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Promoting Safety Behaviour Among Operatives in the SME Manufacturing Sector in Malaysia: The Mediating Effect of Safety Knowledge

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ABSTRACT

Occupational accidents pose a significant challenge to Malaysia's SME manufacturing sector, a critical driver of the national economy. This study investigates the impact of safety attitude, safety training, and safety knowledge on operatives' safety behaviour, exploring the mediating role of safety knowledge. Using a cross-sectional survey design and structural equation modelling (SEM) with SmartPLS, all three factors significantly influenced safety behaviour. Notably, safety attitude and training directly impact safety behaviour, while safety knowledge acts as a mediator, enhancing their positive effect. This research provides valuable insights for promoting a safer working environment within the SME manufacturing sector, underscoring the importance of cultivating positive safety attitudes, delivering effective training, and ensuring a robust foundation of safety knowledge among operatives.

Keywords: Safety attitude, safety behaviour, safety knowledge, safety training, structural equation modelling, SME manufacturing sector

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INTRODUCTION

Malaysia's manufacturing industry has been a cornerstone of the nation's economic growth, evolving significantly since the 1970s when the country transitioned from an agriculture-based economy to an industrial powerhouse. With strategic government

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incentives attracting foreign investments, Malaysia rapidly built its manufacturing capabilities, establishing itself as a global production hub. Today, small and medium-sized enterprises (SMEs) are the backbone of this sector, comprising 97.14% (47,698 firms) of the total manufacturing landscape (Department of Statistics [DOSM], 2022).

In 2022, the manufacturing sector was responsible for 69.3% of Malaysia's total SME exports, highlighting its critical role in the national economy. SMEs contributed 13.5% to the total exports, with manufacturing at 9.4%, followed by services at 3.9% and agriculture at 0.3% (DOSM, 2022). Notably, the services and manufacturing sectors collectively drive more than 80% of SMEs' GDP activities, underscoring their significance to Malaysia's economic stability (DOSM, 2022).

However, this industrial success is shadowed by a concerning rise in occupational accidents, particularly within the manufacturing sector. The Department of Occupational Safety and Health Malaysia (DOSH) reported that over the past six years, from 2018 to 2022, a staggering 32,082 occupational accidents were recorded, with 20,658 occurring in the manufacturing industries alone. The highest number of occupational accidents were reported in 2019 and 2022, with 7,984 and 6,719 cases, respectively, where manufacturing industries accounted for 4,948 and 4,514 of these incidents. However, there was a slight decrease in accidents in 2020 and 2021, with 6,933 and 5,415 incidents, respectively, with 4,506 (in 2020) and 3,462 (in 2021) incidents occurring in manufacturing. This reduction can be partly attributed to the Movement Control Order (MCO) implemented during the COVID-19 outbreak. Nevertheless, occupational accidents in manufacturing accounted for about 65% of all occupational accidents in Malaysia during this period (DOSH, 2022). These statistics indicate the need for robust safety measures to protect workers and sustain economic progress.

Thus, this study addresses these safety concerns by investigating the relationship between safety management practices and safety behaviour among operatives in Malaysia's SME manufacturing sector. Furthermore, it explores the potential mediating role of safety knowledge in enhancing the positive impact of safety management practices on safety behaviour. By examining these dynamics, the study seeks to contribute valuable insights into improving workplace safety and, ultimately, the sustainability of Malaysia's vital manufacturing industry.

LITERATURE REVIEWS

Safety Behaviour

Safety behaviour refers to actions aimed at self-protection, adherence to safety regulations, and the prevention of harm to oneself and others in the workplace (Guo et al., 2016; Seo et al., 2015). Positive safety behaviour is associated with overall workplace well-being and reflects employees' attitudes and actions in performing safety-related tasks (Schwartz et al., 2019). Non-compliance with safety behaviours is critical as it demonstrates

the individual's role in maintaining a safe work environment, with risky behaviours potentially leading to more significant physical hazards (Simanjuntak et al., 2023).

Safety behaviour is typically classified into safety participation (task-oriented) and safety compliance (rule-oriented) (Griffin & Neal, 2000; Li et al., 2020). Safety participation includes practices that promote a safe environment, such as assisting colleagues and contributing to safety programs, while safety compliance involves adherence to standard procedures and regulations (Griffin & Neal, 2000; Li et al., 2020).

Research indicates that workplace accidents are often more closely linked to employees' behaviours, particularly their safety attitudes, than to the inherent risks of their tasks (Schwartz et al., 2019). Safety attitude refers to an individual's mindset towards adhering to safety protocols and practices, which can significantly influence their likelihood of engaging in safe or unsafe behaviours. Organisational factors, such as the quality of safety training provided by firms, are crucial in shaping these attitudes. Effective safety training imparts essential knowledge and fosters a positive safety attitude among employees, thereby reducing workplace accidents (Schwartz et al., 2019).

In addition to safety attitudes, cognitive factors like safety knowledge are closely linked to workplace accidents. Safety knowledge refers to employees' understanding of safety procedures, risks, and best practices within their work environment (Vinodkumar & Bhasi, 2010). Employees with comprehensive safety knowledge are better equipped to recognise hazards and make informed decisions that prevent accidents. This knowledge is an added value to both safety attitudes and training, as it enhances the overall effectiveness of these factors in promoting safe behaviour. A positive safety attitude, high-quality safety training, and robust safety knowledge create a strong foundation for reducing workplace accidents and fostering a safer work environment.

Safety behaviour is essential for workplace safety, encompassing self-protection and adherence to regulations to prevent harm. Positive safety behaviour, linked to overall well-being, involves safety participation and compliance. Employee factors, such as safety attitude, play a crucial role in determining how individuals approach safety protocols and practices. A positive safety attitude increases the likelihood of employees engaging in safe behaviours. Organisational factors, particularly safety training, are significant in equipping employees with the necessary knowledge and skills to effectively understand and implement safety practices. Finally, cognitive factors like safety knowledge are essential for empowering employees to recognise hazards and make informed decisions that prevent accidents.

These predictors are closely linked to workplace accidents and are more significant predictors of safety behaviour than the inherent risks of the tasks themselves. Understanding and enhancing these factors

is especially vital in SME manufacturing firms, where many workplace accidents result from employee actions, underscoring the importance of addressing root causes rather than assigning blame.

Safety Attitude

Attitude significantly influences individual behaviour, especially in the context of workplace safety (Basahel, 2021). A safety attitude refers to a person's tendency to react positively or negatively toward safety-related issues, influencing how they approach safety protocols and procedures (Kao et al., 2019). Middle- and upper-level managers play a crucial role in shaping these attitudes, as their actions and decisions can directly impact employees' commitment to and compliance with safety procedures (Tadesse & Zawdie, 2019).

Although attitudes may seem straightforward, they involve complex processes, often becoming automatic through repeated behaviours (Li et al., 2019). When employees' attitudes diverge from the organisation's safety perspective, it can lead to unsafe behaviours and contribute to industrial accidents. Practical strategies to address these behaviours include replacing old habits and habituation and implementing consequences for non-compliance (Loosemoore & Malouf, 2019).

Additionally, workplace uncertainty can influence safety attitudes and behaviours, highlighting the importance of aligning employee attitudes with organisational safety goals (Basahel, 2021; Li et al., 2019). Leaders and managers play a crucial role in shaping these attitudes and behaviours, mainly through their emotional and behavioural influence on employees (Tadesse & Zawdie, 2019).

Safety Training

Safety training is essential for educating employees about potential hazards, defence methods, and safe practices in the workplace (Bae et al., 2021). Effective training equips employees with the skills and knowledge to perform tasks safely and efficiently, promoting safety-conscious behaviour and boosting productivity (Pamidimukkala & Kermanshachi, 2021). It involves repetitive instruction and practical experience to ensure employees can handle job-specific conditions safely (Che Huei et al., 2020).

Structured safety training programs are critical for new employees, enhancing overall workplace security and well-being (Maliha et al., 2021). Proper training increases adherence to safety procedures and helps identify deficiencies in workplace layouts (Layson et al., 2019). Training and interventions like safety check-ups and meetings significantly reduce the likelihood of occupational accidents (Bae et al., 2021).

Safety training, including first aid, raises safety awareness and encourages safe practices, thereby reducing workplace risks (Loosemore et al., 2019). Ongoing training and refresher programs are vital for maintaining high safety standards and preventing incidents, making accidents more predictable and manageable (Che Huei et al., 2020; Pamidimukkala & Kermanshachi, 2021). Organisations prioritising safety

training demonstrate their commitment to employee well-being and foster a culture of mutual safety goals (Layson et al., 2019).

Safety Knowledge

Safety knowledge, encompassing both theoretical and practical information, is crucial for establishing a secure working environment and is a key determinant of safety behaviour (Hu et al., 2021). Effective risk communication between employers and employees depends on a solid understanding of workplace risks, with knowledge exchange being vital for supporting safe work practices (Huang & Yang, 2019). Insufficient safety knowledge has been linked to increased workplace accidents, highlighting the need for comprehensive safety training and education (Hu et al., 2021).

Enhancing safety knowledge involves disseminating information about safe job performance through safety rules, training, and communication (Duryan et al., 2020). In sectors like mining, a lack of awareness and inadequate training have contributed to accidents, underscoring the importance of effectively transmitting and applying safety knowledge (Guo et al., 2016; Hu et al., 2021). Knowledge exchange, sharing and receiving task-related information, methods, and feedback occur through formal and informal channels and are essential for improving safety behaviour and reducing violations (Wöll & Sulíková, 2022).

Both employees and employers must possess adequate safety knowledge and awareness to prevent occupational accidents. Gaining insights from colleagues' experiences can further reinforce safe work practices, thereby reducing the likelihood of accidents in environments with low safety awareness.

HYPOTHESIS DEVELOPMENT

Safety Attitude and Safety Behaviour

The reviewed literature consistently supports the positive relationship between safety attitude and safety behaviour across various industries. For instance, Li et al. (2019) examined coal miners in China and found that a positive safety attitude is closely linked to safer behaviour. Similarly, Basahel (2021) explored safety attitudes among workers in electrical and construction projects in Saudi Arabia, revealing a strong positive relationship between safety attitude and safety behaviour. Furthermore, Ji et al. (2019) further demonstrated that safety attitude indirectly influences safety behaviour among flight attendants in the aviation industry, highlighting the importance of a positive safety attitude in fostering safer work practices. In manufacturing, Abdullah et al. (2016) found that safety attitude positively affects safety behaviour among operative workers. Sugumaran et al. (2017) also confirmed a positive correlation between safety attitude and safety behaviour in manufacturing firms in Selangor, Malaysia.

However, while the relationship between safety attitude and safety behaviour is well-established, there is a notable lack of empirical evidence, specifically from Small and Medium Enterprises (SMEs)

in the manufacturing sector. This gap in research limits our understanding of how safety attitudes translate into safety behaviours within this crucial segment of the manufacturing industry. In essence, the expected findings from this study strongly suggest that safety attitude is critical in influencing safety behaviour. Therefore, it could be hypothesised that:

> H1: Safety attitude significantly influences safety behaviour among operatives in the SME manufacturing sector.

Safety Training and Safety Behaviour

Loosemore et al. (2019) found that safety training significantly influenced the safety behaviour of construction employees in Australia, demonstrating that well-structured training programs can lead to safer practices on-site. Similarly, Newaz et al. (2019) reported that safety training positively impacted worker safety behaviour in construction firms, highlighting the role of training in promoting a safety-conscious workforce.

In the mining industry, Bae et al. (2021) observed that safety training positively impacted safety behaviour among quarry employees, underscoring the importance of training in hazardous work environments. Hassan et al. (2019) further demonstrated a positive correlation between safety training and safety behaviour among employees at Malaysian SMEs, reinforcing that effective training enhances adherence to safety protocols. Hou et al. (2021) also found a strong connection between safety training and safety behaviour in a study involving employees from a northern SME company, indicating that safety training is critical in encouraging safe practices across different sectors.

As a result, the consistent findings across these studies suggest that safety training significantly influences safety behaviour, making it a critical component of efforts to enhance workplace safety and reduce accidents. However, despite the established link between safety training and safety behaviour, there's a significant lack of research specifically focusing on SME manufacturing firms. This gap in understanding hinders our ability to tailor effective safety training programs for this vital sector, leaving many SMEs vulnerable to safety risks. This lack of research specifically focused on SMEs highlights the need to investigate the impact of safety training within this context. Therefore, it can be hypothesised that:

> H2: Safety training significantly influences safety behaviour among operatives in the SME manufacturing sector.

Safety Knowledge and Safety Behaviour

Safety knowledge is essential for fostering safety behaviour. It equips employees with the awareness to prevent accidents and injuries, creating a safer workplace (Duryan et al., 2020). Most workplace accidents involve a behavioural component, making safety knowledge a critical factor in promoting behaviours that prevent adverse outcomes (Huang et al., 2019).

The relationship between safety knowledge and behaviour is particularly evident in how employees respond to unexpected situations. Workers with thorough safety knowledge can quickly recognise potential hazards and take appropriate actions to mitigate risks, demonstrating proactive behaviour that prevents minor issues from escalating into major accidents (Kao et al., 2019). Regular training and continuous education are essential in reinforcing the importance of translating safety knowledge into everyday behaviour, ensuring that safe practices are consistently applied (Zulkifli, 2020).

Ultimately, the relationship between safety knowledge and safety behaviour is vital for maintaining a safe working environment. Safety knowledge provides the necessary understanding to identify and manage risks, while safety behaviour ensures that this knowledge is actively applied (Basahel, 2020). This dual focus creates a culture of safety, where employees are both aware of hazards and committed to following best practices to prevent them, leading to fewer accidents and a more secure workplace.

However, while the importance of this relationship is evident, research specifically investigating the impact of safety knowledge and behaviour within the context of SME manufacturing firms remains scarce. This lack of focused research limits our understanding of effectively implementing safety training programs that translate into tangible improvements in safety practices within this critical sector. Based on this understanding, it can be hypothesised that;

H3: Safety knowledge significantly influences safety behaviour among operatives in the SME manufacturing sector.

Safety Attitude and Safety Knowledge

Enhancing safety knowledge is crucial to influencing safety attitudes, which drives safety behaviour (Vinodkumar & Bhasi, 2010). When employees acquire safety knowledge, they develop positive or negative attitudes based on this information, which subsequently shapes their behaviour. For example, increased awareness and understanding of safety issues, such as the importance of wearing protective equipment, lead to a more favourable attitude towards safety practices and greater compliance with safety protocols.

Safety knowledge, which involves understanding safety protocols, potential hazards, and appropriate emergency responses, is essential for workers to identify risks and implement preventive measures (Basahel, 2020). However, this knowledge alone is insufficient if it is not coupled with a favourable safety attitude. A strong safety attitude is characterised by a proactive commitment to safety, adherence to protocols, and a sense of responsibility for the safety of oneself and others. Workers with a positive safety attitude are likelier to apply their knowledge effectively, contributing to a safer work environment. In contrast, a lack of safety attitude can result in complacency, where even knowledgeable workers might neglect safety procedures, thereby increasing the risk of accidents (Saini et al., 2023).

Therefore, the relationship between safety attitude and safety knowledge is symbiotic. Safety knowledge provides the foundation for understanding and addressing workplace risks, while a positive safety attitude ensures that this knowledge is consistently applied in practice. They create a strong safety culture that minimises accidents and promotes a secure working environment. Without a positive safety attitude, the impact of safety knowledge is diminished, highlighting the need to foster both elements to achieve optimal safety outcomes.

However, despite this understanding, the specific relationship between safety attitude and safety knowledge among operatives in SME manufacturing firms remains under-researched. This gap in knowledge limits our ability to develop targeted interventions that effectively address the unique challenges faced by operatives in this sector. Thus, it can be hypothesised that:

> H4: Safety attitude significantly influences safety knowledge among operatives in the SME manufacturing sector.

Safety Training and Safety Knowledge

Safety knowledge involves understanding potential hazards and correctly handling machinery, equipment, and processes (Barati Jozan et al., 2023). Safety training builds upon this foundation by providing in-depth information about these hazards and teaching workers how to mitigate them effectively. Training equips employees with the necessary skills and techniques to safely manage potential dangers, ensuring they can apply best practices, protocols, and procedures in their daily tasks (Albert & Routh, 2021). Moreover, safety training is crucial in enhancing existing safety knowledge by introducing new and updated safety guidelines, regulations, and industry standards. This continuous education reinforces a strong safety culture, encouraging workers to prioritise safety and comply with the latest safety regulations (Awolusi et al., 2018). As a result, employees are better equipped to recognise and respond to hazardous situations, reducing the likelihood of workplace accidents and injuries.

The practical aspect of safety training, including hands-on sessions, simulations, and drills, further reinforces safety knowledge by allowing employees to practice and apply what they have learned in a controlled environment (Hussain et al., 2020). This experiential learning solidifies theoretical knowledge and builds confidence in workers' ability to manage real-life risks effectively.

Additionally, the continuous improvement of safety training programs, informed by employee feedback, incident reports, and advancements in safety technology, is essential for sustaining and updating safety knowledge. By regularly revising training content and incorporating new safety practices, companies can ensure that their workforce remains knowledgeable and prepared to address emerging risks (Albert & Routh, 2021). This dynamic relationship between safety training and safety knowledge fosters a proactive

approach to safety management, ultimately leading to a safer and more productive workplace.

However, while the connection between safety training and safety knowledge is well-established, there is a notable lack of research examining this relationship within the context of SME manufacturing firms, particularly among operatives. This gap in knowledge hinders the ability to develop and implement effective safety training programs tailored to this critical sector's specific needs and challenges. In conclusion, drawing from the evidence presented in the literature, it can be hypothesised that:

> H5: Safety training significantly influences safety knowledge among operatives in the SME manufacturing sector.

Safety Knowledge as a Possible Mediator

Safety Attitude and Safety Behaviour

The literature suggests that safety attitudes can be shaped by an individual's level of safety knowledge. When employees are well-informed about safety protocols and the risks associated with their work, they are more likely to develop a positive safety attitude (Kao et al., 2019). This attitude, in turn, influences their behaviour, leading to safer practices and reduced workplace accidents. For instance, employees who understand the importance of wearing protective equipment are likelier to have a favourable attitude toward safety measures and consistently engage in behaviours that align with safety protocols (Basahel, 2020).

Moreover, the relationship between safety attitude and safety behaviour is strengthened when safety knowledge is actively applied in the workplace. A positive safety attitude ensures that the knowledge gained is not merely theoretical but is translated into practical, everyday actions that enhance workplace safety (Saini et al., 2023). Conversely, without a positive safety attitude, even the most comprehensive safety knowledge may not be effectively applied, leading to potential lapses in safety practices and an increased risk of accidents.

Given the interconnectedness of these variables, it can be hypothesised that safety knowledge serves as a mediator between safety attitude and safety behaviour. Specifically, safety knowledge may enhance the impact of safety attitudes on safety behaviour by providing the necessary understanding and tools for employees to act on their positive attitudes toward safety. In this way, safety knowledge bridges the gap between attitude and behaviour, ensuring that employees recognise the importance of safety and consistently engage in behaviours that uphold safety standards (Kao et al., 2019; Saini et al., 2023).

However, while this mediating effect of safety knowledge is a compelling theoretical framework, research investigating this relationship within the context of SME manufacturing firms, particularly among operatives, remains notably limited. This gap in research hinders our understanding of how to effectively leverage safety knowledge to improve safety outcomes within this critical sector. In conclusion,

drawing from the evidence presented in the literature, it can be hypothesised that:

> H6: Safety knowledge mediates the relationship between safety attitude and safety behaviour among operatives in the SME manufacturing sector.

Safety Training and Safety Behaviour

The relationship between safety training, safety knowledge, and safety behaviour is critical in fostering a safe and productive work environment, particularly in high-risk sectors such as manufacturing. Safety behaviour, which includes actions such as adherence to safety regulations, proper use of protective equipment, and proactive identification of potential hazards, is influenced by both the level of safety knowledge employees possess and the training they receive (Schwartz et al., 2019).

Safety training plays a foundational role in imparting safety knowledge. It provides employees with the necessary information and skills to understand potential hazards, proper machinery handling, and appropriate responses to emergencies (Santi et al., 2020). This training equips workers with theoretical knowledge and emphasises practical application through hands-on sessions, simulations, and drills, which are essential for reinforcing and internalising safety protocols (Rezaei & Jamshidi, 2019). As a result, employees who undergo comprehensive safety training are better prepared to recognise and respond to hazardous situations, significantly reducing the likelihood of accidents and injuries in the workplace.

Enhancing safety knowledge through training is crucial for developing effective safety behaviour. When well-trained, employees acquire new safety knowledge and update and reinforce their understanding of safety practices. This continuous learning process ensures that workers remain informed about the latest safety standards and regulations, promoting safety compliance and vigilance (Awolusi et al., 2018).

Moreover, the practical aspect of safety training allows employees to practice applying their knowledge in controlled environments, which boosts their confidence and ability to manage real-life risks effectively (Kao et al., 2019). Safety knowledge serves as a mediator between safety training and safety behaviour. The knowledge gained from training programs directly influences how employees behave in the workplace.

Workers with comprehensive safety knowledge are likelier to exhibit behaviours that prevent accidents and promote a safe working environment. They are also better equipped to make informed decisions contributing to organisational-wide safety (Santi et al., 2019). Therefore, while safety training provides the necessary knowledge, applying this knowledge through safety behaviour ultimately ensures workplace safety.

Given the interrelationship of these variables, it can be hypothesised that safety knowledge mediates the relationship between safety training and safety behaviour. Specifically, safety knowledge enhances the

effectiveness of safety training by translating the information and skills acquired during training into practical safety behaviours that protect employees and reduce workplace risks.

> H7: Safety knowledge mediates the relationship between safety training and safety behaviour among operatives in the SME manufacturing sector.

METHODS

Research Design

This research employed a cross-sectional survey design in which participants were surveyed simultaneously through distributed questionnaires. The study involved hypothesis testing, with six hypotheses grounded in earlier studies on safety management practices, safety knowledge, and safety behaviour. Additionally, a correlational analysis was conducted to examine the relationships among safety attitude, training, knowledge, and behaviour. Moreover, safety knowledge was introduced as a mediating factor to evaluate its influence on the connection between safety attitude, safety training, and safety behaviour.

Instrument Development

The study employed a questionnaire divided into (1) demographic information from participants and (2) gathering items related to four theoretical constructs. These items were adapted from existing literature. Specifically, the items used to assess safety behaviour were based on the work of Hayes et al. (1998). The items were sourced from studies by Sexton et al. (2006) for safety attitudes. Safety training items were derived from Grau et al. (2002). In addressing safety knowledge, the measurement items were adapted from Vinodkumar and Bhasi (2010). All constructs were assessed using a five-point Likert scale, ranging from (1) “Strongly Disagree” to (5) “Strongly Agree.”

Sampling and Data Collection

This study applied multi-stage sampling, combining two probability sampling approaches and one non-probability sampling approach: cluster sampling, simple random sampling, and convenient sampling.

First, the SME manufacturing firms in Selangor state were clustered into four regions: North, South, East, and West. An estimated 95 SME manufacturing firms in Selangor were compiled using information from the Yellow Pages and Google Maps official website, and each company was categorised based on its location in one of the four regions. Therefore, there are twenty-three firms in North Selangor, thirty-five in South Selangor, seventeen in East Selangor and twenty in West Selangor.

After clustering the geographical area in the Selangor state into four categories, the firms were randomly selected using the ballot box. The firms picked from the ballot box were selected for data collection. The researcher selected 32 firms, eight firms in each region. Then, the researcher contacted the company supervisor to ask permission to distribute the questionnaire to the employees.

At last, convenient sampling was used to select the respondents from each chosen firm. The researcher chose operatives from the firms. The number of operatives selected from each firm was determined according to the company's size based on observations made on the day of data collection. However, regardless of size, a minimum of 5 operatives was selected from each firm. Selecting at least five operatives from each firm with a total of 160 could represent the minimum sample size of 108, which is considered adequate for most research purposes. Figure 1 exhibits the flow chart of the sampling procedures of this study.

The survey was conducted using an electronic questionnaire via Google Forms, and the respondents were requested to fill in the Google Forms using the electronic devices provided by the researcher. The sample size was determined by considering the number of predictors and the required analytical power. Following the guidelines by Gefen et al. (2011), the study employed parameters of 80% power, a medium effect size, and a significance level of 0.05, resulting in a minimum required sample size of 108. However, the researchers successfully gathered data from 160 respondents, surpassing the minimum requirement. Therefore, the sample size in this study is considered adequate.

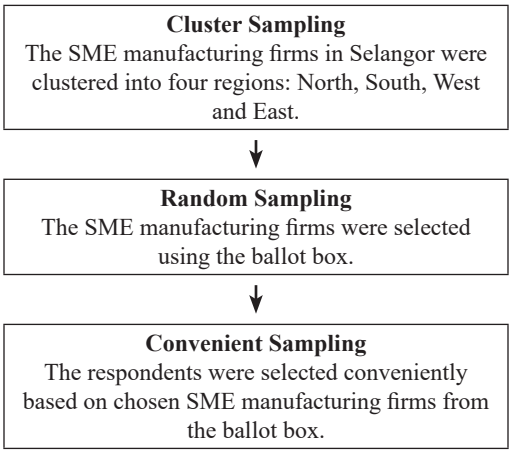

Figure 1. Sampling procedures
Source: Authors' work

The descriptive analysis revealed that 65.6% of the respondents were male, while 34.4% were female. Most of the participants were aged between 36 and 55. In terms of ethnicity, Bumiputera made up the largest group, accounting for 62.5% of the respondents. Marital status analysis showed that 71.9% were married, while 28.1% were single. Additionally, Table 1 highlights that many respondents had SPM-level academic

Table 1
Demographic profiles of respondents

Characteristics	Category	Frequency (n = 160)	Percentage %
Gender	Male	105	35.0
	Female	55	51.7
Age	18–35 years	32	20.0
	36–55 years	106	66.3
	Above 55 years	22	13.7
Race	Bumiputera	100	62.5
	Non-Bumiputera	60	37.5
Marital Status	Married	115	71.9
	Single	45	28.1
Academic Qualifications	SPM	117	73.1
	STPM	43	26.9
Working experience	Less than 5 years	33	20.6
	5–10 years	60	37.5
	11–15 years	28	17.5
	16–20 years	21	13.1
	Above 20 years	18	11.2

qualifications and between 5 and 10 years of work experience.

RESULTS

The main objective of this research was to examine the relationships among the variables outlined in the study's research framework. The data gathered for this study were analysed using Smart-PLS version 4 software. Following a two-stage approach, as Hair et al. (2019) recommended, the analysis began with assessing the measurement model to ensure both convergent and discriminant validity. Subsequently, the structural model was evaluated by applying the bootstrapping method, with a resampling rate of 10,000 iterations (Hair et al., 2019).

Measurement Model

It is essential to confirm both convergent and discriminant validity to ensure the reliability and accuracy of the measurement model. Convergent validity is established when the outer loadings reach at least 0.708, the Average Variance Extracted (AVE) is 0.5 or higher, and the composite reliability (CR) is at least 0.7, as outlined by Hair et al. (2019). As shown in Table 2, the study meets the criteria for convergent validity, with outer loadings, AVE, and CR values exceeding the required thresholds. Once this condition was satisfied, the discriminant validity of the model was assessed.

According to Franke and Sarstedt (2019), discriminant validity is confirmed when the Heterotrait-Monotrait (HTMT) ratios are below 0.85. As presented in Table 3, all HTMT values were below the 0.85 threshold, affirming that the study meets the HTMT criterion. The findings from this study confirm that the model exhibits

Table 2
Convergent validity

Construct	Indicator	Outer Loading	CR	AVE
SA	SA1	0.785	0.763	0.652
	SA2	0.772		
	SA3	0.738		
	SA5	0.749		
SB	SB2	0.812	0.831	0.695
	SB3	0.821		
	SB5	0.833		
	SB6	0.764		
	SB7	0.855		
SK	SK1	0.827	0.754	0.782
	SK2	0.833		
	SK3	0.784		
	SK4	0.815		
ST	ST1	0.781	0.884	0.716
	ST3	0.794		
	ST4	0.821		
	ST5	0.844		

Note. SA = Safety attitude, SB = Safety behaviour, SK = Safety knowledge, ST = Safety training
Indicators SA4, SB1, SK5 and ST2 were removed due to less than 0.708

Source: Author's work

Table 3
Heterotrait-Monotrait (HTMT)

	SA	SB	SK	ST
SA	-			
SB	0.731	-		
SK	0.765	0.693	-	
ST	0.713	0.638	0.727	-

Note. SA = Safety attitude, SB = Safety behaviour, SK = Safety knowledge, ST = Safety training
Source: Author's work

sufficient discriminant validity for the constructs and items analysed.

Structural Model

The next step involved assessing the structural model after a detailed measurement model evaluation. This assessment considered vital aspects such as checking Variance Inflation Factors (VIF) to ensure no collinearity among the constructs. Additionally, the significance of path coefficients, the explained variance (R^2), effect size (f^2), and predictive relevance (Q^2) were evaluated, in line with the guidelines provided by Hair et al. (2019). The hypothesised relationships depicted in Figure 2 were tested using bootstrapping techniques. Table 4 outlines the VIF values, confirming that all inner VIF values are well below the threshold of 5, thereby indicating no multicollinearity issues within this study.

Table 4
Collinearity assessment

CONSTRUCT	VIF
SA	2.345
SB	2.107
SK	2.764
ST	2.346

Note. SA = Safety attitude, SB = Safety behaviour, SK = Safety knowledge, ST = Safety training
Source: Author's work

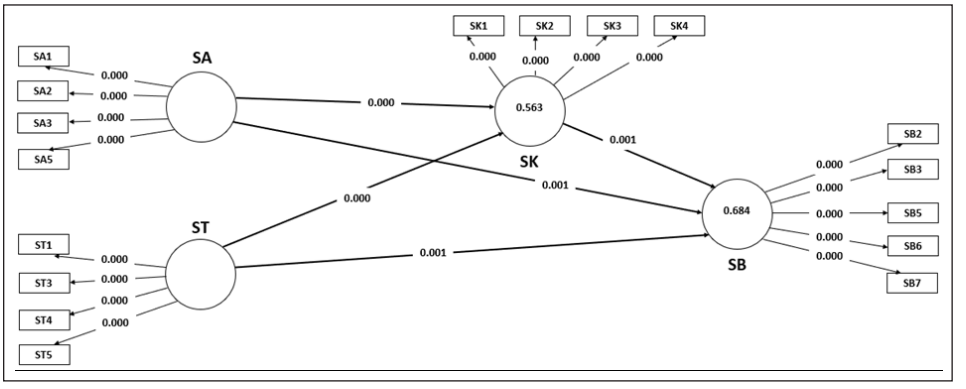

Figure 2. Structural model
Source: Author's work

Table 5
Direct path coefficient

Hypothesis	Paths	β (Beta)	SE	t- value	p-value	R^2	f^2	Q^2
H1	SA ➔ SB	0.362	0.075	4.827	0.001		0.254	
H2	ST ➔ SB	0.286	0.069	4.144	0.001	0.684	0.338	0.325
H3	SK ➔ SB	0.396	0.083	4.771	0.001		0.342	
H4	SA ➔ SK	0.397	0.061	6.508	0.000	0.563	0.369	0.321
H5	ST ➔ SK	0.442	0.064	6.906	0.000		0.357	

Note. SA = Safety attitude, SB = Safety behaviour, SK = Safety knowledge, ST = Safety training
Source: Author's work

Table 5 provides a comprehensive overview of the path coefficient analysis, shedding light on the intricate relationships between several key variables. This model explores five distinct hypotheses, labelled H1 through H5, involving four primary variables: SA, SB, ST, and SK. The analysis aims to uncover the strength and significance of these relationships, offering valuable insights into the underlying structure of the data.

The first three hypotheses (H1, H2, and H3) converge on SB as the dependent variable, examining how SA, ST, and SK influence it. The results reveal that all three variables have significant positive effects on SB, with SK showing the strongest influence (β = 0.396), followed closely by SA (β = 0.362), and then ST (β = 0.286). The statistical significance of these relationships is underscored by their low p-values (all at 0.001), indicating a high degree of confidence in these findings.

Interestingly, the model also explores the factors influencing SK through hypotheses H4 and H5. SA and ST demonstrate strong positive effects on SK, with ST exhibiting a slightly stronger influence (β = 0.442) compared to SA (β = 0.397). These relationships are even more statistically significant, with p-values of 0.000, suggesting an extremely low probability that these results occurred by chance.

The effect sizes (f^2) for all paths range from medium to large, with values between 0.254 and 0.369. It indicates that each construct contributes substantially to explaining the variance in its respective dependent variable. The largest effect sizes are observed for the paths leading to SK (H4 and H5), suggesting that SA and ST are particularly important predictors of SK.

The model's overall explanatory power is impressive, especially for SB. The R^2 value of 0.684 indicates that SA, ST, and SK collectively explain 68.4% of the variance in SB, which is substantial. Similarly, for SK, the R^2 value of 0.563 suggests that SA and ST account for 56.3% of its variance, also a noteworthy explanatory power. Moreover, the model demonstrates good predictive relevance, as evidenced by the Q^2 values (0.325 for SB and 0.321 for SK). These positive Q^2 values indicate that the model has predictive power and can accurately estimate data points.

Additionally, Figure 2 and Table 6 show the indirect effect of safety attitude and safety training through safety knowledge. Based on the findings, safety knowledge has significantly mediated safety attitudes and safety training on safety behaviour.

Table 6
Mediating path coefficient

Hypothesis	Path	β (Beta)	SE	t - value	p-value	Confidence Interval	
						LL	UL
H6	SA ➔ SK ➔ SB	0.475	0.061	7.787	0.000	0.025	0.078
H7	ST ➔ SK ➔ SB	0.532	0.072	7.389	0.000	0.028	0.085

Note. SA = Safety attitude, SB = Safety behaviour, SK = Safety knowledge, ST = Safety training
Source: Author's work

DISCUSSION

This study comprehensively examined the relationships between safety attitude, safety training, safety knowledge, and safety behaviour, with significant findings contributing to understanding workplace safety. First, it was established that safety attitude significantly influences safety behaviour, consistent with prior research (Basahel, 2020; Li et al., 2019; Rau et al., 2018). This relationship is particularly noteworthy in the Malaysian context, where higher occupational accident rates prevail. The study highlights the importance of a disciplined approach to task management, as frustration and poor planning can cloud judgment and increase the risk of unsafe behaviour, thereby affirming the significant impact of a positive safety attitude on safety behaviour.

Similarly, the study found that safety training plays a crucial role in shaping safety behaviour, aligning with the findings of Bae et al. (2021), Barati Jozan et al. (2023) and Hussain et al. (2020). It was observed that improper machinery operation, particularly at unsafe speeds, primarily contributes to occupational accidents. It underscores the importance of effective safety training in promoting adherence to safety protocols and reducing risky behaviours, particularly in environments with low supervision, thereby supporting the study's second hypothesis.

The study revealed that safety knowledge significantly influences safety behaviour, a finding consistent with previous research (Duryan et al., 2020; Huang et al., 2019; Saini et al., 2023). Safety knowledge, which involves understanding safety principles and practices, was identified as a critical predictor of safety behaviour, further validating the study's hypothesis.

The fourth hypothesis found that safety attitude positively impacts safety knowledge, consistent with previous studies (Basahel, 2020; Saini et al., 2023). A positive safety attitude fosters a proactive approach to acquiring and applying safety knowledge, which, in turn, enhances overall safety behaviour. This finding underscores the importance of emotional stability and a positive mindset in promoting safety knowledge and behaviour.

Moreover, the study identified a positive correlation between safety training and safety knowledge, corroborating the research of Albert and Routh (2021), Awolusi et al. (2018), and Hussain et al. (2020). Effective safety training enhances situational awareness and selective attention, particularly in multitasking environments like manufacturing, where distractions can compromise safety. This relationship supports the study's fifth hypothesis.

Finally, the mediating role of safety knowledge in the relationships between safety attitude, safety training, and safety behaviour was confirmed. Safety knowledge serves as a critical intermediary, translating positive safety attitudes and effective safety training into tangible safe practices in the workplace. Without this mediation, the impact of safety attitude and training on behaviour may be diminished. Therefore, the study strongly supports the hypothesis that safety knowledge mediates these relationships, ensuring that safety behaviour is consistently observed in the workplace.

CONCLUSION

In conclusion, this study comprehensively examines the factors influencing safety knowledge and safety behaviour within small and medium enterprises (SMEs) in the Malaysian manufacturing sector. The findings highlight that positive employee safety attitudes, focused training programs, and broad safety knowledge are critical determinants of safety behaviour. SMEs, which often face unique challenges such as resource constraints and lack of technical expertise, can significantly benefit from prioritising these factors to enhance their safety culture and mitigate workplace hazards. SMEs can strengthen their capacity for long-term occupational accident prevention by adopting an evidence-based approach that synthesises these determinants. Enhanced safety knowledge not only safeguards employee welfare but also catalyses improvements in productivity, innovation, stakeholder confidence, and overall competitiveness. This study extends the theoretical understanding of safety knowledge in underexplored contexts and offers practical insights for SMEs to enhance their safety practices systematically. Future research should continue to explore the dynamic interplay of these factors and their impact on firm performance to advance the field of safety management.

Implication of the Study

The study reinforces existing frameworks on safety attitude, training, knowledge, and behaviour, confirming safety knowledge's mediating role in workplace safety outcomes. This study also offers contributions for various stakeholders. For operatives and firms, it emphasises the need for comprehensive safety training programs that impart technical knowledge and foster a positive safety attitude. The research highlights the importance of enhancing workers' situational awareness and selective attention, especially in high-risk environments. It also stresses creating a workplace culture that promotes emotional stability and a positive mindset. Firms are encouraged to tailor their safety initiatives to maximise the benefits of training and positive attitudes toward safety behaviours.

Safety governing bodies can use the study's evidence-based insights to guide the development of safety standards and regulations. The research emphasises the importance of integrating knowledge-building and attitude-shaping components in safety guidelines. It suggests focusing on comprehensive safety programs that address both technical skills and psychological factors.

The study offers data-driven support for occupational safety policymaking for governments, particularly in developing countries like Malaysia. It highlights the need for legislation mandating holistic safety training programs in high-risk industries. The research suggests allocating resources for nationwide safety awareness campaigns that target both knowledge enhancement and attitude improvement. It also emphasises the importance of creating policies that encourage companies to invest in safety culture development.

Limitations and Recommendations for Future Research

This study, while comprehensive, has certain limitations that warrant consideration. One notable limitation is the focus on SMEs within the Malaysian manufacturing sector, which may limit the generalizability of the findings to other sectors or regions. Future research could expand the scope to include SMEs from various industries and geographical locations to provide a more holistic understanding of the factors influencing safety knowledge. Additionally, the study's cross-sectional nature limits the ability to draw causal inferences. Longitudinal studies could be conducted to examine how changes in safety attitudes, training, and procedures over time impact safety knowledge and workplace safety outcomes.

Moreover, this study primarily relies on self-reported data, which may be subject to response biases. Future research could incorporate objective measures of safety knowledge and performance to validate the self-reported data. Additionally, investigating the interaction effects of different factors influencing safety knowledge could provide deeper insights into how these factors collectively impact safety outcomes. Further studies could also explore the mediating and moderating variables that influence the relationship between safety knowledge and organisational performance, thereby offering a more nuanced understanding of the underlying mechanisms at play.

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