



Evaluating the Impact of RTSMS ISO 39001 on Cognitive and Behavioural Change Among Institutional Road Users: Evidence from a Malaysian Safety Agency



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ABSTRACT

Objective – This study examines the impact of the Road Traffic Safety Management System (RTSMS) ISO 39001:2013 on changing the cognitive and behavioural patterns of road users within an institutional setting.

Methodology – Using a case study of a national occupational safety agency in Malaysia, the research investigates whether the implementation of RTSMS significantly influences cognitive awareness and road-user behaviour. Data were collected from 57 respondents across 17 regional offices using an adapted Driver Behaviour Questionnaire (DBQ) and Driver Skill Inventory (DSI). Structural Equation Modelling (SEM) was applied to test three hypotheses.

Findings – The analysis confirmed all hypotheses at a high level of significance ($p < 0.000$), with the strongest influence on the relationship between cognitive changes and RTSMS implementation ($\beta = 0.955$, $R^2 = 0.910$).

Novelty – The findings reinforce RTSMS as a systems-based intervention capable of reshaping road safety behaviour in organizations. This study contributes to the policy discourse by highlighting the potential for behavioural transformation through the implementation of structured RTSMS.

Type of Paper: Empirical

JEL Classification: R40, R41, R42.

Keywords: RTSMS, ISO 39001, road safety, cognitive behaviour, institutional safety, structural equation modelling, Malaysia

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1. Introduction

Malaysia has long grappled with high rates of road traffic accidents (RTAs), consistently recording more than 6,000 road deaths annually despite various safety campaigns and regulations. The country's growing vehicle population and complex road environments have intensified the demand for innovative approaches to road safety. While legislative and enforcement mechanisms have been widely deployed, behavioural and cognitive factors among road users remain under-addressed.

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Recognizing the limitations of punitive measures alone, the Road Traffic Safety Management System (RTSMS) (ISO, 2023) 39001 was introduced to provide a structured, systemic approach to improving road safety outcomes. This research investigates whether the implementation of RTSMS ISO 39001 within a Malaysian government-linked occupational safety agency has significantly altered the cognitive orientation and behavioural responses of its staff who operate as institutional road users. The study posits that beyond compliance, RTSMS fosters deeper changes in how road users perceive risks and make safety-related decisions.

2. Literature Review

Existing literature identifies human error as the dominant cause of road traffic incidents, accounting for over 80% of crashes. Cognitive factors, such as attention, decision-making, and risk perception, are now recognized as critical components in shaping drivers' behaviour. Theoretical foundations, including Heinrich's Domino Theory, the Loss Causation Model, Reason's Model of System Safety, and Bandura's Social Cognitive Theory, collectively underscore the importance of addressing cognitive patterns and systemic influences in safety interventions.

ISO 39001 promotes a risk-based, continuous-improvement model for institutionalizing road safety. While previous research has documented its operational benefits, less attention has been given to its psychological and behavioural effects. This study addresses this gap by empirically testing how the implementation of RTSMS influences cognitive-behavioural outcomes in a structured organizational context. Road safety has evolved into a multidisciplinary concern encompassing engineering, enforcement, education, and behaviour change. Among the four pillars, behavioural and cognitive transformation has recently attracted scholarly attention as crucial for complementing regulatory interventions. According to the World Health Organization (WHO), human error remains the leading contributor to road crashes globally, with risk perception, decision-making errors, and inattention as major cognitive factors. Numerous studies highlight the importance of cognitive-behavioural theories in road safety research. Heinrich's Domino Theory (1931) emphasizes the sequential nature of accident causation and the pivotal role of human error, while Bird and Germain's Loss Causation Model (1985) extends this by incorporating organizational influences. Reason's Model of System Safety (1997) introduces the concept of latent conditions and system-level vulnerabilities, suggesting that accidents are rarely the result of a single failure. Bandura's Social Cognitive Theory (1977) underlines the interaction between personal cognitive factors, environmental influences, and behaviour, proposing that learning and adaptation occur through observation and feedback within a social context.

RTSMS ISO 39001 builds on such theoretical underpinnings by offering a framework that integrates risk management, continual improvement, and safety leadership into daily operations. ISO 39001 is not limited to infrastructure or enforcement; it places substantial emphasis on how organizations manage road safety risks through structured policies, objectives, and audits. Recent studies, including those by Iwaro & Mwashia (2012), have linked ISO certification with improved organizational behaviour and performance, although empirical evidence linking RTSMS with individual cognitive or behavioural change remains limited. Additionally, the use of validated psychological instruments such as the Driver Behaviour Questionnaire (DBQ) and the Driver Skill Inventory (DSI) has been instrumental in diagnosing behavioural patterns. Studies using DBQ have revealed strong correlations between aberrant driving behaviour and crash risk, whereas DSI assesses skill-related self-perceptions, offering insight into overconfidence and misjudgments.

Despite these advancements, the literature on how the RTSMS ISO 39001 specifically affects individual cognition and behaviour within organizational settings remains sparse. This study fills that gap by evaluating how the RTSMS framework interacts with personal safety cognition and routine behaviour among

institutional drivers. It also contributes to understanding how systemic interventions can lead to behavioural normalization and internalized risk perception

The study also reinforces core assumptions derived from Social Cognitive Theory, where behaviour change is achieved when individuals cognitively internalize risk-related feedback within a supportive environment. ISO 39001 creates such an environment by institutionalizing continual improvement, structured auditing, and risk-based thinking. This supports Reason's system-safety view that behavioural failures are symptoms of latent system deficiencies, therefore validating the role of RTSMS as a cognitive-behavioural preventive mechanism (Zhou & Wang, 2022) (Chen et al., 2023).

3. Research Methodology

A quantitative approach was employed, using a validated instrument that combined the Driver Behaviour Questionnaire (DBQ) and the Driver Skill Inventory (DSI). Data were collected from 57 staff members across 17 regional offices of the participating institution. Structural Equation Modelling (SEM) was used to test three core hypotheses concerning the relationships between RTSMS, cognitive change, and behavioural change. The selection of DBQ and DSI instruments aligns with validated international safety behaviour assessment frameworks, whereas SEM provides robust explanatory power for identifying latent behavioural structures. Details of item adaptation and translation procedures, as well as validity thresholds, are provided to ensure methodological transparency and replicability.

3.1 Reliability and Validity Analysis

To ensure measurement quality in the survey, reliability and validity analyses were conducted using Cronbach's Alpha and factor loadings derived from Structural Equation Modelling (SEM).

Table 1: Reliability Statistics (Cronbach's Alpha)

<i>Construct</i>	<i>Number of Items</i>	<i>Cronbach's Alpha</i>
<i>RTSMS Implementation</i>	6	0.912
<i>Cognitive Change</i>	5	0.894
<i>Behavioural Change</i>	6	0.879

All Cronbach's Alpha values exceed the threshold of 0.70, indicating strong internal consistency across constructs.

Table 2: Convergent Validity – Factor Loadings and AVE

CONSTRUCT	ITEM EXAMPLE	FACTOR LOADING	AVE
RTSMS IMPLEMENTATION	"My organization provides RTSMS training regularly."	0.84	0.68
COGNITIVE CHANGE	"I now assess driving risks more thoroughly."	0.86	0.72
BEHAVIOURAL CHANGE	"I have reduced use of mobile phones while driving."	0.81	0.66

All constructs show acceptable convergent validity with Average Variance Extracted (AVE) above 0.5 and factor loadings above 0.7.

Table 3: Discriminant Validity – Fornell-Larcker Criterion

<i>Construct</i>	<i>RTSMS Implementation</i>	<i>Cognitive Change</i>	<i>Behavioural Change</i>
<i>RTSMS Implementation</i>	0.82	0.66	0.60
<i>Cognitive Change</i>	0.66	0.85	0.64
<i>Behavioural Change</i>	0.60	0.64	0.81

Diagonal elements (square root of AVE) are greater than off-diagonal correlations, confirming discriminant validity.

These results collectively confirm that the instrument used in this study is both reliable and valid for assessing the effects of RTSMS ISO 39001 implementation on cognitive and behavioural changes among institutional road users.

Table 4: Hypotheses Testing Results

HYPOTHESIS	STRUCTURAL PATH	BETA	R²	P-VALUE	INTERPRETATION
H1	RTSMS → Cognitive & Behavioural Change	0.848	0.713	< 0.000	Supported: Strong influence of RTSMS
H2	Cognitive Change → Behavioural Change	0.621	0.373	< 0.000	Supported: Cognitive change impacts behaviour
H3	RTSMS → Cognitive Change	0.955	0.910	< 0.000	Supported: RTSMS strongly affects cognition

The analysis confirms that all hypothesized paths are statistically significant ($p < 0.000$), indicating strong model fit and explanatory power.

SEM analysis revealed significant relationships across all proposed paths:

H1: RTSMS implementation significantly influences cognitive and behavioural change ($\beta = 0.848$, $R^2 = 0.713$, $p < 0.000$).

H2: Cognitive change significantly influences behavioural change ($\beta = 0.621$, $R^2 = 0.373$, $p < 0.000$).

H3: RTSMS implementation significantly influences cognitive change ($\beta = 0.955$, $R^2 = 0.910$, $p < 0.000$).

4. Discussion

The results confirm that RTSMS ISO 39001 goes beyond compliance to facilitate substantive changes in how institutional drivers think and act. The strongest path—between RTSMS and cognitive change—suggests that the system serves as an effective cognitive restructuring tool, aligning personal awareness with organizational safety goals. This supports the broader shift from reactive to proactive safety cultures. The results confirm that RTSMS ISO 39001 goes beyond compliance to facilitate substantive changes in how institutional drivers think and act. The strongest path—between RTSMS and cognitive change—suggests that the system serves as an effective cognitive restructuring tool, aligning personal awareness with organizational safety goals. This supports the broader shift from reactive to proactive safety cultures.

These findings are consistent with previous research on ISO-based management systems and safety outcomes. For example, (Wu & Chen, 2021) found that ISO 14001 and OHSAS 18001 certifications were associated with a stronger safety climate and reduced incident rates among manufacturing workers in Taiwan. Similarly, research by (Madsen et al., 2020) showed that systematic implementation of ISO standards was positively associated with improvements in employee attitudes toward safety and accountability.

However, this study diverges by focusing on cognitive restructuring among institutional road users, a less commonly explored outcome. In contrast to enforcement-focused interventions such as those evaluated by (Elvik et al., 2009), which primarily assesses the impact of penalties or road design changes, this study emphasizes internal behavioural transformation. This aligns with Bandura's theory that sustainable behavioural change is driven not just by external control but by changes in belief systems, confidence, and awareness.

Thus, this study provides unique empirical evidence that RTSMS ISO 39001 can positively reshape internal safety cognition and behaviour, complement external regulatory efforts, and highlight the value of ISO 39001 as a behaviourally integrative tool.

Compared with previous applications of RTSMS, which have primarily focused on logistics fleets and large multinational organisations, this study demonstrates strong behavioural transformation even in a public institutional environment with limited vehicle exposure. This suggests scalability and adaptability of the RTSMS model across different operational settings, aligning with global calls for broader adoption in government service fleets where public road exposure remains significant.

RTSMS ISO 39001 as a Safety Culture and Governance Mechanism

Beyond individual behavioural compliance, the findings indicate that RTSMS ISO 39001 functions as an organisational mechanism for safety culture that systematically shapes shared norms, expectations, and accountability related to road use. The exceptionally strong relationship between RTSMS implementation and cognitive change suggests that structured management systems can influence how road users interpret risk, responsibility, and organisational values associated with mobility.

From a governance perspective, RTSMS aligns safety objectives with leadership oversight, internal audits, and continuous improvement cycles. This mirrors Reason's system safety model, where organisational structures either mitigate or amplify latent behavioural risks. By embedding safety considerations into planning, monitoring, and performance evaluation processes, RTSMS reduces reliance on individual vigilance alone and instead distributes responsibility across organisational systems.

Importantly, the institutional context of this study demonstrates that behavioural change does not require high-risk commercial fleet operations to be effective. Even within administrative or regulatory agencies, where driving may not be the primary job function, systematic safety governance can recalibrate everyday driving behaviour. This reinforces the argument that road safety culture must be treated as an organisational competency rather than an individual attribute.

These findings extend existing ISO-based safety literature by empirically demonstrating that RTSMS operates not merely as a compliance framework but as a behavioural governance tool capable of reshaping safety cognition across institutional settings.

Implication

Beyond improving cognitive awareness and behavioural compliance, the findings of this study suggest strategic opportunities for policy integration within national road safety governance. Government agencies may embed RTSMS ISO 39001 within existing safety culture models, such as Malaysia's Occupational Safety and Health Master Plan and the national Road Safety Strategy, to reinforce system-level behavioural accountability. The standard also provides a structured framework that private organizations, particularly in high-risk, vehicle-intensive sectors, can adopt to institutionalize safe driving as part of organizational performance.

Strong leadership commitment is essential to drive internalization of RTSMS principles. Top management must operationalize safety values through continuous communication, visible role-modelling, and strategic resource allocation. Leadership review mechanisms, as required in ISO 39001 audits, can serve as governance checkpoints that ensure the long-term retention of staff behaviours.

In addition, the implementation of RTSMS can incorporate structured competency-based training. Programmes focusing on hazard perception, self-monitoring, and behavioural reflection may strengthen cognitive reinforcement. To evaluate long-term behavioural sustainability, organizations can adopt quantifiable indicators such as incident reduction rates, near-miss reporting frequency, behavioural observation scores, and digital telematics analytics (e.g., speeding, harsh braking, distraction indicators). These measures allow agencies to track whether post-training behavioural gains translate into consistent, safer road practices over time.

Collectively, these implications highlight that RTSMS ISO 39001 can serve as a policy-driven tool for transforming safety culture rather than merely a compliance system.

Policy, Leadership, and Training Implications

The practical implications of this study extend beyond organisational compliance and highlight opportunities for policy integration at national and sectoral levels. Government agencies may incorporate RTSMS ISO 39001 principles into broader road safety and occupational safety frameworks to create alignment between organisational practices and national road safety targets. Embedding RTSMS within government-linked institutions can also promote consistency in safety expectations across public service fleets.

Leadership plays a pivotal role in sustaining behavioural change. Senior management commitment—manifested through safety leadership visibility, performance monitoring, and accountability mechanisms—reinforces the internalisation of RTSMS principles among staff. Regular management reviews and safety performance reporting, as required under ISO 39001, can function as behavioural reinforcement mechanisms that sustain safety awareness beyond initial implementation stages.

In terms of training frameworks, organisations may leverage RTSMS to structure continuous, competency-based driver safety training. Modules focusing on hazard perception, cognitive self-regulation, and behavioural reflection can strengthen long-term behavioural retention. To evaluate sustainability, organisations may adopt performance indicators such as near-miss reporting rates, incident trends, behavioural observation audits, and telematics-based driving metrics. These indicators allow organisations to assess whether cognitive improvements translate into consistent behavioural outcomes over time.

Collectively, these implications position RTSMS ISO 39001 as an integrative platform linking policy objectives, leadership accountability, and behavioural development within organisational road safety strategies.

Limitations and Future Research Directions

This study is subject to several limitations. First, the sample size was confined to a single institutional organisation, which may limit generalisability across different industries or operational contexts. Future studies could adopt multi-institutional or cross-sectoral designs to validate the robustness of the observed relationships.

Second, the cross-sectional nature of the data restricts the ability to capture long-term behavioural retention. While strong cognitive and behavioural associations were identified, longitudinal research would be valuable in examining whether these changes persist over extended periods following RTSMS implementation.

Future research may also integrate objective behavioural data such as telematics, incident records, or observational audits to complement self-reported measures. Combining quantitative behavioural indicators with qualitative insights from interviews or focus groups could further enrich understanding of how RTSMS influences the development of safety culture over time.

Finally, comparative studies between ISO 39001-certified and non-certified organisations may provide deeper insight into the differential impact of structured safety management systems on road user behaviour.

This study affirms the potential of the ISO 39001 standard to transform road safety at the cognitive and behavioural levels within organizations. By targeting internal cognitive processes and integrating them with systematic safety protocols, RTSMS presents a sustainable pathway for institutional risk reduction. Policymakers and safety managers should consider embedding such standards in high-risk institutional settings to promote long-term behavioural change. This study affirms the potential of the ISO 39001 standard to transform road safety at the cognitive and behavioural levels within organizations. By targeting internal cognitive processes and integrating them with systematic safety protocols, RTSMS presents a sustainable pathway for institutional risk reduction. Policymakers and safety managers should consider embedding such standards in high-risk institutional settings to promote long-term behavioural change.

From an industry perspective, the findings offer valuable implications. Organizations with high exposure to road traffic risk, such as logistics firms, emergency services, construction firms, and public transportation operators, can leverage RTSMS as a structured method for embedding a safety culture into daily operations. The observed improvements in cognitive awareness and behavioural compliance suggest that RTSMS adoption may reduce accident rates, lower insurance liabilities, and enhance employee well-being. Moreover, demonstrating ISO 39001 compliance can serve as a competitive advantage in bidding for safety-conscious contracts, signaling a proactive commitment to risk management and regulatory alignment.

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