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Development and Validation of a Work-Related Road Safety (WRRS) Assessment Tool for Malaysia

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ABSTRACT – *Work-related road safety (WRRS) is an emerging occupational safety and health priority in Malaysia, yet organizations lack a standardized tool to systematically assess WRRS management practices. This paper reports the development and content validation of a WRRS Assessment Tool tailored to the Malaysian context. The tool was developed using best-practice guidelines, findings from a prior cross-sectional study, and expert input obtained through a Delphi-based focus group process. A panel of seven purposively selected road safety experts from experts from government, research, academia, and industry evaluated the instrument for face and content validity. The questionnaire comprised four sections: organizational background; infrastructure; background of the person in charge, fleet, and crash involvement; and WRRS management practices. Content validity was assessed using the Content Validity Index (CVI) for each item (I-CVI) and for the overall scale (S-CVI), taking into account relevance, ambiguity, clarity, and simplicity. All items achieved acceptable I-CVI values, indicating excellent overall content validity according to established criteria and strong consensus among the experts. The WRRS Assessment Tool provides a structured, context-specific audit framework to support Malaysian organizations in measuring, monitoring, and improving WRRS performance. It aligns with Malaysia's Road Safety Plan 2022-2030 and National Vision Zero aspirations and is poised to facilitate systematic identification and management of workplace road safety risks, thereby contributing to reductions in occupational road traffic injuries and fatalities.*

KEYWORDS: Work-related road safety, occupational safety and health, fleet safety, assessment tool, content validity index, Malaysia

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1. INTRODUCTION

Road traffic injuries are among the leading causes of death and disability worldwide, with more than 1.3 million fatalities each year, making road traffic injuries the eighth leading cause of death globally (WHO, 2023). Within this burden, work-related road safety (WRRS) constitutes a distinct occupational hazard, as employees who drive for work, operate fleet vehicles, or commute under time and performance pressures face disproportionately high risks of crashes, injuries, and fatalities compared with the general driving population (Mooren et al., 2014). International evidence suggests that work-related driving can account for a substantial share of road traffic crashes – sometimes between one quarter and one third of all incidents – highlighting the importance of addressing WRRS as part of occupational safety and health (Grayson & Herman, 2011).

Over the past two decades, the integration of road traffic safety into occupational safety and health frameworks has gained momentum, supported by formal management system standards and best-practice guidelines. ISO 39001, the Road Traffic Safety Management Systems standard, provides organizations with a structured framework for identifying, prioritizing, and managing road traffic safety risks within broader safety management systems (ISO, 2012). Experience from high-income settings, such as Sweden and Japan, shows that implementing ISO 39001 or equivalent systems can help reduce fleet crash and injury rates and strengthen safety culture and organizational learning (Elvebakk & Steiro, 2009; Newnam & Goode, 2015). In parallel, several fleet safety audit tools and maturity-based assessment instruments have been developed to help organizations gauge the robustness of their road safety practices and benchmark performance over time. Notably, the Fleet Safety Management Audit Tool developed by Mitchell et al. (2011) uses structured indicators across domains such as leadership, driver behavior, vehicle management, and journey planning and has been associated with improved fleet safety outcomes (Mitchell et al., 2011; Mooren et al., 2014).

Despite these advances, low- and middle-income countries (LMICs) continue to face significant challenges in implementing comprehensive WRRS frameworks. Organizations – particularly small and medium enterprises (SMEs) – often operate with limited resources, weaker safety cultures, and constrained technical capacity, which makes the direct adoption of complex international frameworks difficult (Bliss & Breen, 2009; WHO, 2023; PIARC, 2019). Studies from Latin America and Sub-Saharan Africa indicate that SMEs frequently struggle to adapt and operationalize such frameworks without support, reinforcing the need for resource-sensitive, locally adaptable tools (Özkan et al., 2006). In the ASEAN region, road crashes impose a heavy social and economic burden, and a substantial proportion of occupational fatalities are road-traffic related, reflecting the high exposure of workers who drive as part of their jobs (ILO, 2020, 2021).

Malaysia exemplifies many of these challenges. Motorization has grown rapidly, and the country now records a high vehicle ownership rate, with more than 1,000 vehicles per 1,000 population, including a very large share of motorcycles and light-duty vehicles (Asian Transport Observatory, 2025). Research by the Malaysian Institute of Road Safety Research (MIROS) has identified fatigue, distraction, and speed as prominent contributors to work-related and commuting crashes, particularly among commercial and commuting drivers (Norlen et al., 2012; Ministry of Transport Malaysia, 2022; PERKESO, 2018, 2019, 2022b). At the same time, program reports indicate that many SMEs lack structured work-related road safety programs, especially in driver and journey management, prompting initiatives such as PERKESO's Commuting Safety Support Program to build employer capacity (Bakar et al., 2021; ISSA, 2019). Data from the Social Security Organisation (PERKESO) indicate that road crashes, especially those occurring during commuting, constitute a major share of compensated occupational injuries and fatalities, with substantial implications for social security expenditure, productivity, and family wellbeing (PERKESO, 2018, 2019, 2022a). National strategies – such as the Malaysia Road Safety Plan 2022-2030 and broader policy commitments toward Vision Zero – explicitly prioritize WRRS and call for stronger organizational responsibility and systematic approaches to managing work-related driving risks (Ministry of Transport Malaysia, 2022; PERKESO, 2022b).

At the same time, emerging evidence highlights both new opportunities and additional complexities in WRRS. Digital technologies – including telematics, in-vehicle monitoring systems, and data analytics – offer tools for enhanced monitoring, feedback, and risk prediction, but their adoption is uneven and often constrained in resource-limited settings (Ehsani et al., 2023; Newnam & Watson, 2011). Psychosocial and organizational factors such as stress, fatigue, time pressure, and safety climate also play a crucial role in shaping occupational road risk, reinforcing the need for holistic, systems-based approaches that move beyond individual driver blame (Newnam & Goode, 2015; Salmon et al., 2012). Within this context, there is a clear gap in Malaysia: despite strong policy interest and growing evidence on WRRS, no standardized, validated tool has been available to help organizations systematically assess their WRRS practices in a way that is both feasible for SMEs and scalable to larger enterprises.

The present study addresses this gap by developing and validating a Work-Related Road Safety (WRRS) Assessment Tool tailored to the Malaysian context. Its specific objectives are (1) to design a structured assessment instrument comprising key indicators across core WRRS domains, grounded in international best practice and local regulatory and policy requirements; and (2) to evaluate the content validity of this instrument using expert judgement and Content Validity Index (CVI) metrics. The resulting tool is intended for use by organizations as a practical instrument for self-assessment and

benchmarking and by OSH practitioners and regulators as a reference for promoting more systematic, evidence-informed management of work-related road safety in Malaysia.

2. METHODOLOGY

2.1 Study Design

This study employed a descriptive design focusing on instrument development and validation, embedded within a broader multi-phase WRRS research project. It was dedicated to developing the WRRS Assessment Tool using qualitative and quantitative procedures to refine items and establish content validity. The study was conducted over five months, from October 2020 to February 2021.

The initial item pool was generated based on three primary inputs:

- Best practices and guidelines in work-related road safety and fleet safety management.
- Findings from a preceding cross-sectional study that identified organizational gaps and priority areas in WRRS practices.
- Expert opinion gathered through focus group discussions (FGDs) guided by a Delphi technique.

The Delphi technique involved iterative rounds of consultation with subject-matter experts, during which experts reviewed proposed items, shared their views, and responded to feedback summaries in subsequent rounds until convergence of opinion was achieved. This approach facilitated consensus on the scope, wording, and structure of the items, ensuring they reflected both theoretical and practical dimensions of WRRS in Malaysian organizations.

2.2 Participants and Sampling

A total of seven experts were purposively selected to participate in the content validation process. Experts were chosen to represent diverse yet relevant domains, including universities, certification bodies, non-governmental organizations, and related institutions involved in road safety research, policy, or practice. Inclusion criteria required experts to have more than 10 years of experience in practising road safety and in conducting road safety-related research or programmes, and to be affiliated with a university or research organization. This ensured that panel members had both depth of expertise and familiarity with WRRS issues in the Malaysian context.

2.3 Instrument Structure

The WRRS Assessment Tool was structured as a questionnaire with four main sections.

- Section A: Organizational background (7 items), capturing basic characteristics such as size, sector, and fleet profile.
- Section B: Infrastructure (5 items plus additional sub-items), addressing physical and organizational infrastructure related to WRRS.
- Section C: Background of the person in charge (26 items), focusing on the role, competencies, and responsibilities of personnel overseeing WRRS.
- Section D: Fleet, road traffic crash involvement, and WRRS management practices (36 items), examining policies, procedures, monitoring, and interventions related to work-related driving.

For the content validity evaluation, experts were asked to rate each item on a 4-point Likert scale in relation to four dimensions: relevance, ambiguity, clarity, and simplicity. For relevance, a rating of 1 indicated irrelevance, 2 indicated some relevance requiring major revisions, 3 indicated relevance with minor revisions, and 4 indicated full relevance. For the other three dimensions, a rating of 1 suggested that the item required complete revision, whereas 4 indicated that the item was fully adequate as written.

2.4 Face and Content Validity

Face validity was assessed by obtaining feedback from independent experts who were not part of the main content validation panel. These reviewers examined the questionnaire to determine whether the items appeared appropriate and comprehensive for capturing WRRS practices from the perspective of potential respondents. Feedback focused on clarity, comprehensibility, layout, and perceived relevance

to WRRS. Suggestions from this process were used to refine wording and format before formal content validity assessment.

Content validity was evaluated using the Content Validity Index (CVI), calculated at both the item level (I-CVI) and scale level (S-CVI). Experts were provided with detailed guidelines and content validity assessment forms via email, and they independently rated each item. The I-CVI for each item was computed as the proportion of experts who assigned scores of 3 or 4 for the dimension of interest, divided by the total number of experts (n = 7). Mean I-CVI for each dimension (relevance, ambiguity, clarity, simplicity) was then calculated by summing the I-CVIs of all 74 items and dividing by the total number of items.

Two indices were used at the scale level:

- S-CVI/Ave (average S-CVI): the average of the I-CVIs across all items and experts for each dimension.
- S-CVI/UA (universal agreement): the proportion of items that achieved universal agreement (all experts rating 3 or 4) across each dimension.

These indices were interpreted against established criteria, whereby I-CVI values of at least 0.78 are considered acceptable for panels of six or more experts, and S-CVI/Ave values of 0.90 or greater indicate excellent content validity.

3. RESULTS

The results of the content validity assessment indicated a high level of agreement among experts. All the items were judged valid for all the elements. The CVI was calculated based on relevance, ambiguity, clarity, and simplicity. The relevance, ambiguity, clarity, and simplicity of this questionnaire are high at the item and scale levels. Over 90% of the items were considered relevant by almost all experts. It implies that this questionnaire covers the content of items accordingly. The I-CVI values ranged from 0.86 to 1.00 across all items, demonstrating acceptable to excellent content validity. No item fell below the recommended minimum threshold. No item fell below the recommended minimum threshold. The result of S-CVI/UA was 1.00 for relevance and 0.97 for ambiguity, clarity, and simplicity. This reflects that the meaning of the items is ascertained but less simple.

The content validity of this questionnaire is assured. Polit and Beck (2006) recommended CVI to meet the minimum agreement as set by Lynn (1986) for excellent content validity at 0.78 for six experts and 1.00 for fewer than six experts. Also, SCVI/Ave is higher than 0.90. This questionnaire has met the requirements. Overall, this instrument has exceeded the minimum requirement of validity; therefore, all items remain in the questionnaire, and the content is considered valid. Thus, this confirms that the instrument is suitable for subsequent testing and field implementation. The following table presents the content validity index (CVI) results for each construct, showing the range of I-CVI values and the corresponding S-CVI/UA and S-CVI/Ave scores.

TABLE 1: Content Validity Index (CVI) summary

Construct	Mean I-CVI	I-CVI (Range)	S-CVI/UA	S-CVI/Ave
Relevance	1.00	0.86–1.00	1.00	1.00
Ambiguity	0.97	0.86–1.00	0.97	0.97
Clarity	0.99	0.86–1.00	0.99	0.98
Simplicity	0.97	0.86–1.00	0.97	0.98

No items were removed from the instrument as part of the validation process. However, experts recommended minor item wording refinements to enhance clarity, reduce ambiguity, and ensure alignment with terminology commonly used in Malaysian organizations before data collection. These adjustments improved the precision and interpretability of the items without altering their underlying intent. Collectively, the high CVI scores, the absence of item removal, and the nature of the refinements

support the conclusion that the WRRS Assessment Tool is both conceptually sound and practically suited to the Malaysian organizational context.

4. DISCUSSION

4.1 Findings and Contribution

This study developed and validated a context-specific WRRS Assessment Tool for Malaysian organizations and demonstrated excellent content validity across all dimensions assessed. The very high I-CVI and S-CVI values for relevance, ambiguity, clarity, and simplicity suggest that the instrument is both conceptually sound and practically usable. The results indicate that experts considered the items to be representative of WRRS practices and suitable for assessing organizational readiness, management commitment, and operational processes related to work-related driving. The use of a Delphi-based expert consultation process contributed to refining the tool and ensuring consensus on the content to be included.

The development of an audit tool to measure an organization's WRRS practices and procedures was found to be similar to that of Wishart et al. (2011), who conducted a study and concluded that many current workplace health and safety risk management and audit tools were found to lack the necessary content or detail to thoroughly examine work-related risks within organizations. Therefore, according to studies done by past researchers on workplace road safety practices, Wishart et al. (2011) developed an audit tool specifically to assess work-related driving processes within organizations. The audit tool was aimed at establishing an ordered process to evaluate WRRS practices in an organization, which leads to gathering all relevant information about the organization's safety practices. Through the audit tool, it also identifies possible irregularities between the legal requirements and the organization's safety practices, which in the end directs the findings to the improvement of employees' safety through training and thoughtful intervention.

The study found that fleet safety within the organization was not considered a priority, and as a result, the full extent of organizational crashes and vehicle-related injuries was relatively unknown by senior management. In addition, this study identified several operational and procedural deficiencies in relation to fleet safety (Rowland et al., 2006), leading to insufficient management attention and unclear understanding of the true burden of work-related crashes. The present tool directly addresses this challenge by making fleet safety and road risk management visible, measurable, and actionable.

4.2 Strengths, Limitations and Future Directions

A major strength of this study is the rigorous content validation procedure, which combined quantitative CVI metrics with qualitative expert feedback. The inclusion of a diverse panel of experts with more than a decade of experience each in road safety and research added depth and breadth to the assessment. Another strength is the clear linkage between items and a detailed assessment rubric, which promotes objectivity and consistency in scoring.

However, several limitations should be acknowledged. The relatively small number of experts, while adequate for CVI analysis, also means that perspectives from some sectors or regions may not be fully represented. A larger and more diverse panel could further strengthen the evidence base for content validity. The validation process focused primarily on content validity and did not, at this stage, examine other psychometric properties such as construct validity, internal consistency reliability, or test-retest reliability. Furthermore, while the tool was designed with the Malaysian context in mind, its applicability to other countries or regulatory environments may require adaptation and additional validation.

For organizations, especially SMEs, the tool provides a stepwise framework for identifying strengths and gaps in WRRS practices and for prioritizing cost-effective improvement strategies. For regulators and social security bodies, it offers an avenue to promote self-regulation, encourage best practice, and strengthen reporting and learning systems for occupational road accidents. For policymakers, the tool supports the operationalization of the Malaysia Road Safety Plan 2022–2030 and advances Vision Zero by embedding WRRS more deeply within occupational safety management. With further validation and digital integration, the WRRS Assessment Tool has the potential to become a cornerstone instrument

for promoting safer workplaces and mitigating the human and economic costs of occupational road crashes in Malaysia and similar contexts.

5. CONCLUSION

The WRRS Assessment Tool presented in this study is a systematically developed and content-validated instrument for assessing work-related road safety management practices in Malaysian organizations. It offers organizations, particularly SMEs, a practical means to assess their current WRRS practices, benchmark performance, identify gaps, and plan systematic improvements, while remaining applicable to larger enterprises across sectors.

Informed by best-practice evidence, empirical findings, and expert consensus, the tool demonstrates excellent content validity in terms of relevance, clarity, ambiguity, and simplicity. Its structured scoring rubric enables organizations to translate qualitative assessments into quantitative performance indices, supporting monitoring, benchmarking, and targeted improvement in WRRS. Wider application and further psychometric testing will strengthen its role as a core component of WRRS evaluation and intervention efforts in Malaysia and potentially in other settings.

Adoption of the tool is projected to foster culture change that prioritizes road safety, enhances regulatory compliance, and helps reduce occupational road traffic injuries and fatalities. By supporting alignment with Malaysia's Road Safety Plan (MRSP) 2022-2030 and Vision Zero objectives, the tool has potential relevance not only within Malaysia but also for other ASEAN countries and LMICs facing comparable WRRS challenges. Further work should focus on large-scale pilot testing, broader psychometric evaluation (including reliability and construct validity), and digital platform integration to streamline assessments and reporting. These advancements could establish the WRRS Assessment Tool as a cornerstone instrument for promoting safer workplaces and mitigating the human and economic costs of occupational road crashes.

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SUPPLEMENTARY

TABLE S1: Finalized WRRS management practices

No.	Items
1. Management, Systems and Processes	
1.1 Management commitment	
(a)	Are there any documented roles, responsibilities and authorities as well as performance criteria specifically for work-related road safety (WRRS) in your organization? (e.g., organization chart, appointment letter, job description, TOR, KPI)
(b)	Is there a system in place that can assess WRRS management and/or performance agreements or statements of responsibilities? (e.g., safety policy, road safety policy, internal audit, management review [MR], MoM)
(c)	Are there any dedicated and sufficient resources allocated to manage WRRS in your organization? (e.g., budget, operational chart, competent person e.g., SHO, OSH-C)
1.2 Work-related road safety management	
(a)	Is there any specific WRRS policy in your organization? If yes, is there a system for monitoring its application by the management? (e.g., safety policy, road safety policy, internal audit, management review (MR), MoM)
(b)	Is there a risk management approach to manage WRRS? (e.g., risk assessment technique based on ISO 31010:2009 such as HIRARC, FMEA)
1.3 Communication regarding WRRS	
(a)	Does the organization have a formal mechanism for regular two-way consultation and communication for both internal and external stakeholders regarding WRRS? (e.g., safety/ road safety committee meeting, client/stakeholder requirement meeting, complaint mechanism, social media)
(b)	Is there any information dissemination on WRRS performance and performance feedback being carried out by your organization? (e.g., social media, email, poster, toolbox meeting, etc.)
2. Monitoring and Assessment	
2.1 Road traffic crash and incident investigation	
(a)	Are there any processes and documentation for conducting investigations of road traffic crashes and incidents in your organization? (e.g., method of investigation, procedure, crash report)
(b)	Is the information obtained from the investigative process being used to identify appropriate crash and incident preventive strategies? (e.g., crash report, MoM e.g., safety committee, MR, etc.)
(c)	Are the identified prevention strategies being implemented in the organization within a suitable timeframe? (e.g., MoM e.g., safety committee, MR, etc.)
2.2 Monitoring WRRS performance	
(a)	Is there any mechanism in place to monitor WRRS performance on a regular basis? (e.g., MoM e.g., safety committee, MR, etc.)
(b)	Is the WRRS performance being measured using both outcome and proactive performance measures? (e.g., outcome indicators e.g., number of crashes, summons & proactive indicators e.g., speeding from GPS, VKT, etc.)
(c)	Is there a mechanism for ongoing review of existing WRRS management approaches based on WRRS performance results? (e.g., MoM e.g., safety committee, MR, etc.)
(d)	Does your organization benchmark WRRS performance with other organizations? (e.g., benchmarking report, MoM e.g., safety committee, MR, etc.)
2.3 Performance monitoring and recognition	
(a)	Is there any mechanism in place to identify and recognize good or poor driving performance in the organization? (e.g., incentive/ disincentive, merit, and demerit score)
(b)	Does the organization use in-vehicle monitoring technology for driving performance monitoring? (e.g., in-vehicle monitoring technology e.g., GPS, event data recorder (EDR) etc.)
(c)	Is there any corrective action taken as a consequence of poor driving performance? (e.g., mandatory driving training, refresher training, suspension, counselling)

TABLE S1: Continued

No.	Items
3. Driver Management	
3.1 Driver selection and assessment	
(a)	Is there any procedure in place to conduct pre-hire driving history checks for drivers? (e.g., background/ license/ summon/ fitness assessment check)
(b)	Is there a formal system in place to check the driver's competency before permitting vehicle use for the first time? (e.g., test drive, ride-along assessment)
(c)	Is there any mechanism in place to identify risky drivers? (e.g., summon checks, fuel consumption check, speed compliance check, in-vehicle monitoring)
(d)	Do the organization conduct continuous monitoring of driver performance? (e.g., MoM e.g. safety committee, MR, etc.)
3.2 Employee WRRS induction	
(a)	Is there a WRRS induction program for fleet related employees, including general OSH program? (e.g., attendance record, photos, course content)
(b)	Is there any vehicle-specific orientation training (vehicle, safety features, maintenance, checking protocols) for WRRS related employees? (e.g., attendance record, photos, course content)
(c)	Is the WRRS induction program includes specific training for any new vehicle technologies that are fitted in fleet vehicles? (e.g., attendance record, photos, course content)
3.3 Driver training	
(a)	Are there any training needs analysis (TNA) conducted for drivers in relation to fleet driving? (e.g., TNA, training schedule)
(b)	Is the organization providing driver training, as identified in the training needs analysis, for employees, as appropriate? (e.g., training schedule e.g., defensive driving/riding, stress management etc.)
(c)	Are there any reviews and evaluations of training and training materials to monitor effectiveness and impact? (e.g., pre- and post-training assessment)
4. Vehicle Management	
4.1 Road traffic crash and incident investigation	
(a)	Are there any fleet vehicle selection guidelines/ requirement/ regulations that specify specific safety features that should be included in the fleet vehicles? (e.g., vehicle selection guideline, client requirement)
(b)	Is there any consultation with workers regarding fleet vehicle selection including feedback on safety performance? (e.g., safety/ road safety committee meeting, toolbox meeting, electronic communication e.g., email, online forum, WhatsApp)
4.2 Fleet vehicle maintenance	
(a)	Is there any routine maintenance conducted on fleet vehicles? (e.g., preventive schedule maintenance record)
(b)	Is the vehicle condition inspected regularly, and defects are corrected in a timely way? (e.g., maintenance record, vehicle inspection checklist)
(c)	Is there any mechanism for employees to report vehicle defects and a mechanism to ensure that vehicle defects are assessed and corrected in a timely manner? (e.g., pre- and post-trip inspection, apps, etc.)
5. Journey Management	
5.1 Journey management	
(a)	Does the organization have a formal mechanism to assess the needs for trips? (e.g., route selection planning, driver selection, roster system, fitness to drive checklist)
(b)	Does the organization consult with employees regarding route selection and provide information on safe journey planning? (e.g., safety/ road safety committee meeting, toolbox meeting, electronic communication e.g., email, online forum, WhatsApp)
(c)	Is there a mechanism in place to identify risky routes or climate? (e.g., Route hazard mapping, HIRARC, etc.)
(d)	Is there a mechanism to respond to any emergency situation during the journey? (e.g., Emergency Response Plan (ERP), drill related to road accident/incident)