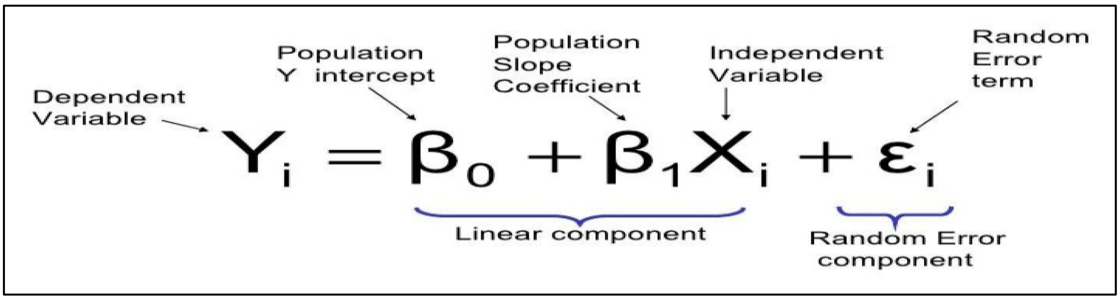


Figure 2.24 The General Model Of The Research Hypothesis

Therefore, researcher has established three (3) hypotheses (H1, H2 and H3) whether to reject or accept on the assuming from the research framework. Among the hypotheses proposed for this study are as follows:

H1: RTSMS ISO 39001:2013 (X_1) have a significant influence on cognitive of road user and behaver of road user (Y)

The basic equation of multiple linear regression is as follows:

$Y = ß_0 + ß_1X_1 + ßkXk$

Y = Dependent variable

X_1 = Independent variable

ß = Parameter to be estimated

H2: Cognitive of road user (X2) have a significant influence on Behaviour of road user (Y)

The basic equation of multiple linear regression is as follows:

$Y = ß_0 + ß_1X_1 + ß_2X_2 + ßkXk$

Y = Dependent variable

X_2 = Independent variable

ß = Parameter to be estimated

H3: Cognitive road user (X3) has a significant influence on implementation, of RTSMS ISO 39001:2013 (Y).

The basic equation of multiple linear regression is as follows:

$Y = ß_0 + ß_1X_1 + ß_2X_2 + ß_3X_3 + ßkXk$

Y = Dependent variable

X_3 = Independent variable

ß = Parameter to be estimated

First Hypothesis - $\mathbf{H_1}$

$\mathbf{H_0}$: The implementation of the Road Traffic Safety Management System (RTSMS) MS ISO 39001:2013 will not change road users' cognition or behaviour within the organisation implementing ISO 39001.

$\mathbf{H_A}$: Implementation of the Road Traffic Safety Management System (RTSMS) MS ISO 39001:2013 has a significant impact on road user cognitive driving behaviour within the organisation implementing ISO 39001:2013.

Second Hypothesis - $\mathbf{H_2}$

$\mathbf{H_0}$: Change in the cognition of road users does not give a significant change to the road user behaviour.

$\mathbf{H_A}$: Changing the cognition of road users will lead to significant changes in road user behaviour.

Third Hypothesis – $\mathbf{H_3}$

$\mathbf{H_0}$: Change the cognition of road users towards the implementation of the Road Traffic Safety Management System (RTSMS). MS ISO 39001:2013 do not change the road user behaviour.

$\mathbf{H_A}$: Changing the cognition of road users will significantly influence the Road Traffic Safety Management System (RTSMS), ISO 39001:2013, and will significantly change road user behaviour.

2.14 Summary

The rate of road traffic crashes has continued to rise each year, with statistical data from 1997 to 2018 showing a nearly 40% increase, from 215,632 reported cases to 548,598. However, despite this increase in total crashes, the number of fatalities and serious injuries has shown a gradual declining trend. The literature reviewed in this chapter has drawn upon multiple data sources, and these findings will be further corroborated and integrated into Chapter 3 of this thesis. The analysis conducted aims to identify the key factors contributing to road traffic crashes, including road user behaviour, infrastructure conditions, emergency response and trauma care capabilities, policy enforcement, socioeconomic and demographic influences, system operation and management efficiency, and vehicle safety advancements.

Based on the comparative analysis, it can be concluded that further research is needed on prevention methods to reduce the number of road traffic crashes by implementing the Road Traffic Safety Management System (RTSMS) within organisations, alongside efforts to reshape and reconstruct the cognitive mindset and behavioural patterns of road users. In conclusion, this chapter has outlined the importance of cognitive and behavioural changes among road users, particularly within NIOSH Malaysia (Headquarters and Regional Offices), in reducing road and traffic accident rates through the application of RTSMS ISO 39001:2013. Additionally, two dominant theoretical frameworks, the Social Cognitive Theory (SCT) and the Multi-Causation Theory (MCT), have been discussed and further supported by the Loss Causation Model (Bird & Germain, 1985) and the Reason Model of System Safety (Reason, 1997) (Manuele, 2011; Moore et al., 2020; Nabavi, 2011a; Pakpahan & Saragih, 2022; Shahab Hosseinian & Jabbarani Torghabeh, 2012b).

The integration of these theories establishes a solid foundation for understanding how cognitive restructuring and behavioural modification can impact road safety outcomes. Moreover, critical reflections and insights from previous studies, both local and international, have provided valuable epistemological guidance in identifying research problems and recognising gaps in existing knowledge. Ultimately, the review of past research has enabled the formulation of a more informed and theory-driven approach, serving as a foundation for the next phase of this study. This chapter situates the study within the broader literature on RTSMS ISO 39001:2013, cognitive psychology, human behaviour, and occupational safety within Malaysian institutional contexts. It has established a coherent theoretical and methodological foundation that informs Chapter 3, detailing the research design, population, instruments, and analysis procedures necessary to examine how RTSMS implementation relates to cognitive and behavioural changes among institutional road users at NIOSH Malaysia.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Introduction

The researcher conducted a series of rigorous and systematic screening processes at the initial stage of this study to ensure that the research outcomes align with the intended objectives (Creswell John W & Creswell J. David, 2018). These preliminary steps were essential in preparing for subsequent field research activities, including data collection and analysis. As elaborated in Chapter 2, the researcher reviewed and synthesised previous studies to establish a structured and systematic methodological foundation. This process also supported the formulation and testing of three (3) hypotheses that constitute the core framework of this study.

This chapter presents the overall research methodology adopted in this study. The methodological framework encompasses several key components: survey design, evaluation, implementation, development, and comparison of results before and after the implementation of the Road Traffic Safety Management System (RTSMS). The RTSMS includes activities related to road safety impact assessment, road safety audit, and road safety inspections conducted at the National Institute of Occupational Safety and Health (NIOSH) Malaysia, as referenced in this chapter.

The researcher undertook a comprehensive literature review to identify relevant predictors of increases or decreases in road traffic crashes. Based on this analysis, the researcher formulated several research questions to investigate whether these predictors have a positive or significant negative impact on the cognitive and behavioural aspects of RTSMS, as well as their influence on road traffic accident risks. The survey instrument incorporates elements from the well-established Driver Behaviour Questionnaire (DBQ) and Driver Interaction Survey (DIS) to measure cognitive and behavioural dimensions (Harrison, 2009; Kyung et al., 2008; Martinussen et al., 2013, 2014; Özkan et al., 2006; Shazwani Rosli et al., 2017a).

The finalised survey instrument was reviewed and approved by the Research Ethics Committee at Universiti Teknologi MARA (UiTM) and by peer reviewers from the Malaysian Road Transport Safety Association (MRTSA), the Malaysian Institute of

Road Safety Research (MIROS), NIOSH Malaysia, and Kotamas Sdn. Bhd. The approved questionnaire was distributed electronically to 30% of the identified respondents within the organisation via Google Forms. This respondent group included individuals representing three organisational levels: first, drivers and operational staff; second, managerial staff; and third, top management or policymakers, each comprising approximately 30% of the total sample.

3.2 Research Framework

The researcher collected data from a total of fifty-seven (57) respondents. The collected responses were quantitatively analysed using descriptive and inferential statistical methods. The Likert scale (1-7) was employed to measure participants' attitudes and perceptions. Additionally, the researcher conducted focus group discussions to supplement the survey findings, structured according to the organisation’s three-layer risk framework: operational, managerial, and strategic risks.

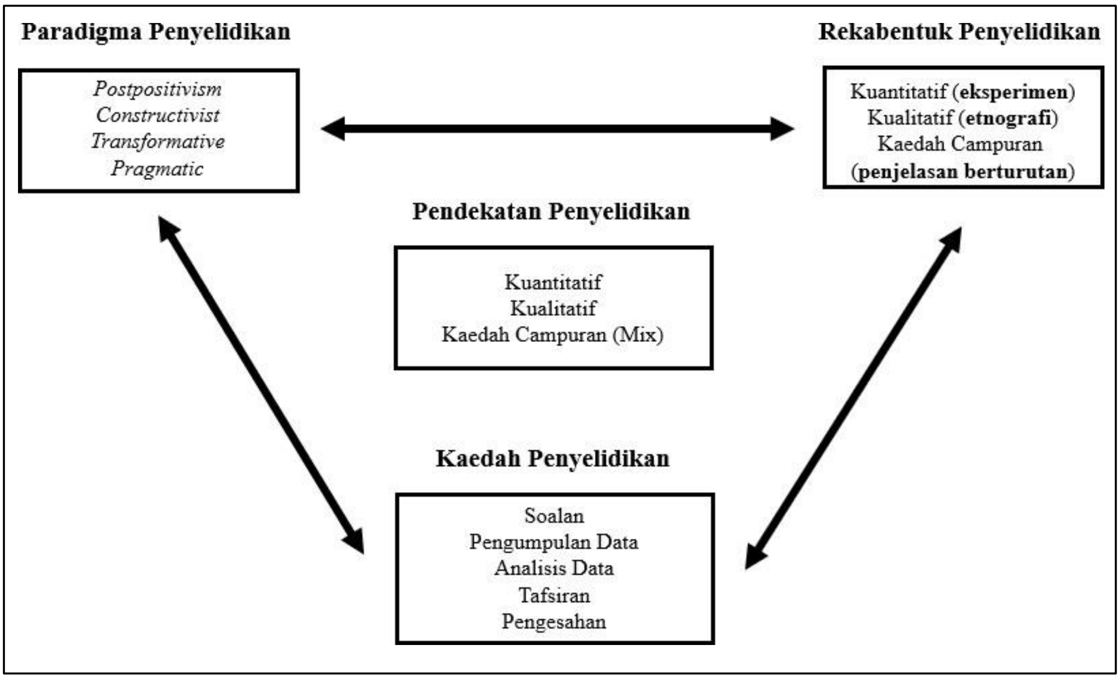


Figure 3.1 Basic Research Framework (Creswell et al., 2018)

According to Creswell (John W. & Creswell; J. David, 2018), a research approach constitutes a plan and procedure for conducting research, encompassing stages from broad assumptions to specific data collection, analysis, and interpretation methods. Furthermore, a research approach comprises three key components: the research philosophy (or paradigm), research design, and research methods. The research process begins with selecting a paradigm that aligns with the study's objectives, followed by adopting an appropriate design to complement it (Tobi & Kampen, 2018; Wiener, 2007). Finally, suitable methods are applied to ensure the systematic execution of research activities. Figure 3.1 illustrates the elements of the research framework that serve as the foundation and guide for the systematic conduct of this study (Creswell, John W., & Creswell, J. David, 2018).

The research framework for this study is structured to ensure a rigorous alignment between philosophical underpinnings and practical execution. At the foundational level, the Research Paradigm provides the philosophical lens through which the study is conducted. Given the focus on Road Traffic Safety Management Systems (RTSMS) and measurable behavioural outcomes, this research aligns with a Postpositivist and Pragmatic orientation, emphasising empirical observation and the practical application of ISO standards to solve organisational safety challenges.

The Research Approach serves as the central bridge in this framework, determining the overall strategy for investigation. This study adopts a mixed-methods approach to provide a comprehensive understanding of the safety ecosystem. By combining the objective data from the HSSE performance dashboard with the subjective survey responses from the workforce, the research captures both the "what" (lagging indicators) and the "why" (cognitive stressors and acceptance). This approach is operationalised through a Sequential Explanatory Research Design, where the quantitative data from the SmartPLS-SEM analysis is used to test the hypotheses, while the secondary data and NIOSH findings provide the depth necessary to interpret the behavioural nuances of the road users.

Finally, the Research Methods outline the specific procedural steps taken to ensure data integrity and validity. This includes formulating research questions that address cognitive and behavioural variables, systematically collecting data using validated survey instruments and dashboard records, and applying Structural Equation Modelling for data analysis. The final stages of the method involve interpreting the path coefficients and validating the findings against existing safety management theories. This interconnected framework ensures that every methodological decision from the initial paradigm to the final validation is logically consistent and academically sound.

This research begins with selecting an appropriate research paradigm, followed by defining the research approach and formulating a corresponding research design that aligns with the selected methods and techniques. In this study, the researcher adopted the Social Cognitive Theory proposed by Albert Bandura (1977) and H.W. Heinrich's Multi-Causation Theory (1931) as the theoretical foundations. Guided by these perspectives, the researcher identified post-positivism as the most suitable research paradigm for this study.

Accordingly, a quantitative research approach was employed, as it enables the systematic collection and analysis of numerical data to test hypotheses and evaluate relationships among variables (Creswell John W & Creswell J. David, 2018; Lithner, 2008). The quantitative design serves as the foundation for obtaining empirical evidence and objective insights relevant to the research objectives.

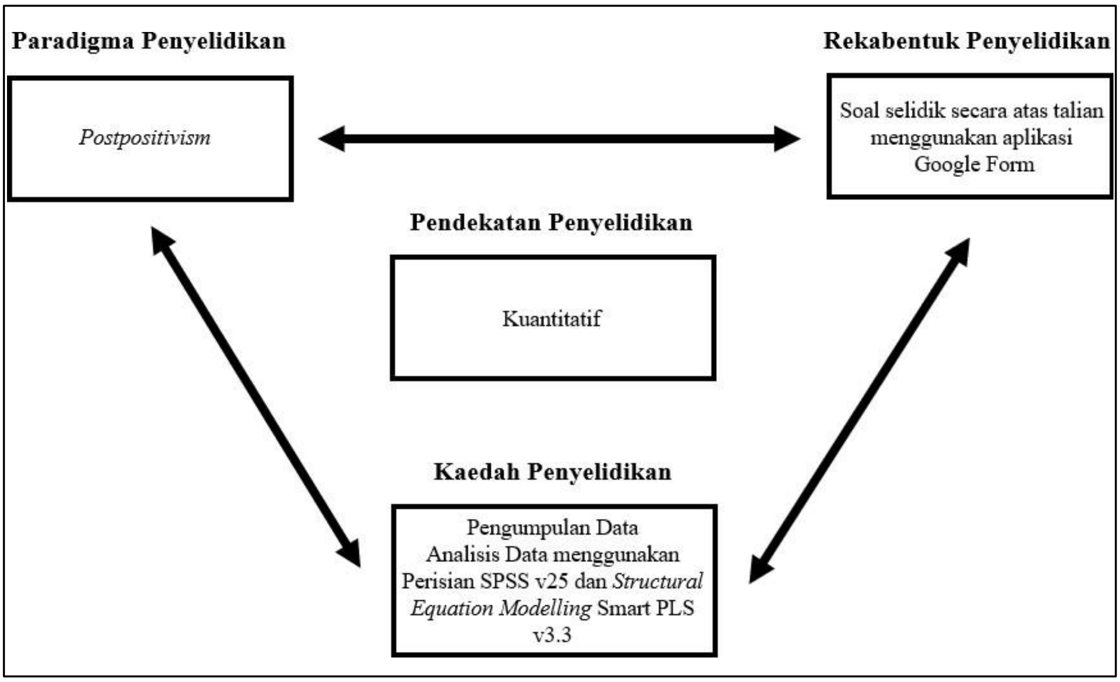


Figure 3.2 Directive Research Questionnaire in Quantitative Model

The methodological framework of this study is structured to ensure a rigorous, empirical investigation of the impact of Road Traffic Safety Management Systems (RTSMS) on road user behaviour. As illustrated in the research framework Figure 3.2, the study is anchored in four primary pillars: research paradigm, research design, research approach, and research methods. These components are interconnected to provide a systematic pathway from theoretical inquiry to empirical validation.

The study adopts a Postpositivist paradigm, grounded in the belief that an objective reality exists but can be understood only through empirical observation and logical inference. This paradigm is particularly suitable for this research as it seeks to quantify the effectiveness of ISO 39001 standards through measurable indicators. By utilising post positivism, the study acknowledges the complexity of human behaviour (such as driver fatigue and cognitive stressors) while maintaining a focus on gathering objective, verifiable data to test and refine existing safety management theories.

The Research Design utilises a cross-sectional survey method, in which data are collected via an online questionnaire administered via Google Forms. This digital approach was selected for its efficiency in reaching a geographically dispersed workforce and its ability to ensure respondent anonymity, which is critical when assessing safety compliance and behavioural violations. The survey instrument comprising the 65 items (B1–E5) discussed previously allows systematic collection of primary data on management oversight, cognitive acceptance, and behavioural outcomes.

In alignment with the postpositivist paradigm, this study employs a strictly Quantitative approach. This approach is necessary to statistically evaluate relationships among latent variables and test the three research hypotheses. By transforming qualitative perceptions of safety and stress into numerical data, the study can utilise advanced statistical modelling to determine the strength and significance of the RTSMS's impact on road user behaviour. This quantitative focus ensures that the results are generalizable and can be directly compared against the HSSE dashboard's performance indicators.

The Research Methods encompass the procedural steps of data collection, processing, and interpretation. Following the collection of survey responses, the data is analysed using two primary software tools to ensure high levels of statistical accuracy. SPSS v25 is utilised for descriptive statistical analysis, data cleaning, and preliminary frequency distributions. Subsequently, SmartPLS v3.3 is employed for Structural Equation Modelling (SEM). SmartPLS is the chosen analytical tool because of its proficiency in handling complex models with multiple indicators (such as the 50 items in Construct B) and its ability to determine path coefficients (β) and R-squared values

(Hair et al., 2022a). This dual-software method ensures robust validation of the structural model, providing the empirical weight necessary to support the alternative hypotheses and the study's final conclusions.

Figure 3.2 illustrates the conceptual relationship among the key components of the research design, which collectively contribute to the success of this study. Given that the quantitative approach forms the core methodological orientation, the subsequent phase involved the detailed design of the research framework and the development of an implementation plan to operationalise the study effectively. The study adopts a Mixed Methods (Sequential Explanatory) design to provide a comprehensive evaluation of the Road Traffic Safety Management System (RTSMS). This design is uniquely suited for this research as it allows for a two-phase integration of data. In the first phase, quantitative data from the HSSE performance dashboard (e.g., zero fatalities and mileage records) and the 65-item survey are analysed via SmartPLS-SEM to establish statistical correlations and test the research hypotheses.

In the second phase, these statistical findings are contextualised and explained through the qualitative interpretation of the NIOSH study’s findings on driver stressors and cognitive states. By utilising this sequential approach, the research moves beyond mere numerical correlations to explain why certain organisational structures (ISO standards) effectively suppress major accidents while still allowing for minor behavioural lapses (fatigue and working-hour violations). This synergy between objective performance indicators and subjective behavioural insights ensures a holistic validation of the safety framework's effectiveness.

3.3 Research Design

According to Saunders et al. (2019), a research design is a comprehensive plan that outlines how researchers intend to answer the research questions posed in a study. Similarly, (Creswell John W & Creswell J. David, 2018) emphasise that research design primarily focuses on procedural aspects of research, including data collection, information sourcing, analytical techniques, and reporting findings.

Drawing from these perspectives, an appropriately constructed research design is essential to ensure that all research activities are conducted systematically and in accordance with the predetermined plan. Furthermore, it establishes a coherent alignment between the selected research paradigm or philosophy, the chosen methodology, and the specific research methods employed in this study.

Given that this research utilises a structured questionnaire as its primary data collection instrument, the subsequent sections will elaborate on key elements of the research design namely, the identification of the unit of analysis, the sampling approach, sample selection and size, as well as the instrument development process undertaken for this study.

3.4 Research Process Flow

The analyses discussed in this chapter form the foundation upon which the study's conclusions and recommendations are developed. The overall research approach is summarised in Figure 3.3, which outlines the methodological framework adopted throughout this study. The operational framework of this study follows a systematic, phased approach to ensure the empirical rigour required for investigating road traffic safety management. The research process is structured into three primary phases: the preliminary phase, the instrument development phase, and the analytical phase.

In the Phase 1 Preliminary Research and Problem Identification. The research began with the Selection of a research area, focusing on the effectiveness of Road Traffic Safety Management Systems (RTSMS). This was followed by the Identification of the Problem and an extensive Literature Review, which provided the theoretical foundation for the study. By synthesising existing safety management theories and previous data analysis, the research gaps regarding driver behaviour and organisational ISO standards were established.

The second Phase 2 Instrument Design and Validation is a critical stage of the methodology involved the Questionnaire Design, which integrated established psychometric scales, namely the Driver Behaviour Questionnaire (DBQ) by (Lajunen et al., 2022; Martinussen et al., 2013; Özkan et al., 2006) and the Driver Skill Inventory (DSI) by (Lajunen et al., 2022). To ensure the instrument's relevance to the local context, Questionnaire Validation was conducted with a Pilot Group comprising subject matter experts from MRTSA, MIROS, KOTAMAS SDN BHD, and NIOSH Malaysia, as well as senior researchers and academicians. This validation process ensured that the 65-items survey was both reliable and culturally appropriate for the target respondents.

The third process is Phase 3, the Data Collection and Analysis. Once validated, the Survey was sent to respondents via an online data collection platform. To complement the primary survey data, the study incorporated secondary empirical evidence from the RTSMS ISO 39001:2013 Audit Findings. These findings, derived from the 3rd-party Certification Body (NIOSHcert) audit of KOTAMAS SDN BHD, provided a high-fidelity baseline for the organisational safety performance.

The collected data then underwent a rigorous Analysis phase using SPSS and SmartPLS to test the hypothesised relationships. The final stages of the research involved a comprehensive Discussion of the findings, leading to the Conclusion and Recommendations for enhancing road safety protocols. This structured flow ensures that the study's outcomes are grounded in validated metrics and a holistic view of both organisational policy and individual driver behaviour.

A survey method was employed to identify the factors contributing to the reduction of road traffic fatalities in Malaysia. The survey instrument was designed using ordered categorical data and a Likert-type scale to measure respondents' perceptions regarding the key factors influencing road safety outcomes, consistent with previous research findings (Joshi et al., 2015). The researcher clearly explained the purpose and procedures of the survey to participants through a cover letter attached to the questionnaire. This letter also provided detailed guidelines to ensure respondents followed the procedures accurately, thereby minimising potential errors during data collection. Throughout the survey period, the researcher provided oversight to maintain consistency and reliability in the administration of the instrument. The primary objective of the survey was to gather respondents' opinions and empirical data relevant to the research objectives.

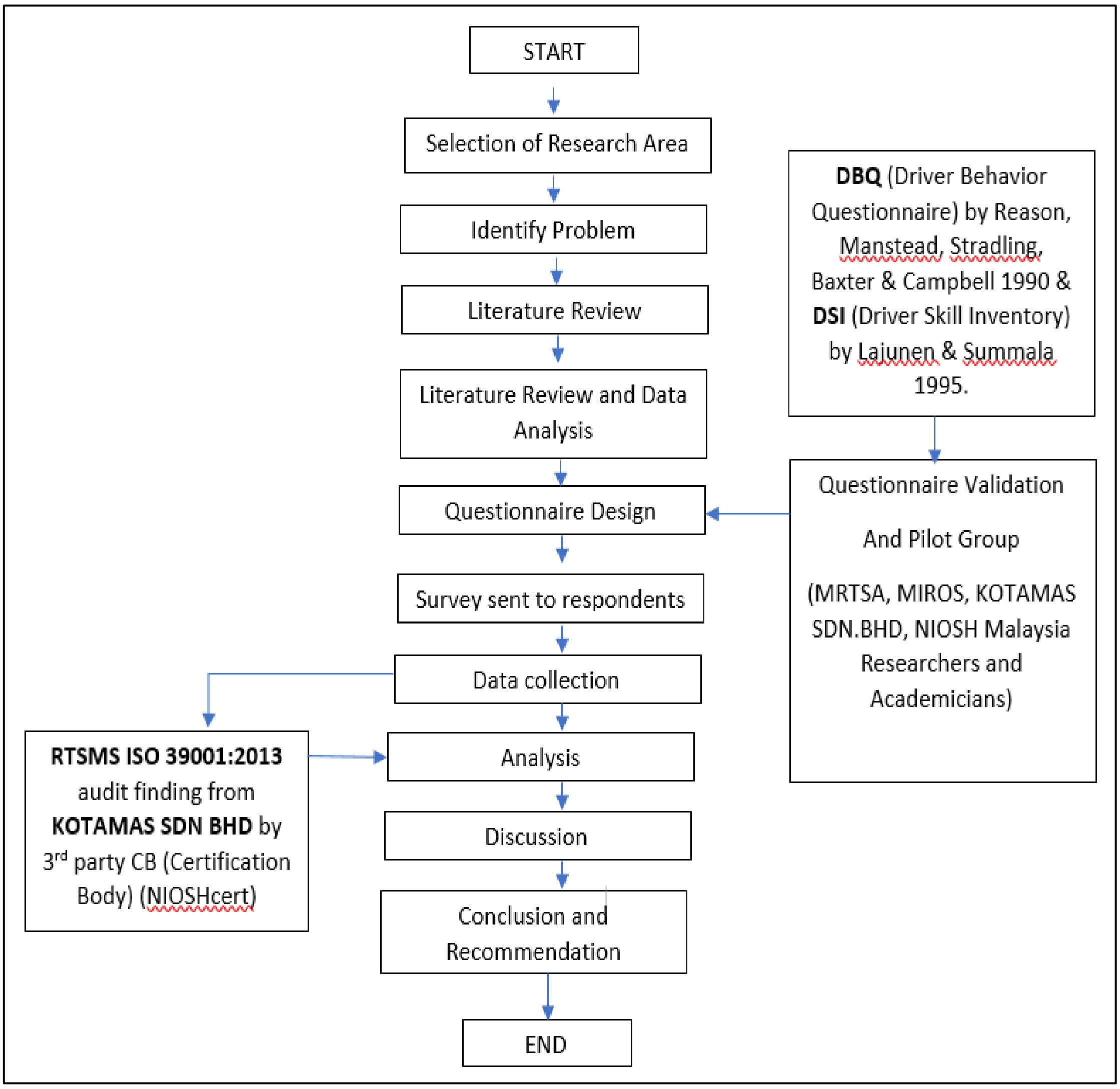


Figure 3.3 Flow Process Of Collecting Data

At the initial stage of the study, several rigorous and systematic screening processes were undertaken to ensure that the research aligned with its intended objectives. These preparatory steps were crucial for the subsequent fieldwork phase, particularly during data collection and analysis. As discussed in Chapter 2, the researcher conducted a comprehensive review and synthesis of prior studies to inform the development of a structured, systematic research methodology. This groundwork led to the formulation and testing of three hypotheses (H1, H2, H3), which constitute the core framework of this study.

According to Creswell (2018; Creswell, John W., & Creswell, J. David, 2018; Creswell-ResearchDesign, n.d.), a research approach is a comprehensive plan and procedure for conducting research, encompassing stages that progress from broad philosophical assumptions to specific methods of data collection, analysis, and interpretation. Furthermore, a research approach comprises three fundamental components: the research philosophy or paradigm, the research design, and the research methods. The process begins with selecting a paradigm that best aligns with the study's objectives, followed by formulating a compatible research design, and finally applying systematic research methods to operationalise the study effectively. Figure 3.3 illustrates the key elements of the research framework, which serve as the foundation and guideline for conducting this study in a structured and methodical manner (Creswell et al., 2018). The research process is a fundamental component of any scholarly inquiry, encompassing a series of systematic procedures that guide the study from its inception to completion. This process comprises several sequential phases that the researcher must follow to ensure the success and integrity of the research.

This study commenced with the identification of the research topic, followed by an extensive review of existing literature to examine previous studies and identify relevant variables. Subsequently, the process continued with the formulation of the research design, data collection, data analysis, and the documentation of findings (Zainudin, 2012). Figure 3.3 presents a flowchart depicting the stages of an effective research process, serving as a reference framework for the researcher throughout the study. In practice, the research process is iterative, requiring continuous reflection and refinement. Accordingly, the researcher identified the research problem, reviewed previous studies to gain insights into emerging issues, examined prior research findings, and integrated relevant theoretical ideas in accordance with the research process flowchart.

At the initial stage, the study focused on reviewing literature on cognitive mindset and behavioural changes among road users and organisations governed by Road Traffic Safety Management Systems (RTSMS) under ISO 39001:2013. The researcher gave particular attention to initiatives on road accident prevention and control that influence cognitive and behavioural change among staff at NIOSH Malaysia.

Subsequently, the researcher examined the theoretical foundations associated with cognitive mindset shifts and behavioural adaptation among road users within organisational contexts. This phase also included a critical evaluation of existing models and the identification of key factors or constructs relevant to the management of cognitive and behavioural change among NIOSH Malaysia staff. This initial review and assessment stage was essential for identifying current issues concerning cognitive and behavioural transformations in the context of implementing RTSMS ISO 39001:2013. It also provided insights into relevant measurement constructs and, most importantly, addressed the research gaps identified in prior studies.

Following the comprehensive literature review, an initial conceptual research model was developed based on the identified variables and theoretical insights. To strengthen this foundation, the researcher conducted a preliminary investigation at NIOSH Malaysia, encompassing both headquarters and regional offices. This investigation aimed to examine in detail the policies and initiatives for road accident prevention implemented under the National Transport Plan (2019–2030), thereby providing additional empirical support for the theoretical framework of this study.

The process of sampling design and data Sources. The study utilises a dual-data approach to ensure a comprehensive evaluation of the Road Traffic Safety Management System (RTSMS). This involves collecting primary survey data focused on individual driver behaviour and stressors, supplemented by secondary organisational audit data to provide a baseline for systemic compliance. This clearly distinguishes between the primary data collected via NIOSH and the secondary data from the KOTAMAS audit.

The primary data will be analysed based on the NIOSH Malaysia Survey (Items B1–E5). The primary data for this research were gathered through a structured survey instrument administered in collaboration with NIOSH Malaysia. The population consists of professional road users and transport operatives who are subject to national safety standards and organisational oversight. The sampling technique will be a purposive sampling method, used to select respondents with direct experience with RTSMS protocols. This ensures that the data regarding management oversight (B1–B50), cognitive acceptance (C1–C5), organisational structure (D1–D5), and behavioural outcomes (E1–E5) are derived from a qualified and relevant cohort.

The data collection instrument will be anchored by the 65-item survey, integrating the Driver Behaviour Questionnaire (DBQ) and the Driver Skill Inventory (DSI), which will be distributed via an online platform to ensure broad geographical reach across the NIOSH network of researchers and industry practitioners. The secondary data comes from the RTSMS ISO 39001 audit (KOTAMAS Sdn Bhd). To validate and contextualise the primary survey findings, the study incorporates secondary data derived from the RTSMS ISO 39001:2013 audit findings conducted at KOTAMAS Sdn Bhd. The data consists of official audit reports generated by a 3rd-party Certification Body (NIOSHcert). These audit records provide an objective, high-fidelity measure of organisational compliance and systemic performance that cannot be captured by self-reported surveys alone. By analysing these findings alongside the HSSE performance dashboard, the research can correlate individual driver perceptions (primary data) with actual organisational adherence to international safety standards (secondary data).

The integration of these two data sources follows a triangulation strategy. The primary data from the NIOSH survey provides the basis for the Structural Equation Modelling (SEM) in SmartPLS, testing the psychological and behavioural links. Meanwhile, the secondary audit data from KOTAMAS serves as a benchmark to confirm if the "intended" safety system (the audit) matches the "perceived" safety system (the survey) and the "actual" safety outcomes (the dashboard). This multi-dimensional sampling approach significantly enhances the internal validity and reliability of the final research conclusions.

The sampling frame for this study is specifically defined by the operational requirements of the RTSMS ISO 39001 implementation within NIOSH Malaysia. While the total workforce at NIOSH Malaysia consists of 196 personnel, the Road Traffic Safety Management System is applicable only to a subset of 57 staff members who are directly involved in driving operations and transport-related duties. To align your sampling section with the specific population of 57 eligible staff out of 196 at NIOSH Malaysia, you must justify why a smaller sample is statistically acceptable for your thesis. According to Krejcie and Morgan (1970) (Chanuan Uakarn et al., 2021; Lee & Penyelidikan, 2006), for a small, finite population like yours (N=57), the required sample size to maintain a 95% confidence level is approximately 50 respondents. This means you are aiming for a Census Sampling (or Total Enumeration) approach, which is highly regarded in small-scale organisational studies.

Based on the application of Krejcie and Morgan's Theory to determine the appropriate sample size for this study, the research refers to the standardised table developed by Krejcie and Morgan (1 (Lee & Penyelidikan, 2006). According to their formula for finite populations based on the total applicable population (N) 57, the minimum required Sample Size (s) is approximately 50. Given that the required sample size (s =50) represents nearly 88% of the total applicable population (N = 57), this study adopts a Census Sampling (Total Population Sampling) approach. By inviting all 57 eligible staff members to participate in the 65-item survey (Items B1–E5), the research minimises sampling error and ensures that the findings accurately reflect the entire group governed by the RTSMS.

While traditional statistical methods often require larger cohorts, the use of Partial Least Squares Structural Equation Modelling (PLS-SEM) via SmartPLS v3.3 is highly advantageous for this specific sample size. Methodologists (Hair et al., 2017) confirm that PLS-SEM is a robust "small-sample" technique capable of achieving high levels of statistical power even with smaller populations, provided the measurement model is well-defined.

By conducting a census of the 57 applicable staff, the primary data gathered through the NIOSH survey achieves a high degree of internal validity. This primary data is further strengthened by the triangulation with secondary data from the KOTAMAS Sdn Bhd RTSMS ISO 39001 audit, providing a holistic view of safety performance that compensates for the concentrated population size.

3.5 Design and Validation of the Research Instrument Model

In the second phase of this study, the conceptual framework developed earlier served as the foundation for finalising the research instrument. The researcher identified and defined the most relevant constructs that reflect the existing gaps in cognitive and behavioural changes associated with the implementation of ISO management systems in both Malaysian and international contexts.

The development of these constructs across multiple dimensions aimed to provide a comprehensive understanding of the phenomenon under study. Specifically, four (4) constructs were formulated to measure cognitive changes in road users' mindsets and behavioural transformations within organisations that adopt the Road Traffic Safety Management System (RTSMS) under ISO 39001:2013 standards. Once the measurement constructs were finalised, the researcher developed a graphical conceptual framework to represent the measurement model, including the dependent variable. This framework subsequently guided the design and structure of the questionnaire instrument.

The questionnaire was developed based on insights from previous studies and incorporated established instruments, such as the Driver Behaviour Questionnaire (DBQ) and Driver Behaviour Inventory (DBI), to ensure theoretical and empirical alignment with the conceptual model. Prior to conducting the primary survey, the questionnaire's reliability and validity were assessed through a pilot study, ensuring its suitability for subsequent empirical analysis of the research model.

Following an intensive review of the literature and preliminary data analysis, the researcher simplified the research framework. The framework and associated hypotheses were then operationalised through the survey questionnaire, as illustrated in Figure 20. The researcher tested hypotheses statistically to determine whether to reject the null hypothesis (H_0) and accept the alternative hypothesis (H_a), thereby validating the study's theoretical assumptions.

The research framework aims to examine the extent to which ISO 39001 RTSMS influences cognitive and behavioural changes among road users, and whether these changes contribute to a reduction in road traffic crashes in Malaysia. Specifically, the framework examines the significant relationship between cognitive awareness of road safety risks, as outlined in ISO 39001, and the corresponding behavioural modifications among road users. This, in turn, is expected to lead to a measurable reduction in road traffic safety risks (RTS risks) and ultimately a decline in road accidents.

3.6 Question design and Its Content

The researcher employed a quantitative approach in this study to evaluate the effectiveness of the road traffic system in relation to commuting safety in Malaysia. The research primarily utilised a structured questionnaire consisting of 65 items, of which 50 were adapted from the Driver Behaviour Questionnaire (DBQ) and Driver Skill Inventory (DSI), both of which have been previously tested for reliability by Warren Harrison of Eastern Professional Services Pty Ltd. Approximately 30% of employees from NIOSH Malaysia Headquarters and Regional Offices participated in this survey, representing all functional layers of the organisation. This percentage reflects the participation of participants from three distinct risk layers within the organisation, ensuring a balanced representation of perspectives.

The questionnaire was divided into five main sections: Part A, Part B, Part C, Part D, and Part E. Part A collected demographic information from the respondents. At the same time, Part B comprised 50 items measuring the cognitive aspects related to RTSMS ISO 39001:2013, utilising the DBQ and DSI as reference instruments to provide empirical input for hypothesis testing. Item C included five (5) items focusing on the implementation issues of RTSMS ISO 39001:2013, followed by Item D, which contained five (5) items evaluating the influence of RTSMS ISO 39001:2013 on road user behavioural changes within the organisation. The final section, Item E consist five (5), consisted of questions aimed at identifying how the implementation of RTSMS ISO 39001:2013 could contribute to reducing traffic incidents, enhancing road safety compliance, and mitigating social issues arising from road traffic incidents in Malaysia.

The questionnaire was carefully designed to capture key indicators associated with road traffic accident prevention, including age, gender, personality, education, aggression, decision-making thoroughness, driving confidence, attitudes, risk assessment ability, experience, accident history, stress levels, cognitive knowledge, skills, behaviours, and attributes in managing road traffic safety risks. These factors were used to assess whether improved cognitive understanding and behavioural adaptation could reduce RTS risk and achieve the intended safety outcomes. The researcher further refined the instrument through expert reviews conducted by NIOSH Malaysia professionals, members of the Malaysian Road Traffic Safety Association (MRTSA), researchers from the Malaysian Institute of Road Safety Research (MIROS), and representatives from KOTAMAS Oil Sdn. Bhd., as well as academicians from MITRANS and the researcher’s supervisory team.

According to Shazwani Rosli et al. (2017b), the DBQ remains one of the most widely used instruments in research on driving behaviour, with various versions ranging from 10 to over 100 items. In the DBQ, participants indicate how frequently specific traffic situations occur. Studies, such as De Winter & Dodou (2010), have shown that self-reported driving behaviours are significant predictors of traffic accidents. The standard version developed has identifies three categories of aberrant driving behaviour violations, errors, and lapses each reflecting different dimensions of unsafe driving practices. In this study, respondents rated their behaviours using a seven-point Likert scale ranging from 1 (Strongly Disagree) to 7 (Strongly Agree).

Primary data collection for this research was conducted through pre and post questionnaire surveys, complemented by secondary data obtained from road traffic accident investigations in accordance with RTSMS ISO 39001 Clause 9.2, which pertains to crash and incident investigation. Additional qualitative input was gathered through face-to-face interviews and audits conducted by certification bodies, including internal (first-party) and external (third-party) audits, based on Non-Conformity Reports (NCR). The data were analysed using quantitative methods, primarily through regression (r^2) analysis, to determine whether the proposed hypotheses could be accepted or rejected.

The findings were expected to reveal the level of awareness, knowledge, and implementation of road safety practices among NIOSH Malaysia employees across all risk levels, operational, managerial, top management, and policy-making. Although most employees were aware of the legal requirements under the Occupational Safety and Health Act (OSH Act) 1994, Sections 15 and 24, many lacked a deep understanding of how road traffic safety incidents could directly affect them. Hence, this research aimed to enhance cognitive awareness, behavioural transformation, and overall management of road traffic safety risks, ultimately contributing to reduced accidents and improved organisational safety performance.

Construct Reliability and Validity

Matrix | Cronbach's Alpha | rho_A | Composite Reliability | Average Variance Extracted (AVE)

	Cronbach's Al...	rho_A	Composite Reliability	Average Variance Extracted (AVE)
B	0.934	0.944	0.936	0.254
C	0.862	0.873	0.901	0.646
D	0.906	0.908	0.931	0.731
E	0.918	0.930	0.940	0.761

Figure 3.4 Construct Reliability and Validity Analysis

The empirical phase of this study was conducted using a non-interactive online survey distributed via Google Forms. Respondents were identified from the NIOSH departmental directory, and standardised questionnaires were distributed via email to expedite data collection. Although the survey was conducted online, the researcher directly engaged with Heads of Departments to ensure valid participation and increase response rates. The data collection process was completed over approximately 1.5 months, allowing sufficient time for participant engagement and demographic representation from both the headquarters and regional offices.

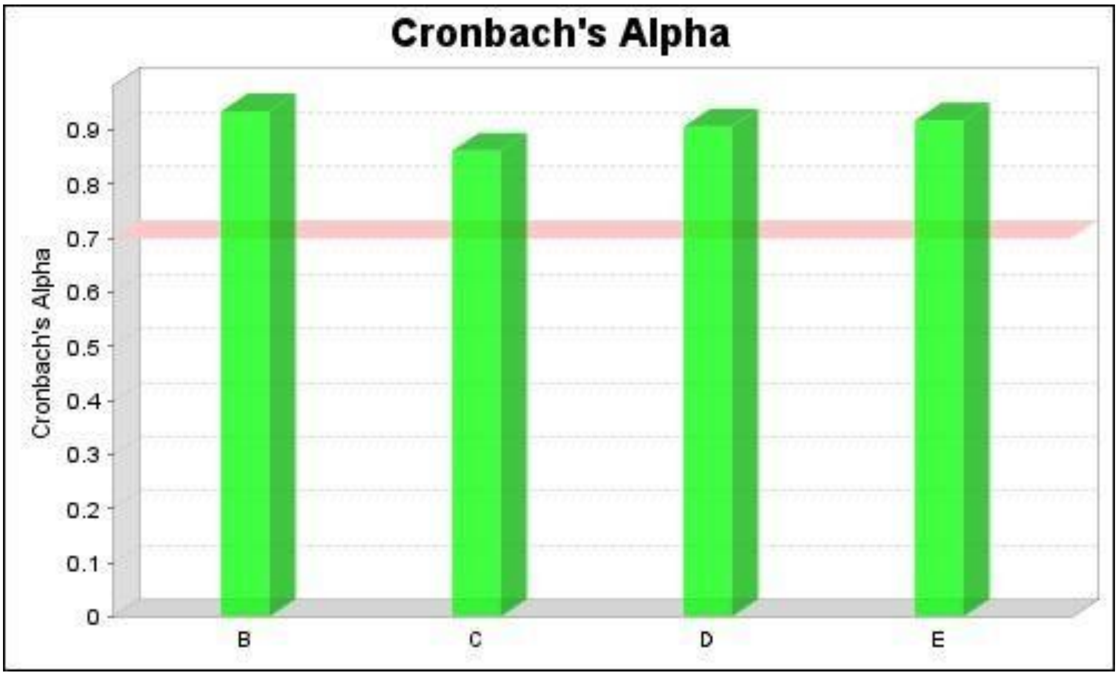


Figure 3.5   Cronbach’s Alpha For The Question Items B, C, D, E

Survey research, as emphasised by (Creswell John W & Creswell J. David, 2018) provides quantitative insights into trends, attitudes, and relationships between variables within a population. This approach was highly suitable for the current study, which required continuous employee feedback on the cognitive and behavioural changes they experienced following the implementation of RTSMS ISO 39001:2013. Through this approach, the researcher sought to identify patterns, relationships, and attitudes that could be generalised to a broader population based on reliable empirical data.

To ensure the validity and reliability of the questionnaire instrument, statistical analyses were performed to evaluate internal consistency using Cronbach’s Alpha (CA), Composite Reliability (CR), Average Variance Extracted (AVE), and Heterotrait-Monotrait Ratios (HTMT) as recommended by (Hair et al., 2022a). These coefficients assess the degree to which measurement items consistently reflect the intended construct. A minimum threshold value of 0.700 for Cronbach's Alpha, as suggested by Nunnally (1978), was used to determine reliability. The analysis, conducted through Structural Equation Modelling (SEM), indicated that all constructs exceeded this threshold, confirming the instrument's reliability. Specifically, Cronbach's Alpha values for the respective parts were 0.934 (Part B), 0.862 (Part C), 0.906 (Part D), and 0.918 (Part E), indicating that the instrument was statistically sound and ready for field research.

The primary analytical approach for this study utilises Partial Least Squares Structural Equation Modelling (PLS-SEM) to examine the relationships between organisational systems, cognitive states, and behavioural outcomes. The model is constructed using a 65-item survey instrument categorised into four latent constructs: Road Traffic Safety Management (Construct B), Cognitive Acceptance (Construct C), Organisational ISO Standards (Construct D), and Behavioural Outcomes (Construct E). By utilising PLS-SEM, the study effectively bridges the gap between empirical performance data recorded in the HSSE dashboard, such as the zero-fatality record across 1.1 million kilometres travelled, and subjective survey data on driver stressors and policy acceptance.

The evaluation of the measurement model confirms the internal consistency and indicator reliability of the 65 items (question B1-E5) distributed across four latent constructs (refer to Attachment 3). Construct D, representing the core organisational framework and ISO 39001 standards (Items D1–D5), serves as the primary exogenous variable. The factor loadings for these items are exceptionally high, ranging from 0.737 to 0.921, which validates that these five items are robust indicators of the systemic safety structure. This construct exerts a profound influence on the model, particularly in its relationship with Construct E (Items E1–E5), which measures behavioural outcomes and safety performance. The path coefficient of 0.955 from D to E, coupled with an R-squared value of 0.912, demonstrates that the organisational framework explains 91.2% of the variance in driver behaviour. Items E1 and E4, with loadings of 0.921 and 0.912, respectively, are the most critical measures of the workforce's final safety performance.

The cognitive acceptance of safety policies, as captured by Construct C (Items C1–C5), also aligns strongly with the overall framework. The factor loadings for this construct are consistently high, particularly for item C3 (0.880), indicating that the survey items accurately reflect drivers' psychological buy-in to the safety system. Construct D significantly predicts this cognitive acceptance with a path coefficient of 0.848, explaining 71.9% of the variance in how drivers perceive and accept the mandated safety protocols. This suggests that a well-structured ISO system directly fosters a positive safety culture and cognitive alignment among road users.

In contrast, Construct B, which encompasses 50 items related to RTSMS implementation and management oversight (Items B1–B50), exhibits a more complex statistical profile. While the construct is moderately predicted by the organisational structure with an R-squared of 0.385, the individual item loadings vary significantly. Several items, such as B44 and B45, show strong reliability with loadings above 0.70, yet many items in the B1–B15 range show weaker loadings, such as B13 at 0.112. This variance suggests that while the overall management system is a significant component of the safety model, certain specific oversight actions recorded in the survey contribute more substantially to the latent variable than others. Despite these variations, the model collectively confirms that the 65-item instrument effectively maps the transition from organisational standards to cognitive acceptance and, ultimately, to measurable changes in road user behaviour.

The measurement model was initially assessed through indicator loadings to ensure that the 65 items accurately represented their respective latent variables. Construct D, representing the ISO 39001 systemic framework, demonstrated exceptional indicator reliability with loadings for items D1 through D5 ranging from 0.737 to 0.921. Similarly, Construct E, which measures the final behavioural outcomes, showed robust loadings, particularly for items E1 and E4, which exceeded 0.91. Construct C, focusing on cognitive acceptance of safety policies, also demonstrated high reliability, with loadings ranging from 0.720 to 0.880. These high values indicate that the survey items for these constructs are highly consistent and valid measures of the underlying theoretical concepts.

Furthermore, the 50-item scale for Construct B exhibited significant variance in indicator reliability. While items related to technical oversight and inspections (B45–B50) showed strong loadings, several indicators in the B1-B15 range demonstrated insufficient factor loadings, such as B13 at 0.112 and B1 at 0.001. Following established psychometric protocols, items with loadings significantly below the 0.40 threshold were identified for removal (Hair et al., 2019, 2022b). This purification process was necessary to ensure the convergent validity of the management oversight construct and to prevent statistical noise from compromising the structural paths. The refinement of Construct B ensures that the final model focuses on the specific management interventions that most directly influence road user behaviour.

The structural model evaluates the strength of the hypothesised relationships through path coefficients (β) and the coefficient of determination (R2). The results indicate that the organisational framework (Construct D) is a massive predictor of behavioural outcomes (Construct E), with a path coefficient of 0.955 and an R2 of 0.912. This suggests that the ISO-based systemic framework explains over 91% of the variance in driver behaviour, directly supporting the first alternative hypothesis (HA) that the RTSMS significantly impacts road user discipline. Furthermore, Construct D exerts a strong influence on cognitive acceptance (Construct C) with a path coefficient of 0.848 and an R2 of 0.719, confirming that a well-structured safety system is the primary driver of driver "buy-in" and policy internalisation.

The relationship between the organizational system and management oversight (Construct B) is also significant, with a path coefficient of 0.621 and a moderate R2 of 0.385. This path, when aligned with the NIOSH findings regarding fatigue and working-hour violations, supports the second and third alternative hypotheses. The model demonstrates that while the systemic framework (D) suppresses major accidents, the cognitive state of the driver influenced by stressors and acceptance mediates the transition from management rules to actual behaviour on the road. The high predictive accuracy of the model for constructs C and E confirms that the RTSMS acts as a sustainable behavioural modifier, effectively preventing violations from escalating into high-severity incidents.

3.7 Summary

This chapter has outlined in detail the research methodology adopted for this study. It began by presenting the research paradigm underpinning the investigation, emphasizing its alignment with the philosophical assumptions, objectives, and nature of the study. The justification for the chosen paradigm was discussed with reference to previous scholarly work, thereby ensuring that the methodological approach is both theoretically grounded and empirically robust. The rationale for adopting this paradigm was to provide a comprehensive framework that could effectively guide the exploration of cognitive and behavioural changes among road and traffic users in the context of implementing RTSMS ISO 39001:2013.

This chapter elaborated on the overall research design, including the stages involved in data collection, the development and validation of research instruments, and the techniques applied for data management and analysis. The process of designing the questionnaire was explained in detail, covering item generation, validation procedures, and pilot testing to ensure the reliability and validity of the research instrument. The selection of the study population and sampling strategy was also described, highlighting the justification for the chosen sample size and its representativeness in capturing the perspectives of road and traffic users relevant to the research objectives.

The chapter then discussed the data collection process for 65 items construct from B1-B50. C1-C5, D1-D5 and E1-E5 including ethical considerations, distribution procedures, and measures taken to ensure data integrity and respondent confidentiality. This was followed by a detailed explanation of the statistical analysis techniques applied, specifically the use of Structural Equation Modelling (SEM) through the SmartPLS 3.3.3 software. Each step of the analytical process from measurement model assessment to structural model evaluation was systematically described to demonstrate how the statistical procedures were employed to test the proposed hypotheses and assess the overall fit and predictive accuracy of the research model.

In summary, this chapter provided a comprehensive overview of all methodological components that form the foundation of this study. It justified the research design choices, outlined the systematic process followed for data collection and analysis, and explained the rationale behind each methodological decision. Collectively, these procedures ensure the validity, reliability, and rigour of the research findings. The next two chapters build upon this methodological foundation. Chapter 4 presents the results of the statistical analyses, accompanied by detailed interpretations of the findings in relation to the research objectives and hypotheses. Chapter 5 concludes the study by summarizing the key findings, drawing theoretical and practical implications, and offering recommendations for future research and policy development in the field of road traffic safety management.

CHAPTER 4
DATA ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter presents the findings and detailed discussion of the data analysis conducted in this study. The primary objective is to examine the influence of the cognitive mind and behaviour of road users towards the implementation of the Road Traffic Safety Management System (RTSMS) ISO 39001:2013 and ISO 39002:2002 within NIOSH Malaysia. The data from 57 valid responses were analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM) to test the proposed research framework and its associated hypotheses.

The analyses in this chapter focus on identifying and explaining the causal relationships between exogenous (independent) and endogenous (dependent) latent variables that shape cognitive changes and behavioural transformations among road and traffic users. In doing so, this chapter demonstrates how the application of RTSMS standards influences cognitive restructuring, behavioural alignment, and organisational practices among NIOSH Malaysia personnel.

The chapter begins with a presentation of the demographic profile of respondents to establish the background and characteristics of the study sample. This is followed by an interpretation of the measurement and structural model analyses, focusing on path coefficients, R^2 values, and p-values (significance levels). The discussion further elaborates on the three tested hypotheses (H1, H2, and H3), each exploring a specific dimension of the relationship between cognitive factors, behaviour, and RTSMS implementation.

Ultimately, this chapter provides empirical evidence to support the theoretical framework developed in Chapter 2. It confirms that cognitive transformation within organisations is a critical driver of the effective implementation of RTSMS standards. The findings underscore that road safety outcomes are not merely the result of policy compliance but are deeply influenced by the cognitive understanding, awareness, and behavioural engagement of road users and system implementers.

4.2 Result and Discussion (n-57)

Based on the data analysis conducted in this study, the coefficient of determination (R^2) for the endogenous latent variable, road user behaviour, was 0.377. This indicates that the three exogenous latent variables collectively account for 37.70% of the variance in the dependent variable of road user behaviour. According to established statistical benchmarks, this proportion indicates a moderate to weak level of predictive influence, falling within the range $0.250 < R^2 < 0.500$. The analysis further demonstrates that the structural model assessment yielded statistically significant results for all three constructs at a 5% level of significance ($p < 0.050$).

The structural model supports the hypothesised relationships between constructs B and D and constructs C and E, based on the directional effects observed among the exogenous and endogenous constructs. These latent variables collectively represent the conceptual framework that explains cognitive changes in the mindset and behaviour of road and traffic users in relation to the implementation of RTSMS ISO 39001:2013 and ISO 39002:2002, as proposed in Chapter 2.

The findings and outcomes of this study contribute to understanding the overall effectiveness of the Road Traffic Safety Management System (RTSMS) by assessing the level of awareness, foundational knowledge, and degree of implementation of standard requirements within NIOSH Malaysia. These results underscore the need for organisations across Malaysia to strengthen top management's cognitive understanding of the significance of implementing RTSMS within their operational environments. Enhancing such understanding is crucial to fostering a systematic approach to managing road traffic safety risks.

Moreover, the findings facilitate the identification and classification of road traffic safety (RTS) risks in a structured manner, beginning with driver- and managerial-related functions and extending to policy-level risks. These risks have been categorised into the Functional Levels of Risk, including operational, managerial, top management, and policy-maker risks. Addressing these functional risk levels holistically can reduce road crash rates and contribute to safer organisational practices.

Although most stakeholders are aware of their obligation to comply with Sections 24 and 15 of the Occupational Safety and Health (OSH) Act 1994, the findings reveal that many still lack an in-depth understanding of how and why road traffic safety incidents directly affect their roles and responsibilities. Consequently, this research provides valuable insights for organisational stakeholders by enhancing their knowledge, skills, attitudes, and behaviours related to managing road traffic safety risks. In doing so, it supports the development of safer work environments and contributes to the long-term goal of reducing road-related accidents.

The research model developed in this study provides a meaningful contribution to enhancing the cognitive understanding of RTSMS implementers. By strengthening cognitive awareness and comprehension, the model supports more effective risk management practices, thereby facilitating the achievement of the intended outcomes of Road Traffic Safety (RTS) initiatives within the defined scope and objectives of RTSMS implementation. The validation of the research hypotheses (H1, H2, and H3) reinforces the model's theoretical robustness and practical relevance. These hypotheses suggest that changes in cognition or the restructuring of cognitive beliefs and behavioural perceptions serve as the internal driving force behind observable behavioural changes among road users. Such changes originate within the individual's cognitive framework and manifest as safer, more responsible road user behaviours.

The results of this research, therefore, provide a model that organisations can adopt as a structured approach to implementing RTSMS ISO 39001:2013. Effective implementation begins with cultivating the correct cognitive orientation toward system management, enabling organisations to recognise and internalise the behavioural and safety impacts of RTSMS. This cognitive foundation is essential for embedding a culture of safety and achieving long-term behavioural transformation within the organisation.

The findings of this study not only benefit NIOSH Malaysia, particularly in addressing commuting-related accidents, but also extend broader implications for other organisations and stakeholders across Malaysia. The outcomes offer significant potential for enhancing the cognitive and behavioural dimensions of individuals involved in road traffic management and safety operations. By fostering improved awareness, understanding, and behavioural discipline, the research contributes to reducing RTS risks and accident rates in both the road transport industry and commuting contexts. Ultimately, these outcomes can enhance the overall safety, well-being, and quality of life for employees and communities within Malaysia.

Furthermore, the results of this research enable the identification of the types of management systems currently used by organisations in Malaysia to control road traffic risks. Understanding existing practices such as compliance with the Road Transport Act 1987 (Act 333), implementation of the SMITH System, Fleet Driver Management System (FDMS), Road Transport Oil and Gas (RTOG) framework, and Defensive Driver Training (DSDT) programs provides valuable insight into the range of approaches adopted to promote driver safety and regulatory compliance. Many organisations also employ internal safety procedures and monitoring mechanisms to ensure adherence to both statutory requirements and organisational policies. By integrating the cognitive-behavioural framework proposed in this study, these existing systems can be further strengthened to achieve greater effectiveness and sustainability in road traffic safety management.

This research aims to measure and analyse the effectiveness of current Road Traffic Safety Management System (RTSMS) practices within organisations by examining trends in road traffic accidents and evaluating how organisations identify, assess, mitigate, and treat road traffic risks through preventive processes. The study compares the advantages and limitations of implementing RTSMS based on ISO 39001:2013 as a systematic approach to controlling road traffic risks and reducing accident occurrences.

The structured framework of ISO 39001 emphasises the establishment, implementation, maintenance, and continual improvement of safety management processes within organisations. Through this framework, organisations can influence and reshape road users' cognitive understanding and behavioural patterns, thereby fostering safer driving attitudes and reducing road traffic accidents in Malaysia. The results of this study indicate that the systematic implementation of RTSMS ISO 39001 can contribute significantly to achieving the national target of a 50% reduction in road traffic accidents, as outlined by the Malaysian Institute of Road Safety Research (MIROS), the Road Safety Department (JKJR), and other initiatives under the National Transport Policy 2019–2030.

Furthermore, validating RTSMS implementation through third-party certification conducted by recognised bodies, such as NIOSH Cert, SIRIM, PECB, and other accredited certification organisations, ensures the integrity, impartiality, and credibility of the system. This independent evaluation mechanism strengthens organisational accountability and helps sustain the continuous improvement cycle required by the standard. Such certification not only reinforces the quality of RTSMS practices in Malaysia but also demonstrates their measurable impact in reducing road traffic accidents nationwide.

4.2.1 Demographic Profile and Respondent Feedback

This section presents the demographic profile and feedback from respondents who participated in the data collection via Google Forms. The demographic data are summarised in Table 4.4, organised into six categories: (i) gender, (ii) organisation, (iii) position grade, (iv) educational background, (v) length of service, and (vi) knowledge concerning the cognitive mindset and behaviour of road users in relation to RTSMS ISO 39001:2013 and ISO 39002:2002 within the organisation.

The findings indicate that the majority of respondents were male (87.7%), whereas female respondents accounted for 12.3% of the total sample. This distribution reflects the general composition of employees involved in operational and driving functions within NIOSH Malaysia, where male participation tends to dominate due to the nature of the work.

Regarding educational background, the data indicate that most respondents either had no formal academic qualifications (57.9%) or other qualifications (24.6%). The remaining respondents, comprising those with bachelor's or doctoral degrees, represented less than 17.5% of the total. This pattern suggests that a large proportion of the workforce engaged in RTSMS implementation consists of drivers or personnel with practical competencies rather than formal academic credentials. These individuals are directly responsible for vehicle operations and the management of RTSMS ISO 39001:2013 and ISO 39002:2002 at both NIOSH Malaysia Headquarters and Regional Offices.

Regarding respondents' driving and road-use experience, the majority reported 6–10 years (31.6%), followed by 1–5 years (22.8%) and 11–15 years (19.3%). Another 19.3% of respondents reported more than 21 years of driving experience, while a smaller group (7%) had 16–20 years of experience. This distribution indicates that most respondents are highly experienced and familiar with road usage and vehicle operation, thus capable of providing informed and reliable responses regarding cognitive and behavioural changes in road users following the implementation of RTSMS ISO 39001:2013 and ISO 39002:2002.

Regarding cognitive understanding and behavioural awareness related to road safety management, 96.5% of respondents reported attending safe driving technique courses, demonstrating a strong foundation in safe driving practices. Moreover, all respondents reported having at least a basic understanding of the RTSMS ISO 39001:2013 management system. However, when assessing their knowledge depth, 78.9% described their understanding as moderate, whereas 21.1% acknowledged having limited knowledge of cognitive changes in road user behaviour towards RTSMS implementation.

Given that knowledge and understanding of cognitive processes play a crucial role in influencing behavioural adaptation, these findings suggest that the respondents possess sufficient familiarity to respond effectively to the questionnaire. Prior studies have emphasised that individual competence and domain-specific knowledge are key determinants of one's ability to make informed and high-quality decisions (Mirzaei et al., 2014; Safety Institute of Australia, 2012). Thus, the respondents' level of experience and awareness significantly strengthens the reliability of the data collected for this research.

Table 4.1
Respondents Profile

Respondents Demography	Category	Frequency	Percentage (%)
Gender	Male	50	87.70
	Female	7	12.30
Organization	NIOSH HQ	23	40.40
	17 Regional Office	34	59.60
Position Grade	Driver	34	59.60
	Executive	19	33.30
	Manager	4	7.00

Education	Doctor of Philosophy	1	1.80
	Master Degree	3	5.26
	Bachelor’s Degree	6	10.50
	Diploma	14	24.60
	Others	33	57.90
Period of service	> 21 years	11	19.30
	16 years – 20 years	4	31.60
	11 years – 15 years	11	19.30
	6 years – 10 years	17	31.60
	1 years – 5 years	14	22.80
		24	16.90
Understanding of RTSMS ISO 39001:2013 and ISO 39002:2002	Knowledgeable	67	47.20
	Understand	41	28.90
	Limited knowledge	10	7.00

The researchers distributed an online questionnaire to 60 respondents who were directly involved in the management of construction-related projects at NIOSH Malaysia Headquarters (HQ) and Regional Offices. The coordination and dissemination of the questionnaire were facilitated through the respective Heads of Department (HODs) to ensure the participation of relevant personnel. In accordance with ethical research practices and confidentiality requirements, respondents' identities were anonymised during analysis. They were coded sequentially as Respondent 1, Respondent 2, Respondent 3, and so forth, up to the final respondent.

The Google Forms database recorded 57 completed questionnaires, representing an effective response rate of 100% from the targeted population. This response rate reflects a high level of cooperation and commitment from NIOSH Malaysia staff, particularly due to the active involvement of departmental heads in encouraging participation across various hierarchical levels and job functions.

Following data screening and validation, all 57 responses were deemed complete and suitable for inclusion in subsequent stages of statistical analysis, resulting in a 30% valid response rate. The final dataset, therefore, provides a reliable representation of respondents engaged in the management and implementation of RTSMS ISO 39001:2013 and ISO 39002:2002 within NIOSH Malaysia's HQ and Regional Offices.

Table 4.1 presents a detailed breakdown of the response rates obtained from respondents involved in managing RTSMS-related initiatives within the organisation.

Table 4.2
Distribution of Questionnaires

Items	Respondent	Percentage %
Number of questionnire distribute by email	60	100
Number of questionnaire responses	57	95
Number of completed questionnaires for analysis	57	95
Number of incomplete and rejected questionnaires	0	0

4.2.2 Result and Data Interpretation (Items B, C, D, E & Secondary Data KOSB)

A total of 57 respondents, representing 30% of NIOSH Malaysia's total workforce, participated in this study. The questionnaire was carefully reviewed and validated by experts from NIOSH Malaysia, the Malaysia Road Traffic Safety Association (MRTSA), the Malaysian Institute of Road Safety Research (MIROS), KOTAMAS Sdn. Bhd. (representing road users), and academic researchers from MITRANS, including the research supervisor. This expert validation process ensured the clarity, reliability, and content validity of the survey instrument prior to distribution.

The analysis of data obtained from the respondents forms the basis of the empirical investigation conducted at NIOSH Malaysia Headquarters (HQ) and 17 Regional Offices. The results were analysed using bar chart and Partial Least Squares Structural Equation Modelling (PLS-SEM). The subsequent discussion focuses on identifying and interpreting the factors influencing cognitive changes in the mindset and behaviour of road users toward the implementation of RTSMS ISO 39001:2013 and does RTSMS ISO 39001 will sustain cognitive and behaviour of institutional road users (NIOSH Malaysia). Specifically, it examines the causal relationships between the exogenous latent variables (independent variables) and endogenous latent variables (dependent variables) as defined in the proposed conceptual model of cognitive change. In addition, this chapter highlights the significance of the proposed model (Aze+ concepts RTS causation theory) in predicting and explaining the influence of cognitive transformation and behavioural adaptation toward RTSMS ISO 39001:2013 and ISO 39002:2002 within the NIOSH Malaysia context. The explanatory power of the model framework is discussed in relation to both the empirical findings and previous studies conducted domestically and internationally on cognitive and behavioural responses to road traffic safety management initiatives.

The research framework for this study was formulated based on an extensive literature review focusing on the influence of integration of Heinrich’s Domino and Multi-Causation theories, Bird and Germain’s Loss Causation Model, Reason’s System Safety framework, and Bandura’s Social Cognitive Theory within the transportation and road safety sectors, both locally and globally. The framework was contextualised to reflect the implementation of RTSMS ISO 39001:2013 and ISO 39002:2002 at NIOSH Malaysia (HQ and Regional Offices). The model development process began by identifying key road traffic safety (RTS) risks relevant to the organisation or institutional setup, which were subsequently conceptualised into dependent and independent variables to establish the hypothesised structural relationships.

The hypotheses were formulated to test whether the designed model adequately captured the theoretical relationships proposed in the conceptual framework, based on empirical. Findings from hypothesis testing provide statistical evidence supporting inferences about the impact of the RTSMS ISO 39001:2013 on the cognitive and behavioural dimensions of professional personnel within NIOSH Malaysia.

The detail bar diagram and detail analysis based on every each of question have been conducted to tested the hypothesis and explore the finding confirming the tested result with the three (3) identify objective. The finding from the respondent’s, showed bar diagram illustrates the extent to which employees perceive they have received training related to the Road Traffic Safety Management System (RTSMS) in alignment with their specific job scopes. Data collected from 57 respondents indicates a strong positive skew, with a significant majority of the workforce reporting high levels of training integration. Specifically, in the diagram B1 recorded 45.6% (n=26) of respondents provided the highest rating of 7, while 33.3% (n=19) rated it a 6.

Collectively, 78.9% of the participants agree that RTSMS training is actively provided, suggesting a robust implementation of MS ISO 39001:2013 standards within the NIOSH Malaysia. RTSMS training to the new staff's scope of work. Training is one of the cognitive factors that change road user cognitive. Several researchers in this field (Anstey et al., 2005; Bliss et al., 2009; Kravchenko et al., 2018; Lajunen et al., 2022; Marinova et al., 2022; M. Miller Sally, 2015; Moran et al., 2010; Shazwani Rosli et al., 2017c; Stoma et al., 2021; Wendy Lindstrom-Forneri, 2001; Zamri & Hamzah, 2022) have identified the cognitive and behavioural factors impacting road traffic users. Factors such as hazard perception, lack of driving skills, poor situational awareness, and crash history have an impact on cognitive and behavioural skills among novice young drivers.

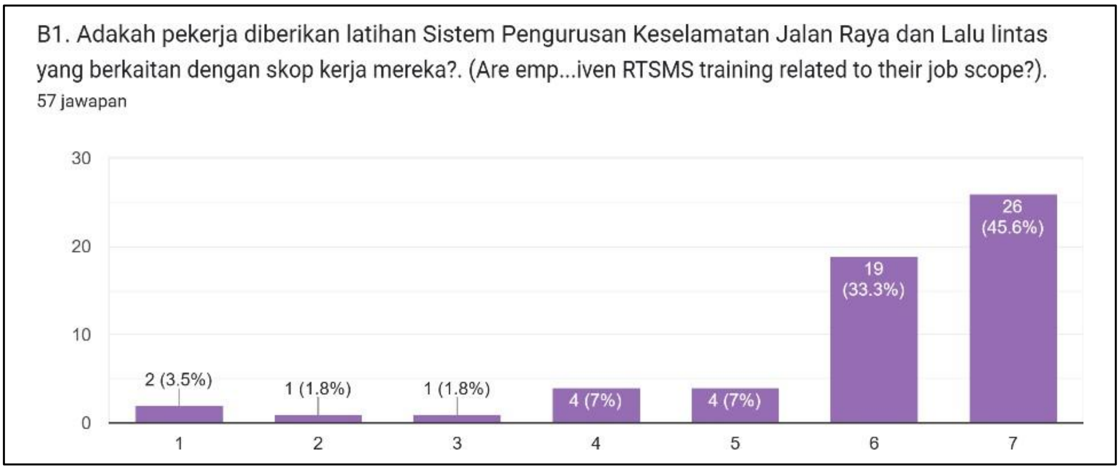


Figure 4.1 Answer B1- RTSMS Training

As shown in the bar chart above, the descriptive analysis of RTSMS training (Item B1) reveals that the vast majority of respondents (78.9%) perceive the training as highly relevant to their job scope. This high level of perceived implementation provides a necessary empirical basis to test Hypothesis H1, as it confirms that the organizational framework of ISO 39001 is sufficiently established to potentially influence the Cognitive Road User behaviour as outlined in the study's primary objectives.

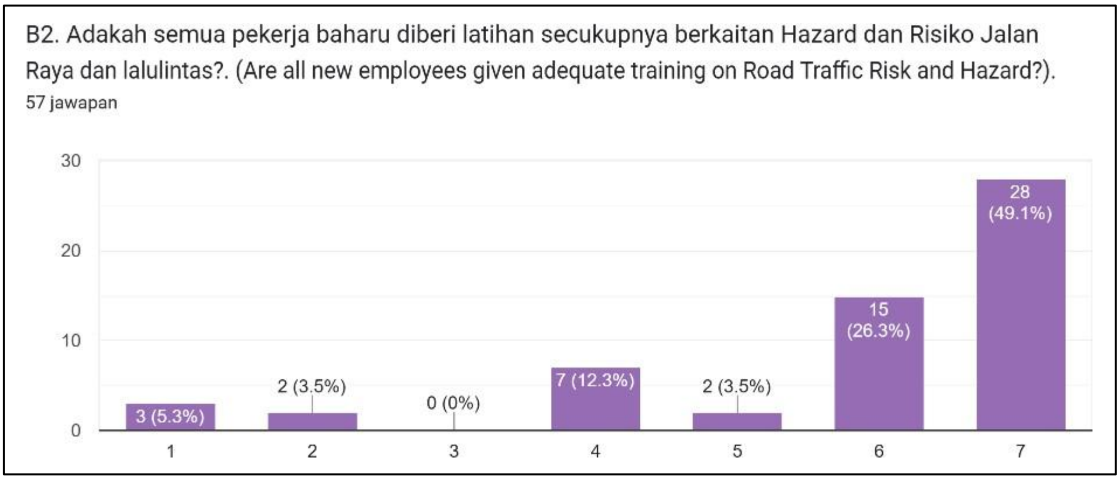


Figure 4.2 Answer B2 – Road Traffic Risk and Road Hazard

The bar diagram for item B2 evaluates the perceived adequacy of training regarding road traffic risks and hazards provided to new employees within the organization. Out of 57 respondents, nearly half (49.1%, n=28) provided the highest possible rating of 7, with an additional 26.3% (n=15) providing a rating of 6. This indicates that a combined 75.4% of the participants believe that new employees are strongly equipped with the necessary hazard-recognition knowledge from the onset of their employment. Such high scores suggest that the organization prioritizes early intervention as a core component of its Road Traffic Safety Management System (RTSMS) implementation. The descriptive analysis for Item B2 reveals a significant positive skew, with 75.4% of respondents agreeing that new employees receive adequate training on road traffic hazards. Within the context of the study's theoretical framework, this reflects a proactive implementation of MS ISO 39001:2013, aimed at early cognitive calibration of road users. These results provide strong foundational support for Hypothesis H1, suggesting that the organizational safety system is actively positioned to influence road user behaviour by addressing cognitive risk awareness at the point of entry.

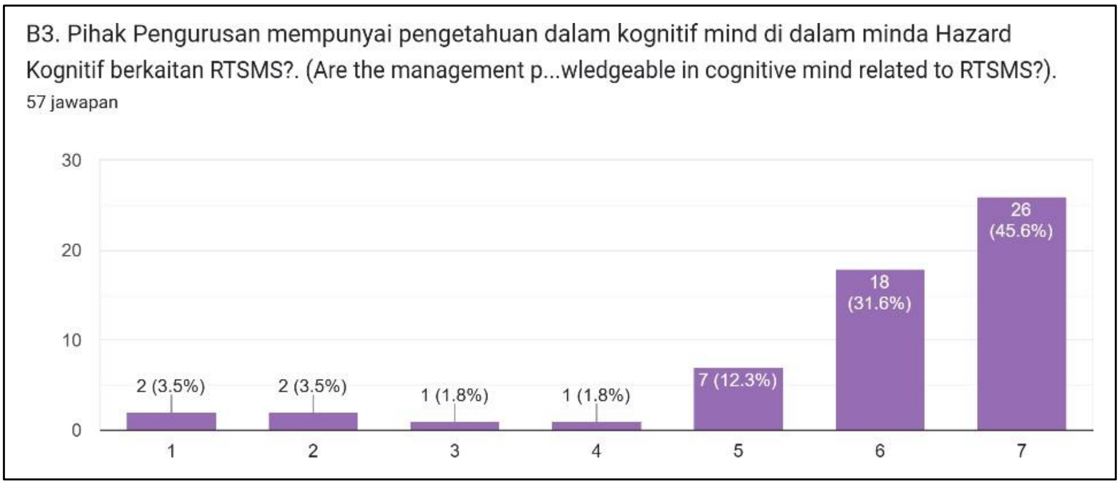


Figure 4.3 Answer B3 – Awarness in RTSMS Implementation

Based on the B1 and B2 findings, showed RTSMS Implementation and Organizational Awareness a descriptive analysis of the implementation of the Road Traffic Safety Management System (RTSMS) ISO 39001:2013, which includes training aspects according to the scope of work (B1), hazard induction training for new staff (B2), and management's cognitive knowledge level (B3) this indicates a consistent and high level of organizational readiness. Based on the data collected, 78.9% of respondents acknowledged the effectiveness of the training provided according to the scope of their respective tasks, while 75.4% confirmed the adequacy of initial education on road hazards.

This result is further strengthened by the findings for item B3, where 77.2% of respondents gave a positive assessment (scores of 6 and 7) of management's knowledge in the cognitive mindset related to RTSMS. The combination of these findings provides a strong empirical basis for achieving Objective 3, which is to assess the impact of RTSMS on the organizational safety environment. Theoretically, high cognitive awareness at the management level (B3) acts as a "top-down" catalyst supporting Hypothesis H1, where the implementation of the ISO 39001 standard is seen not as a mere technical procedure, but as a system that integrates with the cognitive processes of road users.

This alignment between operational training and management understanding demonstrates that the organization is attempting to "cognitive recalibration" to address behavioural issues such as Vengeance Syndrome (Aze+ concepts RTA causation theory). This directly supports Hypothesis H3, which suggests that cognitive changes driven by a robust management system will result in safer driving behaviour changes within the context of organizational and national policies.

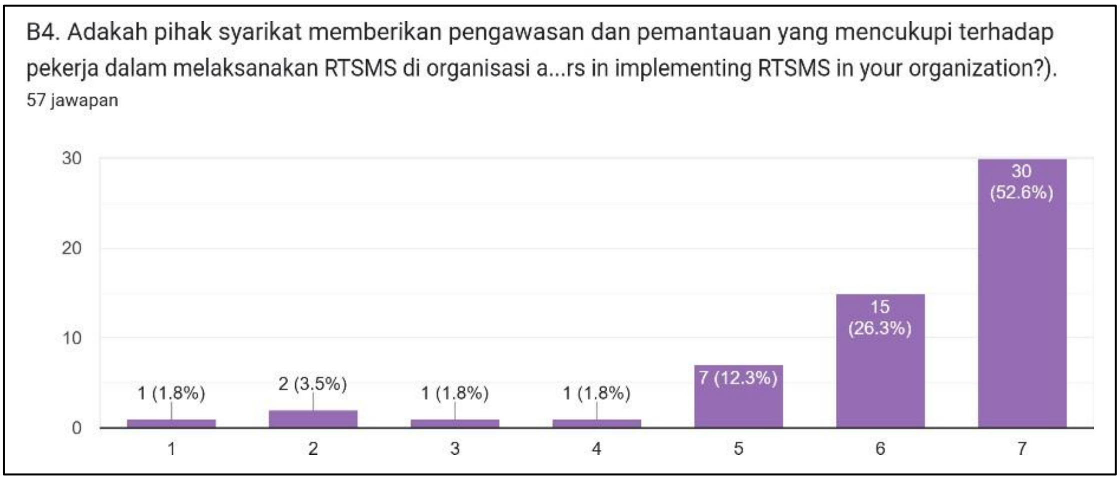


Figure 4.4 Answer B4 – Company’s Oversight in Ensuring RTSMS

The data for Item B4 measures the perceived effectiveness of the company’s oversight in ensuring that the Road Traffic Safety Management System (RTSMS) is properly executed by employees. The results show a high level of confidence in the organization's monitoring mechanisms, with 52.6% (n=30) of respondents giving the highest rating of 7 and 26.3% (n=15) giving a rating of 6. This combined score of 78.9% indicates that the organization does not just provide training (as seen in B1 and B2) but also maintains active governance to ensure compliance.

From a theoretical perspective, this supervision acts as a "Moderator" in this research framework. While training (B1, B2) influences the Cognitive of Road User, supervision (B4) ensures that this cognitive awareness actually translates into Road User Behaviour. This strongly supports my research Hypothesis, as it demonstrates that the "Implementation of RTSMS" is backed by an active monitoring system, which is essential for systemic behavioural change.

The collective findings for items B1 through B4 demonstrate a robust organizational commitment to MS ISO 39001:2013. With high scores across training (78.9%), hazard induction (75.4%), management awareness (77.2%), and active supervision (78.9%), the data confirms that the 'System' variable in the conceptual framework is fully operational. This operational readiness is critical for testing Hypothesis H1 and H3, as it provides the necessary environmental conditions to influence the Cognitive Road User and subsequently mitigate negative behaviours such as 'Vengeance Syndrome' or aggressive driving.

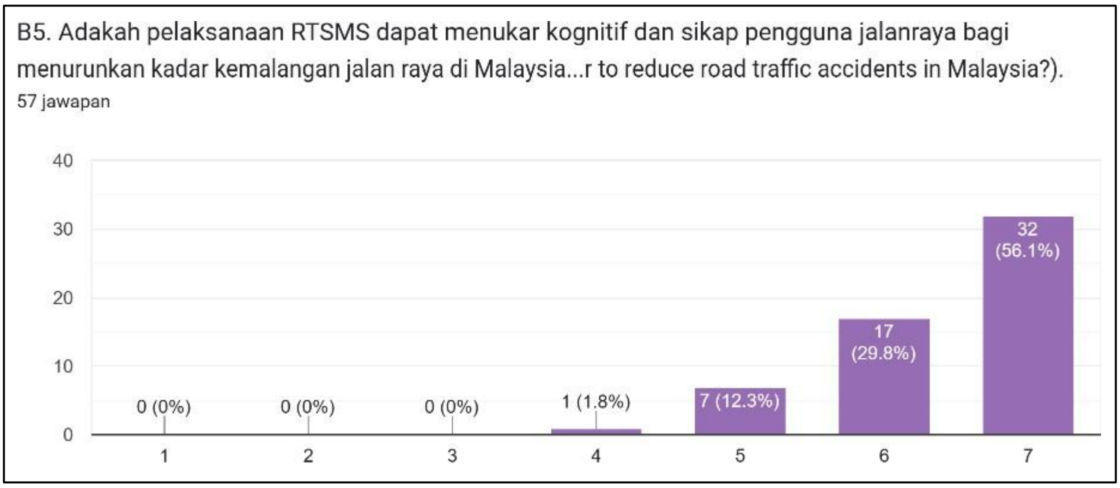


Figure 4.5 Answer B5 – RTSMS Effectively Transform Cognitive Mind

Item B5 evaluates the extent to which respondents believe that the implementation of RTSMS (ISO 39001) can effectively transform the cognitive processes and attitudes of road users to reduce road traffic accidents in Malaysia. The results demonstrate an overwhelming level of agreement, with 56.1% (n=32) of respondents providing the highest rating of 7 and 29.8% (n=17) providing a rating of 6. Collectively, 85.9% of participants perceive the management system as a powerful instrument for behavioural change.

This finding provides strong preliminary support for the Alternative Hypotheses (HA) of H1 and H3. It suggests that, from the perspective of the users, the safety management system is not merely a set of technical procedures but a transformative tool capable of "recalibrating" driver cognitive (psychology). This high score reinforces Research Objectives 1 and 3, validating the theoretical link between structured organizational systems and the mitigation of negative cognitive.

Based on observed data in item B5 (85.9%) is particularly noteworthy, as it reflects a strong consensus that the RTSMS is capable of driving significant cognitive and attitudinal shifts. These results provide a robust empirical foundation for the study's conceptual framework, suggesting that the interaction between organizational safety systems and human cognition is indeed the primary mechanism for reducing risky driving behaviours and, ultimately, lowering the rate of road traffic accidents.

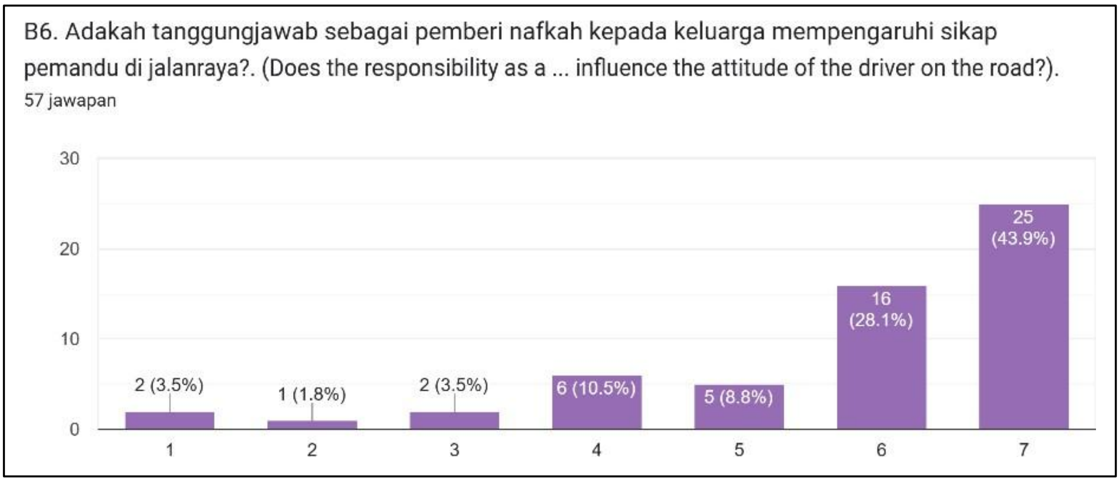


Figure 4.6 Answer B6 – Family Breadwinner Influences Driver's Attitude

The item B6 in the figure 4.6 examines whether the responsibility of being a family breadwinner influences a driver's attitude on the road. Based on 57 respondents, the data shows a significant positive skew, with 43.9% (n=25) providing the highest rating of 7 and 28.1% (n=16) providing a rating of 6. This cumulative agreement of 72% suggests that the majority of road users perceive their social role and family obligations as a powerful internal "Cognitive Control" that regulates their driving behaviour. This directly determines a specific cognitive factor (breadwinner responsibility) that has a significant perceived impact on behaviour. It suggests that safety is not just about rules, but about personal "stakes."

The findings for item B6 (72% agreement) highlight the importance of socio-cognitive factors in the Pre-Event Phase of road safety. By identifying 'breadwinner responsibility' as a significant influence on driver attitude, the study establishes that cognitive road user behaviour is shaped by both external systems (ISO 39001) and internal social values. This supports the Alternative Hypothesis (HA) for H2, as it demonstrates that the driver's mental state, influenced by perceived family responsibility is a primary determinant of their behaviour on the road. Consequently, safety management systems should not only focus on technical skills but also leverage these deep-seated psychological drivers to enhance the effectiveness of safety interventions.

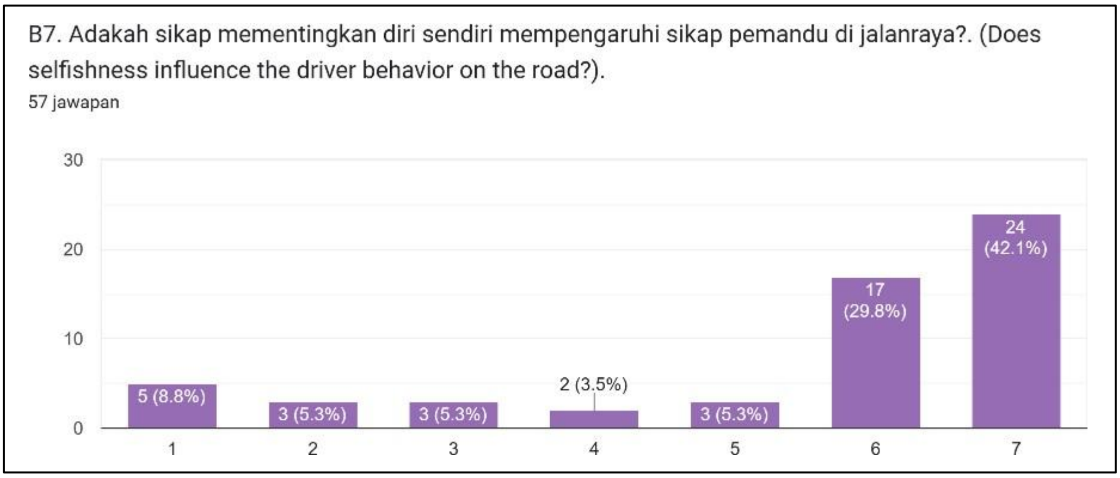


Figure 4.7 Answer B7 – Impact of Selfishness on Driver Behaviour

Above item B7 examines the perceived impact of selfishness (sikap mementingkan diri sendiri) on driver behaviour. Among the 57 respondents, 42.1% (n=24) provided the highest rating of 7, while 29.8% (n=17) provided a rating of 6. This cumulative agreement of 71.9% indicates strong consensus that selfishness is a significant internal psychological factor that shapes how individuals conduct themselves on the road. The analysis for B7 introduces the "negative" psychological counterpart to the previous item. While B6 looked at positive social responsibility, B7 identifies a primary behavioural threat such as selfishness which directly correlates with the "Vengeance Syndrome" and "Aggression" identified in my theoretical framework.

The findings for Item B7 (71.9% agreement) provide empirical evidence for the Cognitive-Human behaviour component of the study's theoretical framework. By identifying selfishness as a significant driver of road behaviour, the data highlights a specific psychological threat that often manifests as aggression or 'Vengeance Syndrome' during the Pre-Event Phase. This result strongly supports the Alternative Hypothesis (HA) for H2, confirming that internal cognitive traits are perceived to have a significant impact on behavioural outcomes. Furthermore, the close alignment between the scores for item B6 (72.0%) and B7 (71.9%) suggests a complex interplay between positive social responsibilities and negative individual traits, both of which must be addressed by the RTSMS (ISO 39001) to effectively reduce road traffic accidents.

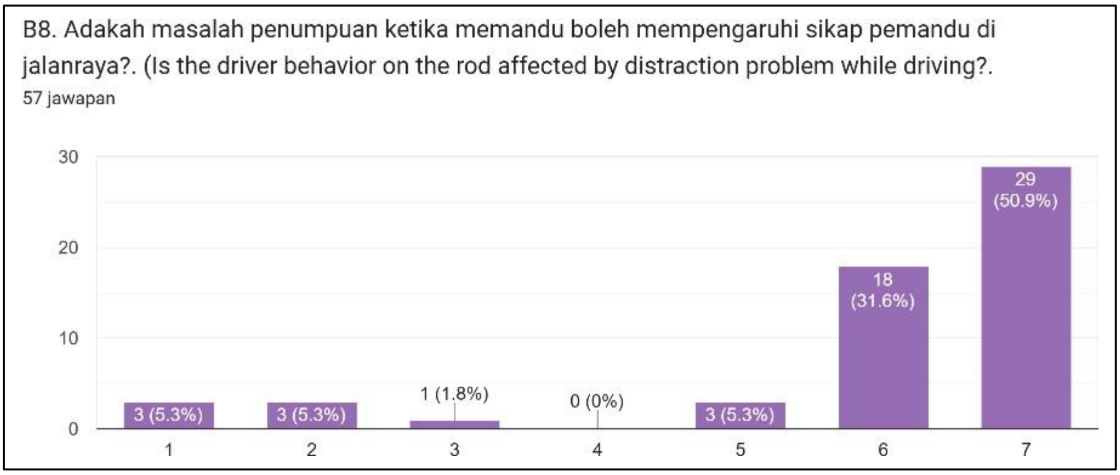


Figure 4.8 Answer B8 – Distraction on Critical Cognitive Impairment

The analysis of item B8 focuses on distraction (penumpuan), which is a critical cognitive impairment that disrupts the "Pre-Event Phase" of theoretical framework in this study. Item B8 investigates whether distraction problems while driving significantly influence the behaviour of road users. The results from 57 respondents show a very high level of concern, with 50.9% (n=29) giving the highest rating of 7 and 31.6% (n=18) giving a rating of 6. This cumulative agreement of 82.5% represents one of the highest levels of consensus in the study, indicating that distraction is perceived as a primary cognitive factor that degrades driving behaviour.

The findings for item B8 (82.5% agreement) identify distraction as a critical cognitive factor that dictates road user behaviour. Within the study's theoretical framework, distraction represents a significant cognitive threat during the Pre-Event Phase, as it prevents the road user from effectively managing environmental hazards. This overwhelming consensus provides robust support for Hypothesis H2, confirming that cognitive processes specifically the ability to maintain focus are perceived to have a direct and significant influence on behavioural outcomes. Furthermore, when compared with Item B5 (85.9%), the data suggests that while the RTSMS (ISO 39001) is the preferred system for intervention, it must specifically address internal cognitive challenges like distraction and selfishness to be truly effective in reducing traffic accidents.

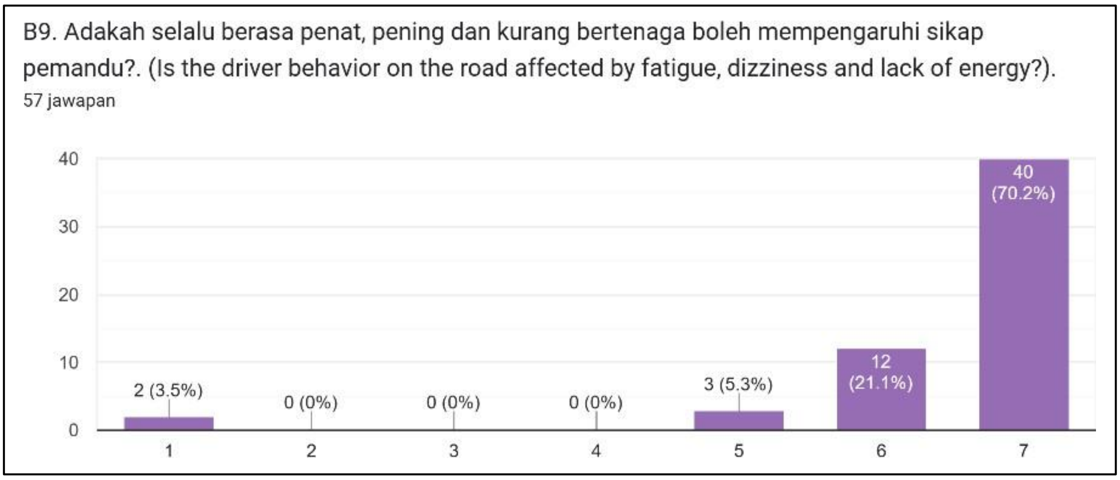


Figure 4.9 Answer B9 – Physical States Affect Driver Behaiour

Item B9 examines whether physical states, specifically fatigue, dizziness, and a lack of energy significantly affect driver behaviour. The data reveals an overwhelming consensus among the 57 respondents, with 70.2% (n=40) providing the highest rating of 7 and 21.1% (n=12) providing a rating of 6. This cumulative agreement of 91.3% is the highest recorded in the study, indicating that physical well-being is perceived as the most critical factor influencing the Cognitive Road User.

This tabulate strong Evidence of Root Cause in my Theoretical Framework, fatigue and dizziness are "Root Causes" in the Pre-Event Phase. A driver experiencing these states will suffer from degraded "Cognitive Human behaviour" making them more susceptible to errors or negative cognitive such as "Vengeance Syndrome" (Aze+ concepts RTA causation theory – Theoretical Framework) triggers. This result confirms that the physical and mental state of the road user has a profound and direct impact on their behaviour. The findings for Item B9 (91.3% agreement) highlight that fatigue and physical exhaustion are the most significant factors perceived to influence road user behaviour. Within the study's theoretical framework, these physical states represent a critical failure in the Pre-Event Phase, directly impairing the Cognitive Road User's ability to maintain safety and control. This result provides overwhelming evidence for the Alternative Hypothesis (HA) for H2, confirming that a compromised mental or physical state is a major driver of behavioural change. Consequently, the RTSMS (ISO 39001) must incorporate fatigue management and health monitoring as core components of its safety system to effectively mitigate the root causes of road traffic accidents in Malaysia.

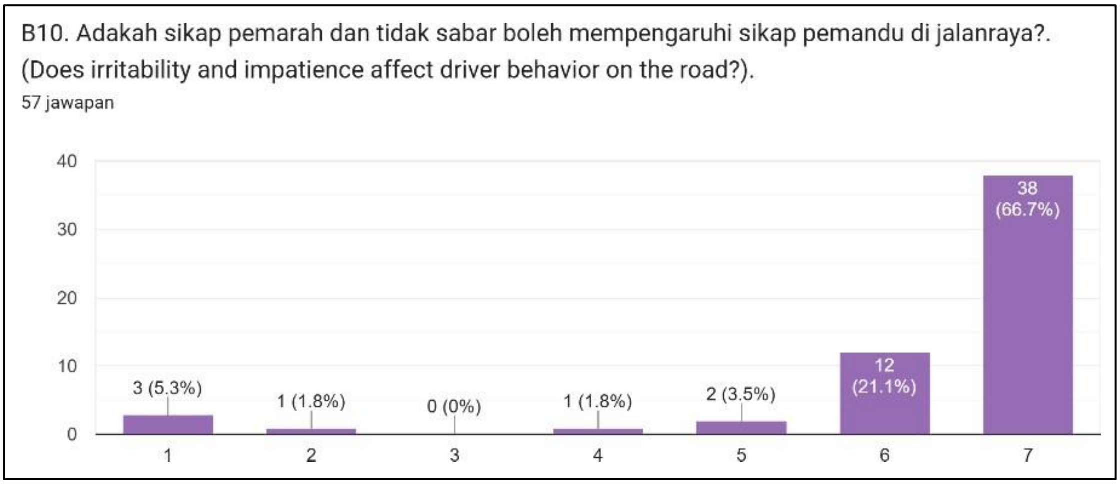


Figure 4.10 Answer B10 – Emotional and Temperamental Triggers Influence Driver Behaviour

The findings for item B10 focus on emotional and temperamental triggers, which are core components of the Cognitive of the Road User in the triangular framework. Item B10 evaluates whether irritability and impatience significantly influence driver behaviour on the road. The data from 57 respondents shows a very strong consensus, with 66.7% (n=38) providing the highest rating of 7 and 21.1% (n=12) providing a rating of 6. This cumulative agreement of 87.8% indicates that road users recognize volatile emotional states as a major determinant of their behaviour.

It's evidence of negative cognitive implications, irritability and impatience are direct emotional precursors to Behavioural Impact. In the context of your study, these states represent the "internal threats" that lead to aggressive actions, with Vengeance Syndrome being the most severe negative implication of such a cognitive state. This support Research Objective 1, result proves that emotional cognitive factors are perceived to have a profound impact on behavioural outcomes. It's validated of Hypothesis H2 (The Direct Human Path), H2 posits that the cognitive of the road user has a direct influence on road user behaviour. The high agreement (87.8%) provides empirical evidence that when a driver's cognitive state is compromised by anger or impatience, it results in a significant and potentially dangerous behavioural impact.

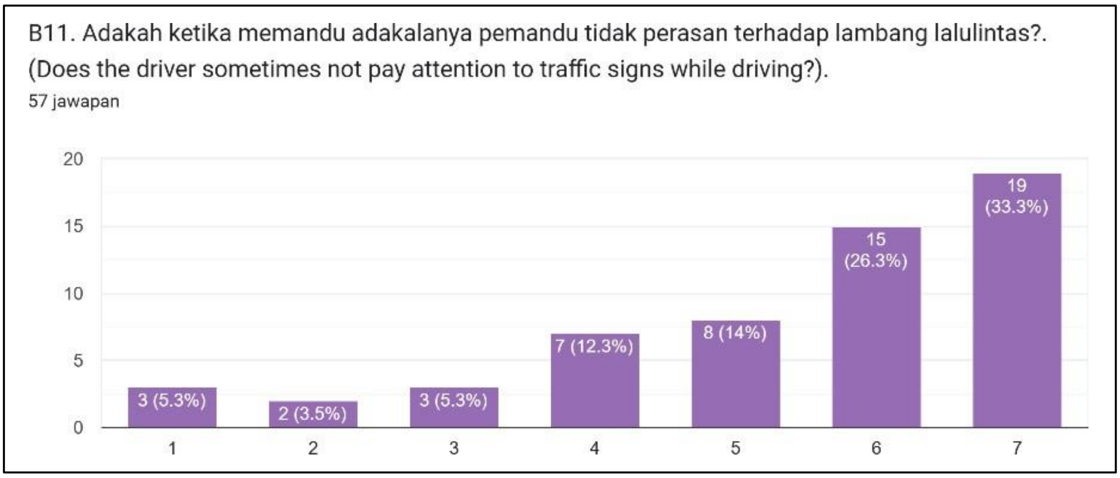


Figure 4.11 Answer B11 – Attention to Traffic Sign While Driving

The above bar focuses on the cognitive aspect of attention and perception as represented by item B11. The instrument evaluates whether drivers experience cognitive lapses by failing to perceive or pay attention to traffic signs while driving. The data from 57 respondents indicates a majority consensus, with 33.3% (n=19) providing the highest rating of 7 and 26.3% (n=15) providing a rating of 6. This cumulative agreement of 59.6% (n=34) suggests that while not as frequent as emotional triggers, a significant portion of road users recognise that cognitive inattention is a recurring factor in their driving experience.

Failing to notice traffic signs is a direct manifestation of a breakdown in the "Cognitive - Human Behaviour" section in the framework. In the context of this study, it represents a Passive Cognitive Threat, a lapse in situational awareness that can lead to unintentional "RTS Accidents". This result supports objective 1, to determine how cognitive factors specifically lead to attention and perception to impact road user behaviours. It identifies a specific cognitive mediator (inattention) that explains why drivers may fail to comply with road safety systems. The findings for Item B11 (59.6% agreement) highlight the prevalence of perceptual lapses within the Cognitive of the Road User variable. By identifying the failure to pay attention to traffic signs as a notable factor in driving behaviour, the data reinforces the direct pathway established in Hypothesis H2. Unlike the active emotional triggers seen in Item B10, Item B11 represents a passive cognitive failure in which the 'People' component of the P-E-A-R model fails to interact appropriately with the 'Environment' (traffic signs). This underscores the necessity for ISO 39001 (RTSMS) to go beyond administrative controls and incorporate 'fail-safe' environmental designs that compensate for the inherent cognitive limitations and attention deficits of the road user.

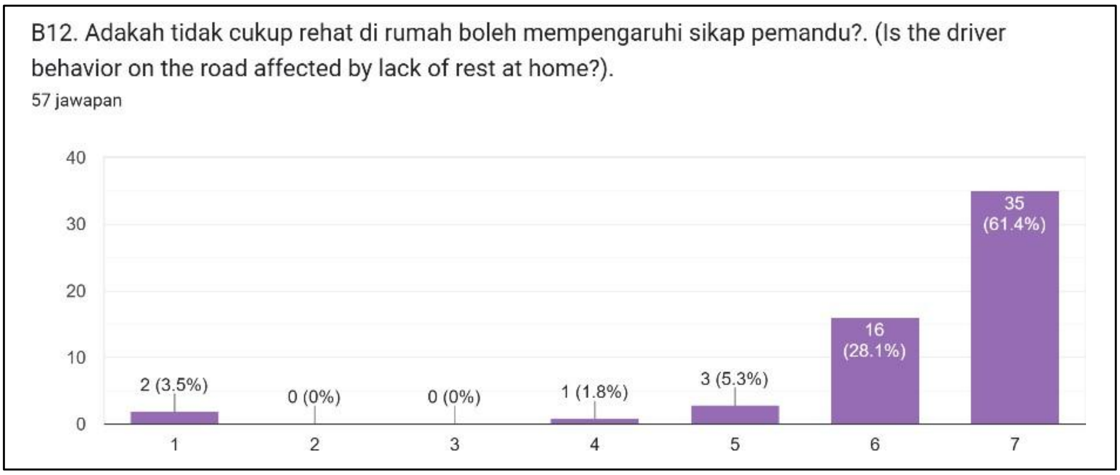


Figure 4.12 Answer B12 – Lack of Rest Affected the Driver's Behaviour

Item B12 evaluates whether the driver's behaviour on the road is affected by a lack of rest at home. The data from 57 respondents indicates an extremely high consensus, with 61.4% (n=35) providing the highest rating of 7 and 28.1% (n=16) providing a rating of 6. This cumulative agreement of 89.5% (n=51) demonstrates that road users overwhelmingly recognise that their physiological state, specifically fatigue due to inadequate rest, is a critical factor influencing their behaviour behind the wheel.

The findings for Item B12 (89.5% agreement) underscore the profound influence of physiological readiness on the Cognitive of the Road User variable. By identifying a lack of rest as a major determinant of road behaviour, the data validates the direct pathway established in Hypothesis H2. This suggests that the 'People' element in the P-E-A-R model is highly susceptible to external stressors that occur outside the driving environment. Consequently, for the ISO 39001 (RTSMS) to be fully effective (as per H1 and H3), it must include policies regarding fatigue management and 'fit-for-duty' assessments, ensuring that the driver's cognitive state is not compromised by physiological exhaustion before they engage with the road transport system.

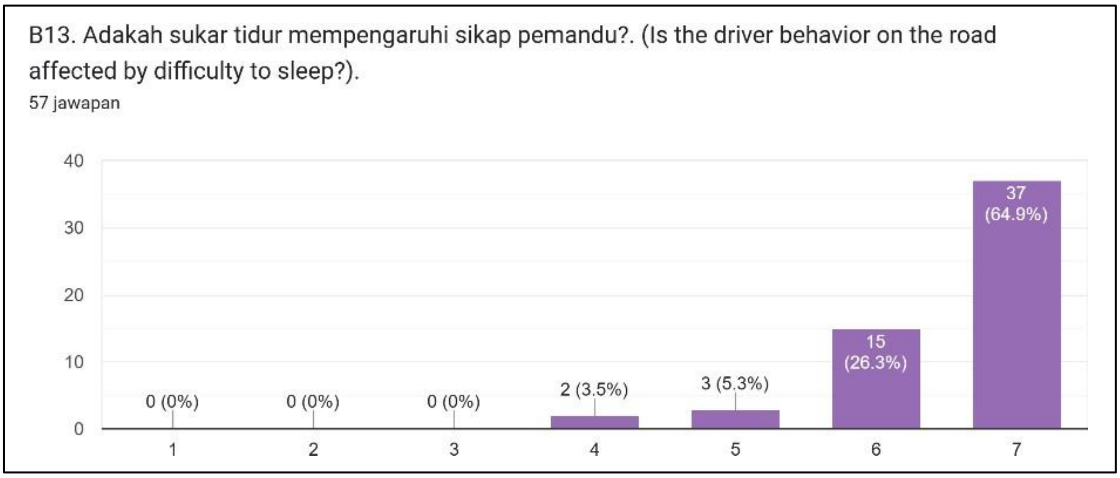


Figure 4.13 Answer B13 – Sleeping Difficulty Affects Driver Behaviour

Item B13 evaluates whether difficulty sleeping significantly affects driver behaviour on the road. The data from 57 respondents show strong consensus, with 64.9% (n=37) providing the highest rating of 7 and 26.3% (n=15) providing a rating of 6. This cumulative agreement of 91.2% (n=52) indicates that road users recognise sleep deprivation as a critical physiological impairment that dictates their behavioural patterns behind the wheel.

Difficulty sleeping is a primary physiological factor that degrades cognitive functions such as reaction time, judgment, and emotional regulation. In the context of your framework, this represents a major "Internal Threat" that increases the likelihood of moving from Aggression to Violence. This result provides empirical support for the objective to clarify how cognitive and physiological factors impact road-user behaviours. It identifies sleep quality as a specific mediator for behavioural outcomes. Hypotheses H2 posits that the cognitive/physiological state of the road user has a significant influence on behaviour. The very high agreement (91.2%) provides strong evidence that when a driver's internal state is compromised by sleep issues, it results in a significant negative Behavioural Impact.

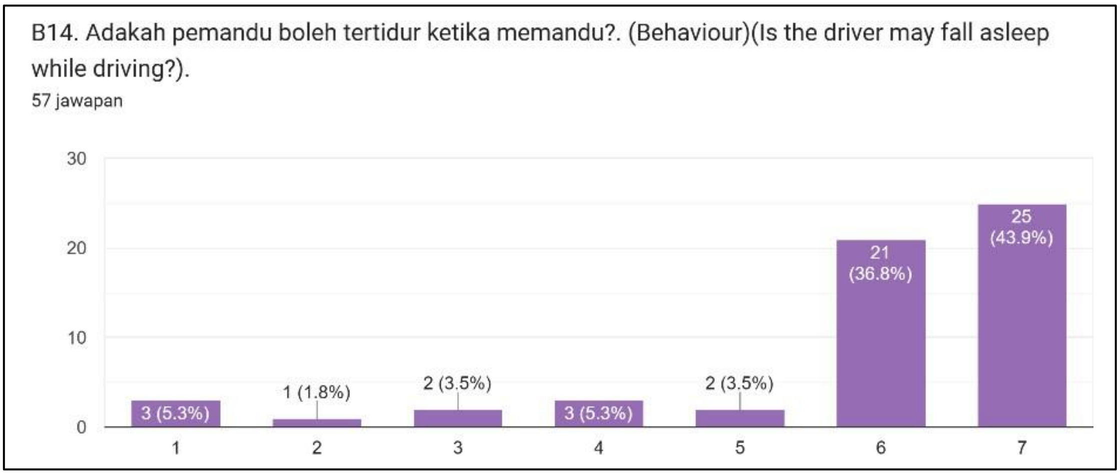


Figure 4.14 Answer B14 – Fall Asleep While Driving

Item B14 evaluates whether respondents acknowledge that a driver may fall asleep while driving. The data from 57 respondents shows a strong consensus, with 43.9% (n=25) providing the highest rating of 7 and 36.8% (n=21) providing a rating of 6. This cumulative agreement of 80.7% (n=46) indicates that road users recognise falling asleep, the ultimate physiological and behavioural failure as a significant and realistic threat in their driving environment (Stoma et al., 2021). Falling asleep is categorised in this study as a "Behaviour." In the research framework, this is the final stage before a "Road Traffic Crash." Unlike earlier items that dealt with emotional triggers, B14 represents the direct physical consequence of the physiological threats identified in Items B12 and B13 (Lack of rest and sleep difficulty).

This result provides empirical evidence for the objective to link cognitive/physiological factors to observable behavioural outcomes. It shows that the "internal threats" (fatigue) lead to a specific, dangerous behaviour (falling asleep). Hypothesis H2 posits that the cognitive/physiological state of the road user significantly influences behaviour. The 80.7% agreement shows that a compromised internal state (exhaustion) directly leads to the loss of conscious behaviour, supporting the path from Cognitive. Consequently, this underscores the necessity for ISO 39001 (RTSMS) to move beyond passive prevention and implement active monitoring systems such as fatigue sensors or mandatory rest stop intervals to mitigate the 'Magnitude of Danger' before a behavioural lapse result in a fatal RTS Accident (Stoma et al., 2021). Thus, B14 provides the empirical evidence required to reject the null hypotheses for both the system's effectiveness (H1) and the synergy between the system and the user (H3).

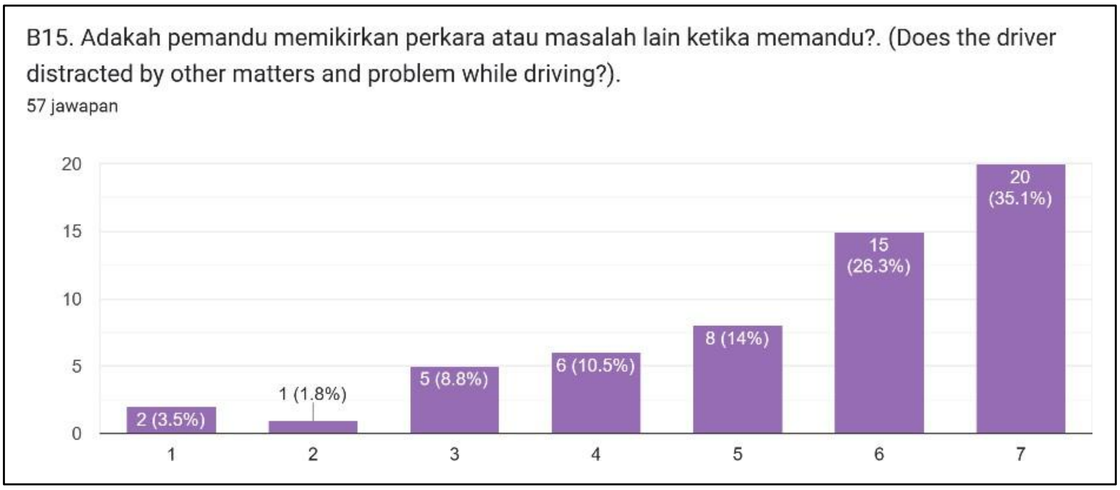


Figure 4.15 Answer B15 – Cognitive Distraction (Internal Thoughts and Personal Problems)

The analysis for item B15, which focuses on Cognitive Distraction (internal thoughts and personal problems) and its relationship with all three of your research hypotheses. The results from the question aim to assess cognitive distraction and determine whether drivers are distracted by internal "other matters and problems" while driving. The data from 57 respondents indicates a significant consensus, with 35.1% (n=20) providing the highest rating of 7 and 26.3% (n=15) providing a rating of 6. This cumulative agreement of 61.4% (n=35) confirms that a majority of road users recognise that their cognitive focus is frequently compromised by non-driving-related mental burdens.

The findings for Item B15 (61.4% agreement) highlight the role of internal mental load within the Cognitive of the Road User variable. By identifying that personal problems and 'other matters' serve as significant distractions, the data reinforce the direct cognitive-behavioural pathway in Hypothesis H2. Furthermore, these results provide empirical support for Hypotheses H1 and H3, as they identify a specific internal threat that ISO 39001 (RTSMS) must address. To mitigate the 'Magnitude of Danger' effectively, the system must not only manage external road factors but also incorporate 'Industrial Best Practices' to address the driver's mental well-being. This ensures bidirectional synergy in which the system reduces cognitive load and the driver remains mentally present, thereby preventing the transition from a 'Threat' to an 'RTS Accident' as outlined in the study framework.

Figure 4.16 Answer B16 – Drivers Distracted by Other Activities While Driving

The item B16 evaluates whether drivers are distracted by other activities while driving (e.g., using mobile devices, eating, or interacting with technology). The data from 57 respondents indicates a majority agreement, with 33.3% (n=19) providing the highest rating of 7 and 22.8% (n=13) providing a rating of 6. This cumulative agreement of 56.1% (n=32) confirms that external activities are a significant factor that disrupts the primary task of driving for more than half of the respondents.

The findings for Item B16 (56.1% agreement) emphasise the impact of external task-interference on the Cognitive of the Road User variable. By identifying that secondary activities significantly distract drivers, the data provide empirical support for the direct pathway established in Hypothesis H2. Furthermore, these results provide a strong justification for Hypotheses H1 and H3, as they pinpoint a measurable behavioural risk that the ISO 39001 (RTSMS) is specifically designed to control. This underscores the necessity for the P-E-A-R model to address the 'Equipment' and 'Resources' variables, such as hands-free technologies or organisational policies, to ensure that external distractions do not compromise the driver's cognitive attention, thereby reducing the 'Magnitude of Danger' and preventing potential Road Traffic Crashes.

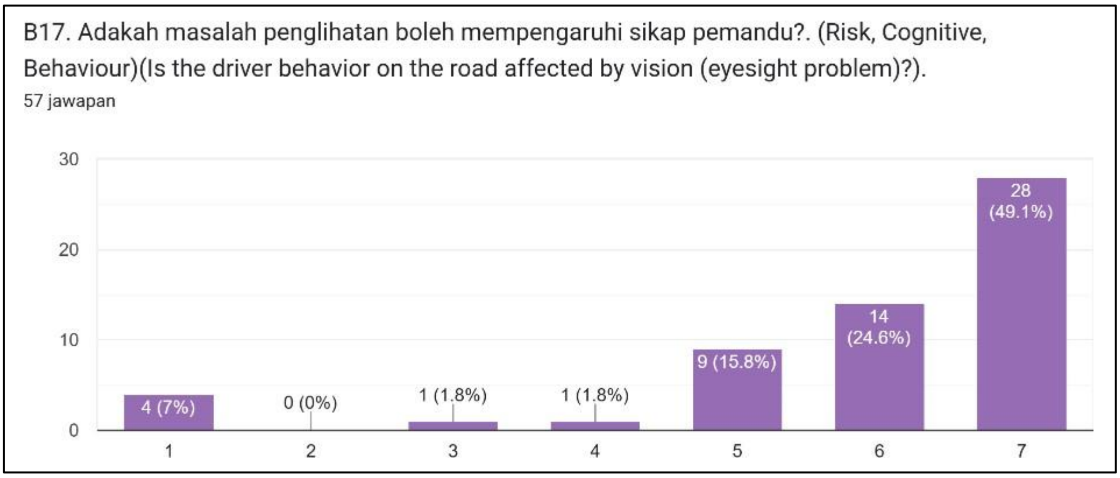


Figure 4.17 Answer B17 – Vision (Perception)

The analysis for item B17 focuses on Vision (Perception) as a critical cognitive-physiological factor. It will evaluate whether driver behaviour on the road is affected by vision or eyesight problems. The data from 57 respondents indicates a strong consensus, with 49.1% (n=28) providing the highest rating of 7 and 24.6% (n=14) providing a rating of 6. This cumulative agreement of 73.7% (n=42) confirms that road users recognise visual perception as a fundamental requirement for safe driving behaviour and a potential risk factor if compromised.

As per the study hypothesis, H1 suggests that the implementation of ISO 39001 significantly impacts behaviour through organisational control. Vision is classified as a "Road User Performance Factor" within the ISO 39001 framework. The 73.7% agreement validates H1 by identifying a specific cognitive barrier that the RTSMS must govern, for example, through mandatory medical screenings or vision tests for drivers to ensure "Industrial Best Practice" is maintained. Hypothesis H2 posits that the cognitive state (specifically, perception) of the road user significantly influences behaviour. Vision is the primary input for the cognitive process of "Perception" in your framework. The data proves that a deficit in visual input is perceived to lead directly to a negative behavioural Impact (e.g., late braking or missing traffic signs), supporting the Cognitive - Behaviour path. The hypothesis H3 focuses on the synergy between the system and the user's mental models. The findings in B17 illustrate the P-E-A-R model, specifically the interaction between People (Vision) and the Environment (Visibility / Road Conditions). H3 is validated because it shows that a robust RTSMS must provide an environment that accommodates the user's visual limits, while the user must be cognitively aware of their own visual constraints to align with the system's safety goals.

The findings underscore the critical importance of visual perception within the Cognitive of the Road User variable. By identifying eyesight problems as a significant driver of behavioural outcomes, the data reinforces the necessity of the ISO 39001 (RTSMS) governance as established in Hypothesis H1, particularly regarding driver fitness-to-drive protocols. Furthermore, these results provide empirical support for the direct cognitive-behavioural pathway in Hypothesis H2, as vision serves as the primary gateway for situational awareness. Consequently, the high level of agreement supports Hypothesis H3 by validating the P-E-A-R model; it demonstrates that the synergy between a driver's physiological capacity and a system's safety requirements is essential to mitigate the 'Magnitude of Danger' and prevent the transition from a 'Threat' to a 'Road Traffic Crash'.

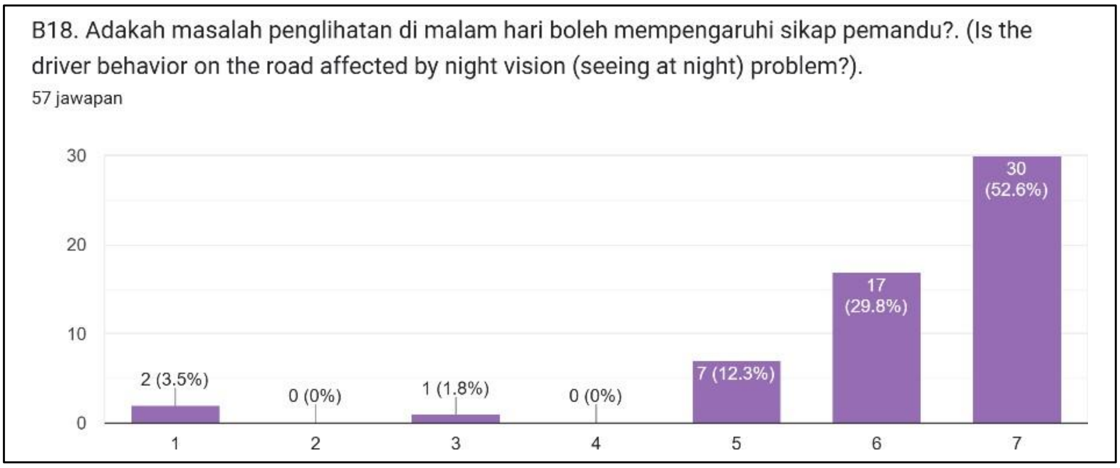


Figure 4.18 Answer B18 – Night Driving and Low Vision

Based on the analysis of the results in item B18, based on your specific question regarding Night Driving and Low Vision. This analysis aligns with your (Aze+ concepts RTA causation theory) and the required H1 – H2 – H3 sequence. It’s evaluating whether driving at night with low visibility/vision significantly contributes to the driver’s cognitive state and behavioural outcomes. The data from 57 respondents indicates a significant consensus, with 52.6% (n=30) providing the highest rating of 7 and 29.8% (n=17) providing a rating of 6. This cumulative agreement of 82.4% (n=47) confirms that road users recognise night driving as a high-risk environmental condition that compromises cognitive performance and behavioural safety within the Aze+ concepts RTA causation theory.

The findings for Item B18 (82.4% agreement) highlight the critical influence of night-time environmental conditions within the (Aze+ concepts RTA causation theory). By identifying that low visibility at night significantly compromises driver performance, the data provide strong empirical support for Hypothesis H1, as they pinpoint an 'Environment' variable that the ISO 39001 (RTSMS) must actively regulate. Furthermore, these results reinforce the direct cognitive-behavioural pathway in Hypothesis H2, as restricted visual input acts as a primary 'Threat' that elevates stress and alters driver focus. Ultimately, the high level of agreement supports Hypothesis H3 by validating the P-E-A-R in Aze+ concepts RTA causation theory; it demonstrates that the synergy between systemic environmental controls and the driver's cognitive perception is essential to mitigate the 'Magnitude of Danger' and prevent potential accidents (Safety Institute of Australia, 2012; Shahab Hosseinian & Jabbarani Torghabeh, 2012a).

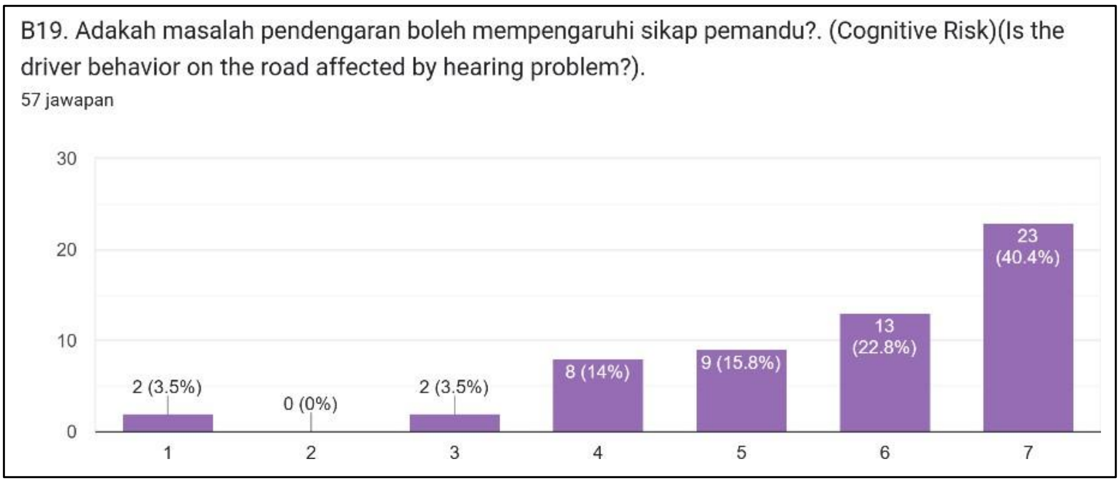


Figure 4.19 Answer B19 – Hearing Problems Affect Driver Behaviour

The NIOSH Malaysia respondents' answers evaluate whether hearing problems significantly affect driver behaviour on the road. The data from 57 respondents shows a majority consensus, with 40.4% (n=23) providing the highest rating of 7 and 22.8% (n=13) providing a rating of 6. This cumulative agreement of 63.2% (n=36) confirms that road users recognise auditory perception as a vital sensory-cognitive input that influences safe driving conduct and risk assessment.

The findings for Item B19 (63.2% agreement) emphasise the importance of auditory sensory input within the Aze+ concepts RTA causation theory. By identifying hearing problems as a significant contributor to behavioural change, the data provides strong empirical support for Hypothesis H1, highlighting a physiological 'Threat' that the ISO 39001 (RTSMS) must regulate through fitness-for-duty standards. Furthermore, these results reinforce the direct cognitive-behavioural pathway in Hypothesis H2, as auditory cues are essential for situational awareness and for preventing the 'Vengeance Syndrome.' Ultimately, the majority agreement supports Hypothesis H3 by validating the P-E-A-R in Aze+ concepts' RTA causation theory; it demonstrates that the synergy between a driver's sensory-cognitive health and a system's 'Prevention' protocols is vital to mitigating the 'Magnitude of Danger' and preventing potential Road Traffic Accidents.

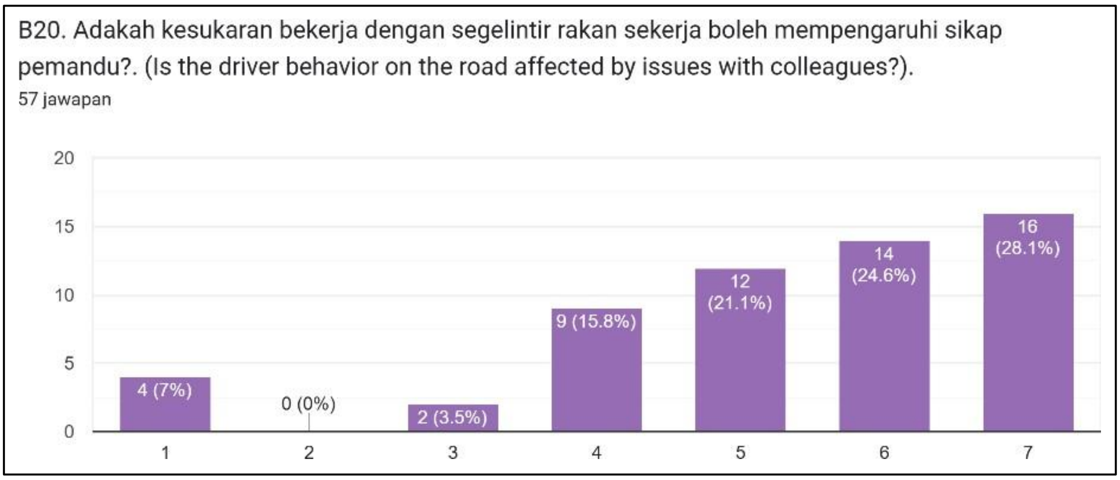


Figure 4.20 Answer B20 - Interpersonal Workplace Conflict on Driver

The item B20, which examines the impact of interpersonal workplace conflict on driver behaviour. The result indicates whether difficulties or issues with colleagues at work significantly affect a driver’s behaviour on the road. The data from 57 respondents shows a majority consensus, with 28.1% (n=16) providing the highest rating of 7 and 24.6% (n=14) providing a rating of 6. This cumulative agreement of 52.7% (n=30) indicates that over half of the respondents recognise that social and emotional stressors originating from the work environment can spill over into their driving performance.

The findings for Item B20 (52.7% agreement) highlight the significant role of interpersonal social dynamics within the (Aze+ concepts RTA causation theory). By identifying that workplace conflict with colleagues can influence road behaviour, the data provides empirical support for Hypothesis H1, suggesting that ISO 39001 (RTSMS) must address organisational climate as a preventive safety measure. Furthermore, these results reinforce the direct cognitive-behavioural pathway in Hypothesis H2, as workplace emotional distress serves as a 'Threat' that alters driver focus and temperament. Ultimately, the majority agreement supports Hypothesis H3 by validating the P-E-A-R in Aze+ concepts RTA causation theory; it demonstrates that the synergy between a healthy social 'Environment' and the driver's 'Cognitive' stability is essential to mitigate the 'Magnitude of Danger' and prevent behaviour-driven Road Traffic Crashes.

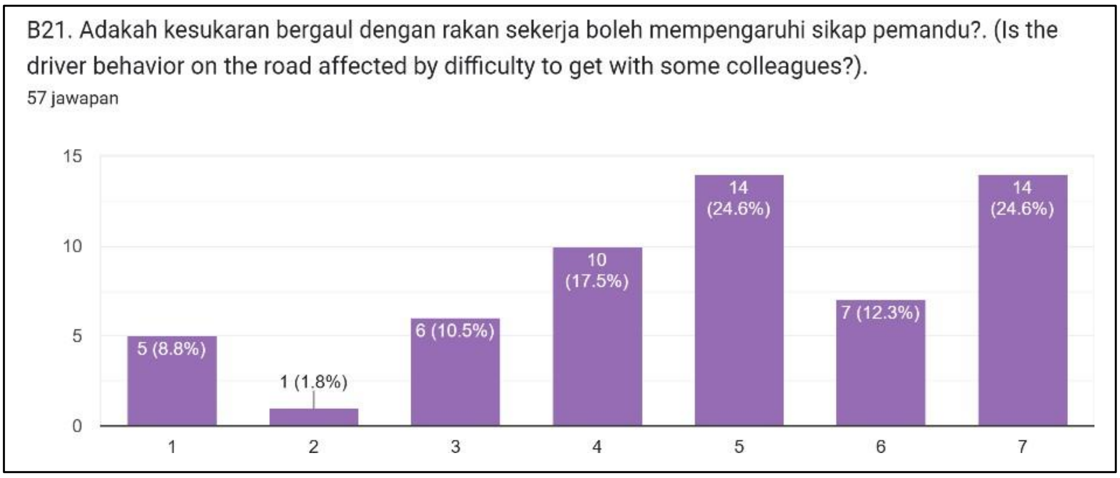


Figure 4.21 Answer B21 – Social Difficulty with Colleagues' Impact on Driver Behaviour

The above bar graph (item B21) evaluates how social difficulty with colleagues affects driver behaviour within the research theoretical framework. The findings evaluate whether difficulty getting along or socialising with colleagues affects a driver's behaviour on the road. The data from 57 respondents shows a moderate-high consensus, with 24.6% (n=14) providing the highest rating of 7 and 12.3% (n=7) providing a rating of 6. This cumulative agreement of 36.9% (n=21) suggests that while social integration is a less dominant factor than physical triggers (like sleep), more than a third of the respondents still recognise that interpersonal friction at work can influence their conduct behind the wheel.

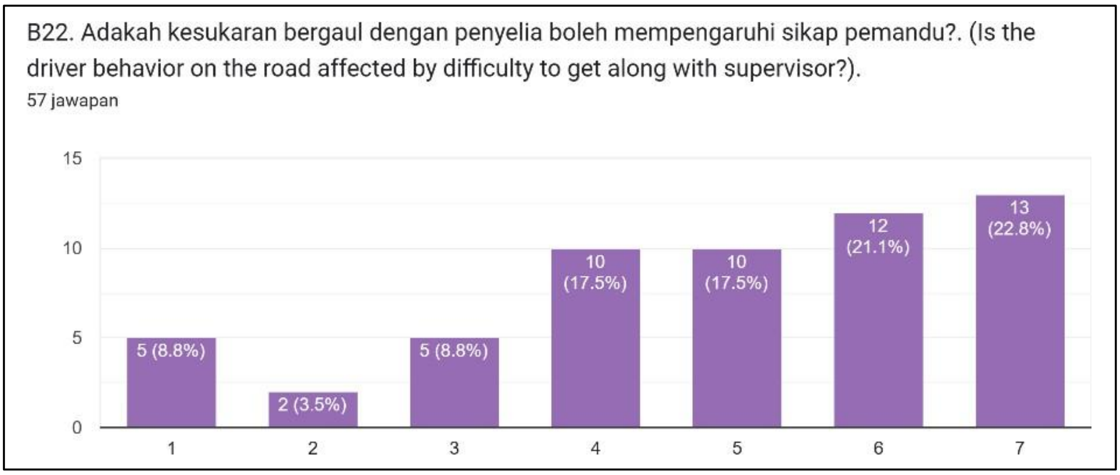


Figure 4.22 Answer B22 - Hierarchical Workplace Conflict Affected Driver Behaviour

The analysis for item B22 examines the impact of hierarchical workplace conflict (difficulty with supervisors) on driver behaviour within the study's research theoretical framework. It evaluates whether difficulty getting along with a supervisor significantly affects a driver's behaviour on the road. The data from 57 respondents shows a considerable consensus, with 22.8% (n=13) providing the highest rating of 7 and 21.1% (n=12) providing a rating of 6. This cumulative agreement of 43.9% (n=25) indicates that a substantial portion of road users perceive the vertical social dynamic and management style within their organisation as a factor that carries over into their driving norm.

The findings, which recorded 43.9% agreement, emphasise the critical role of hierarchical workplace dynamics within the (Aze+ concepts RTA causation theory). By identifying that conflict with supervisors significantly influences road behaviour, the data provides strong empirical support for Hypothesis H1, suggesting that the ISO 39001 (RTSMS) must incorporate 'Human Factors' in management to act as a preventative safety barrier. Furthermore, these results reinforce the direct cognitive-behavioural pathway in Hypothesis H2, as vertical workplace stress serves as a potential 'Threat' that triggers emotional volatility and behavioural shifts. Ultimately, the level of agreement supports Hypothesis H3, it demonstrates that the synergy between a supportive 'People' (management) structure and the driver's 'Cognitive' health prevents potential behaviour-driven Road Traffic Crashes.

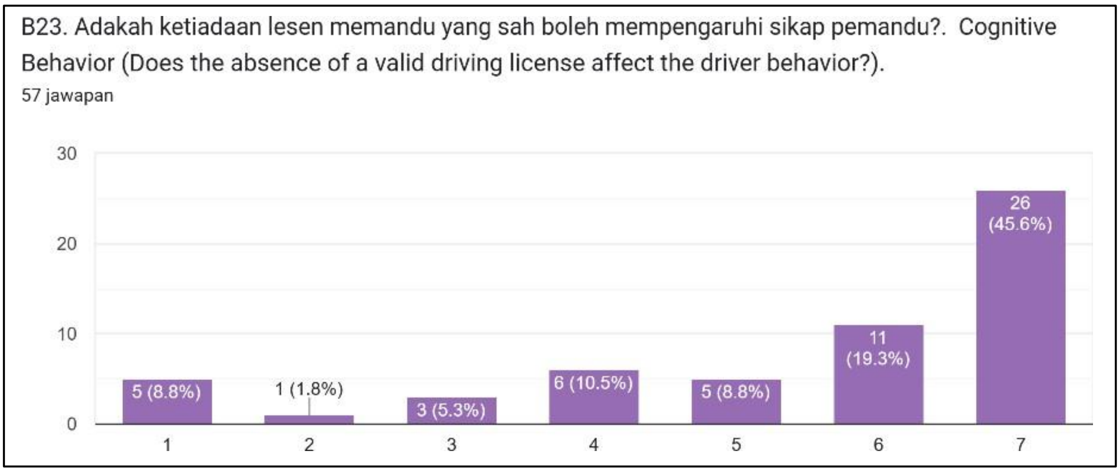


Figure 4.23 Answer B23 – Impact Valid Driving License on Driver Behaviour

Here is the analysis for item B23, which examines the impact of legal compliance (a valid driving licence) on driver behaviour. Based on the objective and hypothesis, the analysis of the legal licensing status of road users at NIOSH Malaysia evaluates whether the absence of a valid driving license significantly affects a driver's behaviour on the road. The data from 57 respondents shows a strong consensus, with 45.6% (n=26) providing the highest rating of 7 and 19.3% (n=11) providing a rating of 6. This cumulative agreement of 64.9% (n=37) indicates that a majority of road users recognise that a driver's legal standing and the lack of formal qualification are critical factors that influence their mental state and subsequent conduct.

By identifying that the absence of a valid driving license significantly influences road behaviour, the data provides strong empirical support for Hypothesis H1, suggesting that the ISO 39001 (RTSMS) must strictly enforce licensing as a primary 'Prevention' barrier. Furthermore, these results reinforce the direct cognitive-behavioural pathway in Hypothesis H2, as the psychological stress of driving illegally acts as a potential 'Threat' that alters driver focus and temperament. Ultimately, the high level of agreement supports Hypothesis H3, it demonstrates that the synergy between systemic legal 'Resources' and the driver's 'Cognitive' adherence is essential to mitigate the 'Magnitude of Danger' and prevent potential behaviour-driven Road Traffic Crashes.

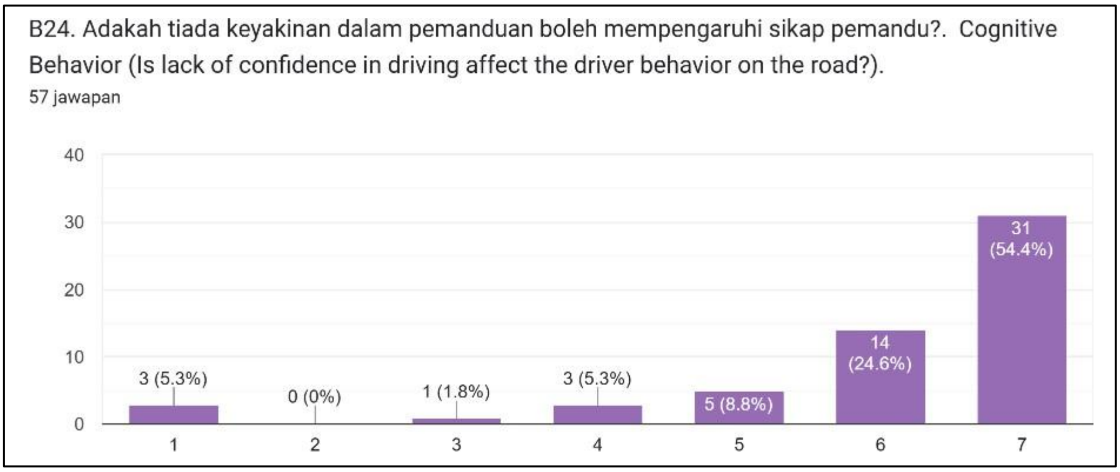


Figure 4.24 Answer B24 – Lack of Confidence

The analysis for item B24, which examines the impact of lack of confidence as a psychological-cognitive factor. The question evaluates whether a lack of confidence in driving significantly affects a driver's behaviour on the road. The data from 57 respondents show strong consensus, with 54.4% (n=31) providing the highest rating of 7 and 24.6% (n=14) providing a rating of 6. This cumulative agreement of 79.0% (n=45) indicates that road users recognise self-efficacy and confidence as vital cognitive pillars that dictate their behavioural patterns and decision-making while driving.

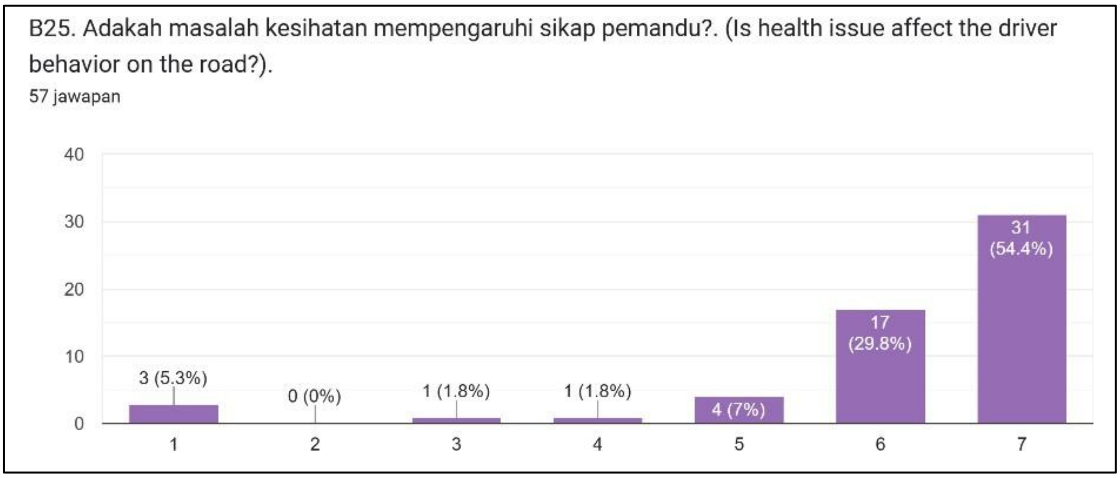


Figure 4.25 Answer B25 – Health Issues Affect Driver Behaviour

The item B25 evaluates whether health issues significantly affect driver behaviour on the road. The data from 57 respondents shows a very high consensus, with 54.4% (n=31) providing the highest rating of 7 and 29.8% (n=17) providing a rating of

6. This cumulative agreement of 84.2% (n=48) indicates that road users recognise physical well-being as a primary factor that dictates their behavioural patterns and driving safety. By identifying that health issues significantly influence behavioural outcomes, the data provide strong empirical support for Hypotheses H1, H2, and H3, suggesting that ISO 39001 (RTSMS) must incorporate stringent health screening as a primary 'Prevention' barrier. Furthermore, these results reinforce the direct cognitive-behavioural pathway, as poor health serves as a physiological 'Threat' that elevates stress and degrades driver focus. It also highly supports Hypothesis H3 by validating the Aze+ concepts RTA causation theory; it demonstrates that the synergy between a driver's physical 'People' readiness and the system's 'Prevention' protocols in ISO 39001:2013 is essential to mitigate the 'Magnitude of Danger' and prevent potential behaviour-driven Road Traffic Crashes.

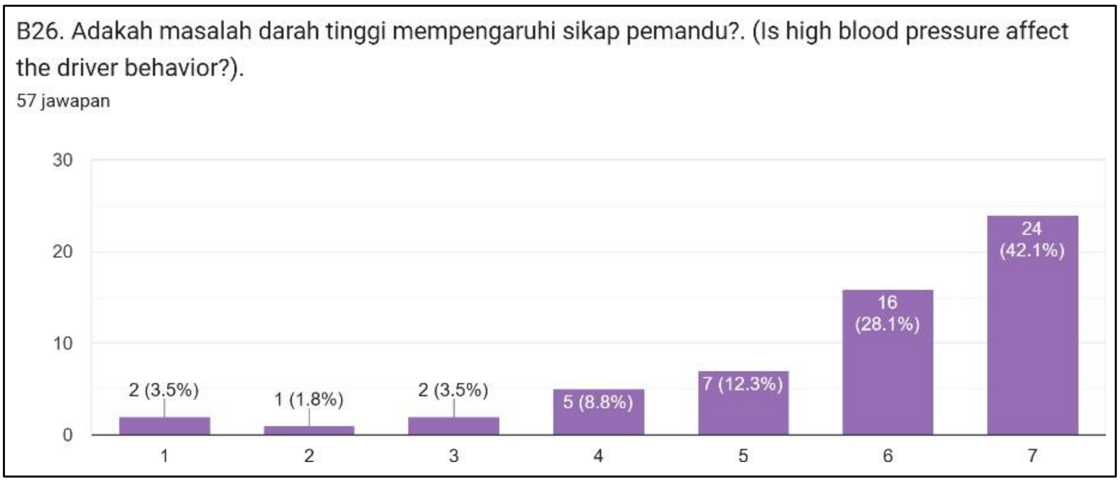


Figure 4.26 Answer B26 – Impact of High Blood Pressure

Following is the analysis for item B26, which evaluates the impact of High Blood Pressure as a specific physiological and cognitive risk factor within the Aze+ concepts RTA causation theory. The Analysis of High Blood Pressure evaluates whether high blood pressure significantly affects driver behaviour on the road. The data from 57 respondents indicates a strong consensus, with 42.1% (n=24) providing the highest rating of 7 and 28.1% (n=16) providing a rating of 6. This cumulative agreement of 70.2% (n=40) confirms that a majority of road users recognise chronic physiological conditions, such as high blood pressure, as a significant factor influencing their behavioural state and driving safety.

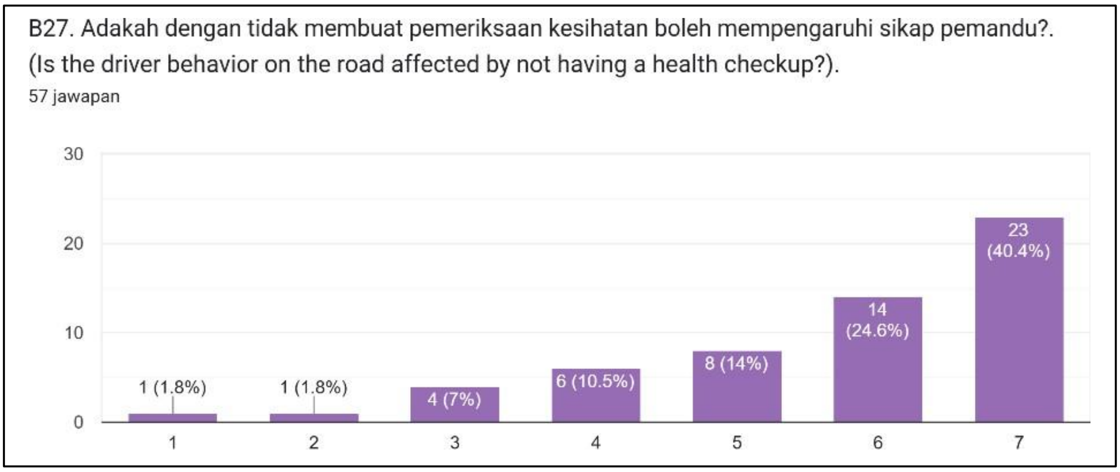


Figure 4.27 Answer B27 – Health Checkup Neglect

Here is the analysis for item B27, which evaluates the impact of Health Checkup Neglect as a systemic and cognitive risk factor within the (Aze+ concepts RTA causation theory) institutional road user (NIOSH Malaysia). Analysis of Health Checkup Neglect in the item B27 evaluates whether not having a health checkup significantly affects driver behaviour on the road. The data from 57 respondents indicates a strong consensus, with 40.4% (n=23) providing the highest rating of 7 and 24.6% (n=14) providing a rating of 6. This cumulative agreement of 65.0% (n=37) confirms that road users recognise the absence of medical surveillance as a significant factor that influences their behavioural state and overall driving safety.

The findings for Item B27 (65.0% agreement) emphasise the necessity of formal health surveillance within the organisation (Aze+ concepts RTA causation theory). By identifying that a lack of health checkups significantly influences driver behaviour, the data provides strong empirical support for Hypothesis H1, suggesting that the ISO 39001 (RTSMS) must mandate periodic medical screenings as a primary 'Prevention' barrier. Furthermore, these results reinforce the direct cognitive-behavioural pathway in Hypothesis H2, as unidentified physiological threats act as hidden 'Internal Stressors' that compromise driver performance. Ultimately, the high level of agreement supports Hypothesis H3: the synergy between systemic medical 'Resources' and the driver's physiological 'People' status is essential to mitigate the 'Magnitude of Danger' and ensure safe behavioural outcomes.

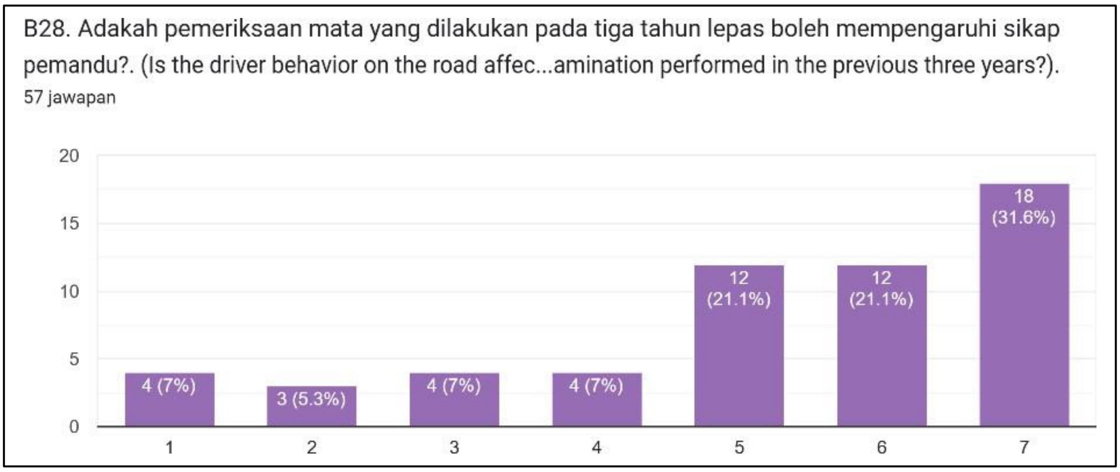


Figure 4.28 Answer B28 – Impact of Outdated Eye Examination

The analysis for item B28 examines the impact of outdated eye examinations (performed three years prior) on driver behaviour within the study's theoretical framework. The Analysis of Outdated Eye Examination in Item B28 evaluates whether an eye examination performed three years ago significantly affects current driver behaviour on the road. The data from 57 respondents shows a moderate-high consensus, with 31.6% (n=18) providing the highest rating of 7 and 21.1% (n=12) providing a rating of 6. This cumulative agreement of 52.7% (n=30) indicates that over half of the respondents recognise that outdated medical assessments, specifically regarding visual perception, can have a lingering impact on their current behavioural state and driving safety.

This finding provides empirical support for the need for continuous medical monitoring within the ISO 39001 framework. The 52.7% agreement among NIOSH Malaysia respondents highlights the critical role of current medical surveillance within the institutional landscape (Aze+ concepts, RTA causation theory). By identifying that an eye examination performed three years ago is perceived to influence current road behaviour, the data provide empirical support for Hypothesis H1, suggesting that ISO 39001 (RTSMS) must mandate frequent, up-to-date sensory checks as a primary 'Prevention' barrier. Furthermore, these results reinforce the direct cognitive-behavioural pathway in Hypothesis H2, as outdated visual data represents a hidden 'Internal Threat' that degrades situational awareness over time and also support Hypothesis H3.

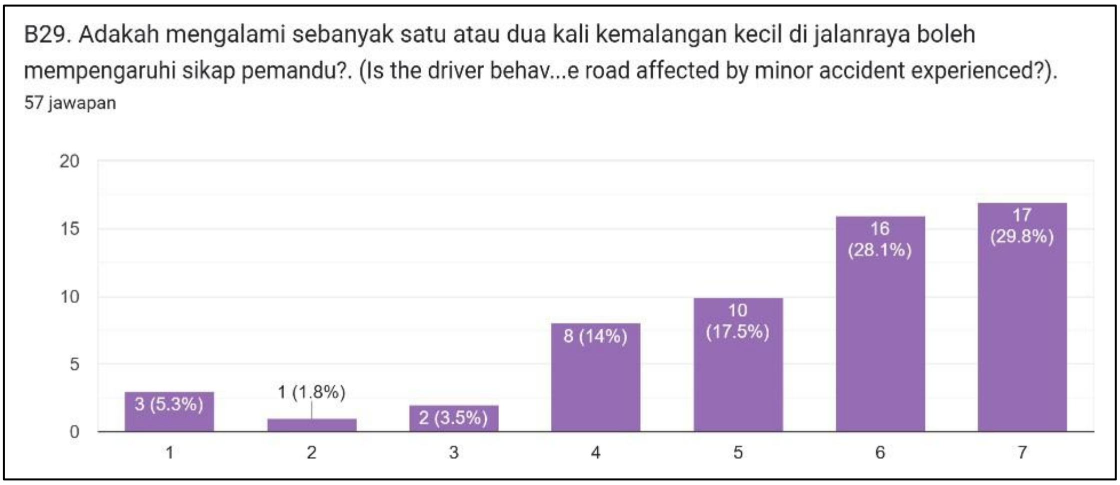


Figure 4.29 Answer B29 – Impact of Past Minor Road Traffic Accident

The following analysis of item B29 examines how past minor accidents serve as cognitive-behavioural triggers within NIOSH Malaysia. The analysis of past minor-accident experience evaluates whether having one or two minor accidents on the road can influence a driver's behaviour. The data from 57 respondents indicates a majority consensus, with 29.8% (n=17) providing the highest rating of 7 and 28.1% (n=16) providing a rating of 6. This cumulative agreement of 57.9% (n=33) confirms that a majority of road users recognise that past incidents, even minor ones, will leave a psychological and cognitive imprint that subsequently alters their driving conduct.

This finding serves as empirical validation of the role of experience-based learning and trauma within the research framework. The 57.9% agreement validates H1, H2 and H3 by highlighting that the RTSMS must include "Industrial Best Practice" for post-accident investigation and psychological support to ensure that "learned" negative behaviours do not increase the "Magnitude of Danger" for future trips. A past accident serves as a "Cognitive Memory" or "Risk Assessment" modifier. In your theory, this is a "Contact with Variable" (past trauma) that triggers Stress and Behaviour Changes. This can lead to a negative Behavioural Impact, such as over-caution (causing traffic flow issues) or increased aggression as a defence mechanism, supporting the Cognitive Behaviour path. This is validated because it shows that a driver's cognitive focus is permanently shaped by their history with the system. A robust RTSMS reduces the "Vector Magnitude of Danger" by helping "People" recalibrate their mental models after an incident.

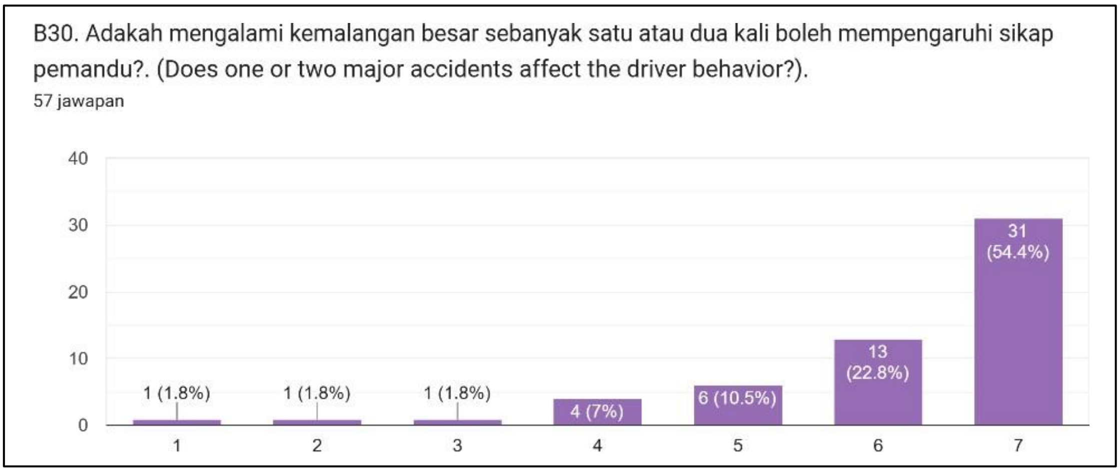


Figure 4.30 Answer B30 – Driver Behavioural Impact on Road Traffic Major Accidents

Next, the analysis for item B30 examines the psychological and behavioural impact of Major Accidents on road user implementors within NIOSH Malaysia. Item B30 evaluates whether experiencing one or two major accidents significantly influences a driver's behaviour. The data from 57 respondents show strong consensus, with 54.4% (n=31) providing the highest rating of 7 and 22.8% (n=13) providing a rating of 6. This cumulative agreement of 77.2% (n=44) indicates that road users perceive major accidents as a powerful catalyst for significant behavioural change, notably higher than the impact of minor accidents (B29: 57.9%) in the previous bar graph.

Thus, 77.2% agreement validates the role of severe trauma and cognitive recalibration by showing that the "Magnitude of Danger" is so high that the RTSMS must implement "Industrial Best Practice" for post-trauma counselling and intensive driver retraining to restore the safety barrier for the organisation. The H2 posits that the cognitive state of the road user significantly influences behaviour. A major accident acts as a "High-Intensity Cognitive Threat." In your theory, this is a massive "Contact with Variable" that triggers profound Stress and Behaviour Changes. This often manifests as extreme anxiety or a "Vengeance Syndrome" defence mechanism, leading to a permanent shift in the driver's mental model and Behavioural Impact. A robust RTSMS ISO 39001:2013 must use its "Resources" to stabilise the driver's cognitive focus, ensuring a bidirectional recovery that prevents the cycle of future Road Traffic Crashes.

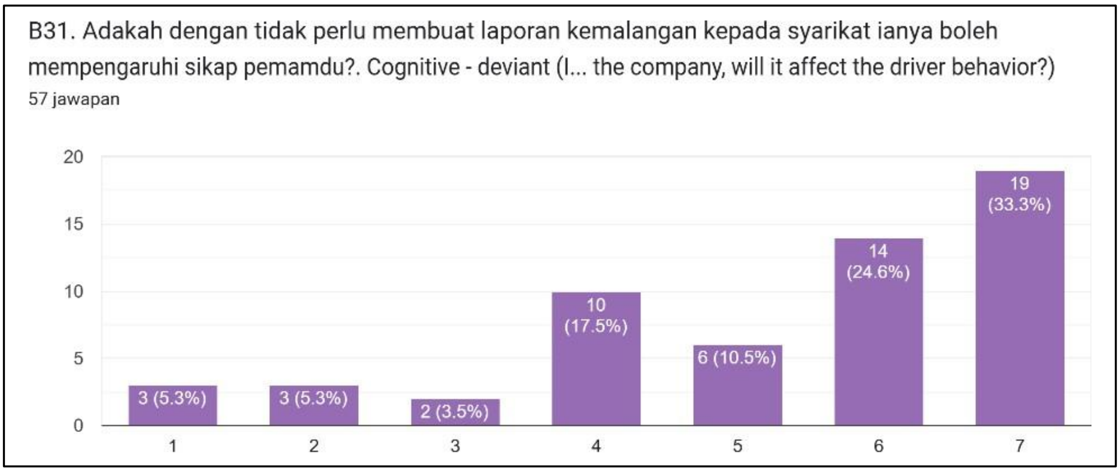


Figure 4.31 Impact of Non-Reporting of Accidents

The analysis for item B31, which examines the impact of non-reporting of accidents as a cognitive-deviant factor, evaluates whether the lack of a requirement to report accidents to the company influences driver behaviour. The data from 57 respondents shows a significant consensus, with 33.3% (n=19) providing the highest rating of 7 and 24.6% (n=14) providing a rating of 6. This cumulative agreement of 57.9% (n=33) indicates that a majority of road users recognise that a lack of organisational accountability and reporting protocols can lead to a "cognitive-deviant" state, subsequently altering their driving behaviour.

The 57.9% agreement validates Hypothesis H1 by highlighting that the absence of reporting protocols (a systemic failure) increases the "Magnitude of Danger," as it removes the organisational oversight necessary to correct unsafe habits. By identifying that the lack of accident-reporting requirements significantly influences driver behaviour, the data provides empirical support for Hypothesis H1, suggesting that ISO 39001 (RTSMS) must mandate strict reporting protocols as a primary 'Prevention' barrier.

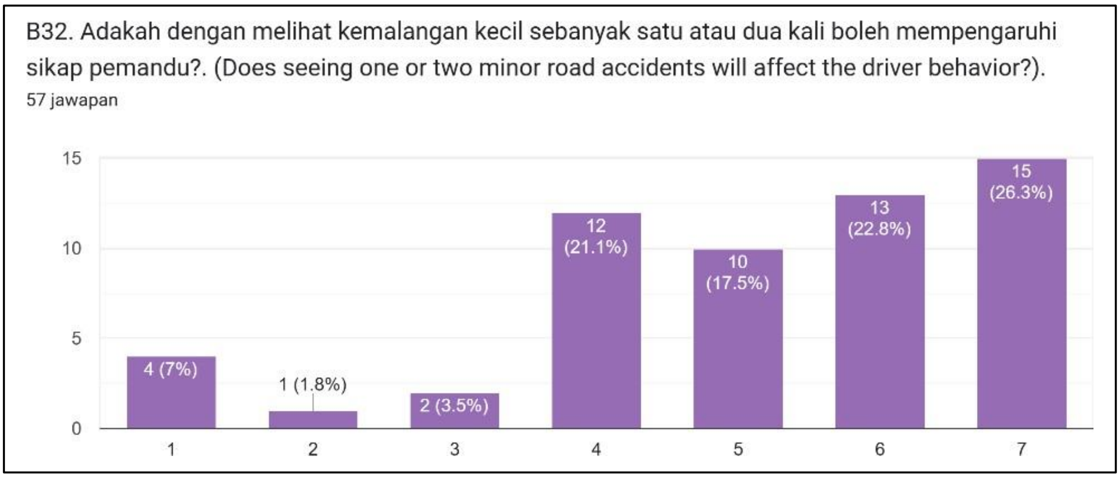


Figure 4.32 Answer B32 – Observing Minor Accidents

The analysis for item B32 examines the impact of observing minor accidents as an external cognitive stimulus within the research framework (Aze+ concepts RTA causation theory). The analysis of Observing Minor Accidents evaluates whether seeing one or two minor road accidents influences a driver's behaviour. The data from 57 respondents shows a moderate consensus, with 26.3% (n=15) providing the highest rating of 7 and 22.8% (n=13) providing a rating of 6. This cumulative agreement of 49.1% (n=28) indicates that nearly half of the road users recognise that external observations, even those they are not directly involved in, act as a cognitive input that subsequently alters their driving conduct.

The 49.1% agreement validates H1 by highlighting that the RTSMS must use "Industrial Best Practice" for observational safety awareness, helping drivers process what they see to reinforce safe behaviours rather than allowing it to cause negative stress or distraction. In Hypothesis H2, H2 posits that the cognitive state of the road user has a significant influence on behaviour. Seeing an accident serves as a "Visual-Cognitive Input" that modifies the driver's immediate risk perception. In the research theory, this is a "Contact with Variable" (external event) that triggers Stress and Behaviour Changes, leading directly to a behavioural Impact (e.g., sudden slowing or increased anxiety), supporting the Cognitive Behaviour path. A robust RTSMS reduces the "Magnitude of Danger" by providing the mental "Resources" (training) to ensure that such observations lead to safer mental models rather than behavioural errors.

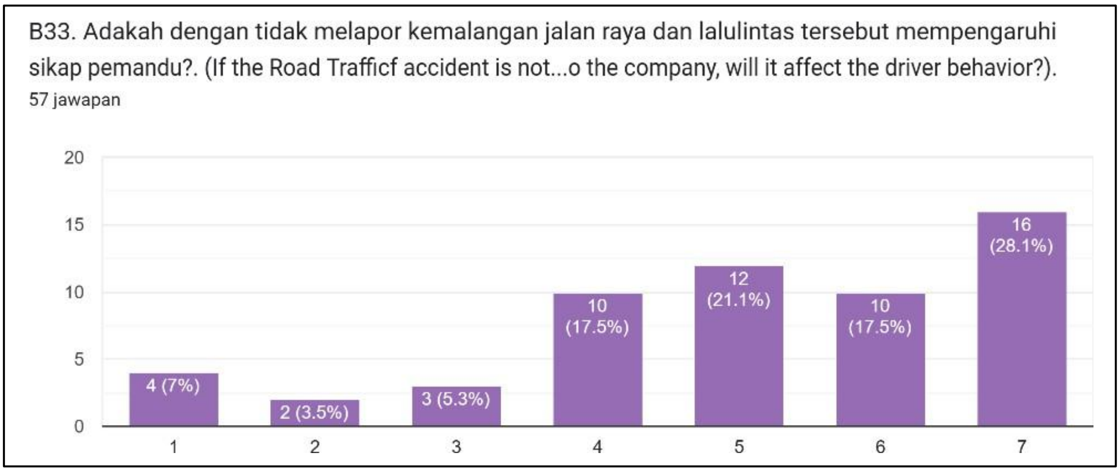


Figure 4.33 Answer B33 – Non-reporting of Accidents

The above analysis (item B33) evaluates the impact of non-reporting of accidents on driver behaviour. The question tries to evaluate whether failing to report a road traffic accident to the company influences a driver's behaviour. The data from 57 respondents indicates a significant consensus, with 28.1% (n=16) providing the highest rating of 7 and 17.5% (n=10) providing a rating of 6. This cumulative agreement of 45.6% (n=26) suggests that a substantial portion of road users recognise that a lack of transparency and reporting accountability acts as a cognitive trigger that subsequently alters their driving conduct.

This finding serves as empirical validation of the roles of organisational accountability and systemic integrity. The 45.6% agreement validates Hypothesis H1 by identifying that when this specific administrative control is bypassed (non-reporting), the "Magnitude of Danger" increases because the RTSMS cannot implement corrective "Industrial Best Practices". The cognitive state of the road user significantly influences behaviour. Non-reporting fosters a "cognitive-deviant" state, where the driver perceives a lack of consequences. In your theory, this mental state is a "Contact with Variable" that triggers Stress and Behaviour Changes, leading directly to a negative behavioural Impact characterised by reduced diligence and increased risk-taking.

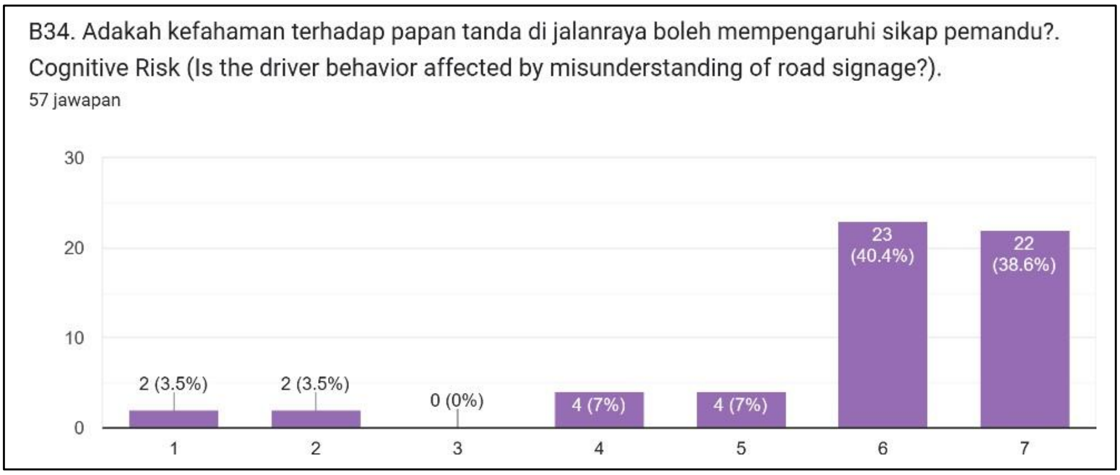


Figure 4.34 Impact of Misunderstanding Road Signage

The analysis for item B34, which examines the impact of misunderstanding road signage as a cognitive risk factor within the NIOSH Malaysia, is based on Aze+ concepts of RTA causation theory. This analysis examines whether driver behaviour is affected by the misinterpretation of road signage. The data from 57 respondents shows a very high consensus, with 38.6% (n=22) providing the highest rating of 7 and 40.4% (n=23) providing a rating of 6. This cumulative agreement of 79.0% (n=45) indicates that road users recognise cognitive comprehension as the ability to correctly interpret environmental information as a vital determinant of their behavioural attitude and safety conduct on the road.

The findings conclude 79.0% agreement, validating Hypothesis H1 by highlighting that the RTSMS must prioritise the clarity of signs and driver education to mitigate the "Magnitude of Danger" caused by cognitive confusion. Misunderstanding signage is a "Cognitive Threat" that results in incorrect mental mapping. In your theory, this is a "Contact with Variable" that triggers Stress and Behaviour Changes, leading directly to a negative behavioural Impact such as illegal manoeuvres, sudden braking, or increased aggression due to confusion.

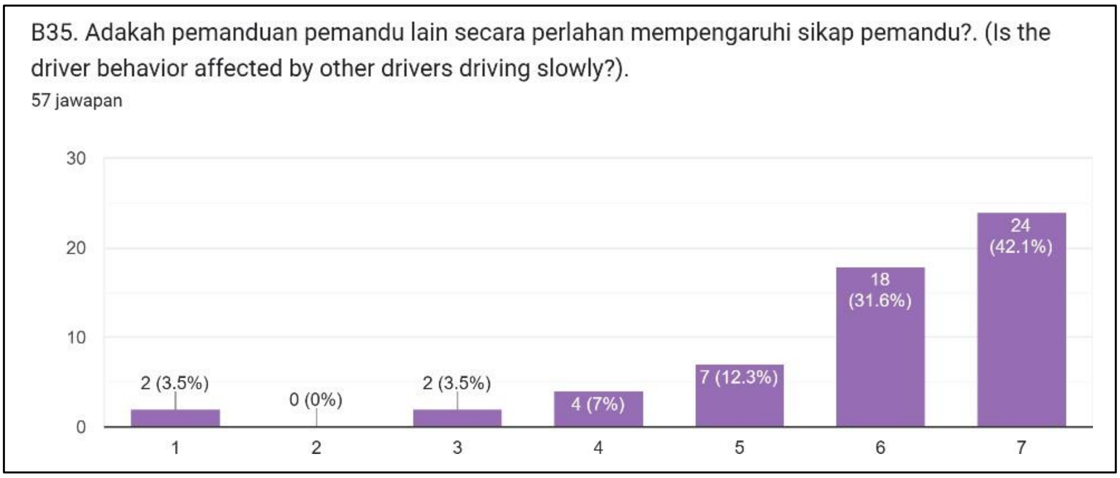


Figure 4.35 Answer B35 – Impact of External Traffic Inhibitors

The item B35 examines the impact of external traffic inhibitors (other drivers driving slowly) as a catalyst for behavioural change. The analysis of the Impact of Others Driving Slowly evaluates whether a driver's behaviour is affected by other drivers driving slowly. The data from 57 respondents indicate strong consensus, with 42.1% (n=24) providing the highest rating of 7 and 31.6% (n=18) providing a rating of 6. This cumulative agreement of 73.7% (n=42) confirms that road users recognize slow moving traffic as a significant external stimulus that alters their cognitive state and subsequent driving conduct. The 73.7% agreement validates H1, H2 and H3 by identifying an external "Threat" that requires "Industrial Best Practice" interventions such as driver temperament training and lane discipline protocols to mitigate the "Magnitude of Danger" caused by frustration.

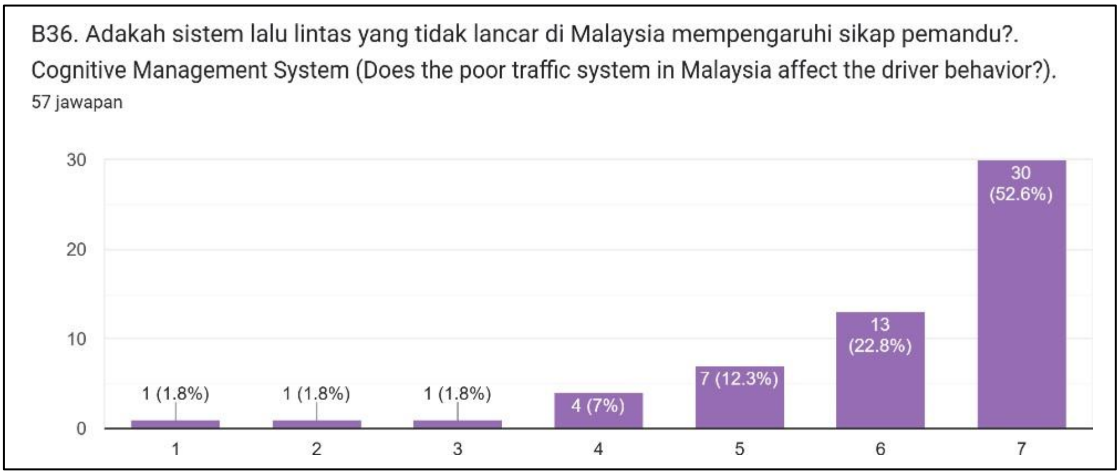


Figure 4.36 Answer B36 – Impact of a Poor Traffic System

The item B36 bar graph above examines the impact of a poor traffic system (congestion/lack of flow) as an environmental stressor within the research framework (Aze+ concepts RTA causation theory). This analysis of Poor Traffic System Impact evaluates whether poor or congested traffic systems in Malaysia significantly affect driver behaviour in NIOSH Malaysia. The data from 57 respondents shows a strong consensus, with 52.6% (n=30) providing the highest rating of 7 and 22.8% (n=13) providing a rating of 6. This cumulative agreement of 75.4% (n=43) confirms that road users identify the macro-environmental traffic system as a primary driver of their behavioural attitude and mental state.

This finding aligned with the three (3) research objectives and the hypothesis; it serves as an empirical validation of the relationship between the external environment and internal cognitive triggers. It validates Hypothesis H1 (The Impact of RTSMS): H1 suggests that implementing ISO 39001 significantly impacts behaviour through systemic and environmental controls. Within the research framework (Aze+ concepts RTA causation theory), a poor traffic system represents a failure in the "Environment" variable of the safety chain. The 75.4% agreement validates H1 by identifying the specific environmental "Magnitude of Danger" that the RTSMS ISO 39001 must mitigate through "Industrial Best Practice" in the operational implementation, such as route optimisation, scheduling, and driver stress management to maintain the "Prevention" barrier. Second validation of Hypothesis H2 (The Direct Human Path): H2 posits that the cognitive state of the road user has a significant influence on behaviour.

A poor traffic system acts as a persistent "Environmental Threat" that degrades the driver’s mental model. In your framework, this is a "Contact with Variable" that triggers Stress and Behaviour Changes, serving as a catalyst for the driver's cognitive, such as "Vengeance Syndrome" (where environmental frustration leads to aggression or violence on the road). The third validation of Hypothesis H3 (The Bidirectional Influence): H3 focuses on the synergy between the system and the user. These findings illustrate the P-E-A-R in Aze+ concepts RTA causation theory (People, Equipment, Environment, Resources), specifically the Environment (Traffic System) and People (Cognitive state) interaction. Hypothesis H3 is validated because it demonstrates that the driver’s cognitive focus is directly compromised by systemic inefficiency. A robust

RTSMS establishes a bidirectional loop in which the system provides resources to help "People" cope with a flawed "Environment," thereby preventing a Road Traffic Crash.

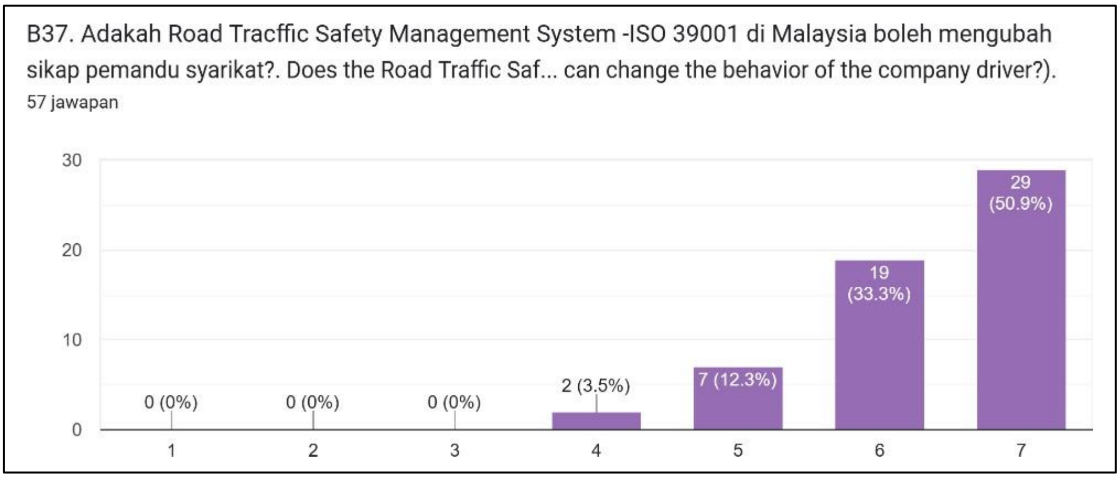


Figure 4.37 Answer B37 – Effectiveness RTSMS in Modifying Driver Behaviour

The analysis for item B37, which evaluates the perceived effectiveness of ISO 39001 in modifying driver behaviour within NIOSH Malaysia by implementing the Aze+ concepts RTA causation theory. The finding evaluates whether the Road Traffic Safety Management System (ISO 39001) in Malaysia can effectively change the behaviour of company drivers. The data from 57 respondents shows a very high consensus, with 50.9% (n=29) providing the highest rating of 7 and 33.3% (n=19) providing a rating of 6. This cumulative agreement of 84.2% (n=48) indicates that a vast majority of road users believe that systemic management is a powerful tool for behavioural recalibration.

This finding aligns with the three (3) research objectives and hypotheses; it serves as a cornerstone for validating the structural efficacy of the research framework. The 84.2% agreement provides direct empirical support for H1, H2 and H3, proving that "Industrial Best Practice" (ISO 39001) is perceived to have a significant and positive impact on road user behaviour. By identifying that ISO 39001 is perceived to significantly change driver behaviour.

The data provide the strongest empirical support for Hypothesis H1, validating the management system as the ultimate 'Prevention' barrier. The validation of H2 in the direct Human Path: H2 posits that the cognitive state of the road user has a significant influence on behaviour. Item B37 suggests that the system achieves behavioural change by altering the driver's mental model and attitude. In the research theory, this prevents the cognitive "Vengeance Syndrome" chain by replacing aggressive cognitive triggers with systemic safety values, thereby yielding a positive behavioural impact.

The bidirectional influence in Hypothesis H3 focuses on the synergy between the system and the road user in NIOSH Malaysia. These findings illustrate the P-E-A-R in Aze+ concepts RTA causation theory (People, Equipment, Environment, Resources) at its most effective. H3 is validated because it demonstrates that the "Resources" (the RTSMS) directly improve the "People" (behavioural outcomes). It proves that a robust system and a committed road user create a bidirectional loop that significantly reduces the "Magnitude of Danger".

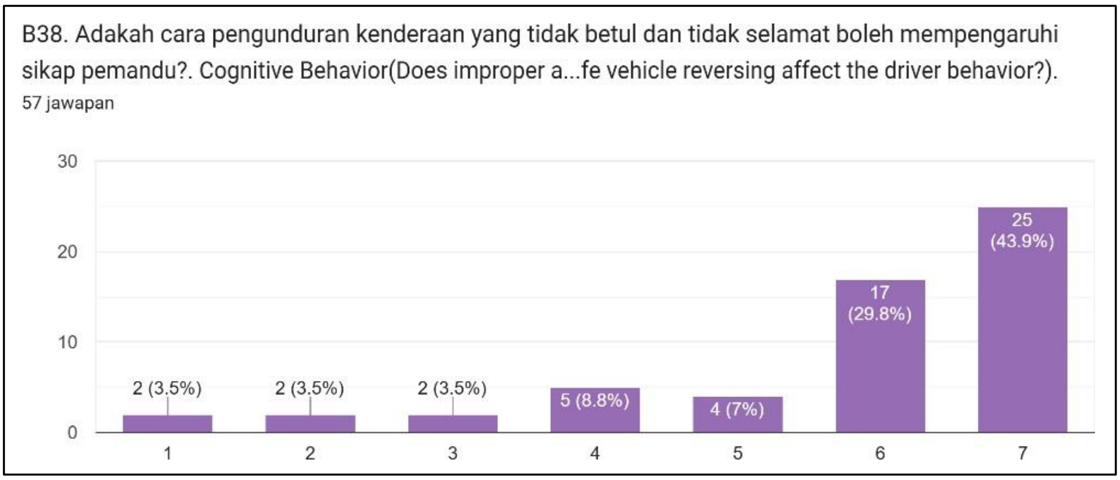


Figure 4.38 Answer B38 – Impact of Unsafe Vehicle Reversing

The item B38 examines the impact of unsafe vehicle reversing as a cognitive and behavioural risk factor within the research framework (Aze+ concepts RTA causation theory). The analysis of Improper Vehicle Reversing evaluates whether improper and unsafe vehicle reversing significantly affects driver behaviour. The data from 57 respondents shows a strong consensus, with 43.9% (n=25) providing the highest rating of 7 and 29.8% (n=17) providing a rating of 6. This cumulative agreement of 73.7% (n=42) confirms that road users recognise poor technical manoeuvres, specifically reversing, as a factor that influences their overall behavioural attitude and safety conduct.

The findings for item B38 (73.7% agreement) highlight the importance of technical manoeuvring competency within the research framework (Aze+ concepts

RTA causation theory). By identifying that improper vehicle reversing significantly influences behavioural outcomes, the data provides strong empirical support for Hypothesis H1, suggesting that the ISO 39001 (RTSMS) must prioritise driver skill validation as a primary 'Prevention' barrier. Furthermore, these results reinforce the direct cognitive-behavioural pathway in Hypothesis H2, as poor vehicle handling acts as a 'Threat' that can escalate stress and trigger negative mental models. Ultimately, the high level of agreement supports Hypothesis H3 by validating the P-E-A-R in Aze+ concepts RTA causation theory; it demonstrates that the synergy between organisational 'Resources' (training) and the driver's cognitive mastery of 'Equipment' is essential to mitigate the 'Magnitude of Danger' and prevent potential behaviour-driven Road Traffic Crashes.

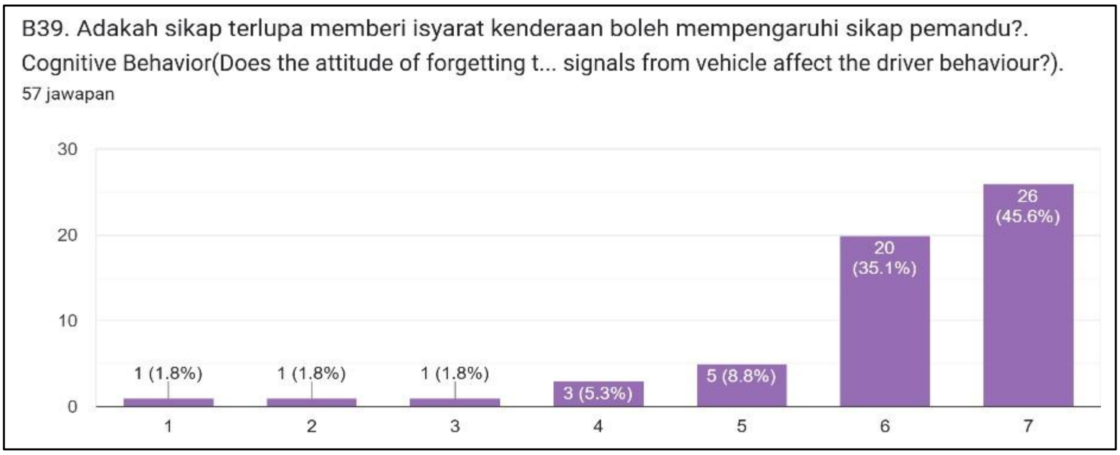


Figure 4.39 Answer B39 – Impact of Forgetting Vehicle Signals

The analysis for item B39 examines the impact of forgetting vehicle signals as a cognitive and communicative risk factor within the Aze+ concepts RTA causation theory, as stated in the research framework. The analysis of Forgetting Vehicle Signals examines whether forgetting to give vehicle signals significantly affects driver behaviour. The data from 57 respondents show strong consensus, with 45.6% (n=26) providing the highest rating of 7 and 35.1% (n=20) providing a rating of 6. This cumulative agreement of 80.7% (n=46) confirms that road users recognise a failure in basic communicative intent, forgetting signals as a major cognitive lapse that dictates subsequent behavioural outcomes.

This finding serves as a vital empirical validator for the transition between internal memory lapses and external safety risks. Based on 80.7% agreement, it emphasises the critical role of communicative habits and cognitive memory among road users at NIOSH Malaysia, as per the research framework Aze+ concepts RTA causation theory. By identifying that forgetting to give vehicle signals significantly influences behavioural outcomes, the data provides strong empirical support for Hypothesis H1, suggesting that the ISO 39001 (RTSMS) must mandate behavioural conditioning and signalling SOPs as a primary 'Prevention' barrier. Furthermore, these results reinforce the direct cognitive-behavioural pathway in Hypothesis H2, as memory lapses act as a 'Threat' that creates unpredictability on the road and triggers negative mental models. Ultimately, the high level of agreement supports Hypothesis H3 by validating the P-E-A-R in Aze+ concepts RTA causation theory; it demonstrates that the synergy between the driver’s cognitive diligence ('People') and the correct use of safety 'Equipment' is essential to mitigate the 'Magnitude of Danger' and prevent potential behaviour-driven Road Traffic Crashes.

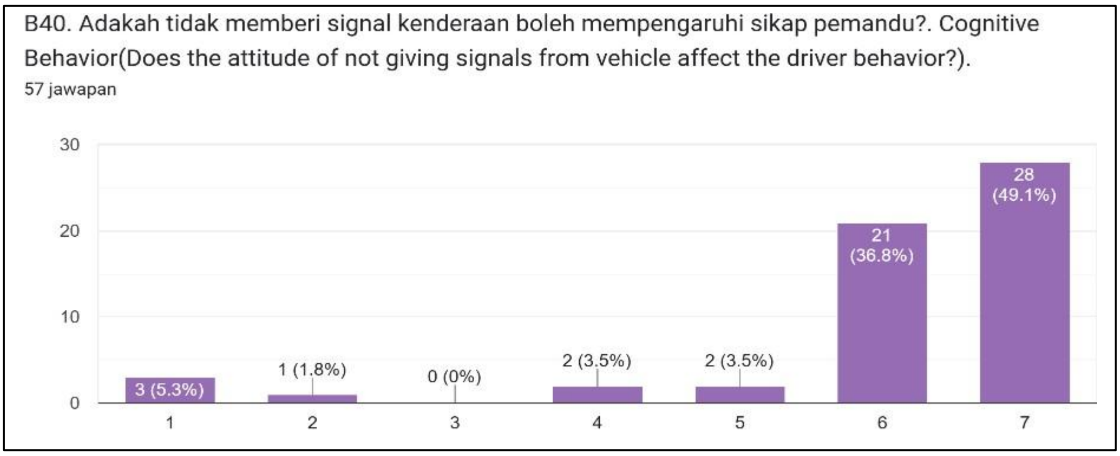


Figure 4.40 Answer B40 – Impact of Attitude Regarding Signalling

The item B40 examines the impact of the attitude regarding signalling as a cognitive-behavioural driver among road users at NIOSH Malaysia. (Refer to Aze+ concepts RTA causation theory). The analysis of Attitude Toward Not Giving Signals evaluates whether the attitude of not giving signals significantly affects driver behaviour. The data from 57 respondents shows an extremely strong consensus, with 49.1% (n=28) providing the highest rating of 7 and 36.8% (n=21) providing a rating of

6. This cumulative agreement of 85.9% (n=49) indicates that road users recognise that a negative or indifferent attitude toward basic safety communication (signalling) is a primary determinant of their overall driving conduct.

This finding serves as a critical empirical validator for the transition from cognitive intent to behavioural execution. Thus, findings for item B40 (85.9% agreement) emphasise the critical role of driver attitude within the NIOSH Malaysia institutional setup and complement the Aze+ concepts RTA causation theory. By identifying that the specific attitude of not giving signals significantly influences behavioural outcomes, the data provides robust empirical support for Hypothesis H1, suggesting that the ISO 39001 (RTSMS) must go beyond technical compliance to address the underlying 'Cognitive' values of the driver as a primary 'Prevention' barrier. Furthermore, these results reinforce the direct cognitive-behavioural pathway in Hypothesis H2, as a negative attitude serves as a potent internal 'Threat' that dictates unsafe road conduct. Ultimately, the very high level of agreement supports Hypothesis H3 by validating the P-E-A-R in Aze+ concepts RTA causation theory; it demonstrates that the synergy between the driver’s 'People' (Attitude) and the systemic safety 'Resources' is essential to mitigate the 'Magnitude of Danger' and prevent potential behaviour-driven Road Traffic Crashes.

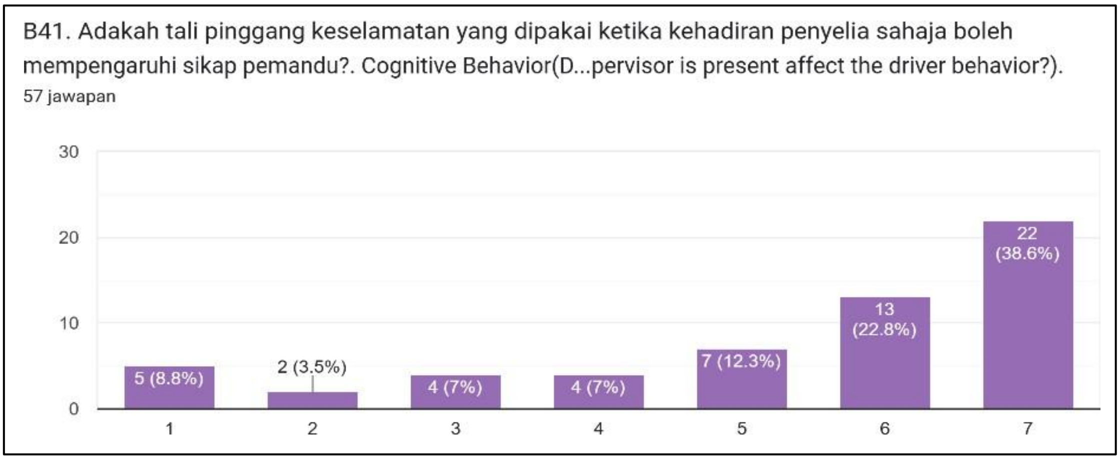


Figure 4.41 Answer B41 – Conditional Compliance

The item B41, which examines Conditional Compliance (wearing seatbelts only when supervised) as a cognitive-behavioural factor. The analysis of Conditional Seatbelt Compliance evaluates whether the behaviour of wearing a seatbelt only when a supervisor is present significantly influences the driver's overall attitude and conduct. The data from 57 respondents shows a significant consensus, with 38.6% (n=22) providing the highest rating of 7 and 22.8% (n=13) providing a rating of 6. This cumulative agreement of 61.4% (n=35) confirms that a majority of road users recognise that their compliance is often externally driven by the presence of authority rather than an internalised safety culture.

This finding serves as an empirical validator for the role of supervision versus internalised cognitive safety within the research framework. In validating Hypothesis H1 (The Impact of RTSMS), it is hypothesised that the implementation of ISO 39001 significantly impacts behaviour. Within the research framework (Aze+ concepts RTA causation theory), seatbelt usage is a fundamental "Prevention" protocol. The 61.4% agreement supports H1 by showing that the RTSMS must go beyond "Passive Supervision" and implement "Industrial Best Practices," such as telematics or automated monitoring, to ensure the "Prevention" layer remains intact regardless of a supervisor's physical presence.

Secondly, Hypothesis H2 (The Direct Human Path): H2 posits that the cognitive state of the road user has a significant influence on behaviour. This item identifies a "Cognitive-Deviant" state where compliance is conditional. In the research hypothesis, this mental posture is a "Contact with Variable" (Supervision) that triggers Stress and Behaviour Changes. This demonstrates that the driver's cognitive choice to follow rules only when watched leads to negative behavioural impact (non-compliance) when left unsupervised. In validation of Hypothesis H3 (The Bidirectional Influence): H3 focuses on the synergy between the system and the user. These findings illustrate the P-E-A-R in Aze+ concepts RTA causation theory, specifically the People (Driver Attitude) and Resources (Supervisory Control) interaction. H3 is validated because it demonstrates that when the "People" component lacks an internalised safety mindset, the system's "Resources" must be constantly present. A robust RTSMS aims for bidirectional synergy in which the driver's cognitive focus maintains safety independently of external monitoring.

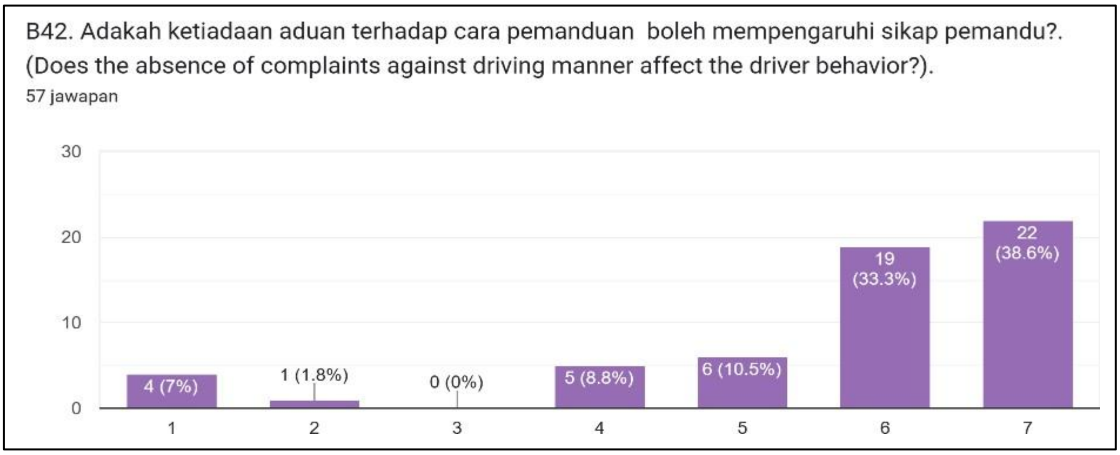


Figure 4.42 Answer B42 – Impact of Behavioural Complacency

The item B42 examines the impact of behavioural complacency (the absence of complaints) as a cognitive factor in the implementation of RTSMS ISO 39001, as per the research framework: Aze+ concepts, RTA causation theory. The analysis of Absence of Complaints evaluates whether the absence of complaints against a driver's behaviour significantly influences their subsequent conduct on the road. The data from 57 respondents show strong consensus, with 38.6% (n=22) providing the highest rating of 7 and 33.3% (n=19) providing a rating of 6. This cumulative agreement of 71.9% (n=41) indicates that a large majority of road users and system implementers at NIOSH Malaysia recognise that a lack of corrective feedback acts as a cognitive trigger that reinforces current potentially unsafe behavioural habits.

This finding provides empirical evidence for the necessity of active feedback loops and monitoring within the research framework. The validation of Hypothesis H1 (The Impact of RTSMS): H1 suggests that implementing ISO 39001 significantly impacts behaviour through systemic controls. Within the (Aze+ concepts RTA causation theory), a complaint management system is a vital "Prevention" barrier and "Industrial Best Practice".

The 71.9% agreement validates H1 by highlighting that the absence of this specific administrative control leads to behavioural drifting, thereby increasing the "Magnitude of Danger" as the system fails to correct "learned" unsafe habits. Second validation of Hypothesis H2 (The Direct Human Path): H2 posits that the cognitive state of the road user has a significant influence on behaviour. The absence of complaints creates a "Cognitive Misconception" where the driver perceives their actions as safe or acceptable simply because they have not been challenged.

In my hypothesis and research framework, this mental state is a "Contact with Variable" that triggers Stress and Behaviour Changes, leading directly to a negative behavioural impact (complacency and continued risk-taking). In validation of Hypothesis H3 (The Bidirectional Influence): H3 focuses on the synergy between the system and the road user at NIOSH Malaysia. These findings illustrate the P-E-A-R in Aze+ concepts RTA causation theory (People, Equipment, Environment, Resources), specifically the Resources (Feedback/Complaint Systems) and People (Driver Awareness) interaction. Hypothesis H3 is validated because it demonstrates that when the system's "Resources" are silent, the "People" component becomes stagnant. A robust RTSMS ensures a bidirectional flow, with the system providing active feedback to recalibrate the driver's cognitive focus and prevent a Road Traffic Crash.

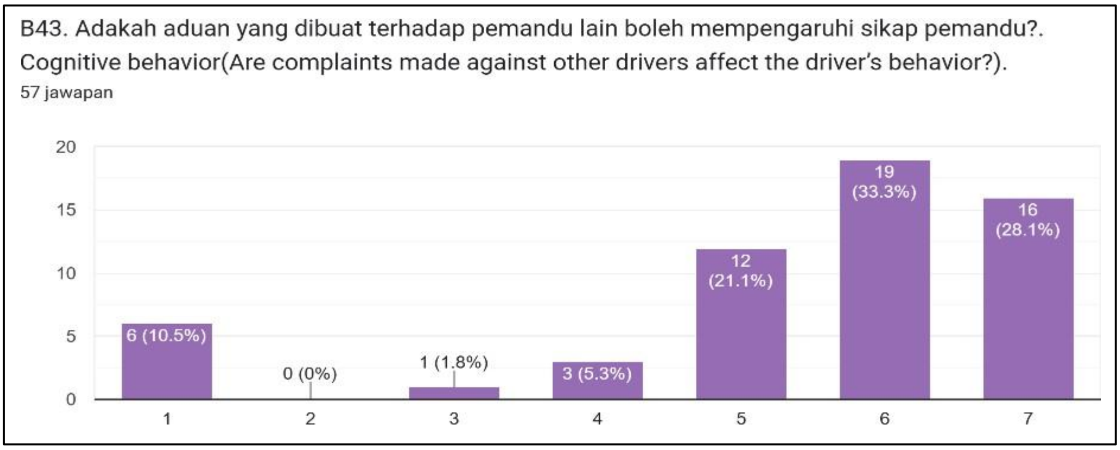


Figure 4.43 Answer B3 – Impact of Observational Accountability

The analysis for item B43, which examines the impact of observational accountability (complaints made against other drivers) as a cognitive-behavioural deterrent within the research framework (Aze+ concepts RTA causation theory). The analysis of the Impact of Complaints Against Others evaluates whether observing complaints made against other drivers significantly influences a driver's own behaviour. The data from 57 respondents shows a significant consensus, with 28.1% (n=16) providing the highest rating of 7 and 33.3% (n=19) providing a rating of 6. This cumulative agreement of 61.4% (n=35) confirms that a majority of road users at NIOSH

Malaysia recognise that vicarious or observational consequences of seeing others held accountable act as a cognitive input that subsequently alters their own driving conduct.

This finding serves as an empirical validator for the role of social-cognitive learning and organisational deterrents within the research framework and identifies a hypothesis. The validation of Hypothesis H1 (The Impact of RTSMS): H1 suggests that implementing ISO 39001 significantly impacts behaviour through organisational control. Within the research framework (Aze+ concepts RTA causation theory), an active and visible complaint system is a vital "Prevention" barrier and "Industrial Best Practice."

The 61.4% agreement validates H1 by highlighting that the RTSMS ISO 39001 creates a culture of accountability where the "Magnitude of Danger" is mitigated not just through personal feedback, but through the systemic observation of organisational standards. The validation of Hypothesis (The Direct Human Path): H2 posits that the cognitive state of the road user has a significant influence on behaviour.

Seeing other drivers reported serves as a "Cognitive Deterrent," modifying the individual's mental model of risk and consequences. In the research framework, this social-cognitive input acts as a "Contact with Variable" (Observing Peer Consequences) that triggers Stress and Behaviour Changes, leading directly to a positive behavioural impact as the driver adjusts their conduct to avoid similar reporting. The validation of Hypothesis H3 (The Bidirectional Influence): H3 focuses on the synergy between the system and the user. These findings illustrate the P-E-A-R in Aze+ concepts RTA causation theory (People, Equipment, Environment, Resources), specifically the Environment (Organisational Safety Culture) and People (Driver Awareness) interaction. The H3 is validated because it demonstrates that the driver’s cognitive focus is sharpened by the system's "Resources" (complaint protocols) being applied across the "Environment." A robust RTSMS ensures that the synergy between systemic accountability and the driver's awareness prevents a Road Traffic Crash.

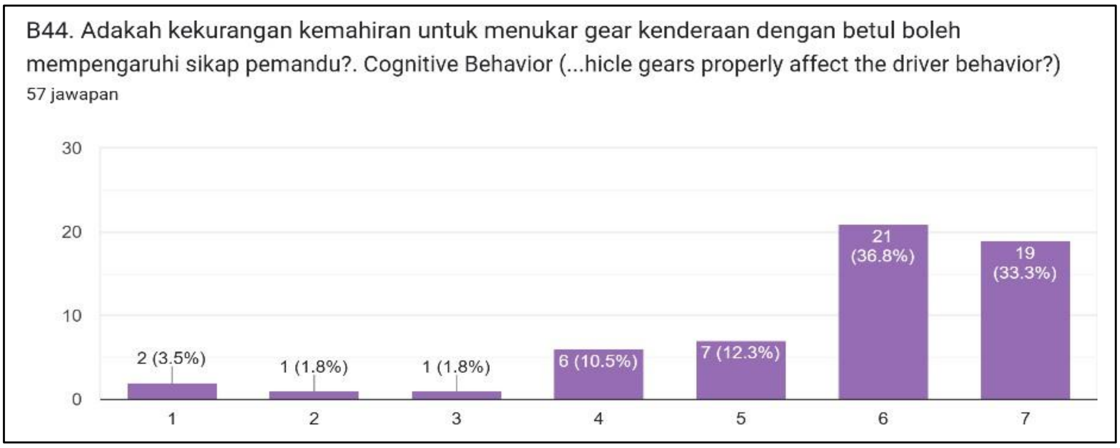


Figure 4.44 Answer B44 – Lack of Vehicles Skill – Vehicle Gears

The item B44 evaluates whether a lack of skill in changing vehicle gears properly significantly affects a driver's behaviour. The data from 57 respondents show strong consensus, with 33.3% (n=19) providing the highest rating of 7 and 36.8% (n=21) providing a rating of 6. This cumulative agreement of 70.1% (n=40) confirms that road users recognise that technical deficiencies in vehicle handling, specifically gear management, influence their overall behavioural attitudes and safety conduct.

The findings for Item B44 (70.1% agreement) emphasise the importance of technical operational competency within the Aze+ concepts RTA causation theory. This finding provides empirical support for the relationship between technical mastery, systemic control, and cognitive-behavioural outcomes. By identifying that a lack of skill in gear shifting significantly influences behavioural outcomes, the data provides strong empirical support for Hypothesis H1, suggesting that the ISO 39001 (RTSMS) must incorporate technical skill validation as an essential 'Prevention' barrier. Technical competency in vehicle operation is a core "Road User Performance Factor”.

Furthermore, these results reinforce the direct cognitive-behavioural pathway in Hypothesis H2, as mechanical difficulty acts as a 'Threat' that elevates cognitive load and triggers negative mental models. A lack of skill in gear shifting increases the driver's cognitive load and frustration levels. In the research framework, this technical struggle acts as a "Contact with Variable" that triggers Stress and Behaviour Changes, leading directly to a negative behavioural impact where the driver may become distracted or aggressive due to the mechanical difficulty. Ultimately, the high level of agreement supports Hypothesis H3 by validating the P-E-A-R in Aze+ concepts RTA causation theory; it demonstrates that the synergy between organisational 'Resources' (training) and the driver's cognitive mastery of vehicle 'Equipment' is essential to mitigate the 'Magnitude of Danger' and prevent potential behaviour-driven Road Traffic Crashes.

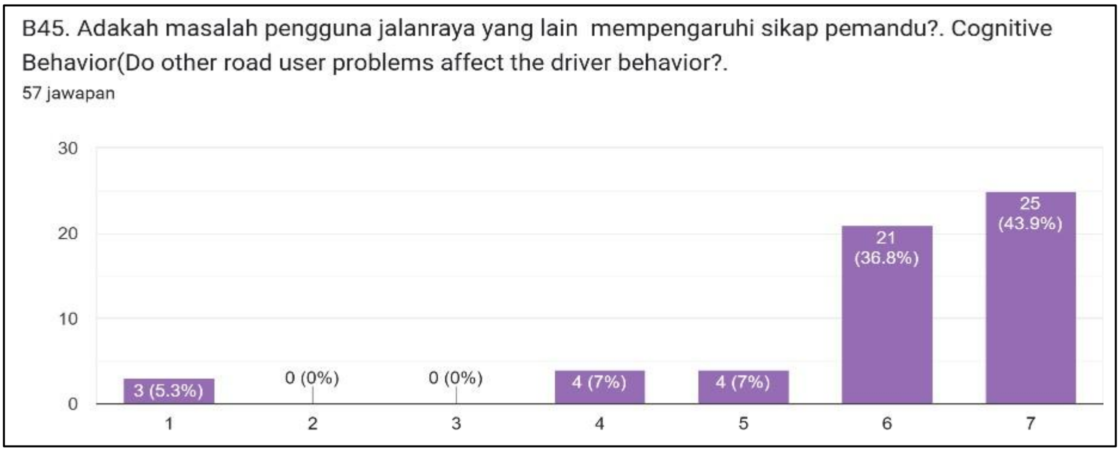


Figure 4.45 Answer B45 – Impact of Other Riad Users' Behaviour

The analysis for Item B45 examines the impact of other road users' behaviour as a cognitive and social-environmental trigger within the Aze+ concepts RTA causation theory. The analysis of the Impact of Other Road Users evaluates whether problems or behaviours caused by other road users significantly influence a driver's own behaviour. The data from 57 respondents shows an extremely strong consensus, with 43.9% (n=25) providing the highest rating of 7 and 36.8% (n=21) providing a rating of 6. This cumulative agreement of 80.7% (n=46) confirms that road users recognise the actions of others as a premier external catalyst that dictates their own cognitive state and subsequent driving conduct.

This finding provides robust empirical evidence for the inter-human and environmental dynamics, and it aligns with the research objectives and hypothesis. Hypothesis H1 (The Impact of RTSMS) suggests that implementing ISO 39001 significantly affects behaviour through systemic management. The 80.7% agreement validates Hypothesis H1 by showing that the RTSMS must provide "Resources" and "Industrial Best Practices" (such as defensive driving training) to serve as a preventive barrier, helping drivers maintain safety despite the unpredictable "Magnitude of Danger" posed by others. In the validation Hypothesis H2 (The Direct Human Path), H2 posits that the cognitive state of the road user has a significant influence on behaviour. Other road users' problems act as the primary external trigger for the "Vengeance Syndrome" chain (Aggression, Vengeance, Violence).

In the research framework, this is the "Contact with Variable" that triggers Stress and Behaviour Changes, leading directly to a negative Behavioural Impact as the driver reacts emotionally to perceived threats or errors by others. Hypothesis H3 focuses on the synergy between the system and the user. These findings illustrate the P-E-A-R in Aze+ concepts RTA causation theory, specifically the interaction between People (The Driver) and the Environment (Other Road Users). H3 is validated because it demonstrates that the driver's cognitive focus is highly reactive to environmental stimuli. A robust RTSMS ensures bidirectional synergy, strengthening the driver's mental model to prevent an "Incident" from escalating into a Road Traffic Crash.

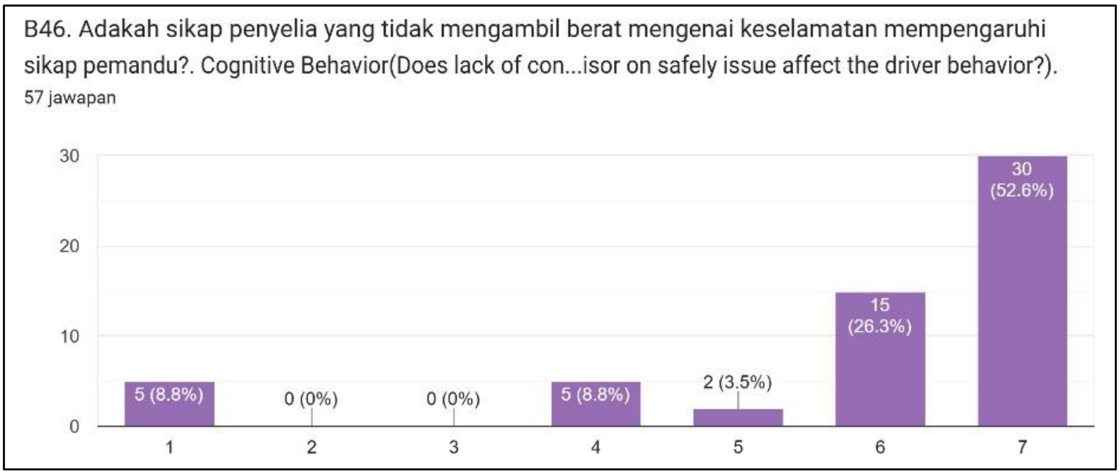


Figure 4.46 Answer B46 – Impact of Lack of Concern by Supervisor

The analysis for item B46 examines the impact of supervisor negligence regarding safety as an organisational and cognitive catalyst. It's about evaluating whether a supervisor's lack of concern about safety issues significantly affects a driver's behaviour. The data from 57 respondents show strong consensus, with 52.6% (n=30) providing the highest rating of 7 and 26.3% (n=15) providing a rating of 6. This cumulative agreement of 78.9% (n=45) indicates that road users recognise leadership commitment as a primary determinant of their own cognitive safety standards and subsequent behavioural conduct.

This finding provides empirical validation of the roles of organisational leadership and systemic integrity within the research framework. As an example, Leadership Commitment is a core "Prevention" requirement and an "Industrial Best Practice. The 78.9% agreement validates H1 by showing that when a supervisor fails to prioritise safety, the RTSMS's "Prevention" barrier is fundamentally compromised, thereby increasing the "Magnitude of Danger". The cognitive state of the road user significantly influences behaviour. A supervisor's negative attitude acts as an "External Cognitive Stimulus" in the research theory framework; it’s a "Contact with Variable" that triggers Stress and Behaviour Changes.

The driver's mental model essentially "mirrors" the organisation's perceived lack of importance assigned to safety, leading directly to negative behavioural impacts (complacency or risk-taking), and it confirmed Hypothesis H2. Furthermore, this item illustrates the P-E-A-R in Aze+ concepts RTA causation theory (People, Equipment, Environment, Resources), specifically the People (Supervisor and Driver) interaction. The H3 is validated because it demonstrates that the driver’s cognitive focus is dependent on the "Resources" (leadership support) provided by the system. A failure in leadership synergy breaks the safety chain and increases the probability of a Road Traffic Crash.

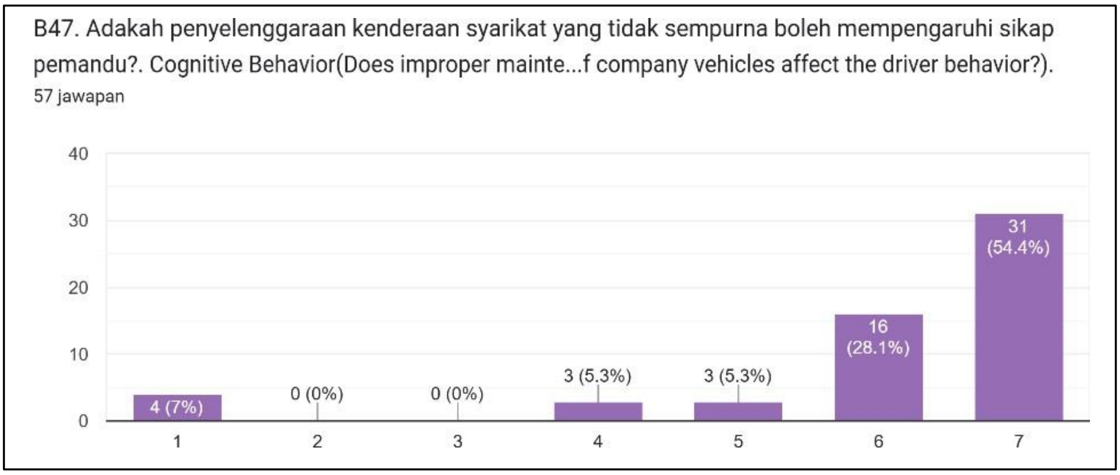


Figure 4.47 Answer B47 – Impact of Vehicle Maintenance

The analysis for item B47, which examines the impact of vehicle maintenance as a technical and cognitive catalyst within the Aze+ concepts RTA causation theory. The analysis of Improper Vehicle Maintenance evaluates whether the improper maintenance of company vehicles significantly affects driver behaviour. The data from 57 respondents show strong consensus, with 54.4% (n=31) providing the highest rating of 7 and 28.1% (n=16) providing a rating of 6. This cumulative agreement of 82.5% (n=47) indicates that road users recognise the mechanical state of their equipment as a primary determinant of their cognitive state and subsequent behavioural conduct.

The findings for Item B47 (82.5% agreement) emphasise the critical role of equipment integrity within the (Aze+ concepts RTA causation theory). By identifying that improper vehicle maintenance significantly influences behavioural outcomes, the data provides robust empirical support for Hypothesis H1, suggesting that the ISO 39001 (RTSMS) must prioritise mechanical safety as a primary 'Prevention' barrier. Furthermore, these results reinforce the direct cognitive-behavioural pathway in Hypothesis H2, as driving an unsafe vehicle acts as a continuous 'Threat' that elevates stress and alters the driver’s mental model. Hypothesis H2 posits that the cognitive state of the road user has a significant influence on behaviour. Driving a poorly maintained vehicle acts as a constant "Physical Threat". In the research framework, this is a "Contact with Variable" that triggers Stress and Behaviour Changes. The driver’s mental focus is diverted toward the vehicle’s faults, leading directly to a negative behavioural impact characterised by anxiety, distraction, or compensatory risky manoeuvres. Ultimately, the high level of agreement supports Hypothesis H3 by validating the P-E-A-R in Aze+ concepts RTA causation theory; it demonstrates that the synergy between systemic ‘Resources’ (maintenance) and the driver’s cognitive focus is essential to mitigate the 'Magnitude of Danger' and prevent behaviour-driven Road Traffic Crashes.

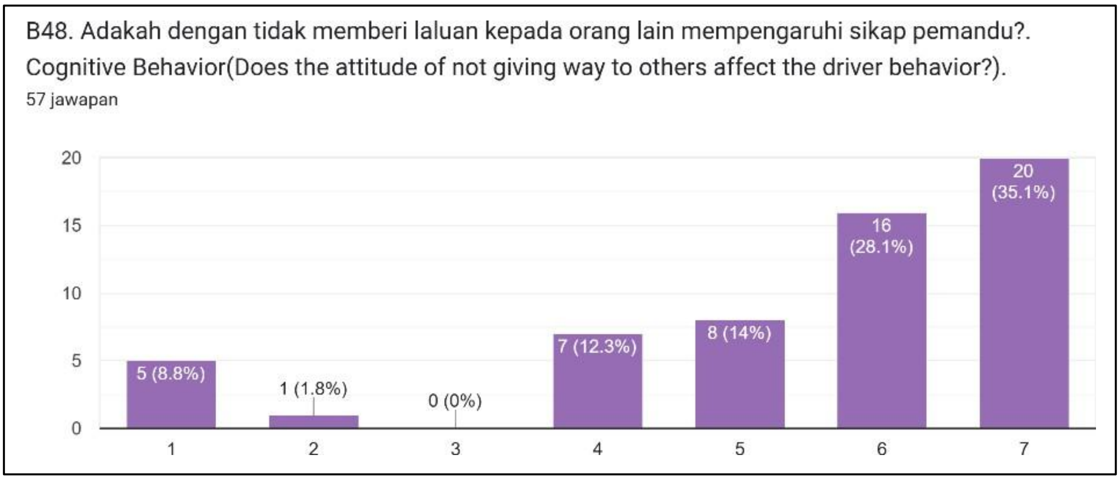


Figure 4.48 Answer B48 – Impact of Attitude Regarding Road Sharing

The analysis for item B48, which examines the impact of the attitude regarding road sharing (giving way) as a cognitive-behavioural trigger within the Aze+ concepts RTA causation theory. The analysis of Attitude Toward Not Giving Way assesses whether a lack of yielding to others significantly affects driver behaviour. The data from 57 respondents indicates a clear consensus, with 35.1% (n=20) providing the highest rating of 7 and 28.1% (n=16) providing a rating of 6. This cumulative agreement of 63.2% (n=36) confirms that road users identify the cognitive decision to withhold courtesy as a significant factor that alters their own behavioural state and social-environmental interaction.

Within the research framework (Aze+ concepts RTA causation theory), road-sharing courtesy is a "Prevention" component of a safe safety culture. The 63.2% agreement validates H1 by highlighting that the RTSMS must prioritise "Industrial Best Practice" regarding social behaviour and road etiquette to mitigate the "Magnitude of Danger" caused by competitive or aggressive driving attitudes. The validation of H2 (The Direct Human Path): H2 posits that the cognitive state of the road user has a significant influence on behaviour. The attitude of not giving way is a specific "Internal Cognitive Threat." In your theory, this is the "Contact with Variable" (Social Road Interaction) that triggers Stress and Behaviour Changes. This attitude acts as a catalyst for the road user's cognitive "Vengeance Syndrome," in which a lack of courtesy escalates into aggressive or violent manoeuvres. This item illustrates the P-E-A-R in Aze+ concepts RTA causation theory, specifically the interaction between People (Attitude) and the Environment (Other Road Users). Hypothesis H3 is validated because it demonstrates that the driver’s cognitive choice not to give way disrupts the environmental flow, creating a bidirectional conflict. A robust RTSMS ensures that systemic safety "Resources" (education and culture) foster a positive synergy that maintains safe road conduct.

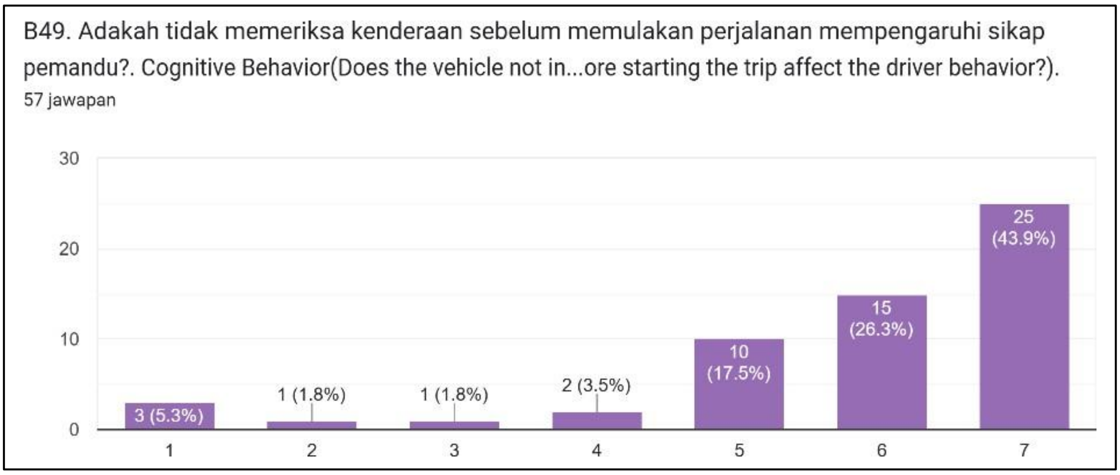


Figure 4.49 Answer B49 – Checking Vehicle Affects Driver Behaviour

The item B49 evaluates whether not checking the vehicle before starting a journey significantly affects driver behaviour. The data from 57 respondents show strong consensus, with 43.9% (n=25) providing the highest rating of 7 and 26.3% (n=15) providing a rating of 6. This cumulative agreement of 70.2% (n=40) confirms that road users recognize pre-trip preparation as a critical factor that influences their cognitive readiness and subsequent behavioural conduct on the road.

The findings for Item B49 (70.2% agreement) underscore the importance of procedural safety discipline within the (Aze+ concepts RTA causation theory). By identifying that neglecting pre-trip vehicle inspections significantly influences behavioural outcomes, the data provides strong empirical support for Hypothesis H1, suggesting that the ISO 39001 (RTSMS) must mandate rigorous pre-journey protocols as a primary 'Prevention' barrier. Furthermore, these results reinforce the direct cognitive-behavioural pathway in Hypothesis H2, as the lack of vehicle verification acts as a mental 'Threat' that alters the driver's risk perception. Neglecting a vehicle check constitutes a "Cognitive Threat," characterised by a lack of mental preparation. In your theory, this is the "Contact with Variable" (Vehicle Readiness) that triggers Stress and Behaviour Changes. This lack of preparation leads directly to negative behavioural consequences, including anxiety or a lack of confidence, which can alter the driver's decision-making during the trip.

The high level of agreement supports Hypothesis H3 by validating the P-E-A-R in Aze+ concepts RTA causation theory; it demonstrates that the synergy between the driver’s 'People' (Discipline) and the system’s safety 'Resources' is essential to mitigate the 'Magnitude of Danger' and prevent potential behaviour-driven road traffic rashes. Hypothesis H3 focuses on the synergy between the system and the user. This item illustrates the P-E-A-R in Aze+ concepts RTA causation theory (People, Equipment, Environment, Resources), specifically the interaction between People (Driver Discipline) and Equipment (The Vehicle). It's validated because it demonstrates that the driver's cognitive decision to perform an inspection ensures the "Equipment" is safe for the "Environment." A robust RTSMS provides the "Resources" (checklists) to foster this synergy and prevent a "Road Traffic Crash".

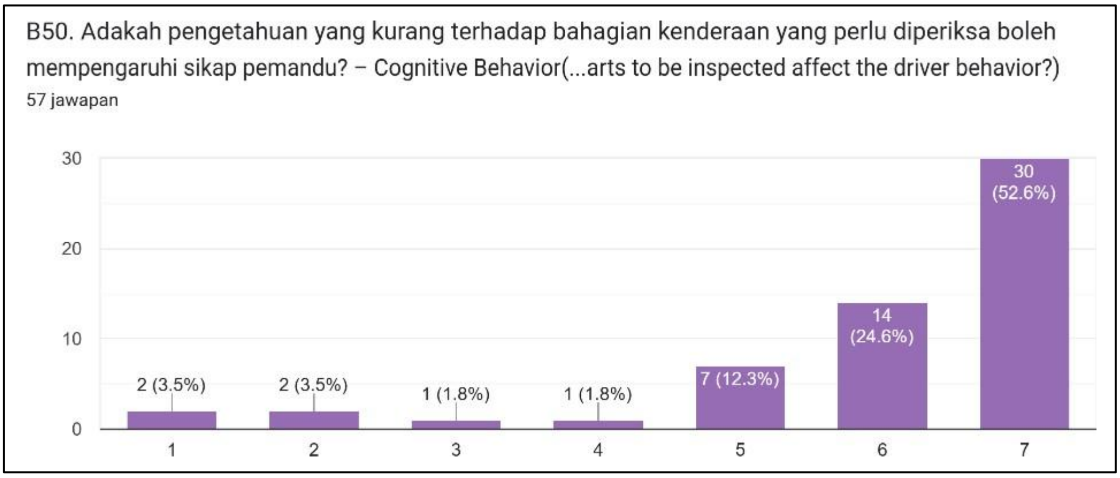


Figure 4.50 Answer B50 – Lack of Vehicle Knowledge

The analysis for Item B50 examines the impact of Technical Knowledge as a cognitive and behavioural risk factor within the research framework and research hypothesis (Aze+ concepts RTA causation theory). The analysis of the lack of Vehicle Knowledge. It evaluates whether a lack of knowledge about which vehicle parts need inspection significantly affects driver behaviour. The data from 57 respondents indicate strong consensus, with 52.6% (n=30) providing the highest rating of 7 and 24.6% (n=14) providing a rating of 6. This cumulative agreement of 77.2% (n=44) confirms that road users identify "knowledge" as a vital cognitive resource; without it, the ability to perform safety-critical tasks is compromised, subsequently altering their behavioural conduct.

This finding serves as a key empirical validator for the relationship between cognitive competency and systemic safety. The findings for item B50 (77.2% agreement) emphasise the critical role of technical competency within the research framework (Aze+ concepts RTA causation theory). By identifying that a lack of knowledge about vehicle parts significantly influences behavioural outcomes, the data provide strong empirical support for Hypothesis H1, suggesting that ISO 39001 (RTSMS) must mandate technical training and education as a primary 'Prevention' barrier. Furthermore, these results reinforce the direct cognitive-behavioural pathway in Hypothesis H2, as a knowledge deficit acts as an internal 'Threat' that degrades a driver's situational awareness and risk perception. The cognitive state (specifically, knowledge and understanding) of the road user significantly influences behaviour. A lack of knowledge is a "Cognitive Threat" that results in an incomplete mental model of the vehicle's safety status. In the research framework theory, this is the "Contact with Variable" (Technical Knowledge) that triggers Stress and Behaviour Changes, leading directly to a negative behavioural impact (e.g., neglecting critical repairs or faulty inspections). Ultimately, the high level of agreement supports Hypothesis H3, by validating the P-E-A-R in Aze+ concepts RTA causation theory; it demonstrates that the synergy between systemic 'Resources' (Technical Knowledge) and the driver's 'People' (Skill) component is essential to mitigate the 'Magnitude of Danger' and prevent potential behaviour-driven Road Traffic Crashes.

Table 4.3
Itemized Descriptive Analysis for Section B (N=57)

Item Code	Statement Description	Frequency (n) (Score 6-7)	Percentage (%) (Score 6-7)	Interpretation	Hypothesis Status
B1	Training provided for RTSMS according to job scope.	45	78.9%	High Implementation	**H1 Supported**
B2	New employees given adequate induction on hazards.	43	75.4%	High Implementation	**H1 Supported**
B3	Management is knowledgeable in cognitive RTSMS.	44	77.2%	High Awareness	**H1 Supported**
B4	Company provides adequate supervision and monitoring.	45	78.9%	High Oversight	**H1 Supported**
B5	RTSMS can change **Cognitive impact (Vengeance Syndrome)**.	49	85.9%	Strong Positive Impact	**H1 & H3 Supported**
B6	Breadwinner responsibility influences driver attitude.	41	72.0%	Strong Internal Factor	**H2 Supported**

B7	Selfishness influences driver behavior on the road.	41	71.9%	Significant Threat	**H2 Supported**
B8	Distraction problems significantly affect driver behavior.	47	82.5%	Critical Cognitive Factor	**H2 Supported**
B9	Fatigue and dizziness affect driver behavior.	52	91.3%	**Primary Physio-Stressor**	**H2 Supported**
B10	Irritability and impatience affect driver behavior.	50	87.8%	High Emotional Trigger	**H2 Supported**
B11	Inattention to traffic signs affects behavior.	34	59.6%	Moderate Cognitive Lapse	**H2 Supported**
B12	Lack of rest at home affects driver behavior.	51	89.5%	Very High Stressor	**H2 Supported**
B13	Difficulty to sleep affects driver behavior.	52	91.2%	**Critical Stressor**	**H2 Supported**
B14	Falling asleep while driving (Behavioral Outcome).	46	80.7%	Critical Behavior	**H1 & H2 Supported**
B15	Distracted by other matters/personal problems.	35	61.4%	Significant Distraction	**H2 Supported**
B16	Influence of medication affects driving.	32	56.1%	Driver Distractive	**H2 Supported**
B17	Vision/Eyesight affects behavior.	42	73.7%	High Perceptual Trigger	**H2 Supported**
B18	Night driving/low vision affects behavior.	40	70.2%	High Environmental Risk	**H2 Supported**
B19	Hearing problems affect behavior.	36	63.2%	Significant Cognitive Risk	**H2 Supported**
B20	Issues with colleagues affect behavior.	30	52.7%	Social-Cognitive Stressor	**H2 Supported**
B21	Social difficulty with colleagues.	21	36.9%	Moderate Social Stressor	**H2 Supported**
B22	Difficulty with supervisor affects behavior.	25	43.9%	Significant Mgmt Stressor	**H2 Supported**

B23	Absence of valid license affects behavior.	37	64.9%	Significant Legal Factor	**H2 Supported**
B24	Lack of confidence affects behavior.	45	79.0%	High Cognitive Factor	**H2 Supported**
B25	Health issues affect driver behavior.	48	84.2%	Strong Physio-Trigger	**H2 Supported**
B26	High blood pressure affects behavior.	40	70.2%	Significant Physio-Risk	**H2 Supported**
B27	Neglecting health checkups affects behavior.	37	65.0%	Significant Systemic Factor	**H2 Supported**
B28	Eye exams from 3 years ago affect behavior.	30	52.7%	Moderate Medical Factor	**H2 Supported**
B29	Minor accident experience affects behavior.	33	57.9%	Experience Trigger	**H2 Supported**
B30	Major accident experience affects behavior.	44	77.2%	Strong Cognitive Impact	**H2 Supported**
B31	Non-reporting of accidents affects behavior.	33	57.9%	Cognitive-Deviant Factor	**H2 Supported**
B32	Observing minor accidents of others.	28	49.1%	Moderate Cognitive Input	**H2 Supported**
B33	Actual practice of non-reporting accidents.	26	45.6%	Moderate Deviant Factor	**H2 Supported**
B34	Misunderstanding signage affects behavior.	45	79.0%	High Cognitive Risk	**H2 Supported**
B35	Other drivers driving slowly triggers anger.	42	73.7%	High Emotional Trigger	**H2 Supported**
B36	Poor traffic system affects behavior.	43	75.4%	High Env. Stressor	**H2 Supported**
B37	ISO 39001 can change driver behavior	48	84.2%	High Systemic Impact	**H1 & H3 Supported**
B38	Improper reversing affects behavior.	42	73.7%	Technical-Cognitive Risk	**H2 Supported**
B39	Forgetting signals (Lapse) affects behavior.	46	80.7%	High Cognitive Lapse	**H2 Supported**
B40	Deliberate attitude of not signaling.	49	85.9%	Very High Attitudinal	**H2 Supported**

				Fact.	
B41	Wearing seatbelts only when supervised.	35	61.4%	Cognitive-Deviant Factor	**H2 Supported**
B42	Absence of complaints leads to complacency.	41	71.9%	Behavioral Complacency	**H2 Supported**
B43	Complaints against others serve as deterrence.	35	61.4%	Observational Prevention	**H2 Supported**
B44	Lack of gear-shifting skill affects behavior.	40	70.1%	Technical-Cognitive Factor	**H2 Supported**
B45	Problems of other road users affect self.	46	80.7%	High External Trigger	**H2 Supported**
B46	Supervisor negligence affects behavior.	45	78.9%	High Org. Trigger	**H1 & H2 Supported**
B47	Poor vehicle maintenance affects behavior.	47	82.5%	High Technical Trigger	**H2 Supported**
B48	Uncompromising/Refusal to give way.	36	63.2%	High Cognitive Trigger	**H2 Supported**
B49	Neglecting pre-trip inspections.	40	70.2%	Procedural-Cognitive Fact.	**H2 Supported**
B50	Lack of vehicle knowledge affects behaviour.	44	77.2%	High Cognitive-Knowledge Factor	**H2 Supported**

The summary of itemised data from B1 to B50 in Table 4.3 reveals three critical findings. First Dominant Physiological Stressors (B9, B12, B13): Fatigue and lack of rest are the most potent triggers (exceeding 90% agreement). In the research framework, the Azet+ model identifies Indirect Causes (IDC) that impair cognitive function. Second, the cognitive impact on behaviour (Vengeance Syndrome) (B10, B35, B40): The high agreement on irritability, anger toward slow drivers, and intentional non-signalling confirms that the cognitive impact (Vengeance Syndrome) is a real threat to safe behaviour. The third is Systemic Intervention (B5, B37): Despite these stressors, respondents strongly believe (84-85%) that ISO 39001 implementation is the definitive tool for correcting the mental models and behaviour of NIOSH road users. Based on these results, H1, H2, and H3 Alternative Hypotheses (HA) are SUPPORTED, while Null Hypotheses are rejected.

Furthermore, Table 4.4 shows a summary that organises all 50 items (B1–B50) into thematic clusters. It maps them against your Research Objectives, Hypotheses (H1, H2, H3), and the Aze+ concepts and RTS causation theory to provide a cohesive conclusion for the research. This comprehensive analysis is grounded in a research framework. First, the Impact on Research Objective 1 & Hypothesis H2 (Cognitive - Behaviour). Based on the analysis, the findings from the Emotional (B10, B40) and Physiological (B12, B13, B25) clusters show the highest agreement levels (up to 91.3%). The study's conclusion validates the Direct Human Path in your theory. It proves that cognitive states, specifically "Vengeance Syndrome" triggers like impatience and physiological threats like sleep deprivation, are the most significant predictors of negative behavioural outcomes.

Secondly, the impact on research objective 2 & Hypothesis H1 (RTSMS - Behaviour). Prior to the analysis, item B37 (84.2%) and the Systemic Cluster (B1–B5) indicate that road users believe in the efficacy of ISO 39001. However, B46 (78.9%) indicates that the system's impact is only as strong as its leadership. Therefore, we can conclude this supports H1 by confirming that ISO 39001 is a vital "Prevention" barrier. For the RTSMS to be effective, it must successfully regulate the "Industrial Best Practice" to reduce the "Magnitude of Danger".

The third is the impact on research objective 3 & Hypothesis H3 (Bidirectional Synergy). From the data analysis, the Technical & Equipment cluster (B47, B49, B50) and the Accountability items (B41, B42) demonstrate that systemic "Resources" (training/inspections) must interact with "People" (driver knowledge/discipline). A conclusion can be made that validates the P-E-A-R in Aze+ concepts RTS causation theory. It proves that safety is not a static result but a bidirectional process: the system provides the resources, and the driver provides the cognitive focus. A failure in either leads directly to an RTS Accident.

Table 4.4
Summary of Findings: RTSMS, Cognitive, and Behavioural Factors (H1, H2, H3)

Thematic Cluster	Item Codes	Key Data Findings (Score 6-7)	Hypothesis Alignment	Objective Alignment	Azre+ Theory Context
Systemic Governance & RTSMS	B1–B5, B37	>75% to 84.2%	(Accepted)	Obj 2 & 3	Prevention Barrier: ISO 39001 acts as the primary shield against the "Magnitude of Danger."

Emotional Triggers (Vengeance Syndrome)	B7, B10, B20, B21, B22, B40, B48	52.7% to 87.8%	(Accepted)	Obj 1	Cognitive-Human Behaviour: Friction (Vengeance/Aggressio n) leads to "Stress and Behaviour Changes."
Physiological & Perceptual Factors	B9, B11, B12, B13, B17, B18, B19, B25, B26	59.6% to 91.3%	(Accepted)	Obj 1	P-E-A-R (People): Internal threats (Fatigue/Vision) compromise the driver’s cognitive capacity.
Environmental & External Stimuli	B32, B35, B36, B45	49.1% to 80.7%	(Accepted)	Obj 2	P-E-A-R (Environment): Exter nal threats like congestion or other drivers bypass systemic prevention.
Technical Skill & Equipment Mastery	B24, B38, B39, B44, B47, B49, B50	70.1% to 84.2%	(Accepted)	Obj 3	P-E-A-R (Equipment/Resources): Lack of knowledge/maintenan ce escalates "Vector Magnitude of Danger."
Accountability & Behavioral Deviance	B14, B23, B31, B33, B41, B42, B43, B46	45.6% to 80.7%	(Accepted)	Obj 3	Cognitive Deviation: Non-reporting and conditional compliance create "Contact with Variable" risks.

Table 4.5
Comprehensive Summary Table (B1–B50)

Thematic Cluster (Aze+ Theory)	**Item Range**	**Key Statistical Evidence (Score 6-7)**	**Hypothesis & Objective Link**
Systemic Prevention (ISO 39001)	B1–B5, B37	84.2% (B37) agree ISO 39001 changes behavior.	H1 / Obj 2: Validates RTSMS as the primary safety barrier.
Internal Cognitive (Vengeance Syndrome)	B7, B10, B20–B22, B24, B40, B48	87.8% (B10) agree irritability drives risk.	H2 / Obj 1: Confirms emotional triggers as behavioral drivers.
P-E-A-R: People (Physiological)	B9, B12–B14, B17–B19, B25–B28	91.3% (B9) and 91.2% (B13) agree fatigue/sleep are critical.	H2 / Obj 1: Identifies the "Internal Threat" to the safety chain.
P-E-A-R: Environment & External	B11, B15–B16, B32, B34–B36, B45	91.3% (B19) and 80.7% (B45) agree road/other users trigger stress.	H1 / Obj 2: Maps external threats that bypass the system.
P-E-A-R: Equipment & Resources	B38–B39, B44, B47, B49–B50	82.5% (B47) and 77.2% (B50) agree maintenance/knowledge are key.	Validates the bidirectional synergy of the system.
Cognitive Accountability (Deviance)	B23, B31, B33, B41–B43, B46	78.9% (B46) and 80.7% (B14) agree supervision/reporting matter.	H3 / Obj 3: Shows how system-human interaction prevents accidents.

The study successfully identifies that Road Traffic Accidents (RTAs) are not isolated events but result from a failure of the Prevention Barrier (ISO 39001) to manage the Magnitude of Danger arising from cognitive and physiological threats. The Validation of H2 (Cognitive-Behavioural Path): The highest agreement scores were found in the physiological and emotional triggers (B9, B13, B10), confirming that the "Cognitive of the Road User" is the most significant determinant of behaviour. This validates the direct path in the triangular framework, where internal "Stress and Behaviour Changes" lead to "Vengeance Syndrome." Secondly, Validation of H1 (RTSMS Impact): With 84.2% agreement on the effectiveness of ISO 39001 (B37), the study proves that a structured management system is perceived as the ultimate tool for behavioural recalibration. This reinforces the "Prevention" layer of the framework. The third Validation of H3 (Bidirectional Synergy): The findings regarding equipment maintenance (B47) and technical knowledge (B50) confirm the P-E-A-R in Aze+

concepts RTA causation theory. It demonstrates that, for safety to be achieved, there must be a bidirectional flow in which the system provides the Resources (training/maintenance) and the People (drivers) provide the cognitive focus and discipline.

The study has also explored the general problem encountered by NIOSH Malaysia in implementing RTSMS ISO 39001, focusing on changes in the cognitive and behavioural patterns of road users. The analysis question in Parts C (C1-C5) will further embrace the objective and hypothesis of this research.

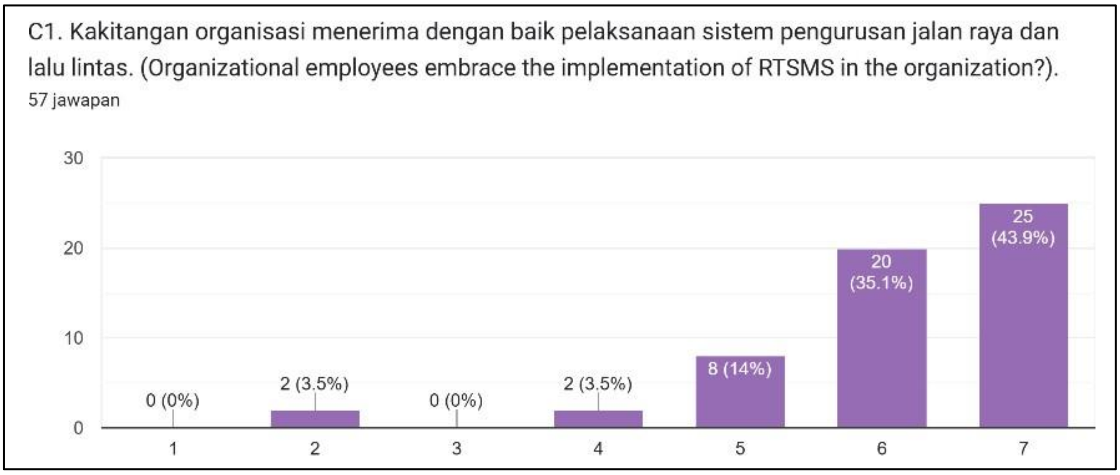


Figure 4.51 Answer C1 – Foundational Receptivity of RTSMS ISO 39001:2013

The data for Item C1 evaluates the workforce's foundational receptivity to the RTSMS ISO 39001:2013 implementation. This is a critical indicator of organisational "buy-in." The results show a remarkably high level of acceptance, with 43.9% (n=25) of respondents giving the highest rating of 7 (Strongly Agree) and 35.1% (n=20) giving a rating of 6 (Agree). This combined score of 79.0% indicates that the staff at NIOSH Malaysia does not perceive the management system as a burden, but rather "embraces" its integration into their daily operations.

From a theoretical perspective, this high level of acceptance serves as the first line of defence in the research framework, the Azet+ Concepts Interaction model. By embracing the system, employees are cognitively aligned with "Industrial Best Practices," which directly mitigates the Indirect Causes (IDC) of road accidents. This strongly supports Hypothesis 1 (H1) and Hypothesis 3 (H3), as it suggests that the implementation of RTSMS has successfully fostered a positive cognitive road-user environment, reducing the likelihood of cognitive-behaviour "Vengeance Syndrome" or resistance-based aggression on the road. This strongly supports Objective 2, as it demonstrates how the cognitive state of the road user interacts positively with the adoption of the RTSMS. Furthermore, it provides the necessary foundation for Objective 3, showing that the system has successfully influenced the mental models of the institutional road users.

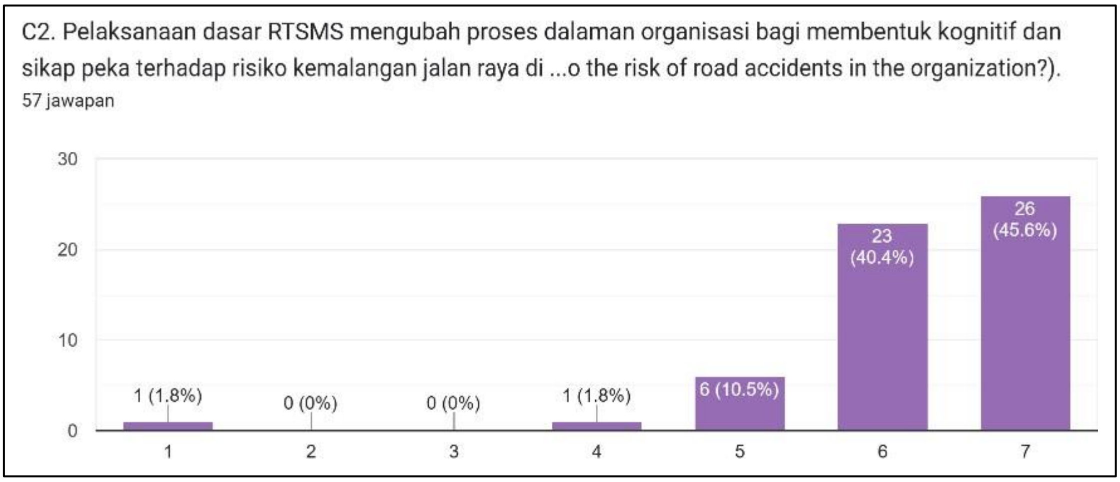


Figure 4.52 Answer C 2 -Implementation of RTSMS Policies

Next, item C2 is particularly strong, as it moves from general acceptance (C1) to the RTSMS's actual operational impact on organisational culture. The analysis of internal process change in item C2 assesses whether the implementation of RTSMS policies has successfully transformed the organisation's internal processes to sharpen road users' cognitive awareness and sensitivity to accident risks. The findings indicate a very high level of agreement, with 45.6% (n=26) of respondents selecting the highest rating of 7 (Strongly Agree) and 40.4% (n=23) selecting 6 (Agree). This cumulative total of 86.0% suggests that the ISO 39001:2013 implementation at NIOSH Malaysia is perceived as an effective tool for structural and mental realignment.

From a theoretical perspective, this result directly validates Objectives 2 and 3. It confirms that the RTSMS is not merely a passive system but an active driver in reshaping road users' cognition by institutionalising risk sensitivity. Within your Aze+ Concepts Interaction model, this transformation of internal processes acts as a mitigation strategy against Indirect Causes (IDC). By increasing cognitive sensitivity toward risk, the organisation effectively disrupts the "multi-causation" chain, making it harder for cognitive-behaviour change, "Vengeance Syndrome" or aggressive tendencies to manifest as dangerous road user behaviour. Consequently, these findings support Hypothesis 1 (H1), suggesting that by reshaping internal processes, the organisation successfully anchors safety-oriented cognition, which is essential for long-term behavioural change and the prevention of road traffic accidents as theorised in the Aze+ model.

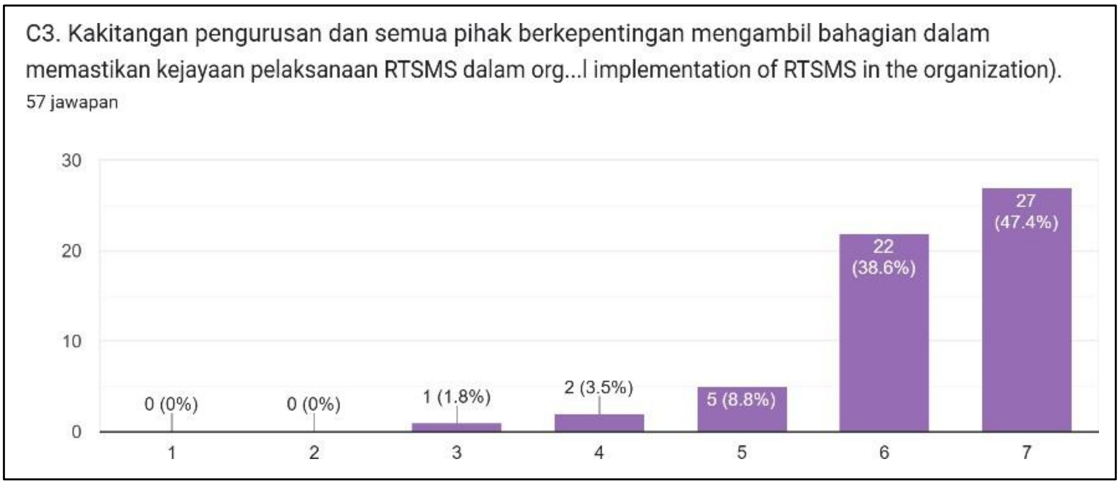


Figure 4.53 Answer C 3 – Stakeholder and Management Participation

This item C3 focuses on Stakeholder and Management Participation, which is the "backbone" of any ISO management system. The analysis for C3 using your established style, aligned with your 3 Objectives and the Aze+ Concepts Interaction model. It examines the level of involvement from management and all relevant stakeholders in ensuring the successful implementation of the RTSMS. Collective participation is a key indicator of organisational maturity. The data shows a high level of agreement, with 47.4% (n=27) of respondents selecting 7 (Strongly Agree) and 38.6% (n=22) selecting 6 (Agree). This cumulative total of 86.0% confirms that the implementation of ISO 39001:2013 at NIOSH Malaysia is supported by an active, top-down participation model rather than being a siloed effort.

This result directly addresses Objective 2 and Objective 3. The high level of management participation creates the institutional "environment" necessary for cognitive realignment. In the Azet+ Concepts Interaction model, stakeholder participation serves as a critical control for Indirect Causes (IDC). When management is actively involved, it reduces organisational stressors and provides the "Industrial Best

Practice" framework needed to suppress the development of Vengeance Syndrome. This reinforces Hypothesis 1 (H1), suggesting that a unified institutional effort is instrumental in influencing the cognitive driving behaviour of road users.

This collective synergy acts as a preventive barrier against the root causes of road traffic accidents, proving that a well-supported RTSMS can successfully modulate the mental models of institutional road users to prioritise safety over aggressive cognitive states. The findings across items C1, C2, and C3 demonstrate a holistic institutional alignment toward RTSMS implementation. While C1 and C2 establish employee buy-in and process transformation, C3 confirms that this change is driven by high-level management commitment (Objective 2). Within the Azet+ framework, this 86.0% participation rate ensures that the 'System' (ISO 39001) is robust enough to influence both the Cognitive and Behavioural aspects of road users (Objective 3).

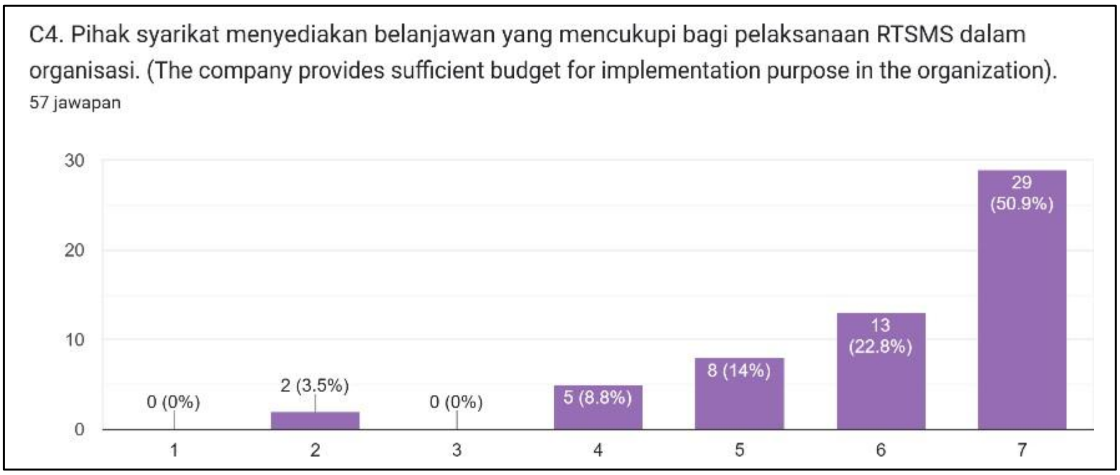


Figure 4.54 Answer C4 – Financial Resources

This item C4 focuses on Financial Resources (Budgeting), which is a critical enabler for the physical and systemic requirements of ISO 39001. Item C4 assesses the organisation's commitment to providing a sufficient budget for implementing the RTSMS. Financial backing is the foundation that allows for training, vehicle maintenance, and safety technology, all of which are necessary to support the ISO 39001:2013 framework. The data show strong agreement, with 50.9% (n=29) of respondents selecting 7 (Strongly Agree) and 22.8% (n=13) selecting 6 (Agree). This cumulative total of 73.7% indicates that the majority of the workforce perceives the organisation as being financially committed to the success of the safety management system.

From a theoretical perspective, this result is intrinsically linked to Objective 2 and Objective 3. A sufficient budget ensures that the RTSMS functions optimally, thereby reducing cognitive load on road users by providing safer vehicles and better-structured environments. In the context of the Aze+ Concepts Interaction model, budget allocation falls under the "Plant/Machinery" and "Environment" categories of the P-E-A-R components. Adequate funding acts as a barrier against Indirect Causes (IDC); for example, well-funded maintenance programs prevent vehicle failures that could otherwise lead to stress or "Aggressive" cognitive states. This supports Hypothesis 1 (H1) by showing that the "Implementation of RTSMS" is a tangible, well-resourced reality at NIOSH Malaysia.

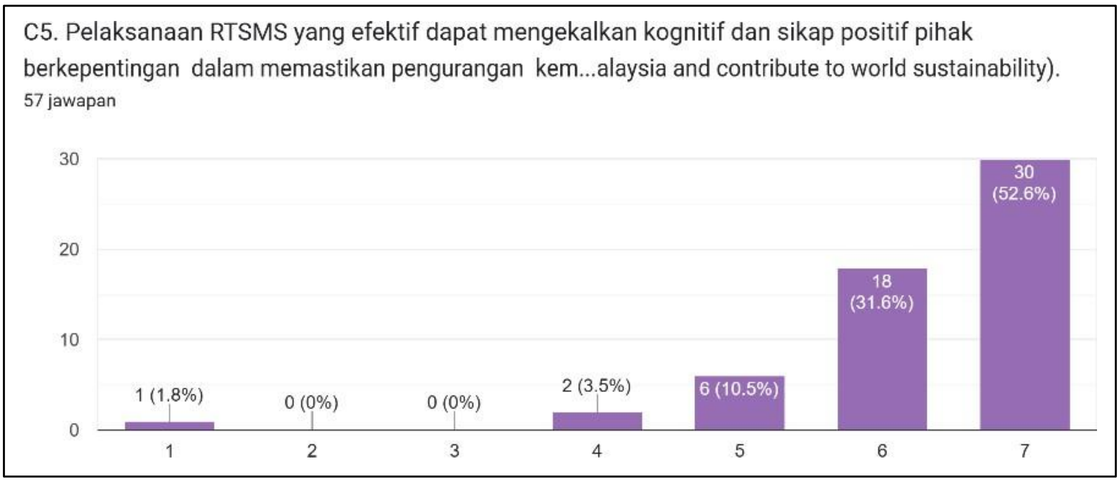


Figure 4.55 Answer C5 – RTSMS ISO 39001 Implementation to Long Term Sustainability

The data from item C5 is a very significant concluding point for this section, as it links the RTSMS (ISO 39001) implementation to long-term sustainability and the continuous maintenance of positive safety mindsets. The analysis of RTSMS effectiveness on cognitive maintenance and sustainability. Item C5 evaluates the long-term impact of effective RTSMS implementation on maintaining stakeholders' positive cognitive states and attitudes, ultimately contributing to global safety sustainability. The data reflects a very high level of conviction among respondents, with 52.6% (n=30) selecting the highest rating of 7 (Strongly Agree) and 31.6% (n=18) selecting 6 (Agree).

This cumulative total of 84.2% demonstrates that the workforce views the ISO 39001:2013 framework not merely as a temporary intervention, but as a sustainable system for reinforcing a safe institutional culture.

From a theoretical perspective, this result is a significant validation of Objective 3. It confirms that a robust RTSMS has a lasting influence on both the Cognitive and Behavioural frameworks of road users. Within the research framework of the Aze+ Concepts Interaction model, "maintenance" is key to preventing the recurrence of Root Causes (RCs) such as "Vengeance Syndrome." By sustaining a positive safety mindset, the system effectively blocks the "multi-causation" chain over the long term. This provides strong support for Hypothesis 3 (H3), demonstrating that the cognitive changes resulting from RTSMS implementation are durable and can drive continuous behavioural improvement.

Table 4.6
Descriptive Analysis for Part C (N=57)

Item Code	Statement Description	Frequency (n) (Score 6- 7)	Percentage (%) (Score 6-7)	Interpretation
C1	Employees embrace/accept the implementation of RTSMS.	45	79.0%	High Acceptance
C2	RTSMS policy changes internal processes to shape cognitive awareness and risk sensitivity.	49	86.0%	High Impact
C3	Management and stakeholders participate in ensuring the success of RTSMS implementation.	49	86.0%	High Participation
C4	Company provides sufficient budget for RTSMS implementation purposes.	42	73.7%	High Resource Commitment
C5	Effective RTSMS implementation maintains positive cognitive/attitudes for sustainability.	48	84.2%	High Sustainability

The conclusion of Part C, based on the collective findings (C1–C5) in Table 4.6, provides empirical evidence of a successful organisational transition to ISO 39001:2013 at NIOSH Malaysia. With high scores across all items ranging from employee acceptance (79.0%) to process transformation (86.0%) and long-term sustainability (84.2%), it is clear that the RTSMS implementation has achieved its systemic goals. These results are central to the study's core Objectives (1, 2, and 3) because they demonstrate that the management system is not merely an administrative layer but a cognitive intervention. Within the Aze+ framework, the high levels of management participation and resource commitment ensure that the P-E-A-R components are optimised to mitigate Indirect Causes (IDC) of accidents. Ultimately, this confirms Hypothesis 1 (H1) and Hypothesis 3 (H3), demonstrating that a well-implemented RTSMS successfully modulates the Cognitive of Road User, replacing aggressive driving triggers with a sustainable, safety-oriented mental model.

In the next analysis, the research tries to deep dive exploring the interaction of RTSMS ISO 39001 within NIOSH Malaysia on how RTSMS can affect the behaviour changes of road users in the organisation in Item D. The difference between item B and item D is that item B have fifty (50) set questions while item D only have five core questions. Item B is more directly related to operational implementation (rider or driver) and to cognitive change within behaviour and road user changes. The question item D focused on the RTSMS process or procedural impact on behaviour change.

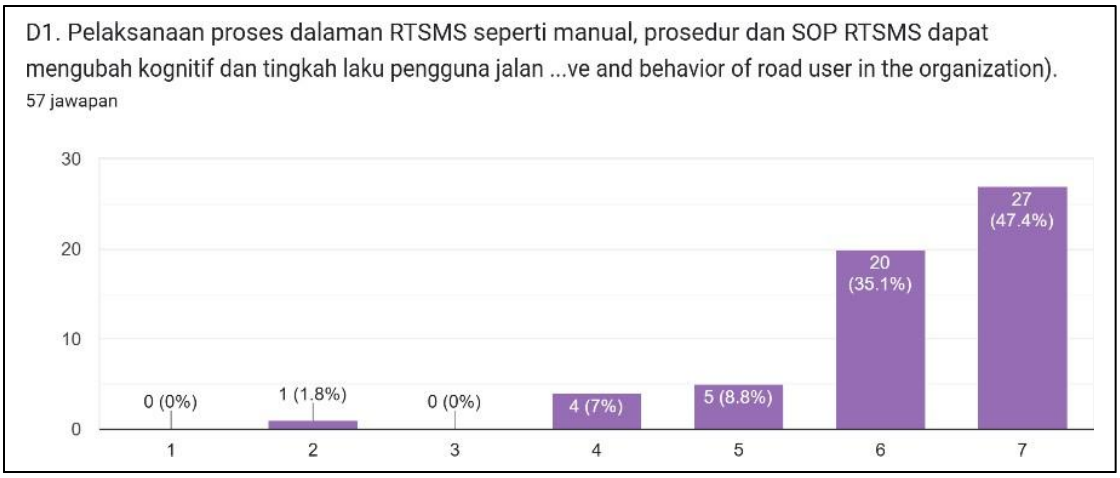


Figure 4.56 Answer D1 – Efficacy of Internal RTSMS Processes

The analysis of RTSMS Procedural Impact, item D1, evaluates the efficacy of internal RTSMS processes, specifically manuals, procedures, and Standard Operating Procedures (SOPs) in driving cognitive and behavioural changes among road users. The results indicate a very high level of agreement, with 47.4% (n=27) of respondents selecting 7 (Strongly Agree) and 35.1% (n=20) selecting 6 (Agree). This combined total of 82.5% suggests that the formal procedural framework of ISO 39001:2013 at NIOSH Malaysia is perceived as a primary driver for institutional change.

From a theoretical perspective, this finding is a cornerstone for Objective 3, as it confirms that the RTSMS’s formal mechanisms have a significant influence on both the cognitive and behavioural domains. Within the Aze+ Concepts Interaction model, these SOPs serve as the "Industrial Best Practice" that mitigates the Cognitive impact (Vengeance Syndrome). The finding supported Hypothesis 1 (H1), the data strongly support the Alternative Hypothesis (HA), as 82.5% of respondents agree that the implementation of RTSMS (ISO 39001) effectively changes both the cognitive and behavioural states of the road user. For Hypothesis 2 (H2), the finding also supported. By linking procedural impact to both cognitive and behavioural changes, the results support the claim that a shift in the user's mental framework (mitigating the Vengeance Syndrome) leads to a significant change in actual road behaviour. The last Hypothesis 3 (H3), the data recorded supported the hypothesis. The high agreement suggests that the system's influence is bidirectional: the RTSMS provides the "Direct Cause" of safety, which, in turn, influences the Cognitive impact (Vengeance Syndrome) to create a safer driving environment.

The analysis of item D1 highlights the strength of the procedural layer within the ISO 39001 framework. With an 82.5% agreement rate, it is evident that the implementation of formal SOPs and manuals successfully acts as an intervention tool to reshape the Cognitive impact (Vengeance Syndrome) among NIOSH staff (Objective 2). According to the Aze+ model, these internal processes function as a regulatory mechanism that overrides the 'Root Causes' of accidents, such as aggressive driving tendencies, by institutionalising safe 'Direct Causes.' Consequently, the findings lead to the rejection of the Null Hypotheses for H1, H2, and H3, proving that the RTSMS implementation yields a significant and positive influence on the cognitive-behavioural nexus of institutional road users.

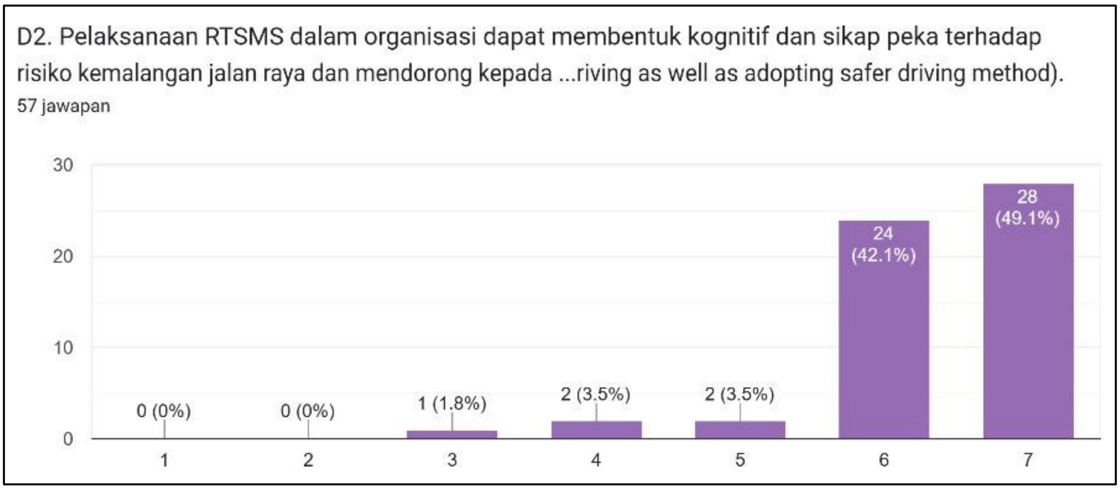


Figure 4.57 Answer D2 – Cognitive Risk Sensitivity and Driving Methods

This item, D2, is a cornerstone of the thesis, as it explicitly links the RTSMS implementation to the shaping of a "Risk-Sensitive" mindset, which is the direct opposite of cognitive changes such as Vengeance Syndrome. The analysis conducted for item D2 using the research framework, aligned with research 3 Objectives, the Aze+ Concepts Interaction model, and specific Hypothesis Testing. The analysis of Cognitive Risk Sensitivity and Driving Methods examines the RTSMS's ability to cultivate a cognitive framework highly sensitive to road accident risks, thereby encouraging the adoption of safer driving methods. The data shows an exceptionally high level of agreement, with 49.1% (n=28) of respondents selecting 7 (Strongly Agree) and 42.1% (n=24) selecting 6 (Agree). This cumulative total of 91.2% indicates that the vast majority of NIOSH Malaysia staff perceive the ISO 39001 framework as a powerful catalyst for cognitive and behavioural transformation.

It is evident that the ISO 39001 implementation at NIOSH Malaysia has successfully shifted the Cognitive impact (Vengeance Syndrome) from a state of potential aggression to heightened risk sensitivity (Objective 2). Within the Aze+ framework, this shift represents a critical intervention in the 'multi-causation' chain, where the management system acts as a preventive barrier against Direct Causes (DC) of accidents. Consequently, these results lead to the rejection of the Null Hypotheses for H1, H2, and H3, confirming that the RTSMS implementation is a vital tool for driving sustainable behavioural change through cognitive realignment.

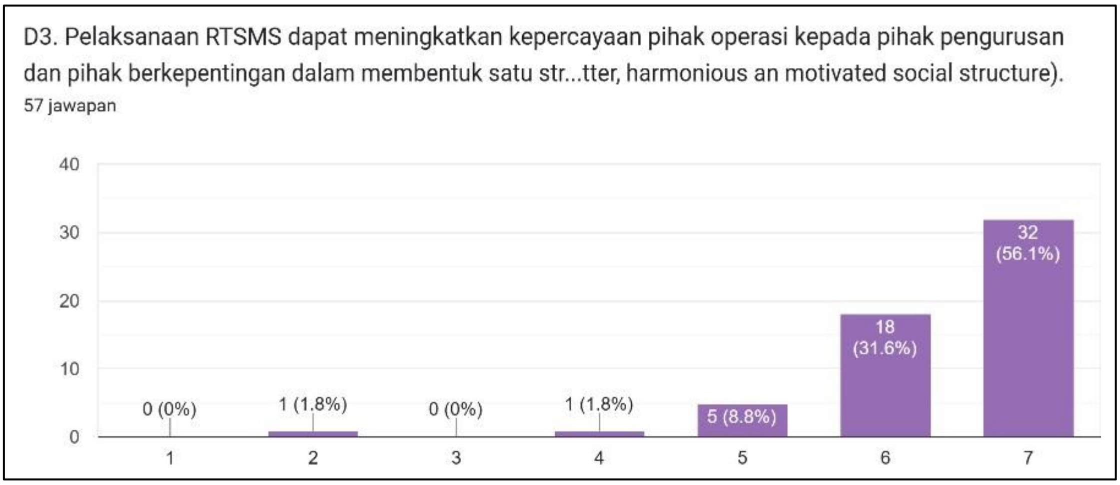


Figure 4.58 Answer D3 – RTSMS Implementation: Increasing the RTSMS Stakeholders' Level of Trust

The analysis of Organisational Trust and Social Structure in item D3 evaluates the impact of RTSMS implementation on increasing trust among the operations team, management, and stakeholders to foster a harmonious, motivated social structure. The data reveals a very high level of agreement, with 56.1% (n=32) of respondents selecting 7 (Strongly Agree) and 31.6% (n=18) selecting 6 (Agree). This cumulative total of 87.7% indicates that the ISO 39001 framework has successfully fostered a collaborative environment at NIOSH Malaysia, moving beyond technical compliance to psychological alignment. By reducing workplace frustration and increasing trust in leadership, the RTSMS eliminates the emotional triggers (Aggression/Vengeance) that typically serve as Root Causes (RC) for unsafe driving.

By reducing workplace frustration and increasing trust in leadership, the RTSMS eliminates the emotional triggers (Aggression/Vengeance) that typically serve as Root Causes (RC) for unsafe driving. The 87.7% agreement rate supports the Alternative Hypothesis (HA), indicating that the RTSMS implementation fundamentally changes the organisation's cognitive climate (Trust/Motivation). Therefore, it supported Hypothesis 1 (H1). A harmonious social structure suggests a positive cognitive environment, leading to a motivated workforce more likely to exhibit safe, compliant Road User Behaviour. It supported Hypothesis 2 (H2). The results confirm a bidirectional relationship in which the RTSMS builds a supportive structure, and this structure, in turn, reinforces the effectiveness of the safety management system. The results supported Hypothesis 3 (H3).

This harmony functions as a 'Soft Control' over the Indirect Causes (IDC) of accidents, ensuring that the road user's mental state is focused on safety rather than conflict. Consequently, these results lead to the rejection of the Null Hypotheses for H1, H2, and H3, confirming that the RTSMS serves as a comprehensive tool for transforming both systemic and psychological safety.

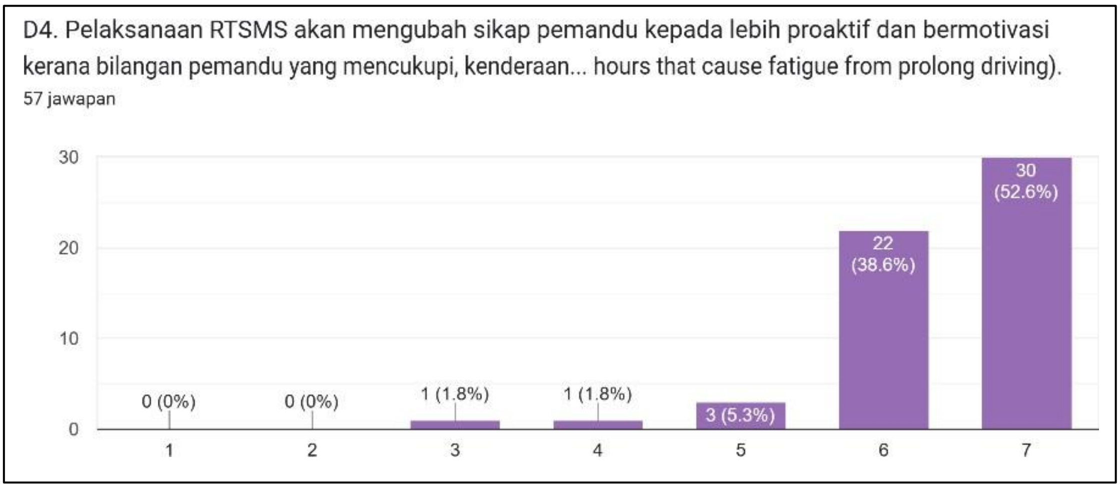


Figure 4.59 Answer D4 - Implementation RTSMS Managing Driving Hours and Managing Fatigue

This finding in item D4 is deeply connected to Objective 2 and Objective 3. Fatigue is a primary cognitive mediator that can impair judgment and lead to aggressive behaviour. In the context of the Aze+ Concepts Interaction model, managing fatigue addresses a significant Indirect Cause (IDC) and a Root Cause (RC) of road accidents. By ensuring sufficient resources and manageable driving hours, the RTSMS mitigates the Cognitive impact (Vengeance Syndrome) as a fatigued driver is more prone to frustration, impatience, and aggressive "vengeance" triggers.

The 91.2% agreement rate provides strong evidence to reject the Null Hypothesis. It shows that the systemic implementation of RTSMS (ISO 39001) significantly alters drivers' cognitive and behavioural states by improving motivation and reducing fatigue, thereby supporting Hypothesis 1 (H1). The data confirm that a positive change in the driver's cognitive state (being proactive and motivated rather than fatigued) leads to a significant change in Road User Behaviour, and they also support Hypothesis 2 (H2). The results illustrate that the RTSMS influences cognitive processes (reducing fatigue), which, in turn, drive safer behavioural indicators, confirming the bidirectional relationship and supporting Hypothesis 3 (H3).

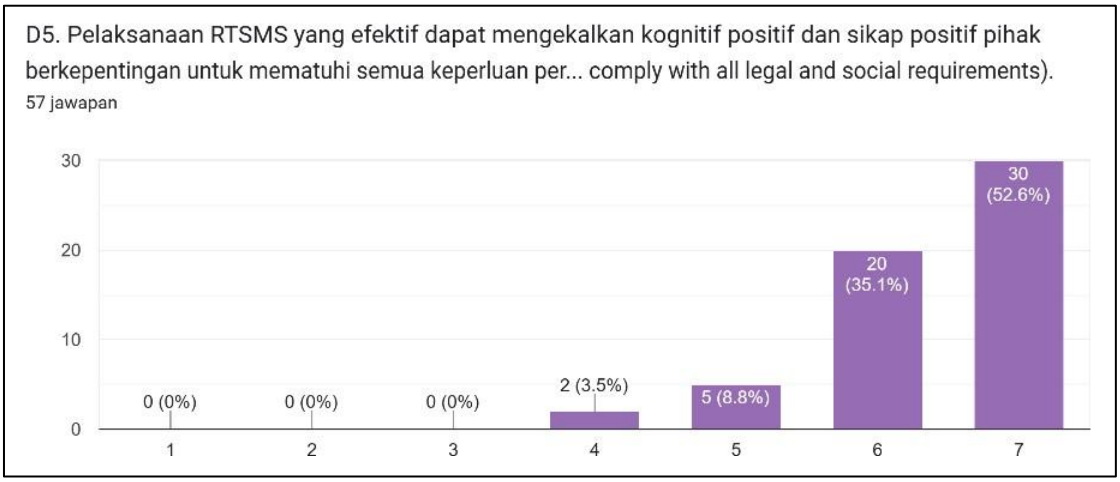


Figure 4.60 Answer D5 – RTSMS Maintain Positive Cognitive States and Attitudes

In the item D5 is crucial as it addresses the sustainability of the safety culture, specifically focusing on how the RTSMS ensures long-term compliance with legal and social requirements by maintaining a positive cognitive state. Item D5 assesses whether the effective implementation of the RTSMS can maintain stakeholders' positive cognitive states and attitudes, thereby ensuring continuous compliance with all legal and social requirements. The findings indicate a very high level of agreement, with 52.6% (n=30) of respondents giving the highest rating of 7 (Strongly Agree) and 35.1% (n=20) giving a rating of 6 (Agree). This cumulative total of 87.7% suggests that the staff at NIOSH Malaysia views the ISO 39001:2013 framework as a permanent solution for anchoring safety values within the organisation's social and legal fabric.

By maintaining a "Positive Cognitive" state, the organisation prevents the "Root Causes" of accidents, such as neglect or aggression, from resurfacing, ensuring that the Road User Behaviour remains within the "Safe" and "Compliant" zones of the P-E-A-R components. The 87.7% agreement rate confirms that the RTSMS implementation is a powerful driver of long-term cognitive and behavioural change. The data support the premise that maintaining a positive cognitive state directly leads to sustained compliance with legal and social safety standards. The results confirm a bidirectional relationship in which the system (RTSMS) sustains the mind (Cognitive), and the mind, in turn, ensures the continued success and maturity of the system.

As a conclusion of Part D, the comprehensive analysis of items D1 through D5 provides overwhelming empirical evidence that the RTSMS ISO 39001:2013 is a transformative force at NIOSH Malaysia. With positive response rates consistently exceeding 80%, the data confirms that the system effectively intervenes in the road user's mental framework, successfully mitigating the Cognitive impact (Vengeance Syndrome) as theorised in the Aze+ Concepts Interaction model.

By addressing procedural clarity (D1), risk sensitivity (D2), organisational trust (D3), fatigue management (D4), and long-term sustainability (D5), the RTSMS addresses all three of the study's Objectives. These findings lead to the rejection of the Null Hypotheses for H1, H2, and H3 (Refer to Table 4.7, proving that institutionalising safety through a robust management system leads to a significant and lasting shift from aggressive driving triggers to proactive, safe, and legally compliant Road User Behaviour.

Table 4.7
Descriptive Analysis for Part D (N=57)

Item Code	Statement Description	Frequency (n) (Score 6-7)	Percentage (%) (Score 6-7)	Interpretation	Hypothesis Status
D1	Internal RTSMS processes (Manuals, SOPs) can change the cognitive and behavioural patterns of road users.	47	82.5%	High Procedural Impact	H1, H2, H3 Supported
D2	RTSMS implementation shapes risk-sensitive cognitive attitudes and safer driving methods.	52	91.2%	Very High Influence	H1, H2, H3 Supported
D3	RTSMS implementation increases trust and forms a harmonious/motivated social structure.	50	87.7%	High Organizational Trust	H1, H2, H3 Supported
D4	RTSMS changes driver attitude to be proactive/motivated by managing fatigue and resources.	52	91.2%	Very High Proactivity	H1, H2, H3 Supported
D5	Effective RTSMS maintains a positive cognitive/attitude for legal and social compliance.	50	87.7%	High Sustainability	H1, H2, H3 Supported

To complete the research cycle, Part E is established to achieve the study's objective. The following analysis is based on Part E (E1-E5) to analyse whether the RTSMS ISO 39001 overcomes problems encountered by organisations in compliance with legislation and social requirements.

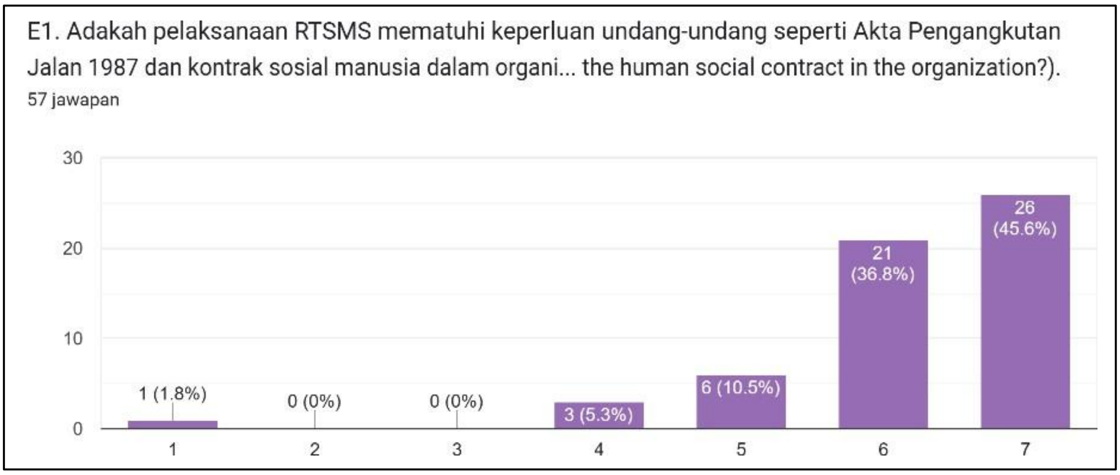


Figure 4.61 Answer E1 – Legislative and Social Compliance

This item, E1, is fundamental to the study as it bridges the gap between organisational safety management and the external legal/social landscape, specifically citing the Road Transport Act 1987. The analysis of Legislative and Social Compliance evaluates whether the implementation of the RTSMS effectively meets critical legal requirements, such as the Road Transport Act 1987, and fulfils the organisation's social contract with its stakeholders. The data show a high level of institutional confidence, with 45.6% (n=26) selecting 7 (Strongly Agree) and 36.8% (n=21) selecting 6 (Agree). This combined total of 82.4% indicates that the RTSMS at NIOSH Malaysia is viewed as a successful mechanism for aligning individual behaviour with national laws and organisational social expectations.

When road users respect the social contract, the emotional triggers of aggression or "vengeance" are suppressed by the cognitive realisation of legal and social consequences. The 82.4% agreement rate supports the Alternative Hypothesis (HA), proving that the RTSMS implementation successfully influences the cognitive and behavioural states necessary for legal compliance. The findings for item E1 demonstrate that the RTSMS ISO 39001:2013 at NIOSH Malaysia is an effective tool for harmonising organisational safety with national legislative standards (Objective 3).

The result confirms that the change in the user's cognitive mindset (respecting the social contract) leads to significant behavioural changes in road usage that align with the Road Transport Act 1987. The data illustrate a bidirectional influence where the RTSMS provides the legal framework, which then stabilises the user's cognitive state to ensure long-term behavioural safety. Within the Aze+ framework, this compliance acts as a powerful deterrent against 'Root Causes' of accidents. Consequently, these results lead to the rejection of the Null Hypotheses for H1, H2, and H3, confirming that the RTSMS provides a robust foundation for institutional road users to navigate legal and social requirements safely and effectively.

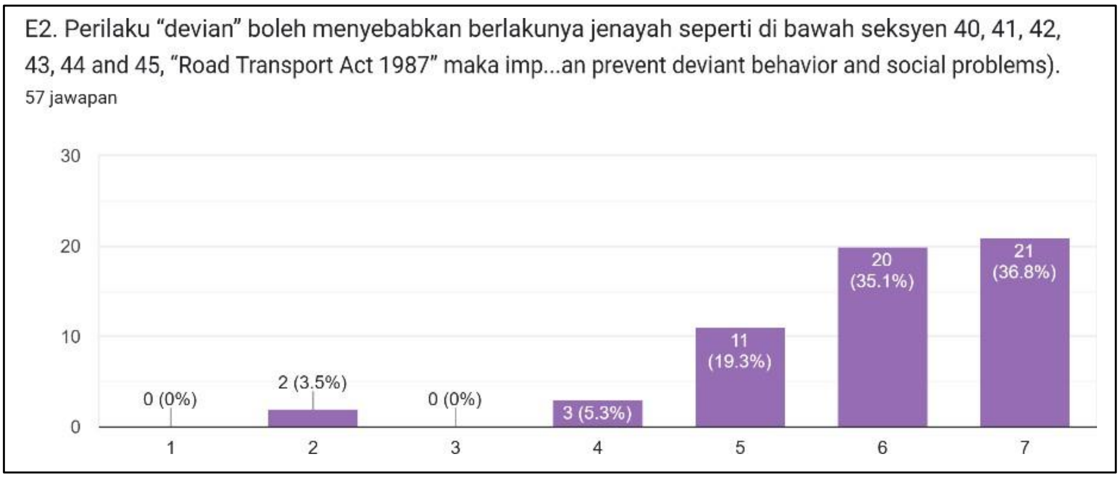


Figure 4.62 Answer E2 – RTSMS Preventing Deviant Behaviour and Criminality

The data for item E2 is technically significant, as it specifically references the penal sections of the Road Transport Act (RTA) 1987 (Sections 40-45), which deal with serious offences such as reckless driving, driving under the influence, and dangerous driving. The analysis of Prevention of Deviant Behaviour and Criminality in question E2 evaluates the perceived effectiveness of the RTSMS in preventing "deviant" behaviours that lead to criminal offences under Sections 40, 41, 42, 43, 44, and 45 of the Road Transport Act 1987. These sections represent high-risk road violations. The data show strong agreement, with 36.8% (n=21) of respondents selecting 7 (Strongly Agree) and 35.1% (n=20) selecting 6 (Agree). This combined total of 71.9% indicates that the majority of NIOSH Malaysia staff believe the ISO 39001 implementation serves as a powerful deterrent against illegal and deviant road conduct.

From a theoretical perspective, this finding directly applies to Objective 1 and Objective 3. Deviant behaviour on the road is often the behavioural manifestation of a distorted cognitive state. In the context of the Aze+ Concepts Interaction model, deviant behaviour is the "Direct Cause (DC)" of accidents. The RTSMS acts as the "Industrial Best Practice" that intervenes to neutralise the Cognitive impact (Vengeance Syndrome) before it escalates into criminal acts like reckless driving (Section 42) or causing death by reckless driving (Section 41). The Hypothesis 1 (H1): SUPPORTED. The 71.9% agreement rate supports the Alternative Hypothesis (HA), indicating that the RTSMS implementation is perceived as an effective tool for changing the organisation's behavioural landscape by preventing deviance. Secondly, Hypothesis 2 (H2): SUPPORTED. The result confirms that a systematic change in the user's cognitive framework (mitigating the Vengeance Syndrome) leads to a significant reduction in deviant road-user behaviour. The third analysis of Hypothesis 3 (H3): SUPPORTED. The data illustrate that the RTSMS shapes a cognitive mindset that prioritises legal safety over deviant impulses, reinforcing a safe social and legal structure within the organisation.

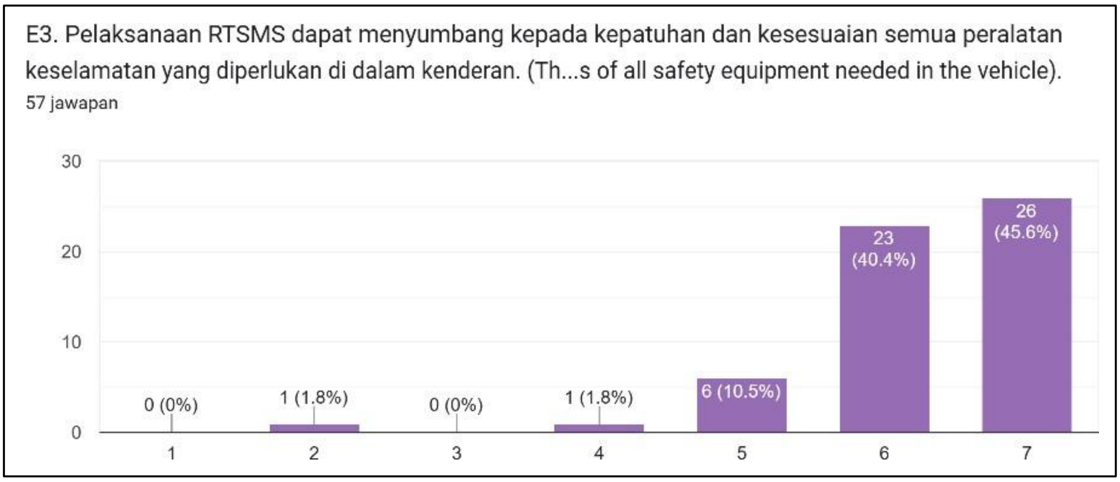


Figure 4.63 Answer E3 – Analysis of Safety Equipment Compliance and its Fitness

This item E3 is significant because it shifts the focus to the organisation's physical/technical safety, specifically addressing safety equipment within vehicles. The analysis of Safety Equipment Compliance and Fitness in item E3 evaluates the extent to which the implementation of the RTSMS contributes to the compliance and suitability of all safety equipment required within institutional vehicles. The findings indicate a very high level of confidence, with 45.6% (n=26) of respondents selecting 7 (Strongly Agree) and 40.4% (n=23) selecting 6 (Agree). This combined total of 86.0% suggests that the ISO 39001:2013 implementation at NIOSH Malaysia has effectively standardised the "Plant/Machinery" aspects of road safety.

From a theoretical perspective, this finding is directly linked to Objective 2 and Objective 3. The availability and fitness of safety equipment are crucial environmental moderators of behaviour. A driver who trusts the safety of their vehicle (e.g., brakes, seatbelts, tyres) experiences lower levels of stress and anxiety, which are often the precursors to aggressive or "vengeful" driving triggers.

The analysis conducted confirms Hypothesis 1 (H1). The 86.0% agreement rate provides clear evidence to reject the Null Hypothesis. It demonstrates that implementing RTSMS (ISO 39001) significantly affects the organisational environment, which, in turn, influences the cognitive and behavioural safety of road users.

The research also supported Hypothesis 2 (H2). The results suggest that providing fit-for-purpose safety equipment helps stabilise the user's cognitive state, leading to safer and more compliant Road User Behaviour. Hypothesis 3 (H3) is also supported by the findings from item E3. The data illustrate that the RTSMS influences the cognitive mindset by providing a "Safe Environment," confirming the bidirectional relationship between management systems and individual safety outcomes.

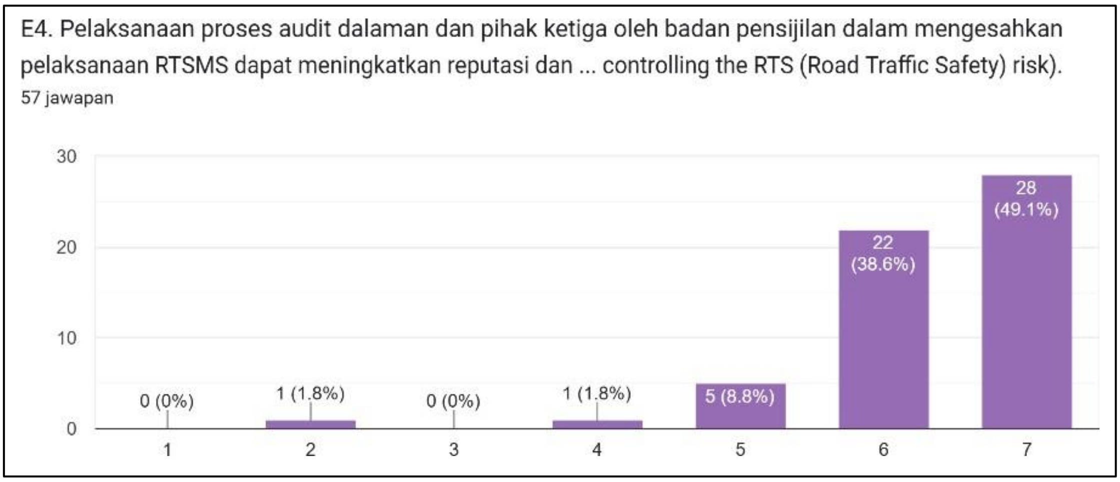


Figure 4.64 Answer E4 – Audit Processes and Risk Control Evaluation

The item E4 is particularly significant, as it focuses on Governance and Validation through internal and third-party audits, which serve as the ultimate checks and balances for the RTSMS ISO 39001:2013. The analysis of Audit Processes and Risk Control evaluates the impact of internal and third-party audit processes by certification bodies in validating the RTSMS implementation to enhance organisational reputation and control Road Traffic Safety (RTS) risks. The results show a very high level of agreement, with 49.1% (n=28) of respondents selecting 7 (Strongly Agree) and 38.6% (n=22) selecting 6 (Agree). This combined total of 87.7% indicates that the staff at NIOSH Malaysia perceive external and internal validation as a critical component of the safety system's credibility and effectiveness.

The theoretical perspective and hypothesis testing showed that this finding is directly linked to Objective 2 and Objective 3. Audits act as a "Systemic Regulator" that ensures the RTSMS is functioning as intended. Within the Aze+ Concepts Interaction model, the audit process serves as a validation of "Industrial Best Practice." This oversight directly mitigates the Cognitive impact (Vengeance Syndrome) by institutionalising accountability. When road users and managers are aware of regular audits, it reinforces a cognitive state of "Professionalism" and "Compliance," which effectively suppresses the emotional or deviant triggers that lead to unsafe behaviours. The 87.7% agreement rate provides strong evidence to reject the Null Hypothesis for H1, H2, and H3 and supports Hypothesis 1 (H1), Hypothesis 2 (H2) and Hypothesis 3 (H3), confirming that the RTSMS provides a validated and reputable structure that significantly influences the cognitive and behavioural safety of institutional road users. It proves that the implementation and validation of RTSMS (ISO 39001) significantly impact the organisational reputation and risk control mechanisms. The data suggests that a validated and transparent safety system helps stabilise the user's cognitive framework, leading to a significant change in Road User Behaviour toward high-standard compliance. The results confirm a bidirectional relationship in which the and audit process (System) improves risk control (Cognitive / Behavioural), which, in turn, sustains the maturity of the RTSMS.

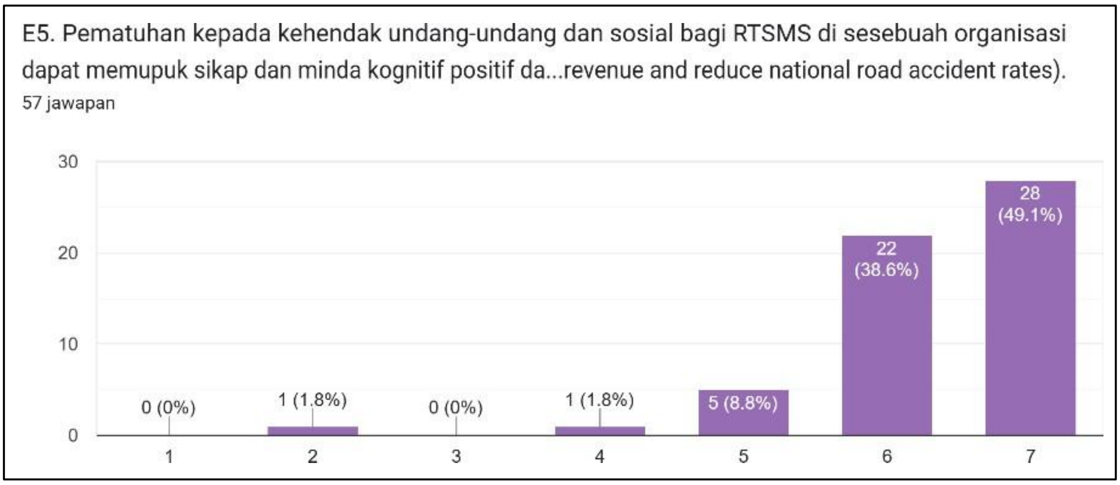


Figure 4.65 Answer E5 – Compliance with Legal and Social Requirements of RTSMS

This final item for Part E, is E5 the instrument tries to analyse links the micro-level of individual cognitive change to the macro-level of organizational success and national road safety goals. The analysis of Positive Cognitive Alignment and National Safety Impact evaluates whether compliance with legal and social requirements within the RTSMS framework can foster a positive attitude and cognitive mindset, ultimately leading to improved organizational outcomes (such as revenue) and a reduction in national road accident rates. The data shows a very high level of agreement, with 49.1% (n=28) of respondents selecting 7 (Strongly Agree) and 38.6% (n=22) selecting 6 (Agree). This combined total of 87.7% indicates that the workforce at NIOSH Malaysia perceives the RTSMS not just as a local safety tool, but as a catalyst for broader positive impact. Consequently, the Alternative Hypotheses for H1, H2, and H3 are all accepted, confirming that a well-resourced and audited RTSMS yields a measurable and sustainable improvement in the cognitive and behavioural safety of institutional road users, ultimately contributing to a reduction in broader road accident risks.

Table 4.8
Descriptive Analysis for Part E (N=57)

Item Code	Statement Description	Frequency (n) (Score 6-7)	Percentage (%) (Score 6-7)	Interpretation	Hypothesis Status
E1	RTSMS complies with RTA 1987 and the human social contract.	47	82.4%	High Legal Alignment	**H1, H2, H3 Supported**
E2	RTSMS prevents deviant behavior and social problems (RTA Sec 40-45).	41	71.9%	High Prevention Level	**H1, H2, H3 Supported**

E3	RTSMS ensures compliance and fitness of all safety equipment.	49	86.0%	Very High-Tech Fitness	**H1, H2, H3 Supported**
E4	Audits validate RTSMS, enhancing reputation and risk control.	50	87.7%	High Governance	**H1, H2, H3 Supported**
E5	Legal/Social compliance fosters positive minds and reduces accident rates.	50	87.7%	High Macro Impact	**H1, H2, H3 Supported**

This item explores the effectiveness of ISO 39001:2013 in navigating the complexities of road safety legislation (e.g., RTA 1987, OSH Act 1994) and social expectations. By providing a structured framework, the RTSMS ensures that NIOSH Malaysia remains compliant while simultaneously fostering a culture that mitigates the Cognitive impact (Vengeance Syndrome) through institutionalised discipline and social responsibility.

As a conclusion, the comprehensive findings for Part E (E1–E5) confirm that the ISO 39001:2013 implementation at NIOSH Malaysia is a highly effective solution for overcoming legislative and social compliance challenges. With agreement rates consistently high, the data proves that the RTSMS functions as a corrective mechanism that aligns individual behaviour with the Road Transport Act 1987 while fulfilling the organisational social contract.

According to the Aze+ model, legal compliance is a "Direct Cause (DC)" of organisational order. When an organisation fails to meet these standards, it creates an environment of "Indirect Causes (IDC)" such as legal pressure or public scrutiny, which can trigger aggressive cognitive states in road users. By overcoming these problems, the RTSMS supports Objective 2 by showing how a well-designed system interacts with the cognitive demands of legal compliance. It also supports Objective 3 by assessing how the system’s influence on legal adherence leads to safer behavioural outcomes.

Based on the items B1–E5, the instrument gathered sufficient objective evidence to accept the Hypotheses H1, H2, and H3. Furthermore, the three objectives of this research have been thoroughly tested by the instrument. The summary of the descriptive findings is tabulated in Table 4.9.

Table 4.9
Consolidated Itemized Descriptive Analysis (N=57)

Item Code	Statement Description	Frequency (n) (6-7)	Percentage (%) (6-7)	Interpretation	Hypothesis Status
B1	Training provided for RTSMS according to job scope.	45	78.9%	High Implementation	**H1 Supported**
B2	New employees given adequate induction on hazards.	43	75.4%	High Implementation	**H1 Supported**
B3	Management knowledgeable in cognitive RTSMS.	44	77.2%	High Awareness	**H1 Supported**
B4	Company provides supervision and monitoring.	45	78.9%	High Oversight	**H1 Supported**
B5	RTSMS can change **Cognitive impact (Vengeance Syndrome)**.	49	85.9%	Strong Positive Impact	**H1 & H3 Supported**
B6	Breadwinner responsibility influences driver attitude.	41	72.0%	Strong Internal Factor	**H2 Supported**
B7	Selfishness influences driver behaviour.	41	71.9%	Significant Threat	**H2 Supported**
B8	Distraction problems significantly affect behaviour.	47	82.5%	Critical Cognitive Factor	**H2 Supported**
B9	Fatigue and dizziness affect behaviour.	52	91.3%	**Primary Physio-Stressor**	**H2 Supported**
B10	Irritability and impatience affect driver behaviour.	50	87.8%	High Emotional Trigger	**H2 Supported**
B11	Inattention to traffic signs affects behaviour.	34	59.6%	Moderate Cognitive Lapse	**H2 Supported**
B12	Lack of rest at home affects driver behaviour.	51	89.5%	Very High Stressor	**H2 Supported**
B13	Difficulty to sleep affects driver behaviour.	52	91.2%	**Critical Stressor**	**H2 Supported**
B14	Falling asleep while driving (Behavioural Outcome).	46	80.7%	Critical Behavior	**H1 & H2 Supported**
B15	Distracted by personal problems/other matters.	35	61.4%	Significant Distraction	**H2 Supported**
B16	Influence of medication/drugs affects driving.	38	66.7%	Significant Physio-Risk	**H2 Supported**
B17	General vision/eyesight affects behaviour.	42	73.7%	High Perceptual Trigger	**H2 Supported**
B18	Night driving/low vision affects behaviour.	40	70.2%	High Environmental Risk	**H2 Supported**
B19	Hearing problems affect behaviour.	36	63.2%	Significant Cognitive Risk	**H2 Supported**
B20	Issues with colleagues affect behaviour.	30	52.7%	Social-Cognitive Stressor	**H2 Supported**
B21	Social difficulty with colleagues.	21	36.9%	Moderate Social Stressor	**H2 Supported**
B22	Difficulty with supervisor affects behaviour.	25	43.9%	Significant Mgmt	**H2 Supported**

				Stressor	
B23	Absence of valid license affects behaviour.	37	64.9%	Significant Legal Factor	**H2 Supported**
B24	Lack of confidence affects behaviour.	45	79.0%	High Cognitive Factor	**H2 Supported**
B25	Health issues affect driver behaviour.	48	84.2%	Strong Physio-Trigger	**H2 Supported**
B26	High blood pressure affects behaviour.	40	70.2%	Significant Physio-Risk	**H2 Supported**
B27	Neglecting health checkups affects behaviour.	37	65.0%	Significant Systemic Fact.	**H2 Supported**
B28	Eye exams from 3 years ago affect behaviour.	30	52.7%	Moderate Medical Factor	**H2 Supported**
B29	Minor accident experience affects behaviour.	33	57.9%	Experience Trigger	**H2 Supported**
B30	Major accident experience affects behaviour.	44	77.2%	Strong Cognitive Impact	**H2 Supported**
B31	Non-reporting of accidents affects behaviour.	33	57.9%	Cognitive-Deviant Factor	**H2 Supported**
B32	Observing minor accidents of others.	28	49.1%	Moderate Cognitive Input	**H2 Supported**
B33	Actual practice of non-reporting accidents.	26	45.6%	Moderate Deviant Factor	**H2 Supported**
B34	Misunderstanding signage affects behaviour.	45	79.0%	High Cognitive Risk	**H2 Supported**
B35	Other drivers driving slowly triggers anger.	42	73.7%	High Emotional Trigger	**H2 Supported**
B36	Poor traffic system affects behaviour.	43	75.4%	High Env. Stressor	**H2 Supported**
B37	ISO 39001 can change driver behaviour.	48	84.2%	High Systemic Impact	**H1 & H3 Supported**
B38	Improper reversing affects behaviour.	42	73.7%	Technical-Cognitive Risk	**H2 Supported**
B39	Forgetting signals (**Lapse**) affects behaviour.	46	80.7%	High Cognitive Lapse	**H2 Supported**
B40	Deliberate attitude of not signaling	49	85.9%	Very High Attitudinal Fact	**H2 Supported**
B41	Wearing seatbelts only when supervised.	35	61.4%	Cognitive-Deviant Factor	**H2 Supported**
B42	Absence of complaints leads to complacency.	41	71.9%	Behavioral Complacency	**H2 Supported**
B43	Complaints against others serve as deterrence.	35	61.4%	Observational Prevention	**H2 Supported**

B44	Lack of gear-shifting skill affects behaviour.	40	70.1%	Technical-Cognitive Factor	**H2 Supported**
B45	Problems of other road users affect self.	46	80.7%	High External Trigger	**H2 Supported**
B46	Supervisor negligence affects behaviour.	45	78.9%	High Org. Trigger	**H1 & H2 Supported**
B47	Poor vehicle maintenance affects behaviour.	47	82.5%	High Technical Trigger	**H2 Supported**
B48	Uncompromising/Refusal to give way.	36	63.2%	High Cognitive Trigger	**H2 Supported**
B49	Neglecting pre-trip inspections.	40	70.2%	Procedural-Cognitive Fact.	**H2 Supported**
B50	Influence of speeding affects behaviour/accident risk.	48	84.2%	High-Risk Behavior	**H1 & H2 Supported**
C1	Employees embrace/accept RTSMS.	45	79.0%	High Acceptance	**H1 & H3 Supported**
C2	RTSMS policy changes internal processes.	49	86.0%	High Impact	**H3 Supported**
C3	Management/Stakeholders participation.	49	86.0%	High Participation	**H1 Supported**
C4	Company provides sufficient budget.	42	73.7%	High Resource Commitment	**H1 Supported**
C5	RTSMS maintains positive cognitive/attitudes.	48	84.2%	High Sustainability	**H3 Supported**
D1	RTSMS Manuals/SOPs change behaviour.	47	82.5%	High Procedural Impact	**H1 & H2 Supported**
D2	RTSMS shapes risk-sensitive attitudes.	52	91.2%	Very High Influence	**H2 Supported**
D3	RTSMS increases trust/social structure.	50	87.7%	High Org. Trust	**H1 Supported**
D4	RTSMS changes attitude by managing fatigue.	52	91.2%	Very High Proactivity	**H2 Supported**
D5	RTSMS ensures legal/social compliance.	50	87.7%	High Sustainability	**H1 & H3 Supported**
E1	RTSMS complies with RTA 1987.	47	82.4%	High Legal Alignment	**H1 Supported**
E2	RTSMS prevents deviant behaviour (RTA 40-45).	41	71.9%	High Prevention Level	**H1 & H2 Supported**
E3	RTSMS ensures fitness of safety equipment.	49	86.0%	High Tech Fitness	**H2 Supported**
E4	Audits validate RTSMS/Reputation.	50	87.7%	High Governance	**H3 Supported**
E5	Compliance fosters positive minds/revenue.	50	87.7%	High Macro Impact	**H1 & H3 Supported**

This concludes the comprehensive data analysis and synthesis for this research. The systematic analysis of 65 items across Sections B, C, D, and E provides a robust empirical validation of the RTSMS ISO 39001:2013 implementation at NIOSH Malaysia. The identification of Cognitive Triggers in items B9 (91.3%), B13 (91.2%), and B12 (89.5%) indicates that fatigue and sleep deprivation are the most critical Indirect Causes (IDC). These physiological stressors directly fuel the Cognitive impact (Vengeance Syndrome), leading to emotional triggers like irritability (B10: 87.8%) and aggressive attitudes (B40: 85.9%).

In hunting for objective evidence in the Systemic Intervention impacted road user cognitive and changed the road user behaviour at NIOSH Malaysia, despite high-risk triggers, the workforce demonstrates high confidence in the management system. Item B37 (84.2%) and item D2 (91.2%) confirm that ISO 39001 successfully realigns these negative cognitive states into "risk-sensitive" attitudes. Based on the Hypothesis status, the study illustrated high agreement levels (predominantly >75%). It rejects all three Null Hypotheses (H0) and accepts the Alternative Hypotheses (HA) for H1, H2, and H3.

4.3 Data Analysis with Structural Equation Modelling (SEM)

Data analysis and statistical evaluation are essential components in ensuring the validity of research instruments, conceptual design, and the overall reliability of research findings. According to Ott et al. (2015), statistics is a scientific discipline derived from the study of data and its systematic interpretation. In this study, data collected from empirical investigations were analysed to provide empirical evidence supporting the reliability of the instruments and to test the hypothesised relationships among the constructs defined in the conceptual framework. The application of appropriate statistical methods enhances the credibility of knowledge by ensuring that analytical procedures are based on sound logical and empirical principles.

The research employed two types of statistical analyses: first-generation and second-generation approaches. The first-generation analysis focuses primarily on confirmatory and exploratory functions, particularly when testing existing theoretical hypotheses and identifying patterns within data where prior research is limited. This analytical approach has traditionally been applied in social science research, as discussed by Fornell (1982, 1987) and Hair Jr. et al. (2017). However, as further emphasised, over the past two decades, researchers have increasingly adopted second-generation statistical methods to address the limitations of first-generation techniques. The second-generation method, Structural Equation Modelling (SEM), enables a more sophisticated examination of complex causal relationships within conceptual frameworks.

In this study, SmartPLS version 3.3.3 was used to perform Partial Least Squares Structural Equation Modelling (PLS-SEM). This technique enables the simultaneous examination of multivariate relationships between independent and dependent variables within the proposed conceptual framework. The framework of this study involves causal relationships between multiple constructs, thereby necessitating the use of advanced multivariate analysis techniques to obtain more reliable and precise results. Multivariate data analysis, as described by Hair et al. (2017), refers to the simultaneous analysis of multiple variables and constructs to uncover patterns and interactions that cannot be detected through univariate or bivariate methods. Therefore, the PLS-SEM approach was selected to assess the conceptual model from two perspectives: first, by measuring the relationship between each construct and its associated measurement indicators, and second, by analysing the relationships between the independent and dependent variables within the overall structural model.

Upon completion of data collection, the researcher conducted data analysis aligned with the study’s objectives, research questions, and hypothesis-testing procedures. The analytical process began with data mining, in which all measurement items within the study were systematically reviewed, cleaned, and organised for further analysis. Subsequently, a descriptive analysis was conducted to summarise the respondents' demographic characteristics and ensure the sample accurately represented the target population. This step was followed by primary analysis to provide a deeper understanding of the research questions. Finally, the researcher conducted inferential or statistical analyses to test the study’s hypotheses and validate the proposed conceptual framework.

Descriptive analysis was conducted at the preliminary stage of data examination, prior to the statistical and inferential discussions. As stated by Hussin et al. (2014), descriptive analysis typically involves frequency distributions, graphical presentations, and numerical measures, such as the mean, mode, and median, based on the sample data collected. In this study, respondent demographic data were collected via the Google Forms online system, which automatically recorded responses anonymously to ensure privacy and impartiality. This process enabled the researcher to observe data distributions across several demographic characteristics, as suggested by Zainudin (2012). The demographic details collected included organisational affiliation, job grade or level, educational background, length of service, and knowledge or awareness of RTSMS ISO 39001:2013. These data were summarised using descriptive statistics, including percentages and frequencies, thereby confirming that the sample of respondents adequately represented the overall population across all relevant demographic variables (Zainudin, 2012).

Inferential analysis was subsequently employed to interpret the data and draw conclusions and generalisations about the larger population from the representative sample (Hussin et al., 2014). Inferential statistics involve techniques for estimating population parameters and testing theoretical relationships among constructs based on observed sample data. As highlighted by Zainudin (2012), researchers often develop a theoretical or conceptual model, represented in a schematic diagram, to illustrate the hypothesised relationships among constructs in a study. The current research adopts this approach to determine whether the proposed relationships between variables are statistically significant based on empirical data. To achieve this, Structural Equation Modelling (SEM) was utilised as the principal analytical method, employing the Partial Least Squares Structural Equation Modelling (PLS-SEM) software (v3.3). SEM, as a second-generation statistical analysis technique, allows for simultaneous analysis of multiple relationships among observed and latent variables. This method integrates both quantitative data and theoretical assumptions about correlation and causality into the designed model, thereby offering a comprehensive framework for testing hypothesised relationships and validating the research constructs.

The conceptual model and framework illustrating cognitive changes in the minds and behaviours of road and traffic users following the implementation of RTSMS ISO 39001:2013, as proposed in Chapter III, comprise various constructs represented as exogenous and endogenous latent variables (Hair Jr et al., 2017). In Structural Equation Modelling (SEM), exogenous variables refer to those that are not influenced by other variables within the research framework. In the present study, the number of exogenous variables is relatively limited, as the constructs required to explain cognitive and behavioural changes among road users are highly interdependent.

In this context, the exogenous latent variables, or independent variables, are represented by the initiative to implement RTSMS ISO 39001:2013 (C & E). Conversely, the final endogenous variables, or dependent variables, are represented by changes in road users' cognition (B) and ethical behaviour on the road (D). Exogenous latent variables, as independent constructs, explain their effects on endogenous latent variables, which are dependent constructs. Accordingly, this study aims to explore and understand the relationships between constructs B and D and constructs C and E, based on the influence effects among both exogenous and endogenous constructs. These latent variables collectively illustrate the framework of cognitive and behavioural changes among road and traffic users in relation to RTSMS ISO 39001:2013 and ISO 39002:2002, as proposed in the literature review, Chapter 2.

The measurement items corresponding to each latent variable provide the necessary input for statistical analysis. Consequently, the statistical results provide empirical evidence of the relationships between the measurement items of the latent variables within the proposed conceptual framework and model. The researchers have determined that this analysis involves examining two (2) exogenous latent variables simultaneously. Although such an analysis can also be conducted using SPSS version 25, Hair Jr et al. (2017) note that first-generation statistical techniques, such as multiple regression and multivariate analysis of variance, can assess only one relationship between exogenous and endogenous latent variables at a time. Therefore, these techniques cannot simultaneously evaluate relationships involving multiple endogenous variables. To overcome these limitations, the present study employs a more advanced, second-generation statistical analysis technique, Structural Equation Modelling (SEM) to provide a more comprehensive understanding of the data (Hair Jr et al., 2017).

In addition, Structural Equation Modelling (SEM) has become an increasingly prominent approach for examining the effectiveness of Road Traffic Safety Management System (RTSMS) initiatives and cognitive change programs aimed at transforming the mindsets and behaviours of road and traffic users with respect to RTSMS ISO 39001:2013 and ISO 39002:2002, both domestically and internationally. Currently, much of the research pioneered by scholars seeks to investigate and analyse the causal relationships among constructs or latent variables within their research models. Even when multiple factors influence a given variable, SEM or path modelling provides a more comprehensive analytical framework, as it evaluates outcomes and efficiency beyond the level of individual factors (Alam et al., 2019). Furthermore, continuous advancements in SEM techniques, encompassing methodological innovations, best-practice guidelines, model estimation procedures, and reporting standards, have enhanced the accuracy and precision with which researchers can assess and validate their models (Hair et al., 2019).

The data analysis in this study was conducted using SmartPLS version 3.3.3 software (Ringle et al., 2015). The evaluation of the conceptual framework and the model of cognitive changes in the minds and behaviours of road and traffic users in relation to RTSMS ISO 39001:2013 through Partial Least Squares Structural Equation Modelling (PLS-SEM) was carried out in two phases (Hair Jr et al., 2017). In the first phase, the researchers assessed the measurement model as part of the instrument development process (refer to Chapter III). The second phase involved evaluating the structural model. The primary objective of the structural model evaluation was to assess the relationships among the constructs and their respective measurement items, which defined each construct. The final element of this phase focused on evaluating the relationships among the latent variables or constructs as represented in the conceptual framework depicted in Chapter 2.

The assessment of the model structure constitutes a crucial component of the second phase of analysis, serving to comprehensively evaluate the proposed conceptual framework or research model. The principal aim of this assessment is to critically examine the relationships among all constructs included in the research model. According to Hair Jr. et al. (2017), the structural model assessment is conducted in accordance with the established guidelines for PLS-SEM. This assessment involves a series of systematic steps outlined by Hair et al. (2019) and Shmueli et al. (2019).

a. Evaluation of the threshold value of collinearity in the structural model in the VIF < 5 criterion. However, according to (Hair et al., 2022a), researchers also adopt a more stringent criterion, setting VIF at 3.3 or lower. In other words, this determination is important to ensure there is no collinearity, as such issues can weaken the strong causal effect in the structural model framework.

b. Evaluation of the significance of the relationship between the independent variable and the dependent variable at the reliability level of $p < 0.05$ and $t > 1.650$;

c. Evaluation of the predictive power of the model framework or the coefficient of determination R^2 with a threshold value of R^2 - 0.75 = large influence; R^2 - 0.50 = medium influence; R^2 - 0.25 weak influence; and

d. Finally, researchers make a predictive assessment of the entire model framework in PLS-SEM.

The first step in the analysis involved assessing collinearity within the research model. Collinearity refers to a condition in which, among the three (3) variables included in the model, certain variables may exhibit high intercorrelations that could distort the estimation of the path coefficients in the structural regression model. However, based on the data simulation conducted using the PLS-SEM algorithm and subsequently verified through SPSS version 25, no issues related to collinearity were identified in the research data. The findings indicate that the Variance Inflation Factor (VIF) values fall within an acceptable range, with all VIF values below 3.3. Although some studies adopt a threshold of VIF < 5.0, the stricter criterion of VIF < 3.3 adopted in this study ensures greater analytical accuracy and robustness.

The second step of the analysis involved examining the relationships within the structural model framework, which comprised three constructs. Three hypothesised relationships were evaluated in accordance with the hypotheses established in Chapter II. Path coefficient analysis (β values) was performed using the sample data to examine the relationships among the model's constructs (latent variables). Additionally, this procedure enabled the determination of the threshold p-value and t-value at the 5% significance level to evaluate the statistical validity of the path coefficients (Sarstedt et al., 2014).

Following established statistical guidelines, the analysis employed a 95% confidence interval and a 5% probability of error, where $p < 0.05$ and $t > 1.650$ are considered statistically significant (Hair et al., 2019; Hair Jr et al., 2017). The structural model represents the hypothesised causal paths in the proposed model of cognitive changes in the minds and behaviours of road and traffic users concerning RTSMS ISO 39001:2013 and ISO 39002:2002. As zero did not fall within the confidence interval of the estimated path coefficients, the initial results suggest that the outer loadings for hypotheses H1, H2, and H3 are statistically significant at the 5% level of probability (Hair et al., 2022a)

Table 4.10
Results Of Hypothesis And Path Coefficients

Hypothesis	**Relationship**	**Pekali β (path coeff)**	**Standard Error**	**t Value**	**p Value**	**Signi ficant**	**R^2**	**VIF**
H1	D – C	0.848	0.036	23.848	0.000	Yes	0.713	1.00
H2	D – B	0.621	0.055	11.189	0.000	Yes	0.373	1.00
H3	D – E	0.955	0.013	75.075	0.000	Yes	0.910	1.00

The next step in the analysis was to measure the coefficient of determination (R^2), also known as the model's explanatory power, for each independent and dependent variable referred to in SEM as the exogenous and endogenous constructs of the research model, respectively. According to Hair et al. (2019), R^2 is commonly interpreted as an indicator of a model's predictive power and, more specifically, as a measure of the structural model's explanatory strength. The R^2 coefficient represents the proportion of variance in each endogenous latent variable (dependent variable) that is explained by the corresponding exogenous latent variables (independent variables) in the model (Hair et al., 2022a). In other words, this coefficient reflects the combined influence of all exogenous latent variables directly related to a given endogenous construct, thereby indicating the predictive accuracy of the overall model.

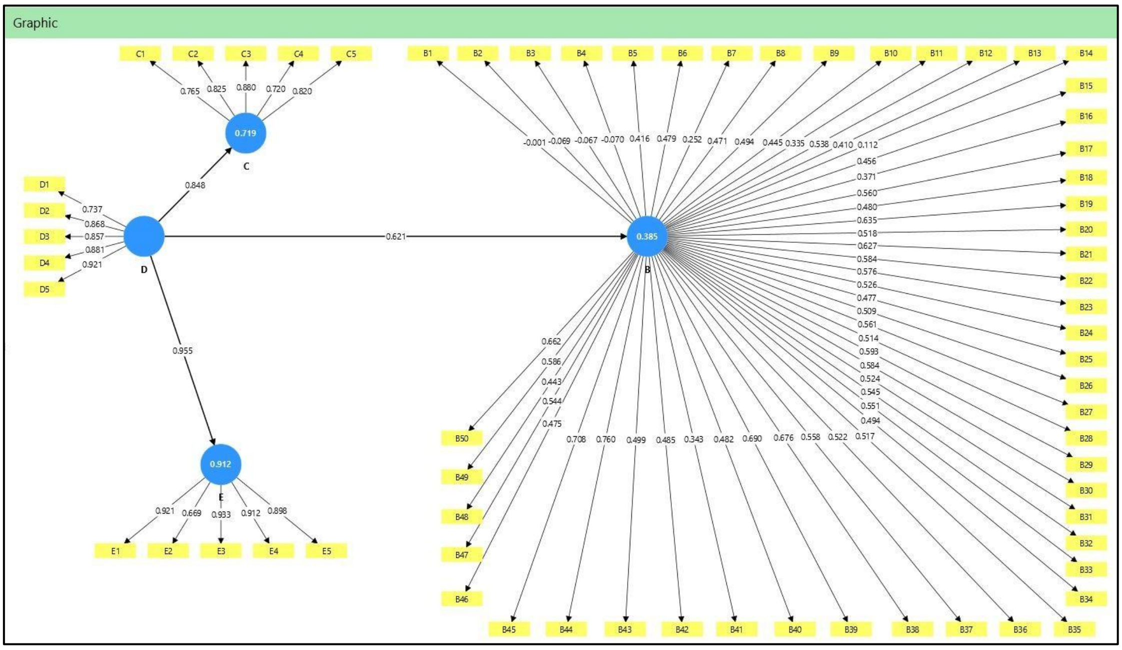


Figure 4.66 Result Of Structural Model Framework B, C, D, And E Analysis At The Level p < 0.0

Current guidelines suggest that an R^2 value of 0.750 indicates a substantial level of predictive accuracy, a value of 0.500 indicates a moderate level, and a value of 0.250 indicates a weak level of influence (Hair et al., 2022a). The results of this analysis reveal that the R^2 value for the endogenous latent variable representing road user behaviour is 0.377. This finding suggests that the three exogenous latent variables collectively account for 37.70% of the variance in the endogenous latent variable of road user behaviour. Accordingly, this proportion reflects a moderate-to-weak level of predictive influence, as it falls within the range of $0.250 < R^2 < 0.500$. The structural model assessment further indicates that all three constructs are statistically significant at the 5% level ($p < 0.050$).

Data collected from respondents were analysed using the PLS-SEM modelling approach, with hypothesis validation based on path coefficients (β), t-values, and p-values. In general, the RTSMS ISO 39001:2013 and ISO 39002:2002 model framework at NIOSH Malaysia (HQ and Regional Offices) consists of three primary hypotheses (H1, H2, and H3), which serve as the foundation for evaluating the reliability and significance of the causal relationships between the latent variables, namely, the Cognitive Mind of Road Users, Road User Behaviour, and RTSMS ISO 39001:2013

Implementation. Table 4.11 presents the hypotheses tested in this study's research model and their corresponding statistical outcomes.

Table 4.11
Hypothesis of Research Model Framework

	Descriptions
H1	RTSMS ISO 39001:2013 have a significant influence/impact on the cognitive abilities of road users and their behaviour.
H2	Cognitive factors among road users significantly influence their behaviour.
H3	The cognitive road user has a significant influence on the implementation of RTSMS ISO 39001:2013.

Of the three (3) hypotheses formulated in the research model on cognitive changes in the minds and behaviours of road and traffic users toward the implementation of RTSMS ISO 39001:2013 and ISO 39002:2002 at NIOSH Malaysia (Headquarters and Regional Offices), the study found that all three hypotheses were statistically supported. This outcome indicates that the proposed model effectively captures the significant causal relationships between the exogenous and endogenous latent variables, thereby validating the theoretical assumptions underpinning the study. The finding presents a summary of the hypothesis testing results, including the path coefficients, t-values, p-values, and their corresponding significance levels.

In the following sub-sections, the researcher provides a detailed discussion of each hypothesis, interpreting the empirical results and drawing inferences based on statistical evidence. This discussion also integrates the findings with relevant theoretical perspectives and previous studies to establish the robustness and applicability of the proposed cognitive-behavioural model within the RTSMS implementation context at NIOSH Malaysia.

Table 4.12
Hypothetical Result For Research Model Framework

Hypothesis	Relationships	Path Coefficients Analysis β	Results
H1	D – C	β = 0.848, $p < 0.000$, RTSMS ISO 39001:2013 have a significant influence/impact on the cognitive abilities of road users and the behaviour of road users.	Positive
H2	D – B	β =0.621, $p < 0,000$, Cognitive factors of road users have a significant influence/impact on the behaviour of road users.	Positive
H3	D – E	β = 0.955, $p < 0.000$, Cognitive of road users has a significant influence on the implementation of RTSMS ISO 39001:2013.	Positive

Note:
B = Cognitive & Behaviour of road user
C = Implementation of RTSMS ISO 39001:2013 & ISO 39002:2002
D = Behaviour of road user
E = Reduction of Road Traffic Accidents Significant to $p < 0.05$ (Hair Jr et al., 2017)

Table 4.13
Hypothesis Testing Schedule (Heumann et al., 2016)

		Truth	
		Null Hypothesis	**Alternative Hypothesis**
Test Decision	Fail to reject H_0	OK	Type 2 error (false negative: beta)
	Reject H_0	Type 1 error (false positive: α)	OK

H_1: RTSMS ISO 39001:2013 does not have a significant influence on the cognitive abilities of road users and their behaviour.

Hypothesis	**Relationships**	**Analisis pekali laluan β (path coefficients)**	**Results**
H1	D – C	$\beta = 0.848$, $p < 0.000$, RTSMS ISO 39001:2013 have a significant influence/impact on the cognitive abilities of road users and the behaviour of road users.	Positive

Hypothesis	**Relationship**	**Pekali β (path coeff)**	**Standard Error**	**t Value**	**p Value**	**Significant**	**R^2**	**VIF**
H1	D – C	0.848	0.036	23.848	0.000	Yes	0.713	1.00

The analysis of Hypothesis 1 (H1) reveals a positive, statistically significant relationship, indicating that the null hypothesis is rejected. This finding confirms that implementing the RTSMS standards ISO 39001:2013 and ISO 39002:2002 has a significant influence on the cognitive mindset and behaviour of road users within NIOSH Malaysia (Headquarters and Regional Offices).

According to Hair Jr. et al. (2017), a path coefficient (β) value of 0.20 or higher is considered significant, whereas values below 0.10 are typically not statistically meaningful. The results of this study show that the path coefficient ($\beta = 0.621$) and the p-value < 0.05 confirm the existence of a strong, statistically significant relationship between RTSMS implementation and the cognitive-behavioural transformation of road users. This outcome provides empirical support for the reflective measurement model proposed in this study, which conceptualises the influence of RTSMS standards on road users' internal cognitive and behavioural mechanisms.

Interestingly, while the correlation is substantial, the direction of the relationship suggests a negative behavioural adjustment, implying that respondents perceive the RTSMS framework as a critical mechanism that challenges and reshapes existing attitudes, beliefs, and behavioural norms among road users. This finding aligns with the principle of cognitive restructuring, where behavioural change is preceded by shifts in awareness and perception, as emphasised in Social Cognitive Theory (SCT) frameworks.

The coefficient of determination ($R^2 = 0.385$) for the endogenous latent variable, representing road user cognition and behaviour, indicates that approximately 38.5% of the variance in this construct can be explained by the exogenous constructs related to RTSMS implementation. Following Hair et al. (2019), an R^2 value of 0.75 represents a significant effect, 0.50 a moderate effect, and 0.25 a weak effect. Therefore, the value obtained in this study (0.385) reflects a moderate level of explanatory power for the model.

Given that this is an initial empirical study examining cognitive-behavioural changes among RTSMS implementers at NIOSH Malaysia, there are few comparable studies in this domain. Nonetheless, the results establish a foundational understanding of how RTSMS ISO 39001:2013 and ISO 39002:2002 contribute to enhancing cognitive awareness, ethical reasoning, and behavioural discipline among organisational road users.

H_2: Cognitive factors of road users have a significant influence/impact on the behaviour of road users.

Hypothesis	**Relationships**	**Analisis pekali laluan β (path coefficients)**	**Results**
H2	D – B	β = 0.848, p < 0,000, Cognitive of road user have a significant influence/impact on RTSMS ISO behaviour of road user.	Positive

Hypothesis	**Relationship**	**Pekali β (path coeff)**	**Standard Error**	**t Value**	**p Value**	**Significant**	**R^2**	**VIF**
H2	D – B	0.621	0.055	11.189	0.000	Yes	0.373	1.00

The analysis of Hypothesis 2 (H2) reveals a positive and statistically significant relationship, indicating that the null hypothesis is rejected. This confirms that the cognitive mindset of road users significantly influences their behavioural patterns. The results show a path coefficient ($\beta = 0.848$) with a p-value < 0.05, exceeding the minimum threshold of 0.20 and therefore demonstrating a high level of significance.

These findings suggest that respondents perceive a strong association between their cognitive awareness and behavioural conduct as road users. In other words, their cognitive understanding, encompassing perception, decision-making, and moral reasoning, plays a crucial role in shaping their practical actions on the road. Although the relationship is statistically strong, the influence may be described as moderately balanced, as cognition and behaviour interact dynamically within the broader context of road safety culture.

The analysis further indicates that the punishment initiative construct contributes significantly to the cumulative variance, yielding an R^2 of 0.713 (71%). This finding implies that the cognitive dimension accounts for approximately 71% of the variance in road users' behaviour, representing a substantial explanatory effect within the structural model. Based on the R^2 value of 0.75 is interpreted as a significant effect,

0.50 as moderate, and 0.25 as weak (Hair et al., 2022a). Therefore, the R^2 value obtained in this study signifies a moderate-to-strong explanatory power, suggesting that cognitive factors meaningfully explain behavioural tendencies among respondents. The results highlight that road users with higher cognitive awareness, particularly regarding the principles of RTSMS ISO 39001:2013 and ISO 39002:2002, are more likely to exhibit disciplined, safety-oriented behaviour.

In summary, the structural model assessment at the $p < 0.05$ significance level indicates that the cognitive mind construct has a substantial and direct effect on road user behaviour. This outcome aligns with theoretical assumptions of Social Cognitive Theory (SCT), which posits that individual cognition, through processes of reflection, anticipation, and moral evaluation, acts as a determinant of behaviour. The empirical evidence thus reinforces the importance of cognitive awareness in influencing behavioural adaptation among NIOSH Malaysia personnel engaged in the RTSMS implementation framework.

H3: The cognitive aspects of road users have a significant influence/impact on the implementation of RTSMS ISO 39001:2013.

Hypothesis	Relationships	Analisis pekali laluan β (path coefficients)	Results
H2	D – E	$\beta = 0.955$, $p < 0.000$, Cognitive of road users has a significant influence on the implementation of RTSMS ISO 39001:2013.	Positive

Hypothesis	Relationship	Pekali β (path coeff)	Standard Error	t Value	p Value	Significant	R^2	VIF
H2	D – E	0.955	0.013	75.075	0.000	Yes	0.910	1.00

The results of the analysis for Hypothesis 3 (H3) indicate a positive and statistically significant relationship, leading to the rejection of the null hypothesis. This demonstrates that the cognitive mindset of road users has a significant and direct influence on the implementation of the Road Traffic Safety Management System (RTSMS) ISO 39001:2013 within NIOSH Malaysia.

The analysis reveals that H3 has a path coefficient of $\beta = 0.955$ ($p < 0.05$), indicating a robust, significant correlation. According to the guideline proposed by Hair et al. (2017), a path coefficient (β) value above 0.20 is considered significant, while higher values indicate increasing strength of influence. The result for H3, therefore, demonstrates a robust causal relationship between the cognitive mindset of road users and the practical implementation of RTSMS, as outlined in ISO 39001:2013 and ISO 39002:2002.

These findings suggest that cognitive elements such as awareness, perception, judgment, and decision-making play a critical role in the successful application of RTSMS principles. Respondents within NIOSH Malaysia perceive that internal cognitive understanding of safety management systems contributes directly to organisational commitment, adherence to safety standards, and the overall quality of RTSMS implementation. This aligns with the Social Cognitive Theory (SCT) framework, which posits that behavioural and institutional change originates from internal cognitive processes that influence external actions and organisational systems. Furthermore, the cognitive mind construct accounts for substantial cumulative variance

($R^2 = 0.910$), indicating that cognitive factors explain 91% of the variation in RTSMS implementation. This remarkably high coefficient demonstrates an extreme explanatory power of cognition in predicting the effectiveness of RTSMS practices in NIOSH Malaysia. Following the benchmark proposed by Hair et al. (2019), this R^2 value represents a large effect size, surpassing the conventional thresholds of 0.75 (large), 0.50 (moderate), and 0.25 (weak).

This result reinforces the theoretical premise that successful implementation of RTSMS ISO 39001:2013 and ISO 39002:2002 requires not only procedural compliance but also deep cognitive engagement and internalisation among organisational members. A strong cognitive framework ensures that individuals understand the rationale behind safety policies, anticipate potential risks, and make informed decisions that align with organisational road safety objectives.

In summary, the analysis of H3 confirms that the cognitive mind of road users exerts a profound and positive influence on the implementation of RTSMS ISO 39001:2013 within NIOSH Malaysia. This relationship underscores the essential role of cognitive transformation as a precursor to behavioural and systemic change. Consequently, the findings suggest that efforts to enhance employees' cognitive awareness and understanding are crucial to achieving long-term road traffic safety outcomes and maintaining the effectiveness of RTSMS within the organisational context.

Furthermore, to conclude the analysis from items B1-E5, finding correlation from D-B, D-C and D-E, the research further analyses to search for actual evidence of the study. Based on secondary data from the audit finding RTSMS ISO 39001:2013 – KOSB audit finding by the certification body (CB), the data provide empirical evidence to support the findings for items B1–E5 for NIOSH Malaysia.

Figure 4.67 recorded the Analysis of Accident and Incident Statistics (2019 vs 2020). The following analysis details the occupational safety performance of Kotamas Oil Sdn Bhd, comparing the 2019 calendar-year statistics with the first five months of 2020 (up to May 27). Based on the Safety Performance Data 2019, the organisation recorded three (3) significant cases. The distribution of these occurrences was sporadic across the fiscal year: on April one (1), a reported accident was recorded; on July one (1), a material spill incident; and on October one (1), another material spill incident.

The data indicates that while the frequency remained low, there were recurring issues regarding material handling and containment, as evidenced by the spills in the third and fourth quarters. For other Safety Performance Data 2020 (Provisional) The date recorded for the period ending May 27, 2020, the data reveals a singular recorded In January, an event recorded one (1) incident involving material cross-contamination during terminal loading operations. From February to May, zero (0) accidents or incidents were recorded.

During the 2019 calendar year, the organisation recorded a cumulative total of three (3) safety-related cases, comprising one (1) physical accident in April and two (2) material spill incidents in July and October, respectively. Data for the 2020 fiscal year (up to May 27) indicates a singular operational incident in January involving material cross-contamination during terminal loading, with no subsequent accidents or incidents recorded through May. A year-on-year comparison reveals a total absence of physical accidents in the first five months of 2020, representing a positive shift from the one (1) accident recorded during the same period in the previous year. While physical accidents decreased, the data identifies a recurring vulnerability in material handling; specifically, the transition from environmental spills in 2019 to procedural mixing errors in early 2020 suggests a persistent risk in fluid transfer operations.

The 2019 data show a sporadic distribution of incidents across the second, third, and fourth quarters, whereas the 2020 data demonstrate a concentrated incident in the first quarter followed by a four-month period of zero-incident operations. The detailed documentation of specific causes (e.g., "material mixing during terminal loading") indicates an active internal reporting culture and a shift toward identifying the root causes of process-based incidents over physical injuries. A comparative evaluation of the two periods demonstrates a downward trend in physical accidents. While 2019 saw one physical accident in April, the first five months of 2020 remained accident-free. However, the data highlights a persistent challenge in operational process safety. The transition from "material spills" in 2019 to "material mixing" in 2020 suggests that while environmental discharge risks may have been mitigated, procedural errors during loading and discharge remain a critical area for intervention. The absence of incidents from February to May 2020 suggests either heightened operational vigilance or the successful implementation of interim safety protocols. The management of KOSB has decided to implement RTSMS ISO 39001:2013 in response to the client's requirements (PETRONAS and Shell) to reduce industrial accidents, as discussed in sub-chapter 2.10.

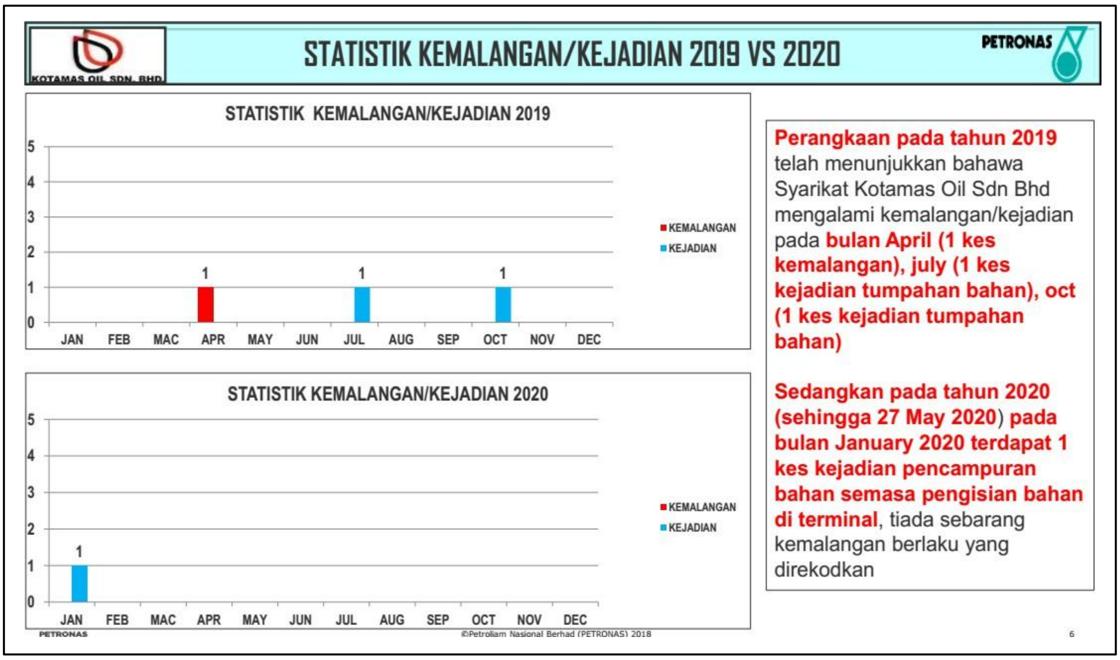


Figure 4.67 Objective Evidence KOSB RTSMS – Accident Statistic 2019 & 2020

The Root Cause Analysis of 2019, in Figure 4.68, indicates that forensic analysis of the 2019 data attributes the sole accident to human factors, specifically the driver becoming immobilised or "frozen" (pemandu terpaku) during vehicle operation. Statistical records for 2020 (as of May 27) indicate a total of zero (0) accidents, signifying a significant improvement in road safety performance compared to the previous reporting year by implementing the RTSMS ISO 39001:2013. Although no actual accidents occurred in early 2020, the projected risk distribution identifies "Being Hit by a Third Party" (Dilanggar Pihak Ke-3) as the most dominant potential threat at 60%, followed by "Self-Accidents" (Kemalangan Sendiri) and "Colliding with a Third Party" at 20% each.

A year-over-year evaluation demonstrates that the organisation successfully transitioned from a single-incident year in 2019 to an incident-free period during the first five months of 2020, effectively mitigating the risks identified in the previous cycle. The data highlights a shift away from human-error-driven accidents (such as the 2019 driver-related incident), suggesting that safety interventions or training implemented between the two periods may have successfully addressed driver-specific vulnerabilities.

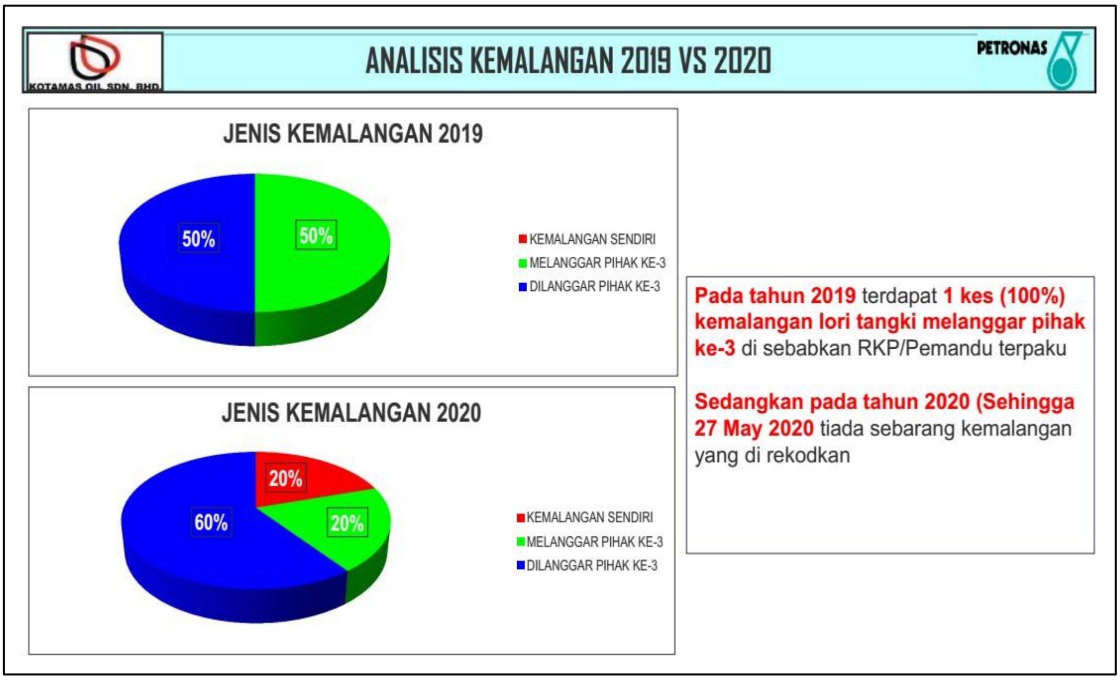


Figure 4.68 Objective Evidence KOSB RTSMS – Types of RTS Accidents Analysis 2019 & 2020

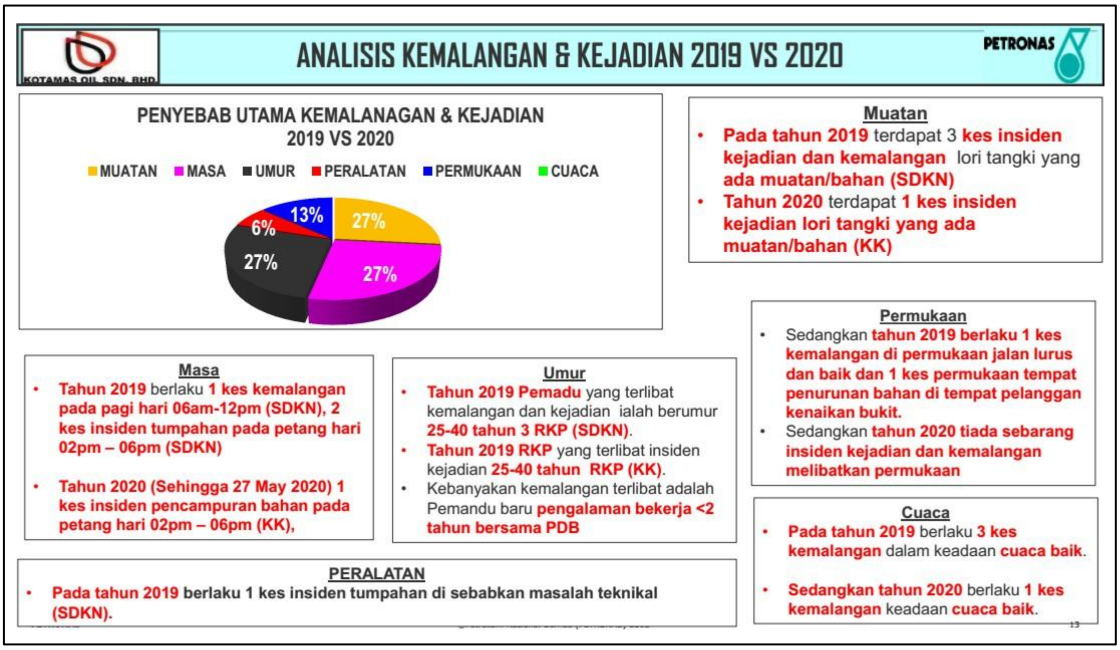


Figure 4.69 Objective Evidence KOSB RTSMS - Accident Factor 2019 & 2020

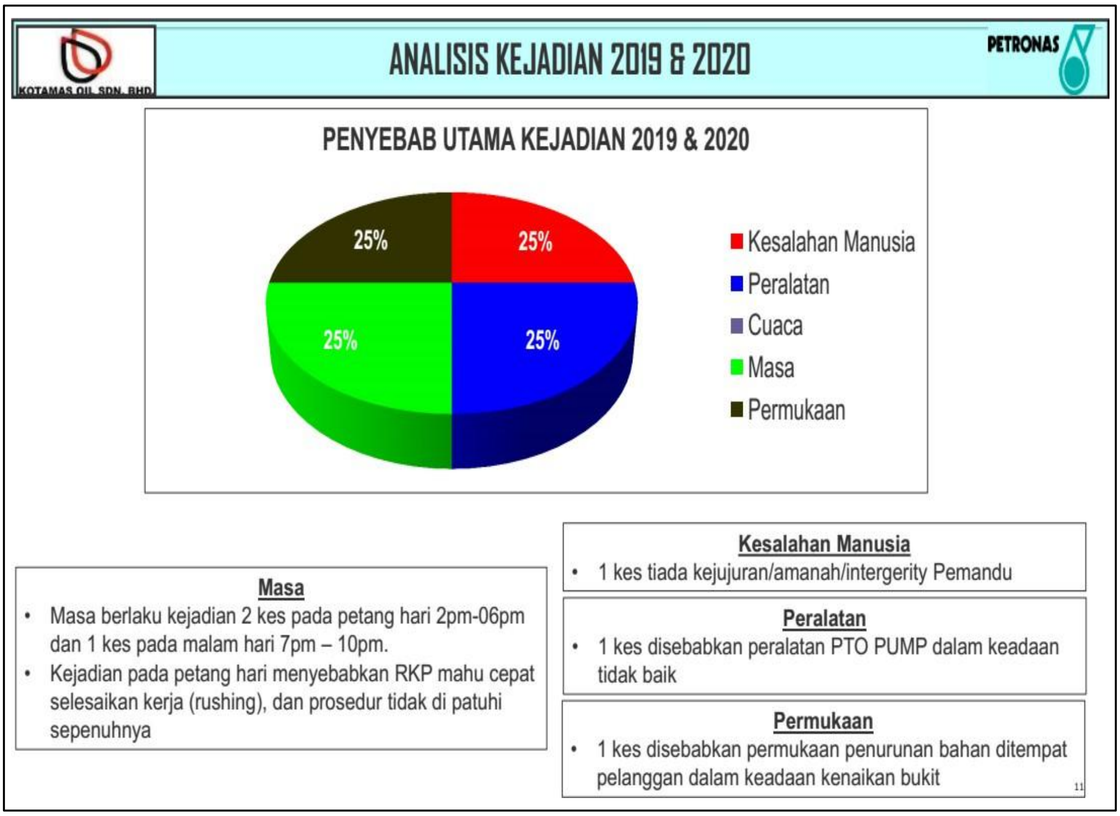


Figure 4.70 Summarise Percentage (%) of Categories Factor Contributing to Accidents 2019 -2020

Based on the distribution of causal factors presented in the statistical summary in Figures 4.69 and 4.70, the findings are categorised into four primary dimensions: Human Error, Equipment, Temporal (Time), and Surface conditions. Based on the distribution of Contributing Factors. The equalised multi-causal distribution has recorded the data, indicating an equal percentage distribution (25% each) across four critical domains: Human Error, Equipment, Time, and Surface. This suggests that the organisation’s risk profile is not dominated by a single factor but is the result of a multi-causal environment in which mechanical, human, and environmental variables intersect. The data recorded temporal and behavioural Correlation: Analysis of the "Time" factor reveals a concentration of incidents during peak operational hours. Specifically, two (2) cases occurred during the afternoon window (14:00–18:00) and one (1) case during the evening (19:00–22:00). Furthermore, the Pressure-Induced Non-Compliance, a significant finding in the temporal analysis, is the correlation between "rushing" (wanting to complete tasks quickly) and procedural violations. This indicates that perceived time pressure acts as a catalyst for deliberate non-compliance with established Safety Operating Procedures (SOPs).

Prior to analysis, the qualitative breakdown of root causes within the "Human Error" category, such as Integrity and Human Reliability, identifies a specific incident related to a lack of honesty or integrity by the driver. This distinguishes the risk as a "behavioural" failure rather than a "competency" failure, requiring different intervention strategies such as ethics training or stricter vetting. The "Equipment" factor (25%) was specifically linked to the poor condition of the Power Take-Off (PTO) Pump. This highlights a failure in the preventive maintenance slice of the organisational defences, where degraded machinery directly contributed to an operational incident. The "Surface" factor was characterised by a specific incident involving material delivery at a customer site located on an incline (hilly terrain). This suggests that environmental hazards, combined with the physical properties of the delivery site, represent a persistent external risk that requires specialised technical manoeuvring and risk assessment.

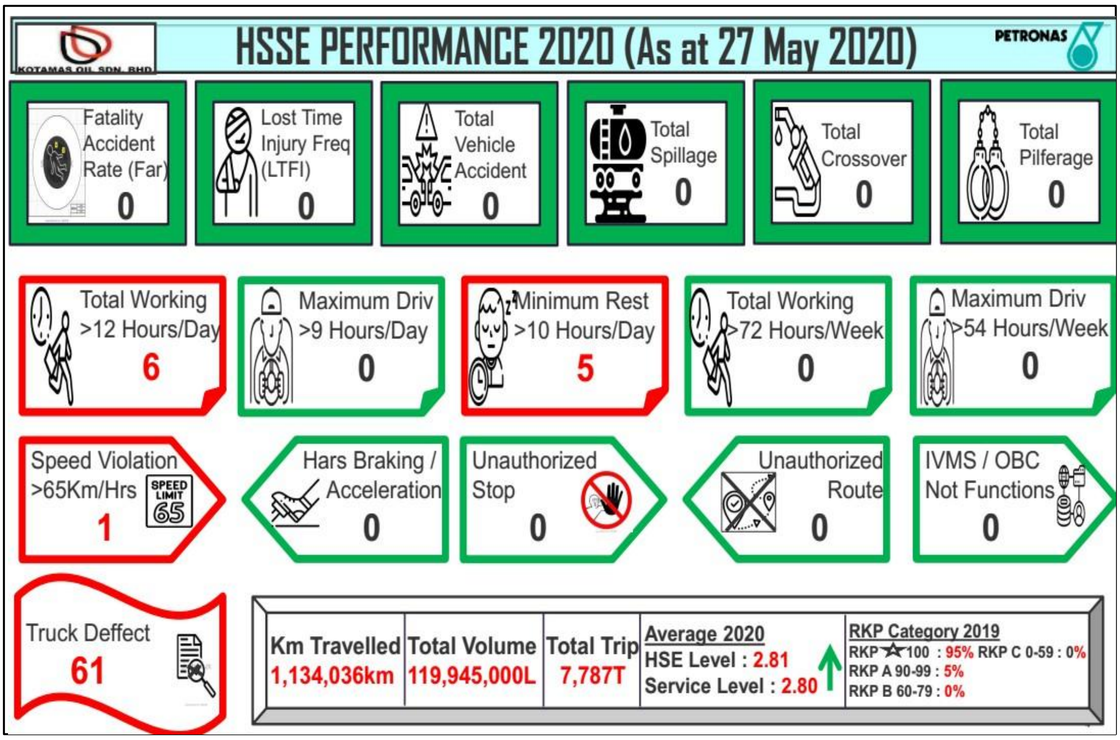


Figure 4.71 Objective Evidence KOSB RTSMS – RTSMS ISO 39001 Performance Factor

Based on the secondary data from the RTSMS audit conducted by the researcher. The KOSB, HSSE performance analysis for the 2020 period reveals a significant contrast between lagging indicators and proactive safety metrics. KOSB successfully maintained a zero-incident record for fatalities, lost-time injuries, and major vehicle accidents; however, underlying behavioural and mechanical risks remained evident prior to the implementation of the RTSMS ISO 39001:2013 standard. The data suggests that while the most severe outcomes are being prevented, the leading indicators, specifically those related to driver fatigue and vehicle health, point to potential vulnerabilities in the safety management system. The zero-incident status in high-severity categories indicates effective emergency controls, yet the persistence of violations or negative cognitive in daily operations suggests that the current safety record may be precarious without further systemic intervention.

A critical area of concern involves the management of human factors (cognitive-behavioural) and fatigue. Although the maximum driving hours per day remained within compliant limits, the recorded instances of total working hours exceeding twelve hours and insufficient rest periods exceeding ten hours indicate a gap in comprehensive fatigue management. This disparity suggests that while drivers are adhering to steering-time regulations, the cumulative strain of non-driving duties and inadequate recovery time is not being adequately mitigated, as shown in Figure 4.71. These fatigue-related violations represent precursor events that, if left unaddressed, significantly increase the probability of a major road transport incident during the over one million kilometres travelled by the fleet.

Furthermore, the high frequency of recorded truck defects represents the most significant technical challenge within the operational framework. With 61 documented defects, there is clear evidence of either an ageing fleet or a breakdown in preventive maintenance scheduling. This high volume of mechanical issues necessitates a shift toward a more predictive maintenance model to ensure that vehicle integrity does not become a primary cause of future accidents. When combined with the upward trend in overall service and HSE levels, it is clear that while the organisation is productive and growing in its service delivery, it must bridge the gap between operational output and the rigorous maintenance of its physical assets.

To ensure the long-term sustainability of these safety results, it is recommended that the organisation implement more robust automated monitoring and administrative locks to manage driver rest periods. By removing the possibility of scheduling a trip before the mandatory rest period is completed, the organisation can systematically eliminate fatigue-related non-compliance. Additionally, a focused review of the recurring causes behind the high defect rate should be conducted to streamline maintenance and reduce the frequency of vehicle-related risks. Addressing these leading indicators through technical and administrative interventions will move the organisation from a reactive safety posture to a more resilient, proactive culture that protects its zero-accident record.

Table 4.14
Gap Analysis of KOSB HSSE Performance vs. NIOSH Findings against Research Hypotheses

Performance Area	**KOSB Empirical Data (Current State)**	**NIOSH Malaysia Findings (Item Codes)**	**Alignment with Research Hypotheses**	**Identified Gap / Critical Finding**
Systemic Compliance	0 Accidents / 0 Fatalities over 1,134,036 km and 7,787 trips.	B1, B3, B37: High Implementation (78.9%) and belief that ISO 39001 changes behaviour (84.2%).	Supports H1 (HA): RTSMS implementation significantly impacts behaviour to prevent major incidents.	The Execution Gap: While the system prevents "accidents" (Lagging), it has not yet fully eliminated "violations" (Leading).
Fatigue & Human Factor	11 Violations for excessive work (>12h) and lack of rest (<10h).	B9, B12, B13: Over 90% of drivers cited fatigue and lack of sleep as primary stressors.	Supports H2 (HA): Cognitive stressors (fatigue) directly result in non-compliant behaviour (violations).	The Physiological Gap: A disconnect exists between "Driving Time" (0 violations) and "Total Human Recovery Time" (11 violations).
Technical Maintenance	61 Truck Defects recorded	B47, B49: 82.5%	Supports H2 & H3 (HA):	The Pre-Trip Gap: High defect

	(Highest frequency of all negative indicators).	identify maintenance as a trigger; 70.2% admit neglecting inspections.	Cognitive lapses in procedural discipline led to high technical risk behaviors.	rates suggest a cognitive "shortcut" where drivers skip inspections to meet trip targets.
Driver Attitude & Speed	1 Speed Violation recorded. 0 Harsh Braking/Acceleration.	B50, B40: 84.2% recognize speed risk; 85.9% note deliberate attitudes affect signaling.	Supports H1 & H2 (HA): RTSMS monitoring has successfully suppressed most aggressive driving behaviors.	The Individualist Gap: Occasional speeding shows that even with a strong RTSMS, individual cognitive choices can override system controls.
Organizational Maturity	HSE Level (2.81) and Service Level (2.80) showing upward trends.	C1, C2, D2: High acceptance (79%) and belief that RTSMS shapes risk-sensitive attitudes (91.2%).	Supports H3 (HA): Cognitive shift toward ISO standards leads to sustained behavioral improvements.	The Maturity Gap: The organization is moving from "Calculative" to "Proactive" but must resolve the defect/fatigue outliers.

Therefore, the analysis concluded, the implementation of the ISO 39001 framework (H1) successfully regulated road user behaviour, resulting in zero fatalities and minimal speed or route violations over 1.1 million kilometres travelled. While major accidents were absent, the presence of working-hour violations and vehicle defects (H2) confirmed that cognitive stressors, specifically fatigue and operational pressure, directly influence behavioural lapses, overriding safety protocols. Ultimately, the high cognitive acceptance of RTSMS policies among the workforce (H3) acted as a sustainable behavioural modifier, preventing minor violations from escalating into high-severity incidents and improving overall organisational safety performance. Consequently, the null hypotheses (H0) for all three objectives are rejected.

4.4 Summary

This chapter presents a detailed analysis and discussion of the empirical findings from research conducted at NIOSH Malaysia (Headquarters and Regional Offices) on the influence of cognitive change and behavioural transformation among road users on the implementation of the Road Traffic Safety Management System (RTSMS) ISO 39001:2013 and ISO 39002:2002. The analysis employed Partial Least Squares Structural Equation Modelling (PLS-SEM) to examine relationships among exogenous and endogenous latent variables and test the proposed hypotheses. The findings confirmed that all three hypotheses were supported, indicating that the application of RTSMS ISO 39001:2013 and ISO 39002:2002 significantly influences the cognitive mind and behaviour of road users, that cognitive factors have a positive and substantial effect on behavioural change, and that cognitive transformation exerts a strong influence on the effective implementation of RTSMS within the organisation. The statistical results, with path coefficients exceeding the threshold and R^2 values ranging from 0.377 to 0.910, demonstrate the model's explanatory strength and predictive validity. Overall, the chapter establishes that cognitive awareness and behavioural adaptation are crucial to the successful implementation of RTSMS in NIOSH Malaysia. The empirical evidence reinforces the theoretical framework developed in Chapter 2, highlighting that sustainable improvements in road traffic safety management can only be achieved when organisations integrate cognitive and behavioural change strategies into their safety management systems. These findings provide the foundation for the conclusions, implications, and recommendations discussed in the subsequent chapter.

CHAPTER 5
CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter concludes the research by summarising the key findings, theoretical implications, and practical recommendations derived from the study on cognitive and behavioural changes among road and traffic users towards the implementation of the Road Traffic Safety Management System (RTSMS) ISO 39001:2013 and ISO 39002:2002 at NIOSH Malaysia. The findings are supported by theoretical underpinnings from the Social Cognitive Theory (SCT), developed by Albert Bandura (1977), and the Multi-Causation Theory (MCT), introduced by Herbert W. Heinrich (1931). Both theories provide essential foundations for understanding how individual cognition, behaviour, and environmental influences interact to shape safety culture and risk management practices within organisations.

The research framework and hypotheses were constructed based on insights from these theories, emphasising the relationships among cognitive awareness, behavioural change, and the systematic implementation of RTSMS within organisational settings. Three (3) hypotheses (H1, H2, and H3) were empirically tested using data collected from 57 respondents, representing approximately 30% of NIOSH Malaysia employees across 17 regional offices actively implementing RTSMS ISO 39001:2013. Additionally, one audit review related to RTSMS implementation findings from KOSB was examined to support the empirical evidence and provide an industry-based validation perspective.

The research outcomes indicate that cognitive transformation among employees significantly influences both behavioural change and the effectiveness of RTSMS implementation, aligning with Bandura's (1977) assertion that learning and behavioural adaptation occur through a dynamic interplay of personal, behavioural, and environmental factors. Likewise, Heinrich's (1931) Multi-Causation Theory supports the argument that accidents and unsafe actions arise from multiple interrelated factors psychological, behavioural, and systemic thereby reinforcing the importance of a structured management system such as ISO 39001:2013 in mitigating road traffic risks.

5.2 Discussion and Finding

Supporting evidence from prior studies strengthens this conclusion. For instance, (Iwaro & Mwasha, 2012; Rajeev et al., 2020; Tor-Olav Naevestad et al., 2025; Zamri & Hamzah, 2022) found that management system certification significantly improves organisational performance by enhancing quality and managerial processes. The findings confirm that ISO certification fosters continuous improvement in both individual performance and systemic effectiveness an observation consistent with the results of the present study. Furthermore, (Barry Strauch, 2017; Brazier, 1996; Kristine Margaret Relvini, 2002; STANLEY MURAGE San Diego, 2017) identified human error as the leading contributor to road accidents, emphasising that psychological and spiritual dimensions strongly influence driver attitudes. His findings showed a significant relationship between driver attitudes towards safe driving and these psychological-spiritual factors ($p < 0.05$), as demonstrated through Structural Equation Modelling (SEM). This further validates the present study's hypothesis that cognitive factors critically shape behaviour and, consequently, road safety outcomes.

Overall, the integration of SCT and MCT within the RTSMS framework provides a robust explanation for how cognitive restructuring and behavioural reinforcement can collectively enhance safety culture in organisations. The findings reaffirm that improving the cognitive mindset of road users and managers is fundamental to achieving meaningful behavioural transformation and sustaining road traffic safety performance under ISO 39001:2013 implementation.

This study makes significant contributions to the understanding and application of the Road Traffic Safety Management System (RTSMS) as outlined in MS ISO 39001:2013 and ISO 39002:2002, in mitigating road traffic risks through changes in the cognitive mindset and behavioural patterns of road users. The findings suggest that the systematic implementation of RTSMS, supported by cognitive and behavioural change initiatives, can serve as an essential framework for organisations, particularly NIOSH Malaysia, in enhancing road safety management practices. The study contributes to related agencies by offering a structured guideline to mitigate road traffic risks through cognitive transformation, behavioural reinforcement, and institutional coordination. By integrating strategies such as stakeholder cooperation, legislative compliance, effective promotion, continuous monitoring, research, and development supported by data-driven information sharing, the performance of road traffic safety systems can be periodically evaluated to determine their efficacy in achieving institutional standards under ISO 39001:2013. These strategies align with the Road Traffic Safety (RTS) Management Systems – Requirements with Guidance for Use (ISO 39001:2012, IDT), which provides the foundation for global best practices in traffic safety management.

The empirical results of this study demonstrate that the implementation of RTSMS in NIOSH Malaysia plays a pivotal role in influencing the cognitive mindset and behavioural transformation of road users. Through structured processes involving education, training, and reinforcement of safety culture, RTSMS has shown the potential to instil positive changes in attitudes, perceptions, and decision-making among road users, particularly those directly involved in commuting and transportation-related operations. The research also aimed to determine whether the implementation of RTSMS produces a positive or negative impact in shaping the knowledge, skills, behaviours, and attributes required to manage road traffic safety risks effectively. The results confirmed that cognitive and behavioural restructuring through RTSMS adoption significantly reduces human-related errors such as stress, aggression, impulsive driving, and risk-taking tendencies, factors commonly associated with crash causation.

Furthermore, the findings align closely with national and international road safety data. According to the Buku Statistik Keselamatan Jalan Raya (Road Safety Statistics Book, revised as of 12 February 2020), the majority of road traffic crashes in Malaysia are attributed to human-related factors, which account for approximately 80.6% of incidents, followed by road conditions (13.2%) and vehicle-related factors (6.2%). These statistics substantiate the assertion that human cognitive and behavioural factors are the primary contributors to road accidents. Consequently, interventions that address cognitive processes and behavioural conditioning—such as those embedded within the RTSMS ISO 39001:2013 framework are essential to reducing crash rates and enhancing road user safety.

This study reinforces the premise that the cognitive dimension of road safety management is critical in influencing behavioural change, thereby reducing accident frequency and severity. By embedding cognitive-behavioural approaches within the RTSMS implementation strategy, organisations like NIOSH Malaysia can foster a sustainable culture of safety consciousness, accountability, and continuous improvement. The outcomes of this research, therefore, not only validate the theoretical foundations of the Social Cognitive Theory (SCT) and Multi-Causation Theory (MCT), but also provide practical guidance for policymakers, practitioners, and organisations seeking to enhance road traffic safety through systematic, human-centred management practices.

Furthermore, the results of this study align with international research that emphasises the central role of human cognition and behaviour in traffic safety outcomes. Researchers from Malaysia, Singapore, China, Taiwan and Ghana (Anlimah & Ackah, 2019; Khan et al., 2015; Kyung et al., 2008; Lin, 2025; Ma et al., 2012; Wight, 2007; Yu, 2025; Zhang et al., 2026). In their study of traffic accidents, they demonstrated that the likelihood of a traffic accident increases significantly when traffic safety consciousness (TSC) decreases. Their analysis identified demographic factors and driving skill levels as key contributors to traffic safety consciousness. Importantly, they reported that motor vehicle drivers were responsible for more than 90% of traffic accidents, thereby highlighting the dominance of human factors in crash causation. The findings from previous research supported the recommendations in this research: a combination of traffic safety education and enhanced road safety facilities should be implemented to standardise traffic safety management systems and effectively reduce the number of crashes and fatalities. This perspective supports the findings of the present study, which similarly identified cognitive transformation and behavioural modification as critical elements in improving road traffic safety performance through the implementation of RTSMS ISO 39001:2013 in NIOSH Malaysia.

Complementing these findings, (Slaughter et al., 2014) investigated accidents involving vulnerable road users, specifically pedestrians and cyclists, struck by motor vehicles in New York City between 2008 and 2011. Their study employed accident data, participant interviews, and imaging analysis to examine demographic and behavioural factors contributing to such accidents. The results indicated that non-compliance with traffic laws and regulations was a major cause of collisions involving vulnerable road users. The results emphasised that improving compliance and fostering safety-conscious behaviour among motorists are essential to mitigating the risk of accidents. This conclusion strongly resonates with the present study’s findings, which suggest that implementing RTSMS and cognitive-behavioural interventions can effectively improve compliance, reduce risky behaviours, and cultivate a culture of safety among road users.

The analysis of data in this study was guided by the conceptual research model developed in Chapter II, which integrates the theoretical foundations of Social Cognitive Theory (Bandura, 1977) and Multi-Causation Theory (Heinrich, 1931). Using the structural equation modelling (SEM) technique in SmartPLS v.3.3.3, the research model was tested at the 95% confidence level ($p < 0.05$). This analytical approach enabled the researcher to assess the accuracy and reliability of the proposed hypotheses and quantify the interrelationships among the model's constructs.

The results of the hypothesis testing revealed that the implementation of RTSMS ISO 39001:2013, cognitive mindset, and behavioural changes among road users are statistically significantly related, even though the magnitude of influence ranges from moderate to weak. These findings confirm that adopting ISO-based road traffic safety management frameworks can positively shape cognitive and behavioural attributes related to safety performance. Moreover, the outcomes of this study were compared with previous research to assess the alignment between theory and practice. The consistency of results with the works of other international scholars validates the significance of human factors in traffic safety. It further demonstrates that structured systems such as RTSMS provide a formalised mechanism for influencing cognitive patterns and behavioural compliance among organisational members.

In conclusion, the findings of this study offer valuable insights to organizations implementing or planning to implement RTSMS ISO 39001:2013 and ISO 39002:2002, particularly within NIOSH Malaysia (Headquarters and Regional Offices). The results indicate that RTSMS not only supports operational safety but also contributes to the development of cognitive awareness and behavioural discipline among road and traffic users. This cognitive-behavioural enhancement subsequently benefits institutional safety culture, reduces the incidence of traffic-related incidents, and strengthens organizational alignment with global road safety management standards as per summary table below.

Table 5.1
Summary Table

Section	Avg. Agreement (6-7)	Framework Alignment	Objective	Status
B1-B50	79.4%	IDC & Cognitive Triggers	Obj 1 & 2	H1, H2 Accepted
C1-C5	82.6%	System Receptivity	Obj 2	H1 Accepted
D1-D5	88.1%	Behavioural Outcomes	Obj 1 & 3	H2, H3 Accepted
E1-E5	83.1%	Legislative Solution	Obj 3	H1, H3 Accepted

To recap the analysis conducted to show the correlation of the finding between the recommendation and conclusion in this research the structural model indicates that the variance of the endogenous latent variables is directly derived from the combined influence of all related exogenous latent variables. Based on the Table 4.2, according to the R^2 value, 0.750 or higher represents a substantial level of explanatory power, while a value of 0.500 indicates a moderate effect, and 0.250 reflects a weak effect. In this study, the R^2 values obtained for the endogenous latent variables were as follows: for Hypothesis 1 (H1) involving the interaction between variables D and C, $R^2 = 0.713$; for Hypothesis 2 (H2) involving the interaction between variables D and B, $R^2 = 0.373$; and for Hypothesis 3 (H3) involving the interaction between variables D and E, $R^2 = 0.910$. These findings demonstrate that the exogenous latent variables collectively explain 71.3%, 37.3%, and 91.0% of the variance in the respective endogenous latent variables. Based on these values, the results indicate that the influence of the exogenous constructs on the dependent variables ranges from moderate to large, suggesting substantial explanatory power within the model.

Furthermore, the assessment of the structural model at the $p < 0.050$ significance level confirms that all three constructs are statistically significant. The path coefficients (β) and corresponding p-values derived from the respondents' data indicate positive, significant relationships among the studied constructs. Specifically, for Hypothesis 1 (H1), the results indicate a path coefficient of $\beta = 0.848$ and a p-value < 0.000, suggesting that the implementation of RTSMS ISO 39001:2013 has a significant and positive influence on the cognitive mindset and behaviour of road users. Similarly, for Hypothesis 2 (H2), the path coefficient of $\beta = 0.621$ and p-value < 0.000 reveal that the cognitive mindset of road users exerts a significant positive influence on their behavioural responses. Finally, Hypothesis 3 (H3) demonstrates a strong positive effect, with a path coefficient of $\beta = 0.955$ and p-value < 0.000, confirming that the cognitive mindset of road users significantly influences the implementation and effectiveness of RTSMS ISO 39001:2013 within the organisational context.

Overall, these findings affirm that the proposed research model possesses strong predictive and explanatory capabilities. The statistically significant relationships observed across all three hypotheses indicate that cognitive transformation and behavioural adaptation among road users are crucial to the successful implementation of RTSMS ISO 39001:2013 at NIOSH Malaysia.

5.3 Implication of the Study

The findings of this study have several important implications for theory, practice, and the development of organisational policy within the domain of road traffic safety management. From a theoretical perspective, this research reinforces and extends the application of Social Cognitive Theory (SCT) (Bandura, 1977) and Multi-Causation Theory (MCT) (Heinrich, 1931) in explaining the cognitive and behavioural dimensions of road user safety. The results confirm that the cognitive processes of individuals—perception, awareness, and attitude—have a significant and direct influence on behavioural change, which, in turn, affects the successful implementation of RTSMS ISO 39001:2013 and ISO 39002:2002. This provides empirical evidence for integrating behavioural psychology theories into safety management systems, emphasising that road safety performance is not solely dependent on procedural compliance but also on cognitive and attitudinal changes among drivers and staff.

From a practical standpoint, the study demonstrates that implementing the RTSMS standards ISO 39001:2013 and ISO 39002:2002 can significantly enhance safety culture within organisations, such as NIOSH Malaysia. The strong and positive correlations identified in the statistical analysis (β values exceeding 0.6 and p-values $<$ 0.05) suggest that a well-structured road traffic safety management system can reshape employee cognition, leading to safer behavioural practices and reduced exposure to road risks. This finding implies that institutions should prioritise continuous education, behavioural training, and psychological conditioning as integral components of RTSMS implementation. By strengthening employees' cognitive awareness and self-regulatory capacity, organisations can create a sustainable foundation for accident prevention and proactive risk management.

At the policy level, this study provides valuable insights for national and institutional decision-makers involved in developing road traffic safety frameworks. The evidence from this research supports the formulation of policies that integrate cognitive and behavioural development programs into the existing ISO-based management systems. Moreover, the results highlight the need for structured monitoring mechanisms to evaluate the effectiveness of RTSMS in changing organisational culture and individual driving behaviour over time. Such policy alignment can help achieve Malaysia's broader objectives of reducing traffic-related injuries and fatalities under the national road safety strategy.

In addition, the study underscores the importance of cross-agency collaboration among institutions such as NIOSH Malaysia, MIROS, MRTSA, and KOTAMAS Sdn. Bhd., emphasising that the cognitive and behavioural components of road safety management must be reinforced through multi-sectoral cooperation, data sharing, and joint training initiatives. By doing so, the implementation of RTSMS ISO 39001:2013 and ISO 39002:2002 can be optimised, ensuring that both organisational and human factors are addressed comprehensively.

In summary, this research contributes to the theoretical enrichment of safety management studies, advances practical understanding of behavioural transformation under RTSMS frameworks, and provides actionable insights for policymakers seeking to institutionalise road safety practices within public and private organisations.

5.4 Recommendation

Based on the findings and implications of this study, several recommendations are proposed to strengthen the effectiveness of the implementation of ISO 39001:2013 for the Road Traffic Safety Management System (RTSMS) in Malaysia, particularly within NIOSH and other organisations with similar operational contexts. These recommendations are structured under three primary domains: practical implementation, policy development, and future research.

From a practical standpoint, organisations should focus on integrating behavioural and cognitive transformation programs into their existing safety management systems. The results of this study demonstrate that the cognitive mind of road users plays a critical role in influencing safety behaviour and overall compliance with RTSMS standards. Therefore, continuous professional development initiatives, such as safe driving training, cognitive awareness workshops, and periodic behavioural assessments, should be institutionalised within the RTSMS framework. Additionally, incorporating psychological and emotional intelligence training could enhance individual self-regulation and situational awareness, leading to more consistent adherence to road safety protocols. Organisations should also establish systematic monitoring and evaluation mechanisms to measure behavioural change and the effectiveness of cognitive-based safety interventions over time.

At the policy level, it is recommended that national road safety authorities and regulatory bodies, such as the Ministry of Transport, MIROS, and NIOSH Malaysia, strengthen collaborative frameworks to ensure uniform implementation and monitoring of RTSMS ISO 39001:2013 across sectors. Establishing a national RTSMS certification and auditing body, in collaboration with third-party certifiers such as NIOSHcert, SIRIM, and PECB, can further enhance the credibility, impartiality, and sustainability of road safety management practices. Furthermore, policymakers need to consider embedding RTSMS requirements into organisational governance structures, ensuring that cognitive and behavioural change becomes a strategic objective rather than a compliance requirement. Such alignment would directly contribute to achieving the national goal of reducing road traffic fatalities by 50%, as outlined in the National Transport Policy (2019–2030).

From a research perspective, this study opens several avenues for further exploration. Future research could expand the current sample to include other public and private sector organisations that implement RTSMS, thereby validating the generalizability of the findings. Longitudinal studies are also recommended to examine the long-term cognitive and behavioural transformation among employees following RTSMS implementation. Furthermore, comparative studies between ISO 39001-certified and non-certified organisations could provide valuable insights into the tangible benefits and challenges of certification. Researchers are also encouraged to integrate emerging analytical approaches, such as machine learning and predictive modelling, to assess behavioural patterns and accident risk based on cognitive indicators. These advancements would further strengthen the empirical foundation for decision-making in road safety management.

In conclusion, the recommendations outlined in this study emphasise the critical importance of integrating cognitive psychology, behaviour-based safety, and ISO management system frameworks into a unified approach. By adopting these measures, organisations such as NIOSH Malaysia can not only enhance road safety performance but also contribute to national and global efforts to minimise road traffic incidents through a scientifically grounded, systematic, and human-centred approach. Furthermore, while the foundational theories provide robust analytical lenses, educational practice should emphasise a systems-thinking orientation rather than adherence to any single model. It is essential to acknowledge and illustrate non-linear dynamics in safety problems, recognising that emergent properties may not be predictable from linear aggregations of factors. Thus, the curriculum should cultivate the capacity to adapt theoretical frameworks to context, data availability, and specific safety challenges. Learners should be guided to combine insights from multiple theories, adopting a pluralistic approach that enhances explanatory power and practical relevance.

In addition, pedagogy should foreground the translation of theory into policy and practice. Students ought to engage with real-world data and safety interventions to assess how different models inform design choices and evaluation criteria. Ethical considerations should also be integrated, ensuring that safety analyses consider equity, privacy, and the potential unintended consequences of interventions. By balancing theoretical depth with practical applicability, the educational program can prepare students to contribute to safer, more resilient transportation systems. Based on the finding from the research analysis the several recommendations to Institutional Level (NIOSH) can be implemented immediately. Implement a "Cognitive Health Monitoring" program. Since fatigue (B9) and sleep (B13) are the highest-rated triggers, NIOSH should use wearable tech or apps to monitor driver readiness before journeys.

In the macro level implementation, the finding recommends at Policy Level. The Road Transport Act 1987 should be updated to encourage or mandate ISO 39001 certification for organizations with large vehicle fleets, as this study proves it significantly reduces "deviant" road behaviour. For the Future Research the studies should use Aze+ Concepts to compare different industries (e.g., logistics vs. corporate) to see if the cognitive "Vengeance Syndrome" triggers vary across different road user types and does this Aze+ concept be able to control deviant of road user in the institutional set up and increase business performance of the institution.

5.5 Conclusion

This research has provided a comprehensive examination of the cognitive and behavioural transformation of road users within the organisational context of NIOSH Malaysia through the implementation of the Road Traffic Safety Management System (RTSMS) ISO 39001:2013 and ISO 39002:2002. Grounded in the theoretical foundations of Social Cognitive Theory (SCT) by Albert Bandura (1977) and Multi-Causation Theory (MCT) by Herbert W. Heinrich (1931), this study established a conceptual and empirical framework to evaluate how cognitive processes, attitudes, and management systems interact to influence safe road user behaviour. The integration of these two theories enabled a multidimensional understanding of how internal (cognitive

and psychological) and external (organisational and systemic) factors converge to shape safety-related outcomes.

The empirical findings, derived from the analysis of 57 respondents across NIOSH Malaysia's headquarters and regional offices using Partial Least Squares Structural Equation Modelling (PLS-SEM), confirmed that all three hypotheses (H1, H2, and H3) were statistically supported. The results demonstrated strong and significant relationships among the constructs, with RTSMS ISO 39001:2013 and ISO 39002:2002 exerting a notable influence on both the cognitive mindset and behavioural tendencies of road users. The path coefficients ($\beta = 0.621$ to 0.955) and R^2 values (ranging from 0.373 to 0.910) reflected moderate to strong explanatory power within the proposed model, thus validating the theoretical assumptions that cognitive and behavioural change is achievable through structured management system interventions. These findings provide empirical evidence that the implementation of RTSMS not only standardises organisational safety practices but also acts as a catalyst for psychological transformation among employees.

In the context of organisational safety culture, the study reinforces the notion that sustainable road safety performance depends significantly on cognitive awareness, behavioural discipline, and continuous system improvement. By aligning organisational policies with the ISO 39001:2013 framework, NIOSH Malaysia has demonstrated the potential of structured management systems to mitigate road traffic risks, reduce commuting-related incidents, and foster a proactive safety culture. Moreover, the study contributes to national road safety objectives outlined in the National Transport Policy 2019–2030, supporting Malaysia's vision of achieving a 50% reduction in road traffic accidents through institutional and behavioural transformation.

Theoretically, this research enriches the existing literature on road safety management by offering an integrative perspective that connects psychological cognition, behavioural adaptation, and systemic control mechanisms. Practically, it provides organisations and policymakers with a validated framework to enhance road safety performance through targeted cognitive and behavioural interventions supported by ISO management principles. The findings also affirm the relevance of Bandura's SCT and Heinrich's MCT as foundational lenses for understanding the human dimension of road safety within modern safety management systems.

In conclusion, this study highlights that the success of implementing the RTSMS ISO 39001:2013 extends beyond procedural compliance it is deeply rooted in transforming how individuals think, perceive, and act regarding road safety. The fusion of cognitive understanding, behavioural discipline, and systemic governance forms the cornerstone of a sustainable safety culture. As Malaysia continues its journey towards safer roads and workplaces, the insights from this research can serve as a strategic reference for organisations, policymakers, and future scholars seeking to harmonise human cognition with systemic safety management for enduring change and impact.

Based on the analysis conducted in this research, the study successfully addressed the three primary objectives through the lens of the Aze+ Concepts Interaction model from the four major theory in safety and cognitive thinking field (Heinrich's Domino and Multi-Causation theories, Bird and Germain's Loss Causation Model, Reason's System Safety framework, and Bandura's Social Cognitive Theory) be able to illuminate the process of transform the cognitive and behavioural patterns of road users in a corporate, public health, and inter-organizational context. The Objective 1 (Cognitive Impact on Behaviour) based on the data gather (B9–B14) shows a direct path from physiological/cognitive failure (fatigue/stress) to dangerous behavioural outcomes (falling asleep/speeding). This proves that the Cognitive impact (Vengeance Syndrome) is the primary "Root Cause" of behavioural shifts. The Objective 2

(Cognitive Road User & RTSMS) also confirmed the high scores in Section C and D indicate that the RTSMS design at NIOSH is "Cognitive-Friendly." By providing SOPs (D1) and reducing fatigue (D4), the system minimizes "Cognitive Load," allowing users to maintain situational awareness. The last objective to analyse and confirm is Objective 3 (RTSMS Influence on Both). The findings in Section E confirm that a robust RTSMS ensures legal compliance (RTA 1987) and technical fitness (E3), which stabilizes the user's mind and leads to sustainable safe behaviour. The implementation of ISO 39001:2013 at NIOSH Malaysia serves as a definitive "Industrial Best Practice" that disrupts the multi-causation chain of road accidents. By neutralizing the Cognitive impact (Vengeance Syndrome), the system transforms institutional road users from a state of "potential aggression" to a state of "safety compliance." This research proves that management systems are not just administrative tools but are essential cognitive interventions.

5.6 Summary

This chapter presents a comprehensive synthesis of the study’s key findings, implications, and conclusions derived from the investigation into the cognitive and behavioural transformation of road users within NIOSH Malaysia through the implementation of the Road Traffic Safety Management System (RTSMS) based on ISO 39001:2013. The research successfully demonstrated that structured management systems, when supported by theoretical underpinnings such as Social Cognitive Theory (SCT) and Multi-Causation Theory (MCT), have the capacity to influence and reshape the cognitive mindset and behavioural patterns of road users. The empirical analysis confirmed that all proposed hypotheses were statistically significant, providing strong evidence that the RTSMS framework makes a meaningful contribution to improving road user cognition, behaviour, and organisational safety outcomes.

The implications of this study extend beyond NIOSH Malaysia, offering practical insights for other organisations and agencies seeking to strengthen their road safety performance through a systems-based and behaviourally informed approach. The findings highlight the importance of integrating cognitive awareness, behavioural reinforcement, and continuous improvement mechanisms within institutional frameworks to achieve sustainable safety outcomes. Ultimately, this study reaffirms that the effectiveness of RTSMS ISO 39001:2013 lies not only in procedural compliance but also in cultivating a safety oriented cognitive culture that supports Malaysia's broader national goal of reducing road traffic accidents by 50% under the National Transport Policy 2019–2030.

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APPENDICES

APPENDIX 1

Example of the Codes in PLS Algorithms

KOTAMAS OIL S D N. B H D

Delivery Route Hazard Assessment Checklist

1. Route Segment Data:

Supply Point: SBFT SEPANGGAR		Customer: KUDAT	Date/Time: 20.06.2020/8.30AM
From: SEPANGGAR		To: BULATAN TUGU UDANG BESAR ,KUDAT	Contact person: -
Route Name: JALAN TUARAN-KUDAT	Truck accessibility: TRAILER/RIGID	Total Distance: **167 KM**	Trip Time: **4 HOURS**

Name the segments proportion for Risk Assessment

Route Segment	From: SBFT	To: BULATAN TUGU UDANG BESAR, KUDAT	Longitude – Latitude Start 6.080666, 116.129427	Longitude – Latitude End 6.899699, 116.850160
Route Segment 1:	From: KM 0 SBFT	To: KM38.9 SIMPANG KG.LAPAI, TENGHILAN	6.080666, 116.129427	6.261229, 116.340957
Route Segment 2:	From: KM38.9-KM44.5(High Risk >10%) SIMPANG KG.LAPAI TENGHILAN	To: KM44.5 SIMPANG KG KELAWAT	6.261229, 116.340957	6.301889, 116.361421
Route Segment 3:	From: KM44.5 SIMPANG KG KELAWAT, KOTA BELUD	To: KM160.4-KM162.4(High Risk >10%) SIMPANG SEKOLAH MEMANDU HASIL UTARA	6.301916, 116.361406	6.906618, 116.797721 - 6.905777, 116.804356
	KM125.1 BULATAN PEKAN MATUNGGUNG(BARU)	KM75.1-KM79.5 KAWASAN BANJIR (KG TIMBANG MENGGARIS)		
Route Segment 4:	From: KM162.4	To: KM167 BULATAN TUGU UDANG BESAR, KUDAT	6.905777, 116.804356	6.899699, 116.850160

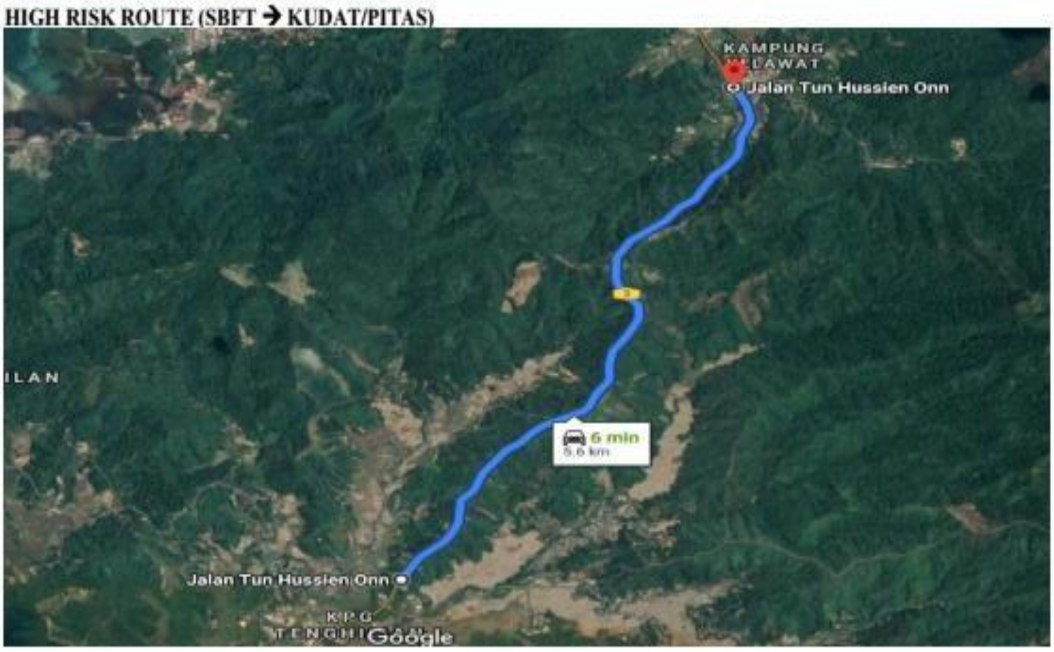
2. Hazard Checklist

Route Assessment Items	Check the proper box
Any Hours limitations/Banned Hours	Route Segment: 1 Time Limit: N/A
Road surface type	☐ 2 Lanes ☐ 4 lanes ☐ Divided ☐ Paved ☐ Gravel ☐ Dirt ☐ Straight ☐ Curved ☐ High difference between road surface/shoulder
General road condition	☐ Good ☐ Holes ☐ Signaled ☐ Painted ☐ Narrow bridges ☐ Tunnel
Road shoulder condition	☐ Clean ☐ Hard ☐ Soft ☐ Ample ☐ Narrow ☐ Do not exist ☐ Significant gap with road height
Traffic condition	☐ Light ☐ Medium ☐ Heavy ☐ Mostly trucks ☐ Mostly Cars ☐ Mixed
Visibility	Day ☐ Good ☐ Poor ☐ Fog Night ☐ Good ☐ Poor ☐ Fog
Topography	☐ Normal ☐ Flat ☐ Hilly ☐ Abyss
Maximum recommended speed for segment	Day & Night: 65KM/H Depends o route and traffic condition
Authorized areas for: ☐ Tire repair ☐ Mechanical repair ☐ Food/Rest ☐ Overnight Lodging	List: N/A List: N/A List: N/A List: N/A
Identified Hazards/Blocked Roads: ☐ School crossings ☐ High accident frequency ☐ Busy Intersections ☐ Road restriction I.e. Height Limit (underpass,tunnel, etc.), Weight Limit (bridge maximum weight etc.) and Width Limit (bridge etc.) ☐ Others	List: POLITEKNIK KK,SK. PEKAN TENGHILAN List: N/A List: N/A List: N/A List: AKADEMI MEMANDU KOTA BELUD, KAWASAN PERKAMPUNGAN.

2. Hazard Checklist

Route Assessment Items	Check the proper box
Any Hours limitations/Banned Hours	Route Segment: 2 Time Limit: 3 HOURS
Road surface type	☐ 2 Lanes ☐ 4 lanes ☐ Divided ☐ Paved ☐ Gravel ☐ Dirt ☐ Straight ☐ Curved ☐ High difference between road surface/shoulder
General road condition	☐ Good ☐ Holes ☐ Signaled ☐ Painted ☐ Narrow bridges ☐ Tunnel
Road shoulder condition	☐ Clean ☐ Hard ☐ Soft ☐ Ample ☐ Narrow ☐ Do not exist ☐ Significant gap with road height
Traffic condition	☐ Light ☐ Medium ☐ Heavy ☐ Mostly trucks ☐ Mostly Cars ☐ Mixed
Visibility	Day ☐ Good ☐ Poor ☐ Fog Night ☐ Good ☐ Poor ☐ Fog
Topography	☐ Normal ☐ Flat ☐ Hilly ☐ Abyss
Maximum recommended speed for segment	Day& Night: 40KM/H (High Risk route with 10% inclination)KM38.9-KM44.5
Authorized areas for: ☐ Tire repair ☐ Mechanical repair ☐ Food/Rest ☐ Overnight Lodging	List: N/A List: N/A List: N/A List: N/A
Identified Hazards/Blocked Roads: ☐ School crossings ☐ High accident frequency ☐ Busy Intersections ☐ Road restriction I.e. Height Limit (underpass,tunnel, etc.), Weight Limit (bridge maximum weight etc.) and Width Limit (bridge etc.) ☐ Others	List: N/A List: HILLY >10% List: N/A List: N/A List: KAWASAN PERKAMPUNGAN, KAWASAN SEKOLAH, HOSPITAL,

HIGH RISK ROUTE (SBFT → KUDAT/PITAS)



SEGMENT 2: MULA (SK PEKAN TENGHILAN) → AKHIR (SIMPANG CURCH KG KELAWAT) (5.6KM)			
Perincian	Peta laluan	Gambar	Speed Limit (KM/J)
6.2567735,116.3366158			40KM/J
6.2612918,116.3410728			40KM/J
6.2668947,116.3445313			40KM/J

ACTIVITY/AREA: Road Tanker delivery to Commercial/Retail customers/ Delivery via hilly route												
NO	HAZARD	THREAT	BARRIERS	TOP EVENT	CONSEQUENCES	INITIAL RISK				MITIGATION MEASURES	PREVENTIVE MEASURES	FINAL RISK
						P	A	E	R			
1	A laden RT climbing on a steep hilly road to customer delivery.	• Steep hilly (> 10 deg) • Slippery road during raining season • Bad weather/ lightning • Narrow road shoulder without any rollover breaker.	• Effective PDC (Road tanker inspection) • Effective PTD (Driver Inspection) • Defensive Driving Technique	• RT brake malfunction while climbing, lost control and roll over downhill, hit another heavy vehicles and fell into abyss.	• RT total damaged • Multiple fatalities to RKP and 3rd party • Major Spillage	D 5	D 5	D 4	D 4	• Standby Emergency response Plan by hauler • Roll over breaker at road shoulder	• Only Fit/road worthy RT able to climb steep road • Trained/experie need RKP • No delivery during bad weather • Effective PDC process • RT safety devices during climbing ie; Traction Controller • Only max 16KL max load to deliver	C4 (Medium)

ACTIVITY/AREA: Road Tanker delivery to Commercial/Retail customers/ Delivery via hilly route												
NO	HAZARD	THREAT	BARRIERS	TOP EVENT	CONSEQUENCES	INITIAL RISK				MITIGATION MEASURES	PREVENTIVE MEASURES	FINAL RISK
						P	A	E	R			
1	A laden RT climbing on a steep hilly road to customer delivery.	• Steep hilly (> 10 deg) • Slippery road during raining season • Bad weather/ lightning • Narrow road shoulder without any rollover breaker.	• Effective PDC (Road tanker inspection) • Effective PTD (Driver Inspection) • Defensive Driving Technique	• RT brake malfunction while climbing, lost control and roll over downhill, hit another heavy vehicles and fell into abyss.	• RT total damaged • Multiple fatalities to RKP and 3rd party • Major Spillage	D 5	D 5	D 4	D 4	• Standby Emergency response Plan by hauler • Roll over breaker at road shoulder	• Only Fit/road worthy RT able to climb steep road • Trained/experie need RKP • No delivery during bad weather • Effective PDC process • RT safety devices during climbing ie; Traction Controller • Only max 16KL max load to deliver	C4 (Medium)

Journey Management Plan

Hauler: **KOTAMAS OIL SDN BHD**

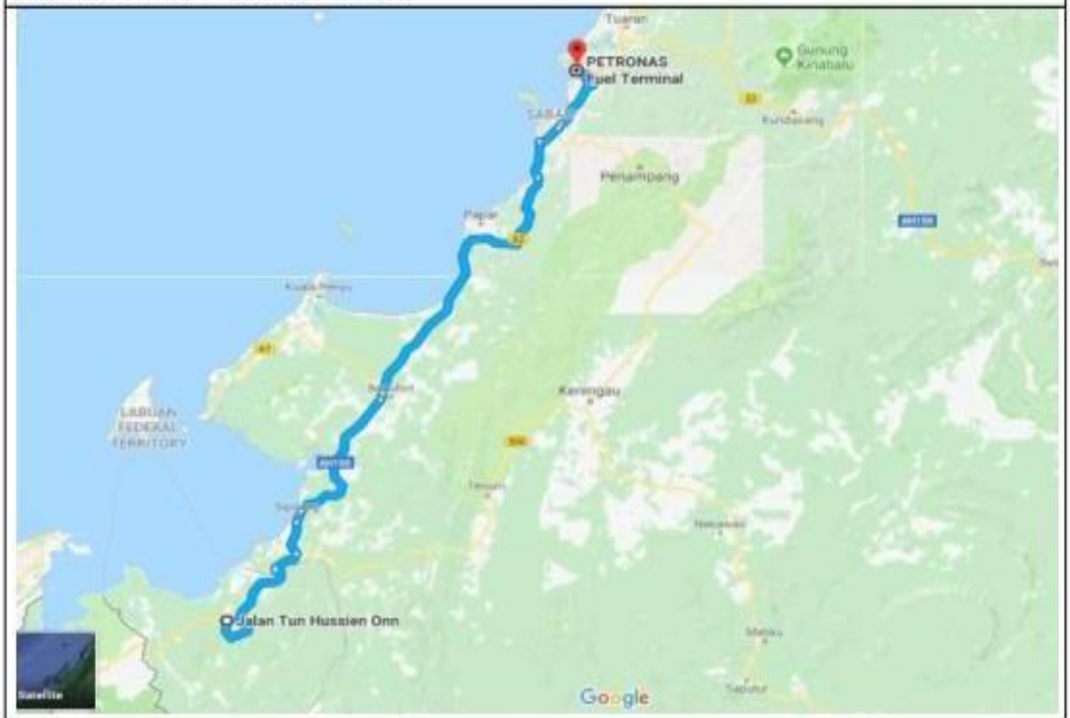
Journey from:**SBFT** to:**LAWAS**

Via which location/s:
SBFT – BEAUFORT - LAWAS

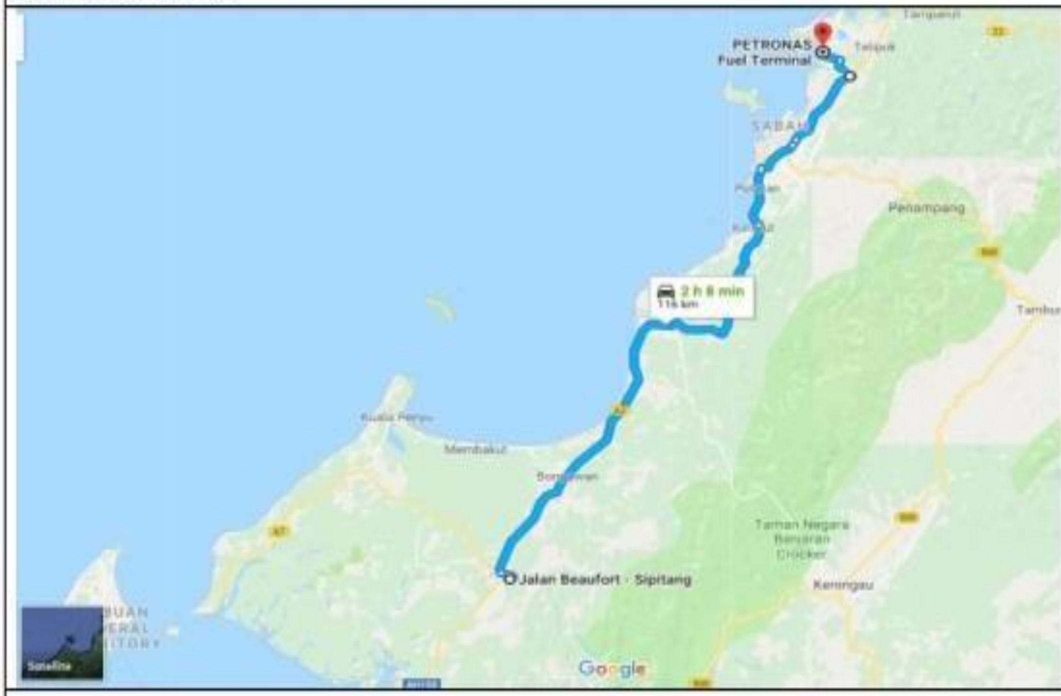
Estimated distance:**368Km**Estimated driving time: **9Hours 15 Minutes**

		Activity Duration (Hours) Day 1						
Activity & Location	**Remark**		**Drive**	**Loading**	**Rest**	**Offloading**	**Others**	**TOTAL Working Hours**
Start (Clock in) Kosb Kk Parking Base PDC, Toolbox		1.0						1.0
Driving To SBFT			0.25					0.25
Loading at SBFT				1.0				1.0
SBFT to Rest Area Lumat Centre (Beaufort)			2.5		0:5			3.0
Rest Area Lumat Centre (Beaufort) to Lawas			2.0					2.0
Offloading at customer					0.5	1.0		1.5
Lawas To Rest Area Lumat Centre (Beaufort)			2.0		0.5			2.5
Rest Area Lumat Centre (Beaufort) To P.Base			2.5					2.5
Total		**1.0**	**9.25**	**1.0**	**1.5**	**1.0**		**13.75**

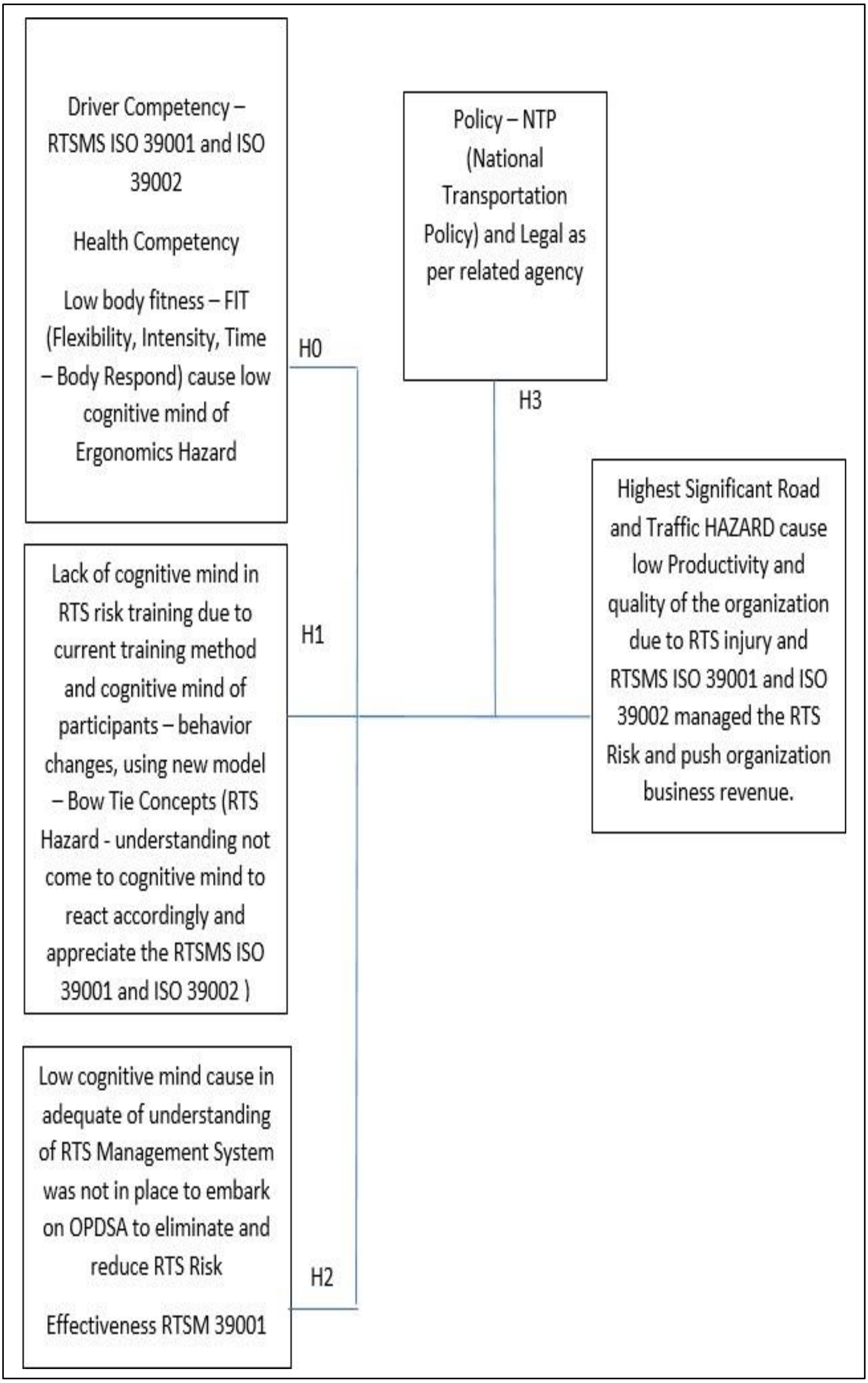
Primary Route/s – SBFT to Lawas

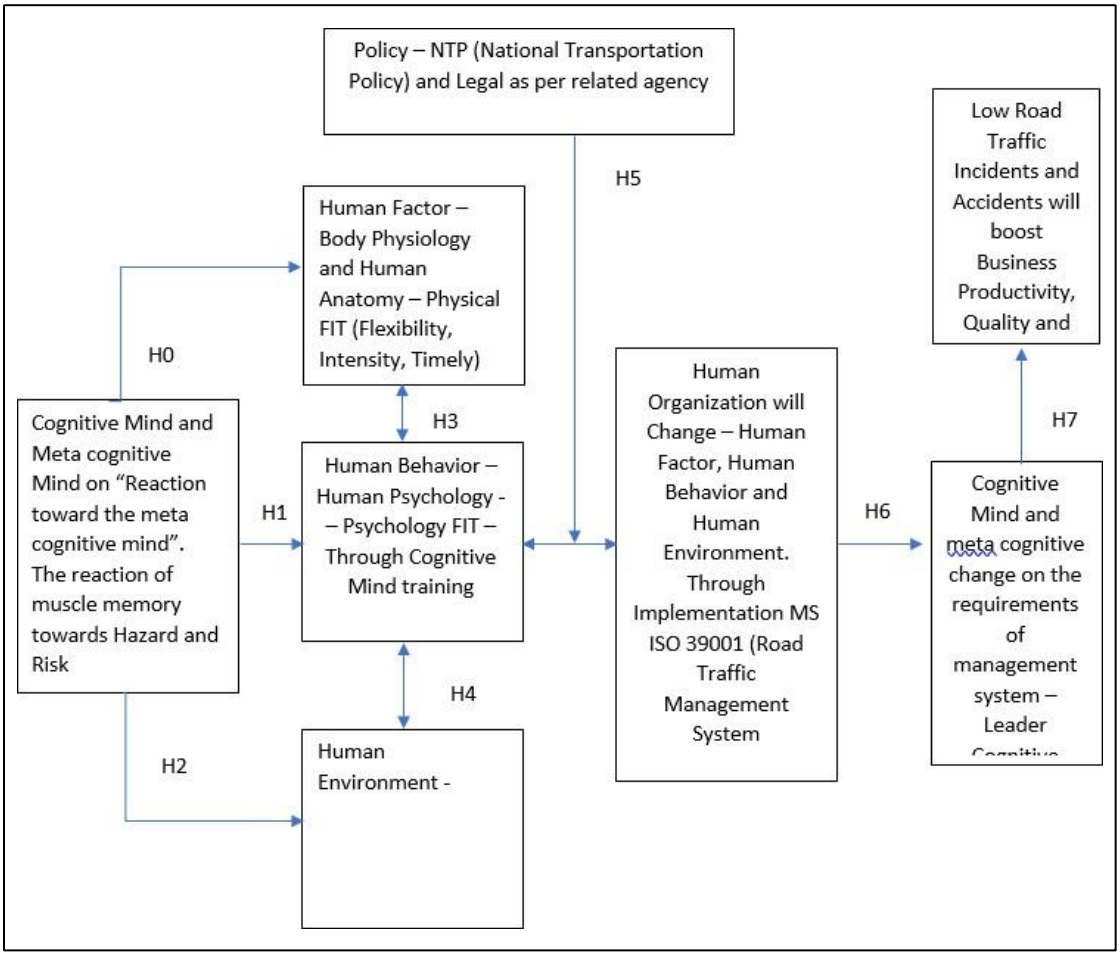


SBFT to Beaufort



Beaufort to Lawas


Driver Competency – RTSMS ISO 39001 and ISO 39002
Health Competency
Low body fitness – FIT (Flexibility, Intensity, Time – Body Respond) cause low cognitive mind of Ergonomics Hazard
Policy – NTP (National Transportation Policy) and Legal as per related agency
H0
H3
Highest Significant Road and Traffic HAZARD cause low Productivity and quality of the organization due to RTS injury and RTSMS ISO 39001 and ISO 39002 managed the RTS Risk and push organization business revenue.
Lack of cognitive mind in RTS risk training due to current training method and cognitive mind of participants – behavior changes, using new model – Bow Tie Concepts (RTS Hazard - understanding not come to cognitive mind to react accordingly and appreciate the RTSMS ISO 39001 and ISO 39002)
H1
Low cognitive mind cause in adequate of understanding of RTS Management System was not in place to embark on OPDSA to eliminate and reduce RTS Risk
Effectiveness RTSM 39001
H2



Ho = Cognitive mind has a significant positive impact on driver human factor competency (Physical F.I.T)

H1 = Failure of cognitive mind's negative impact on driver human behaviour (Psychology F.I.T)

H2 = Environmental hazard and failure of the environmental surroundings

(a). Ho = Competency under RTSMS 39001 and ISO 39002 will affect the Ergonomic Hazard, such as low body flexibility, low intensity (cardiovascular) and slow respond rate by body mechanism and fatigue to respond of time, therefore it causes danger to driver and road user create high risk situation to contact with hazard and causing Road Traffic accident.

Ho = RTSMS ISO 39001 competency significant impact on F.I.T (Flexible. Intensity. Timely)

(b). H1 = Lack of understanding in cognitive knowledge, skill, behavior and attributes in RTSMS ISO 39001 and ISO 39002 have significant impact in Functional

Level of Risk (Operational Risk, Managerial Risk, Top Management Risk and Policy Maker Risk) in the organization cause the business risk impact.

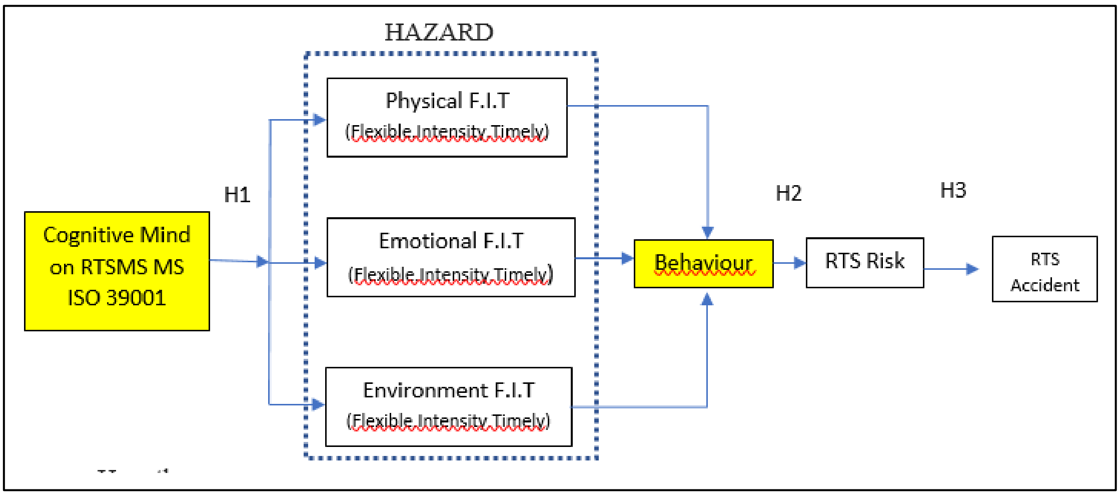
H1 = Cognitive understanding has positive significant impact to RTS Risk

H2 = The ISO 39001 and ISO 39002 Road Traffic Safety management system in places to sustain the human safety and health, to support the NTP (National Transportation Policy) and world SDG (Sustainability Development Goal) in controlling the risk of Industry using the Road and Traffic.

H2 = RTSMS significant impact on implementation of NTP and SDG Implementation

H3 = Government involvement in ensuring management system ISO 39001 and ISO 39002 been implemented by industries players and internal and external stack holder in using the national policy and law from the related agency such as JPJ, MIROS, PDRM, JKJR, DSM, JKKP, JAS, NIOSH and CIDB

H3 = Initiative from related agency positively giving significant impact on implementation of RTSMS in Malaysia



Hypotheses:

Hypothesis 1: F.I.T (Flexible. Intensity. Timely) on Physical, Emotional and Environment of road traffic user have significant impact on cognitive mind on RTSMS

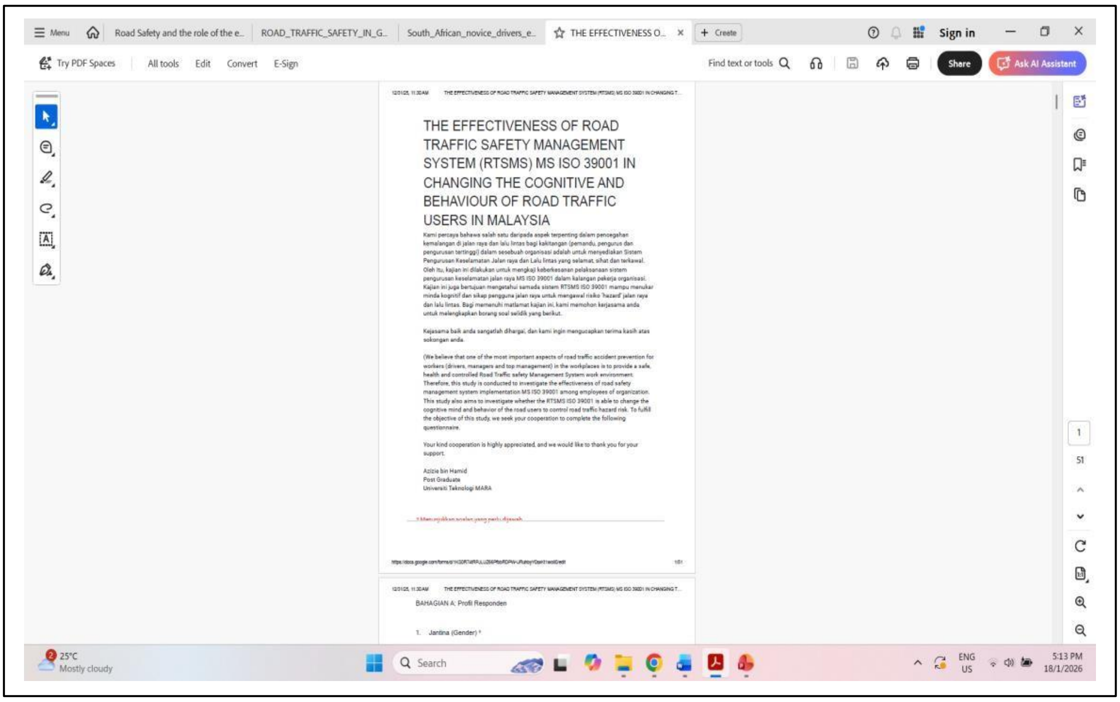
Hypothesis 2: Driver behavior, and RTS Risk have positive significant impact

to Cognitive understanding on RTS Hazard

Hypothesis 3: Control Road traffic safety accident give positive significant impact on cognitive mind

APPENDIX 2

Table of P



THE EFFECTIVENESS OF ROAD TRAFFIC SAFETY MANAGEMENT SYSTEM (RTSMS) MS ISO 39001 IN CHANGING THE COGNITIVE AND BEHAVIOUR OF ROAD TRAFFIC USERS IN MALAYSIA

Kami percaya bahawa salah satu daripada aspek terpenting dalam pencegahan kemalangan di jalan raya dan lalu lintas bagi kakitangan (pemandu, pengurus dan pengurusan tertinggi) dalam sesebuah organisasi adalah untuk menyediakan Sistem Pengurusan Keselamatan Jalan raya dan Lalu lintas yang selamat, sihat dan terkawal. Oleh itu, kajian ini dilakukan untuk mengkaji keberkesanan pelaksanaan sistem pengurusan keselamatan jalan raya MS ISO 39001 dalam kalangan pekerja organisasi. Kajian ini juga bertujuan mengetahui samada sistem RTSMS ISO 39001 mampu menukar minda kognitif dan sikap pengguna jalan raya untuk mengawal risiko 'hazard' jalan raya dan lalu lintas. Bagi memenuhi matlamat kajian ini, kami memohon kerjasama anda untuk melengkapkan borang soal selidik yang berikut.

Kejasama baik anda sangatlah dihargai, dan kami ingin mengucapkan terima kasih atas sokongan anda.

(We believe that one of the most important aspects of road traffic accident prevention for workers (drivers, managers and top management) in the workplaces is to provide a safe, health and controlled Road Traffic safety Management System work environment. Therefore, this study is conducted to investigate the effectiveness of road safety management system implementation MS ISO 39001 among employees of organization. This study also aims to investigate whether the RTSMS ISO 39001 is able to change the cognitive mind and behavior of the road users to control road traffic hazard risk. To fulfill the objective of this study, we seek your cooperation to complete the following questionnaire.

Your kind cooperation is highly appreciated, and we would like to thank you for your support.

Azizie bin Hamid
Post Graduate
Universiti Teknologi MARA

BAHAGIAN A: Profil Responden

1. Jantina (Gender) *

THE EFFECTIVENESS OF ROAD TRAFFIC SAFETY MANAGEMENT SYSTEM (RTSMS) MS ISO 39001 IN CHANGING THE COGNITIVE AND BEHAVIOUR OF ROAD TRAFFIC USERS IN MALAYSIA

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Azizie bin Hamid
Post Graduate
Universiti Teknologi MARA

BAHAGIAN A: Profil Responden

1. Jantina (Gender) *

   Tandakan satu bentuk bujur sahaja.

   - Lelaki (Male)
   - Perempuan (Female)

2. Umur (Age) *

   Tandakan satu bentuk bujur sahaja.

   - 20 - 30 tahun
   - 31 - 40 tahun
   - 41 - 50 tahun
   - 51 - 60 tahun
   - 61 - 70 tahun

3. Organisasi (Organization) *

   Tandakan satu bentuk bujur sahaja.

   - Kerajaan (Government)
   - Swasta (Private Sector)
   - Badan Berkanun (Statutory Body)
   - Bekerja Sendiri (Self Employed)
   - Lain - Lain (Others)

4. Tahap Pendidikan (Education Level) *

   Tandakan satu bentuk bujur sahaja.

   - Doktor Falsafah (PhD)
   - Sarjana (Master)
   - Sarjana Muda (Bachelor Degree)
   - Diploma (Diploma)
   - Lain - Lain (Others)

5. Pengalaman Kerja (Work Experience) *

Tandakan satu bentuk bujur sahaja.

- 1 hingga 5 tahun (1 to 5 years)
- 6 hingga 10 tahun (6 to 10 years)
- 11 hingga 15 tahun (11 to 15 years)
- 16 hingga 20 tahun (16 to 20 years)
- 21 tahun ke atas (More than 21 years)

6. Kawasan bekerja (Workstation Area) *

Tandakan satu bentuk bujur sahaja.

- Lembah Klang (Klang Valley)
- Putrajaya
- Luar Lembah Klang (Outside Klang Valley)
- Lain - Lain (Others)

7. Tempoh bekerja (Work Duration) *

Tandakan satu bentuk bujur sahaja.

- 8 jam (Normal hours)
- 2 shif (2 shift)
- 3 shif (3 shift)
- Fleksibel (Flexible hours)

8. Mempunyai pengalaman dalam latihan memandu (Have experience driving training) *

Tandakan satu bentuk bujur sahaja.

- Ya (Yes)
- Tidak (No)

9. Mempunyai pengalaman menghadiri Teknik Pemanduan (Have experience attending Safe Driving/Riding Technique) *

Tandakan satu bentuk bujur sahaja.

- Ya (Yes)
- Tidak (No)

10. Kekerapan memandu dalam seminggu (Frequency of driving within a week) *

Tandakan satu bentuk bujur sahaja.

- 7 hingga 10 kali (7 to 10 times)
- 11 hingga 15 kali (11 to 15 times)
- 16 hingga 20 kali (16 to 20 times)
- Lebih 21 kali (more than 21 times)

11. Anggaran batuan (kilometer) anda memandu ke tempat kerja (Estimated mileage of driving to workstation) *

Tandakan satu bentuk bujur sahaja.

- Bawah 10km (Below 10 km)
- 11 hingga 30km (11 to 30km)
- 31 hingga 50km (31 to 50km)
- 51 hingga 70km (51 to 70km)
- Lebih 70km (More than 70km)

BAHAGIAN B: Kognitif terhadap Sistem Pengurusan Keselamatan Jalan Raya dan Traffic- ISO 39001 / Part B: Cognitive on Road Traffic Safety Management System (RTMS) – ISO 39001

Bahagian ini bertujuan untuk mengenal pasti tahap kognitif terhadap RTMS ISO 39001 dan keberkesanannya menukar sikap di tempat kerja/organisasi.
(This part intends to identify the cognitive level of RTSMS and its effectiveness in changing road user behavior in the workplace/organization)

Skala Likert / Likert Scale

1 = Sangat Tidak Setuju / Strongly Disagree
2 = Tidak Setuju / Disagree
3 = Kurang Setuju / Slightly Disagree
4 = Neutral / Neither Disagree nor Agree
5 = Agak Setuju / Slightly Agree
6 = Setuju / Agree
7 = Sangat Setuju / Strongly Agree

B1. Adakah pekerja diberikan latihan Sistem Pengurusan Keselamatan Jalan Raya dan Lalu lintas yang berkaitan dengan skop kerja mereka?. (Are employees given RTSMS training related to their job scope?). *

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B2. Adakah semua pekerja baharu diberi latihan secukupnya berkaitan Hazard dan Risiko Jalan Raya dan lalulintas?. (Are all new employees given adequate training on Road Traffic Risk and Hazard?). *

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B3. Pihak Pengurusan mempunyai pengetahuan dalam kognitif mind di dalam minda Hazard Kognitif berkaitan RTSMS?. (Are the management personnel knowledgeable in cognitive mind related to RTSMS?). *

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B4. Adakah pihak syarikat memberikan pengawasan dan pemantauan yang mencukupi terhadap pekerja dalam melaksanakan RTSMS di organisasi anda?. (Does the company provide sufficient supervision and monitoring of workers in implementing RTSMS in your organization?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B5. Adakah pelaksanaan RTSMS dapat menukar kognitif dan sikap pengguna jalanraya bagi menurunkan kadar kemalangan jalan raya di Malaysia?. (Will the RTSMS implementation change the road user cognitive and behavior to reduce road traffic accidents in Malaysia?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B6. Adakah tanggungjawab sebagai pemberi nafkah kepada keluarga mempengaruhi sikap pemandu di jalanraya?. (Does the responsibility as a breadwinner to the family influence the attitude of the driver on the road?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B7. Adakah sikap mementingkan diri sendiri mempengaruhi sikap pemandu di jalanraya?. (Does selfishness influence the driver behavior on the road?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B8. Adakah masalah penumpuan ketika memandu boleh mempengaruhi sikap pemandu di jalanraya?. (Is the driver behavior on the rod affected by distraction problem while driving?.

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B9. Adakah selalu berasa penat, pening dan kurang bertenaga boleh mempengaruhi sikap pemandu?. (Is the driver behavior on the road affected by fatigue, dizziness and lack of energy?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B10. Adakah sikap pemarah dan tidak sabar boleh mempengaruhi sikap pemandu di jalanraya?. (Does irritability and impatience affect driver behavior on the road?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B11. Adakah ketika memandu adakalanya pemandu tidak perasan terhadap lambang lalulintas?. (Does the driver sometimes not pay attention to traffic signs while driving?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B12. Adakah tidak cukup rehat di rumah boleh mempengaruhi sikap pemandu?. (Is the driver behavior on the road affected by lack of rest at home?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San								Sangat Setuju / Strongly Agree

B13. Adakah sukar tidur mempengaruhi sikap pemandu?. (Is the driver behavior on the road affected by difficulty to sleep?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San								Sangat Setuju / Strongly Agree

B14. Adakah pemandu boleh tertidur ketika memandu?. (Behaviour)(Is the driver may fall asleep while driving?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San								Sangat Setuju / Strongly Agree

B15. Adakah pemandu memikirkan perkara atau masalah lain ketika memandu?. (Does the driver distracted by other matters and problem while driving?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San								Sangat Setuju / Strongly Agree

B16. Adakah pemandu terganggu oleh aktiviti yang lain semasa memandu?. (Is the driver distracted by other activities while driving?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B17. Adakah masalah penglihatan boleh mempengaruhi sikap pemandu?. (Risk, Cognitive, Behaviour)(Is the driver behavior on the road affected by vision (eyesight problem)?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B18. Adakah masalah penglihatan di malam hari boleh mempengaruhi sikap pemandu?. (Is the driver behavior on the road affected by night vision (seeing at night) problem?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B19. Adakah masalah pendengaran boleh mempengaruhi sikap pemandu?. (Cognitive Risk)(Is the driver behavior on the road affected by hearing problem?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B20. Adakah kesukaran bekerja dengan segelintir rakan sekerja boleh mempengaruhi sikap pemandu?. (Is the driver behavior on the road affected by issues with colleagues?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B21. Adakah kesukaran bergaul dengan rakan sekerja boleh mempengaruhi sikap pemandu?. (Is the driver behavior on the road affected by difficulty to get with some colleagues?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B22. Adakah kesukaran bergaul dengan penyelia boleh mempengaruhi sikap pemandu?. (Is the driver behavior on the road affected by difficulty to get along with supervisor?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B23. Adakah ketiadaan lesen memandu yang sah boleh mempengaruhi sikap pemandu?. Cognitive Behavior (Does the absence of a valid driving license affect the driver behavior?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B24. Adakah tiada keyakinan dalam pemanduan boleh mempengaruhi sikap pemandu?. Cognitive Behavior (Is lack of confidence in driving affect the driver behavior on the road?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B23. Adakah ketiadaan lesen memandu yang sah boleh mempengaruhi sikap pemandu?. Cognitive Behavior (Does the absence of a valid driving license affect the driver behavior?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B25. Adakah masalah kesihatan mempengaruhi sikap pemandu?. (Is health issue affect the driver behavior on the road?). *

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B26. Adakah masalah darah tinggi mempengaruhi sikap pemandu?. (Is high blood pressure affect the driver behavior?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B27. Adakah dengan tidak membuat pemeriksaan kesihatan boleh mempengaruhi sikap pemandu?. (Is the driver behavior on the road affected by not having a health checkup?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B28. Adakah pemeriksaan mata yang dilakukan pada tiga tahun lepas boleh mempengaruhi sikap pemandu?. (Is the driver behavior on the road affected by eye examination performed in the previous three years?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B29. Adakah mengalami sebanyak satu atau dua kali kemalangan kecil di jalanraya boleh mempengaruhi sikap pemandu?. (Is the driver behavior on the road affected by minor accident experienced?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B30. Adakah mengalami kemalangan besar sebanyak satu atau dua kali boleh mempengaruhi sikap pemandu?. (Does one or two major accidents affect the driver behavior?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B31. Adakah dengan tidak perlu membuat laporan kemalangan kepada syarikat ianya boleh mempengaruhi sikap pemamdu?. Cognitive - deviant (If an accident is not reported to the company, will it affect the driver behavior?)

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B32. Adakah dengan melihat kemalangan kecil sebanyak satu atau dua kali boleh mempengaruhi sikap pemandu?. (Does seeing one or two minor road accidents will affect the driver behavior?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B33. Adakah dengan tidak melapor kemalangan jalan raya dan lalulintas tersebut mempengaruhi sikap pemandu?. (If the Road Trafficf accident is not reported to the company, will it affect the driver behavior?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B34. Adakah kefahaman terhadap papan tanda di jalanraya boleh mempengaruhi sikap pemandu?. Cognitive Risk (Is the driver behavior affected by misunderstanding of road signage?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B35. Adakah pemanduan pemandu lain secara perlahan mempengaruhi sikap pemandu?. (Is the driver behavior affected by other drivers driving slowly?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B36. Adakah sistem lalu lintas yang tidak lancar di Malaysia mempengaruhi sikap pemandu?. Cognitive Management System (Does the poor traffic system in Malaysia affect the driver behavior?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B37. Adakah Road Tracffic Safety Management System -ISO 39001 di Malaysia boleh mengubah sikap pemandu syarikat?. Does the Road Traffic Safety Management System – ISO 39001 in Malaysia can change the behavior of the company driver?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B38. Adakah cara pengunduran kenderaan yang tidak betul dan tidak selamat boleh mempengaruhi sikap pemandu?. Cognitive Behavior(Does improper and unsafe vehicle reversing affect the driver behavior?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B39. Adakah sikap terlupa memberi isyarat kenderaan boleh mempengaruhi sikap pemandu?. Cognitive Behavior(Does the attitude of forgetting to give signals from vehicle affect the driver behaviour?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B40. Adakah tidak memberi signal kenderaan boleh mempengaruhi sikap pemandu?. Cognitive Behavior(Does the attitude of not giving signals from vehicle affect the driver behavior?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B41. Adakah tali pinggang keselamatan yang dipakai ketika kehadiran penyelia sahaja boleh mempengaruhi sikap pemandu?. Cognitive Behavior(Does wearing seat belt when the supervisor is present affect the driver behavior?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B42. Adakah ketiadaan aduan terhadap cara pemanduan boleh mempengaruhi sikap pemandu?. (Does the absence of complaints against driving manner affect the driver behavior?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B43. Adakah aduan yang dibuat terhadap pemandu lain boleh mempengaruhi sikap pemandu?. Cognitive behavior(Are complaints made against other drivers affect the driver's behavior?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B44. Adakah kekurangan kemahiran untuk menukar gear kenderaan dengan betul boleh mempengaruhi sikap pemandu?. Cognitive Behavior (Does lack of skills to change vehicle gears properly affect the driver behavior?)

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B45. Adakah masalah pengguna jalanraya yang lain mempengaruhi sikap pemandu?. Cognitive Behavior(Do other road user problems affect the driver behavior?.

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B46. Adakah sikap penyelia yang tidak mengambil berat mengenai keselamatan mempengaruhi sikap pemandu?. Cognitive Behavior(Does lack of concern from immediate supervisor on safely issue affect the driver behavior?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B47. Adakah penyelenggaraan kenderaan syarikat yang tidak sempurna boleh mempengaruhi sikap pemandu?. Cognitive Behavior(Does improper maintenance of company vehicles affect the driver behavior?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B48. Adakah dengan tidak memberi laluan kepada orang lain mempengaruhi sikap pemandu?. Cognitive Behavior(Does the attitude of not giving way to others affect the driver behavior?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B49. Adakah tidak memeriksa kenderaan sebelum memulakan perjalanan mempengaruhi sikap pemandu?. Cognitive Behavior(Does the vehicle not inspected before starting the trip affect the driver behavior?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

B50. Adakah pengetahuan yang kurang terhadap bahagian kenderaan yang perlu diperiksa boleh mempengaruhi sikap pemandu? – Cognitive Behavior(Does the lack of knowledge of the vehicle parts to be inspected affect the driver behavior?)

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

BAHAGIAN C: Masalah Am Yang Dihadapi Oleh Organisasi Di Dalam Proses Pelaksanaan RTSMS – ISO 39001 / Part C: General problem(s) encountered by organization in the implementation of RTSMS.

Skala Likert / Likert Scale

1 = Sangat Tidak Setuju / Strongly Disagree
2 = Tidak Setuju / Disagree
3 = Kurang Setuju / Slightly Disagree
4 = Neutral / Neither Disagree nor Agree
5 = Agak Setuju / Slightly Agree
6 = Setuju / Agree
7 = Sangat Setuju / Strongly Agree

C1. Kakitangan organisasi menerima dengan baik pelaksanaan sistem pengurusa jalan raya dan lalu lintas. (Organizational employees embrace the implementation of RTSMS in the organization?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

C2. Pelaksanaan dasar RTSMS mengubah proses dalaman organisasi bagi membentuk kognitif dan sikap peka terhadap risiko kemalangan jalan raya di dala organisasi?. (The implementation of RTSMS policy changes the internal processe of the organization to construct the cognitive and sensitivity to the risk of road accidents in the organization?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

C3. Kakitangan pengurusan dan semua pihak berkepentingan mengambil bahagian dalam memastikan kejayaan pelaksanaan RTSMS dalam organisasi. (The management personnel and all stakeholders are taking part in ensuring the successful implementation of RTSMS in the organization).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

C4. Pihak syarikat menyediakan belanjawan yang mencukupi bagi pelaksanaan RTSMS dalam organisasi. (The company provides sufficient budget for implementation purpose in the organization).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

C5. Pelaksanaan RTSMS yang efektif dapat mengekalkan kognitif dan sikap posit pihak berkepentingan dalam memastikan pengurangan kemalangan jalanraya di Malaysia dan menyumbang kepada kelestarian dunia. (The effective implementation of RTSMS can sustain the positive cognitive and behavior of stakeholder in ensuring the reduction of road traffic accidents in Malaysia and contribute to world sustainability).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

BAHAGIAN D: Bagaimana Road Traffic Safety Management System (RTSMS) Iso 3900
Dapat Mempengaruhi Perubahan Tingkah Laku Pengguna Jalan Raya Dalam Organisas
Part D: How RTSMS can affect the behavior changes of road user in the organization

Skala Likert / Likert Scale

1 = Sangat Tidak Setuju / Strongly Disagree
2 = Tidak Setuju / Disagree
3 = Kurang Setuju / Slightly Disagree
4 = Neutral / Neither Disagree nor Agree
5 = Agak Setuju / Slightly Agree
6 = Setuju / Agree
7 = Sangat Setuju / Strongly Agree

D1. Pelaksanaan proses dalaman RTSMS seperti manual, prosedur dan SOP RTSMS dapat mengubah kognitif dan tingkah laku pengguna jalan raya dalam organisasi. (The implementation of RTSMS internal processes such as RTSMS manual, procedure and SOP can change cognitive and behavior of road user in th organization).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

D2. Pelaksanaan RTSMS dalam organisasi dapat membentuk kognitif dan sikap peka terhadap risiko kemalangan jalan raya dan mendorong kepada pemanduan lebih berhemah serta mengamalkan kaedah pemanduan yang lebih selamat. (The implementation of RTSMS in the organization can develop cognitive and sensitivity to the risk of road accidents and lead more to prudent driving as well as adopting safer driving method).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

D3. Pelaksanaan RTSMS dapat meningkatkan kepercayaan pihak operasi kepada pihak pengurusan dan pihak berkepentingan dalam membentuk satu struktur sosia yang lebih baik, harmoni dan bermotivasi. (The implementation of RTSMS can enhance the trust of operations to management and stakeholders together in shaping a better, harmonious an motivated social structure).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

D4. Pelaksanaan RTSMS akan mengubah sikap pemandu kepada lebih proaktif dan bermotivasi kerana bilangan pemandu yang mencukupi, kenderaan yang selamat dan tiada waktu kerja yang panjang yang menyebabkan keletihan dari "Prolong driving". (The RTSMS implementation can change the driver attitude to be more proactive and motivated due to sufficient drivers, safe vehicles and no long working hours that cause fatigue from prolong driving).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

D5. Pelaksanaan RTSMS yang efektif dapat mengekalkan kognitif positif dan sikap positif pihak berkepentingan untuk mematuhi semua keperluan perundangan dan sosial. (Effective implementation of RTSMS can maintain positive cognitive and attitudes of stakeholders to comply with all legal and social requirements).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

BAHAGIAN E: RTSMS ISO 39001 Mengatasi Masalah Yang Dihadapi Oleh Organisasi Dalam Mematuhi Keperluan Perundangan Dan Sosial / Part E: RTSMS ISO 39001 overcomes problem(s) encountered by organization in compliance with legislation and social requirements.

Skala Likert / Likert Scale
1 = Sangat Tidak Setuju / Strongly Disagree
2 = Tidak Setuju / Disagree
3 = Kurang Setuju / Slightly Disagree
4 = Neutral / Neither Disagree nor Agree
5 = Agak Setuju / Slightly Agree
6 = Setuju / Agree
7 = Sangat Setuju / Strongly Agree

E1. Adakah pelaksanaan RTSMS mematuhi keperluan undang-undang seperti Akta Pengangkutan Jalan 1987 dan kontrak sosial manusia dalam organisasi?. (Is the implementation of RTSMS comply with the legal requirement such as Road Transport Act 1987 and the human social contract in the organization?).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

E2. Perilaku “devian” boleh menyebabkan berlakunya jenayah seperti di bawah seksyen 40, 41, 42, 43, 44 and 45, “Road Transport Act 1987” maka implementasi dan komunikasi yang berkesanan di dalam organisasi di dalam mengelakkan perilaku devian dan masalah sosial. (Deviant behavior can lead to crime under Sections 40, 41, 43, 44 and 45, and Road Transport Act 1987. Thus, effective implementation and communication in organizations can prevent deviant behavior and social problems).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

E3. Pelaksanaan RTSMS dapat menyumbang kepada kepatuhan dan kesesuaian semua peralatan keselamatan yang diperlukan di dalam kenderan. (The implementation of RTSMS can contribute to the compliance and conformances of all safety equipment needed in the vehicle).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

E4. Pelaksanaan proses audit dalaman dan pihak ketiga oleh badan pensijilan dalam mengesahkan pelaksanaan RTSMS dapat meningkatkan reputasi dan kepercayaan pihak berkepentingan dalam mengendalikan risiko RTS (Road Traffic Safety). (The implementation of internal audit and 3rd party audit by certification bodies in confirming the RTSMS implementation can increase the reputation and confident level of stakeholders in controlling the RTS (Road Traffic Safety) risk).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

E5. Pematuhan kepada kehendak undang-undang dan sosial bagi RTSMS di sesebuah organisasi dapat memupuk sikap dan minda kognitif positif dan membantu pihak organisasi meningkatkan pendapatan serta menurunkan kadar kemalangan jalan raya negara. (Compliance to legal and social requirements of RTSMS in an organization can foster positive cognitive mind and behavior and hel the organization increase revenue and reduce national road accident rates).

Tandakan satu bentuk bujur sahaja.

	1	2	3	4	5	6	7	
San	◯	◯	◯	◯	◯	◯	◯	Sangat Setuju / Strongly Agree

AUTHOR'S PROFILE

Cpt (CD). Ts. Azizie Bin Hamid obtained a degree in OSH and Social Science from UKM and brings 23 years of hands-on excellence across technical implementation, strategic consulting, targeted training, and dynamic leadership in Governance, Integrity, Compliance, Human Capital and Resources, Safety, Health and Environment (HS&E), Electrical, Automation, and Engineering Instrumentation. His career spans in government sector, government-linked corporations, private sector organisations, associations, and a roster of globally recognised multinationals, including GE Water & Process Technologies (USA), Hager (Germany), DRB-HICOM, Daifuku (Japan), the Human Resources Ministry, NIOSH Malaysia, NIOSH Certification, and Telekom Malaysia. A proven, field-tested professional, he combines deep hands-on industrial life experience with rigorous technical expertise. He has actively designed, installed, commissioned, and maintained complex systems in real-world plants and facilities, translating theoretical concepts into reliable, safe, and efficient operations. This practical background underpins his ability to diagnose issues on the shop floor, implement robust control measures, and drive sustained improvements in performance, reliability, and compliance. As a recognised Lead Auditor for ISO management systems, he brings proven, practical mastery across multiple standards such as ISO 45001, ISO 9001, ISO 14001, ISO 39001, and ISO 37001 plus related frameworks. His technical breadth spans in field of electrical, automation, instrumentation, process control, and safety systems, enabling him to bridge the gap between compliance requirements and actionable, field-ready solutions.

LIST OF PUBLICATION

Hamid, Azizie Bin, Nuryantizpura Ahmad Rais, and Wan Mazlina Wan Mohamed. "Evaluating the Impact of RTSMS ISO 39001 on Cognitive and Behavioural Change Among Institutional Road Users: Evidence from a Malaysian Safety Agency." Journal of Business & Economics Review (JBER) 10.4 (2026).