Exploring Predictors of Safety Behaviors among Railway Construction Workers in Malaysia: A Pilot Study

Siti Maisarah Amdan[1,2*], Siti Nurhafizah Saleeza Ramlee[3] , Mohd Azroy Ag Rajak[4], Azmi Bin Mohamed[5], Kamariah Hussein[6] and Mohd Tajuzzaman Hassanor[7]

[1,4,5,6,7]Faculty of Technology and Applied Sciences, Open University Malaysia, Malaysia

[2,3]Faculty of Defence Studies and Management, National Defence University of Malaysia, Malaysia

***Corresponding Author**

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ABSTRACT

Malaysia's rapid expansion of railway infrastructure has intensified the need to understand the behavioural factors that influence safety performance among railway construction workers. Despite the sector's high-risk environment characterised by electrical hazards, elevated structures, complex coordination, and multi-contractor operations empirical research focusing on behavioural predictors in Malaysian railway construction remains limited. This study explores the extent to which management commitment, safety training, and safety motivation influence workers' safety behaviour. A quantitative cross-sectional survey was conducted among 30 workers involved in trackwork, overhead line, structural, and system integration activities. Data were analysed using descriptive statistics and multiple linear regression. The findings show that safety training ($\beta = .591$, $p < .001$) and safety motivation ($\beta = .358$, $p = .011$) significantly predict safety behaviour, highlighting the critical role of competency development and intrinsic motivation in promoting safe work practices. However, management commitment was not a significant predictor ($p = .931$), suggesting that organisational intentions may not always translate into frontline behavioural outcomes in subcontractor-driven project environments. These results underscore the need for targeted training strategies and motivation-enhancing approaches to strengthen behaviour-based safety in Malaysia's railway construction sector. The study offers preliminary insights that can inform larger-scale investigations and support ongoing efforts to cultivate a stronger safety culture in railway infrastructure development.

Keywords: safety behaviour, railway construction, safety training, safety motivation, management commitment

1.0 INTRODUCTION

Malaysia has invested heavily in railway infrastructure over the last decade, with projects such as the MRT, LRT extensions, and KTMB upgrades shaping the country's urban mobility. These projects bring significant benefits, but they also expose workers to a wide range of hazards. Tasks such as overhead catenary system (OCS) installation, traction power work, and track construction involve high-voltage systems, elevated structures, heavy equipment, and confined workspaces (DOSH, 2022). Because of the technical and risky nature of this work, even small lapses in judgment or unsafe actions can lead to serious accidents. Although Malaysia has strengthened its regulatory frameworks, including the Occupational Safety and Health Act (OSHA) 1994, unsafe behaviors at construction sites remain one of the main contributors to workplace incidents (Rahim et al., 2020).

Safety behavior often described in terms of workers' willingness to comply with procedures and participate in safety activities has gained increasing attention in high-risk industries. Research shows that human factors account for a large proportion of workplace incidents, sometimes exceeding 80 percent (Mansour et al., 2021). In railway construction, where tasks require coordination between multiple teams, strong situational awareness, and adherence to strict technical procedures, the impact of safety behavior becomes even more

critical. Mistakes can have cascading effects, not just for workers but also for rail assets and project timelines (Ismail et al., 2023).

Several organizational and individual factors are known to influence safety behavior. Management commitment shapes the overall safety climate by signalling the importance of safety through leadership involvement, communication, and consistent enforcement (Alruqi & Hallowell, 2019). Safety training is another central factor, as effective and relevant training helps workers understand risks, develop competency, and adopt safer work practices—particularly in specialized fields like railway construction (Kang et al., 2021). Safety motivation also plays a role by influencing how willing workers are to put effort into safe behavior, even in demanding or time pressured environments (Zhang et al., 2020).

Despite the importance of these factors, research focusing specifically on Malaysia's railway construction environment is still limited. Most studies concentrate on general construction or manufacturing settings, which differ substantially from the hazards and task demands experienced in railway work. Because of this gap, there is a need to better understand the behavioral factors that shape safety performance in the railway construction sector.

In this pilot study, we aim to investigate the effects of management commitment, safety training, and safety motivation on safety behavior among railway construction workers in Malaysia. The findings are intended to provide early insights that can guide larger studies and help industry practitioners strengthen behavior-based safety strategies in this specialized sector.

2.0 LITERATURE REVIEW

2.1 Safety Behaviour in Railway Construction

Safety behaviour is a central element of occupational safety performance, especially within high-risk sectors such as railway construction. According to Neal and Griffin (2006), safety behaviour comprises two fundamental components: safety compliance, which describes workers' adherence to rules, procedures, and the use of protective equipment; and safety participation, referring to voluntary efforts that contribute to improving workplace safety. These behavioural dimensions play a crucial role in preventing accidents in complex operational environments.

Railway construction work differs from conventional construction due to its high degree of technical coordination, interface management, and exposure to unique hazards such as energized systems, night-shift operations, limited work windows, and simultaneous activities on elevated or confined structures. Even small behavioural lapses such as incorrect lockout-tagout practices, miscommunication during track possession, or a moment of reduced vigilance can escalate into major incidents and service disruptions (Katsakiori et al., 2020). This highlights why behavioural consistency must be treated as a core element in railway safety management systems.

In Malaysia, railway projects such as the MRT, LRT, and ECRL have significantly expanded the workforce involved in rail construction and maintenance activities. Within this context, Amdan, Ramlee, and Daruis (2024) examined knowledge, attitude, and practices (KAP) related to musculoskeletal disorders among Malaysian railway maintenance workers. While the primary focus was ergonomic outcomes, the authors identified behaviour-related factors, including unsafe practices, gaps in procedural adherence, and limited risk awareness, which contributed to physical strain and increased risk exposure. These findings demonstrate that behavioural aspects although not the main variable in their study are significantly embedded within everyday railway maintenance operations. As such, the behavioural gaps noted by Amdan et al. (2024) indirectly reinforce the importance of examining safety behaviour among railway workers.

Other Malaysian studies further support this concern. Ismail et al. (2023) highlighted human factors and behavioural inconsistencies as contributing causes of operational risks in the railway sector. Internationally, Lingard et al. (2022) and Zhang et al. (2021) found that safety behaviour tends to deteriorate in high-pressure project environments where productivity demands overshadow safety priorities. These insights provide strong justification for investigating behavioural predictors in Malaysia's railway construction industry, where empirical evidence remains limited.

2.2 Management Commitment and Safety Behaviour

Management commitment is one of the most frequently cited determinants of safety behaviour across various industries. It encompasses the actions and attitudes of leaders that communicate the importance of safety, such as enforcing standards, conducting supervision, providing resources, and demonstrating safety leadership. Workers who perceive strong management commitment often show higher compliance with procedures and greater willingness to participate in safety initiatives (Fernández-Muñiz et al., 2017).

In railway construction, the importance of management commitment becomes even more pronounced due to multi-layered work teams and highly coordinated activities. Studies in high-risk construction environments show that when management consistently monitors safety, provides clear communication, and enforces SOPs, workers are more likely to practice safe behaviours (Mansour et al., 2021). Conversely, weak supervisory oversight and unclear communication channels can result in behavioural shortcuts and procedural violations.

Malaysian evidence reinforces these observations. Although Amdan et al. (2024) primarily investigated ergonomic risks, their findings also indicated insufficient monitoring and inconsistent adherence to procedures among railway maintenance workers issues often associated with gaps in supervisory enforcement and management oversight. These behavioural tendencies underscore why management commitment is expected to serve as a key predictor of safety behaviour among railway construction workers.

2.3 Safety Training and Safety Behaviour

Safety training is essential in equipping workers with the knowledge and skills needed to perform tasks safely. Effective training improves hazard perception, decision-making, and behavioural consistency in routine and high-risk tasks (Burke et al., 2020). Railway construction requires specialised training such as track possession rules, electrical isolation, work-at-height, lifting operations, and emergency procedures. Workers who lack proper training may misinterpret hazards, underestimate risks, or unintentionally violate safety protocols.

Malaysian research indicates ongoing challenges in the quality and consistency of training across the construction sector. Ismail et al. (2023) found that gaps in safety training delivery, particularly among foreign workers, resulted in uneven safety performance on site. Similar issues were noted indirectly in Amdan et al. (2024), where poor ergonomic practices were partially linked to limited knowledge and inconsistent understanding of safe work procedures reflecting the importance of adequate training in shaping workplace behaviour. International literature also supports the view that structured and repetitive training improves both safety compliance and participation (Schwatka & Rosecrance, 2016).

These findings collectively suggest that safety training is an important predictor of railway workers' behavioural consistency.

2.4 Safety Motivation and Safety Behaviour

Safety motivation represents a worker's inner drive to behave safely and influences how consistently individuals apply safety rules and self-regulate their actions. Motivated workers tend to avoid unnecessary risks, use PPE voluntarily, participate in safety meetings, and report hazards more actively (Griffin & Curcuruto, 2016).

Railway construction requires extensive focus, precision, and situational awareness. Without adequate motivation, workers may resist safe work practices, disregard PPE requirements, or take shortcuts under time pressure. Studies in Malaysia confirm the significant role of motivation in shaping safety outcomes. Ismail et al. (2020) found that safety motivation predicted both compliance and participation among Malaysian construction workers. Although Amdan et al. (2024) did not directly examine safety motivation, some of the behavioural patterns observed such as inconsistent adherence to safe practices are often associated with motivation-related factors.

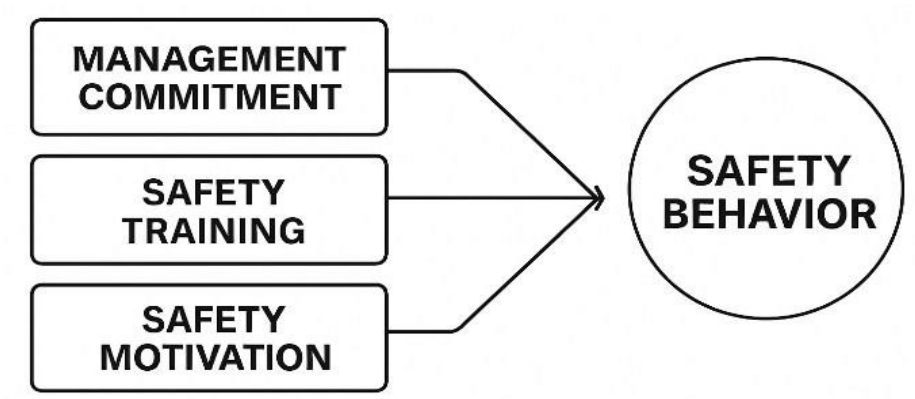
International research further strengthens this relationship. Kim et al. (2021) demonstrated that safety motivation mediates the influence of safety climate on compliance behaviour in high-risk industries. These findings indicate that safety motivation is expected to have a significant influence on workers' safety behaviour in railway construction settings.

2.5 Summary of Conceptual Position

The reviewed literature confirms that management commitment, safety training, and safety motivation are consistently linked to safety behaviour across various industries. However, empirical investigation within Malaysia's railway construction sector remains limited, especially studies focusing specifically on behavioural predictors. Railway workers operate in complex, dynamic, and technically demanding environments where behavioural consistency is critical. The gaps identified in ergonomic and behavioural practices among railway maintenance workers (Amdan et al., 2024) highlight the need for deeper investigation into behavioural determinants.

Based on this evidence, the present study conceptualizes safety behaviour as being influenced directly by three key predictors: management commitment, safety training, and safety motivation. This framework aligns with established models and fills an important research gap by focusing on an underexplored yet high-risk workforce railway construction workers in Malaysia.

Figure 1: Conceptual Framework



3.0 METHODOLOGY

3.1 Research Design

This study adopted a quantitative, cross-sectional survey design to examine the predictors of safety behaviour among railway construction workers in Malaysia. The design was suitable for capturing workers' perceptions of management commitment, safety training, safety motivation, and their safety behaviour at a single point in time. As this research functions as a pilot investigation, the intention was to identify preliminary patterns prior to a larger-scale study.

3.2 Population and Sample

The population of this study consisted of workers involved in railway construction projects within the Klang Valley region, including those working on track installation, overhead line equipment, structural works, and system integration tasks. This workforce typically operates in high-risk environments that require strict procedural adherence, making them an important population for safety behaviour research.

A total of 30 respondents were recruited using convenience sampling. The sample size meets the minimum requirement for pilot regression studies as suggested by Johanson and Brooks (2010), who recommended 30 participants for preliminary statistical testing. All participants were full-time workers or subcontracted personnel actively engaged in railway construction activities.

3.3 Instrumentation

Data were collected using a structured questionnaire adapted from established instruments in occupational safety research. The questionnaire consisted of five sections with a total of 34 items, excluding demographic items. All items in Sections B to E were scored using a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). The distribution of items is as follows:

Section	Content	Number of Items	Description
A	Demographic Information	8 items	Collects background details including age, gender, job role, work experience, education level, employment status, and type of railway project.
B	Management Commitment	10 items	Adapted from Zaira & Hadikusumo (2017) and Fernández-Muñiz et al. (2017). Measures the extent of management support, communication, enforcement of procedures, and prioritization of safety.
C	Safety Training	6 items	Adapted from Burke et al. (2020) and Ismail et al. (2023). Assesses clarity, relevance, frequency, and usefulness of training received by workers.
D	Safety Motivation	8 items	Adapted from Griffin & Curcuruto (2016). Evaluates workers' willingness to behave safely, the importance they place on safety, and their internal drive to follow procedures.
E	Safety Behaviour	10 items	Based on Neal & Griffin (2006). Examines employee compliance with safety rules, PPE use, participation in safety communication, and voluntary safety actions.

3.4 Data Collection Procedure

Data collection was conducted over a two-week period at active railway construction sites. Permission was obtained from site management before approaching participants.

The procedure involved:

1. A short briefing explaining the purpose of the study, confidentiality, and voluntary participation.
2. Distribution of questionnaires during toolbox meetings and break sessions to avoid interrupting work operations.
3. Respondents completed the questionnaire within approximately 10–15 minutes.
4. Completed documents were collected immediately and screened for completeness before entry into SPSS.

3.5 Data Analysis

Data were analysed using IBM SPSS Version 26. Descriptive statistics (frequency and percentage) were used to summarise demographic characteristics. Mean and standard deviation were computed for all major study variables.

To identify predictors of safety behaviour, multiple linear regression analysis was performed using management commitment, safety training, and safety motivation as independent variables. Statistical significance was evaluated at $p < 0.05$, in line with conventional social science research standards.

4.0 RESULT AND DATA ANALYSIS

4.1 Demographic Profile

Table 1 summarises the demographic characteristics of the 30 respondents. The age distribution shows that the largest group of workers was between 31–40 years (40.0%), followed by those aged 21–30 years (26.7%), 41–50 years (23.3%), and a smaller proportion over 50 years (10.0%). The sample consisted predominantly of male workers (90.0%), with only three female respondents (10.0%).

In terms of job category, general workers formed the largest group (40.0%), followed by technicians (33.3%), supervisors (16.7%), and others (10.0%). Working experience varied, with 33.3% having 4–6 years of experience, 30.0% having 1–3 years, 23.3% with more than 6 years, and 13.3% with less than 1 year. Slightly more than half of the respondents worked under contract status (53.3%), while 46.7% were permanently employed.

Table 1: Demographic Characteristics of Respondents (N = 30)

Variable	Category	Frequency (n)	Percentage (%)
Age	21–30 years	8	26.7
	31–40 years	12	40.0
	41–50 years	7	23.3
	>50 years	3	10.0
Gender	Male	27	90.0
	Female	3	10.0
Job Category	Supervisor	5	16.7
	Technician	10	33.3
	General Worker	12	40.0
	Others	3	10.0
Work Experience	< 1 year	4	13.3
	1–3 years	9	30.0
	4–6 years	10	33.3
	> 6 years	7	23.3
Employment Status	Permanent	14	46.7
	Contract	16	53.3

4.2 Multiple Regression Analysis

Table 2 presents the regression coefficients for the three proposed predictors of safety behaviour: management commitment, safety training, and safety motivation. The model examined how these variables statistically relate to self-reported safety behaviour among railway construction workers.

According to the results, safety training demonstrated the strongest association with safety behaviour, with an unstandardised coefficient of B = 0.605 and a standardised coefficient β = .591, accompanied by a statistically significant value of p = .001. This indicates that safety training contributed the largest weight among the predictors in the model. Safety motivation also recorded a significant contribution, with B = 0.407, β = .358, and p = .011, showing a positive relationship with safety behaviour.

In contrast, management commitment recorded a very small coefficient, B = 0.016, and its standardised coefficient was only β = .012, with a non-significant p = .931, suggesting no meaningful statistical contribution within this pilot sample. All VIF values ranged between 1.411–2.203, demonstrating that multicollinearity was not a concern in this analysis.

Overall, Table 2 summarises the relative weight of each predictor and identifies safety training and safety motivation as statistically significant contributors to safety behaviour within the studied railway construction workforce.

Table 2: Regression Coefficients for Predictors of Safety Behaviors

Variables	B	SE	Beta	t	Sig.	VIF
Management Commitment	0.016	0.176	0.012	0.089	.931	2.073
Safety Training	0.605	0.162	0.591	3.732	.001	2.203
Safety Motivation	0.407	0.148	0.358	2.741	.011	1.411

Significant if p-value is less than 0.05

5.0 DISCUSSION

This study examined the predictors of safety behaviour among railway construction workers in Malaysia, focusing on management commitment, safety training, and safety motivation. The regression results revealed that safety training and safety motivation significantly predicted safety behaviour, while management commitment showed no measurable relationship within the pilot sample.

The first objective explored whether management commitment influenced workers' safety behaviour. Although past studies consistently emphasise management commitment as a fundamental element for shaping safety culture (Zaira & Hadikusumo, 2017; Fernández-Muñiz et al., 2017), the present findings did not support this relationship. One possible explanation is that railway construction projects in Malaysia often involve multilayered subcontracting structures, where workers interact more frequently with direct supervisors than with higher-level management. Him and Ismail (2023) similarly found that even when management expresses strong safety intentions, inconsistent supervisory presence and fragmented communication can weaken workers' perception of management involvement. Therefore, management commitment may not always translate directly into observable behavioural outcomes at the frontline level, particularly in complex, multi-contractor environments.

The second objective examined the influence of safety training, and the results identified it as the strongest predictor of safety behaviour. This is consistent with extensive literature establishing that relevant, practical, and continuous training enhances workers' knowledge, hazard awareness, and behavioural consistency (Burke et al., 2020). In railway construction, where tasks involve track works, lifting operations, electrical systems, and restricted-time work windows, workers rely heavily on training to perform tasks safely. Malaysian studies also highlight disparities in training quality, especially among foreign or subcontracted workers, which can contribute to behavioural inconsistencies on site (Ismail et al., 2023). The present findings reinforce the need for structured, competency-based training that reflects the technical complexity of railway operations.

Safety motivation also emerged as a significant predictor of safety behaviour, addressing the study's third objective. Motivation plays a central psychological role in determining how workers internalise safety values and choose to engage in both compliance and participation behaviours. This finding aligns with established models by Neal and Griffin (2006), who argue that safety motivation acts as the bridge between safety climate and behavioural outcomes. Recent Malaysian research also emphasises that intrinsically motivated workers demonstrate greater adherence to procedures, higher PPE usage, and lower tendencies to engage in unsafe acts (Mohd Said et al., 2022). Isa et al. (2022) further noted that motivation remains a key behavioural factor even in physically demanding and high-risk sectors, reflecting its importance in sustaining consistent safety practices.

Taken together, the results suggest that behavioural and competency-related factors—such as training and personal motivation play a more direct role in shaping safety behaviour among railway construction workers than organisational-level perceptions such as management commitment. This aligns with previous findings that frontline workers in high-risk environments often depend more on their own knowledge, skills, and willingness to behave safely (Burke et al., 2020; Kim et al., 2021). Although management commitment was not significant in this pilot sample, it remains an essential component of safety systems and may show stronger effects in larger or more diverse samples.

Overall, the findings highlight the importance of enhancing safety training standards and strengthening intrinsic motivation as key strategies for improving safety behaviour in Malaysia's railway construction sector. These insights contribute to the limited literature focusing specifically on railway construction workers and provide a foundation for future large-scale studies.

6.0 CONCLUSION

This study set out to examine how management commitment, safety training, and safety motivation influence safety behaviour among workers in railway construction projects in Malaysia. The results demonstrate that safety training and safety motivation play substantial roles in shaping safe work practices, highlighting the importance of equipping workers with relevant knowledge, procedural clarity, and the internal drive to act safely in demanding site environments. Given the technical complexity of railway construction where tasks involve electrical systems, elevated structures, and coordinated multi-team operations workers rely heavily on both competency-based training and intrinsic motivation to maintain behavioural consistency.

In contrast, management commitment did not emerge as a significant predictor within this sample. Although management commitment is widely recognised in the literature as a key component of organisational safety performance, its influence may be less visible in fragmented, subcontractor-driven railway projects where dayto-day behaviour is more directly shaped by supervisors, peer norms, and immediate task demands. This finding suggests that future studies should explore how safety directives, leadership actions, and communication flow through multi-tiered project structures, and how these factors are perceived and enacted at the frontline.

Overall, the findings underscore the need to prioritise high-quality safety training and to strengthen workers' safety motivation as practical, high-impact strategies for improving safety behaviour in railway construction. While this study was limited by a small sample size, it offers valuable early insight and establishes a foundation for more comprehensive future research. As Malaysia continues to expand its railway infrastructure, cultivating a workforce that is well-trained, motivated, and behaviourally aligned with safety goals will be essential for reducing accidents and supporting a sustainable safety culture in the rail construction sector.

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