RESEARCH IN MANAGEMENT OF TECHNOLOGY AND BUSINESS
e-ISSN: 2773-5044

RMTB

Vol. 7 No. 1 (2026) 478-498
https://publisher.uthm.edu.my/periodicals/index.php/rmtb

Risk Management Approach to Enhanced Construction Safety in Selangor

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DOI: https://doi.org/10.30880/rmtb.2026.07.01.039

Article Info

Received: 31 March 2026
Accepted: 31 May 2026
Available online: 30 June 2026

Keywords

Risk Management Approach, Construction Safety, Problems, Impact, Improvement

Abstract

The construction industry in Selangor keeps encountering safety problems. The Department of Occupational Safety and Health (DOSH) reports show that there are more injuries and deaths in construction. Most of the problems arise due to poor safety management, lack of training, weak leadership, using limitations technology, and acting on safety problems once they happen. The current objectives aimed to investigate the problems faced by the contractor towards implementing risk management in construction safety in Selangor, to identify the impact of implementation of implementation of risk management towards construction safety in Selangor, to suggest the improvement of risk management implementation in construction safety in Selangor. This study focuses on G7 contractors who registered with CIDB in Petaling district, Selangor. The total population G7 contractor in Petaling district is 1323, so the sampling size be 302 respondents. Out of this amount, 30 percent of the respondents or 91 contractors were chosen at random to take part in the project. The data analysis, in respect to the implementation of risk management approach, is done to the Statistical Package for Social Sciences, SPSS was discussed. It shows that risk management implementation involves risk identification and appropriate approaches such as safety training and improved communication provides a basis for improvement to construction safety performance and ensuring long-term sustainability of the construction industry in Selangor. This research identifies poor communication as the main problem in safety in the construction industry. The impact of failed safety is increasing projects expenses, while behavior-based safety is the suggestion to improvement. Focusing on safety through communication and behavior to enhance safety performance.

1. Introduction

In Malaysia, the construction industry is one of the most important sectors within the economy. However, this industry is facing new problems in relation to operational risks and concerns, particularly in high-density areas such as the state of Selangor. Economic contribution is high, but the nature of the project tends to cause systemic

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concerns in relation to safety and efficiency on site (Dyreborg *et al*., 2022). In this specific chapter, it is necessary to expose and understand the significance of the definition of the research background, statement of the problem, research question, objective, scope of study, methodology, outcome, and significance of the study, as well as summary of this specific chapter.

Despite such regulatory frameworks as OSHA 1994 and FMA 1967, the state of construction safety in Malaysia is still at risk. Contractor's view managing risks as a formality to comply with and not as an integrated practice in their firms. Therefore, risk identification is mostly incomplete, and there is inconsistency in the approach taken regarding safety. This discontinuation has been based on inappropriate training, weak leadership, poor communication, and resistance to adopting new technologies (Kumi *et al*., 2024). These emerging gaps in safety contribute to preventable accidents that cause financial losses and have made stakeholders lose trust.

The construction industry in Malaysia remains problems in terms of safety, despite the presence of a variety of safety standards. Many contractors treat risk management as just a formality for compliance, rather than using it as a proper tool to improve on-site safety (Akter *et al*., 2025). All results in poor hazard identification, as well as divergent safety procedures (Lee *et al*., 2018). These include a lack of training, inadequate leadership with respect to safety, poor communication, as well as a failure to leverage technology to monitor hazards (Woolford *et al*., 2017). As a result, accidents still happen, causing delays, financial loss, and loss of trust from stakeholders. Workers also lose interest in safety because they see that the system doesn't work well. This study will look at these issues more closely and suggest ways to improve risk management and overall safety in the construction industry (Yap *et al*., 2024).

Data from DOSH shows Figure 1 of the problems. Injuries reduced by 42%, from 3,958 in 2020 to 2,297 in 2021 but surged to 4,324 in 2022 and 5,379 in 2023 (DOSH, 2025). This is an indication that the gains made in safety approach were not long-term. This might be attributed to the rapidness of project implementation without careful safety measures and ineffective implementation of safety regulations (YA & Nadirah, 2024). Similarly, deaths dropped to 73 in 2021 but rose again to 88 in 2023, the highest in four years (DOSH, 2025). This shows that the current safety approaches are not sufficient during the periods of intense construction. Problems like poor enforcement, lack of training, and not using safety technology continue to cause preventable deaths (Dasgupta *et al*., 2024). Therefore, better and more proactive safety systems are urgently needed.

The construction industry in Malaysia still faces major safety issues, especially when looking at the number of deaths at worksites. During the COVID-19 pandemic, the number of fatalities dropped to 73 in 2021. However, as construction activities picked up again, the number of deaths increased by 22% to 88 in 2023, the highest in the past four years (DOSH, 2025). This shows that current safety systems are not strong enough during busy periods. The increase in deaths is caused by non-compliance with safety regulations, poor training of workers, and inadequate on digital tools of ensuring construction-related safety. This results in accidents that can be prevented. The regular occurrence of these deaths is evident enough to show that the construction sector of Malaysia requires an effective approach in ensuring that safety measures go beyond compliance with regulations. The approach that can be applied is proactive risk management methodology based on data (Dasgupta *et al*., 2024).

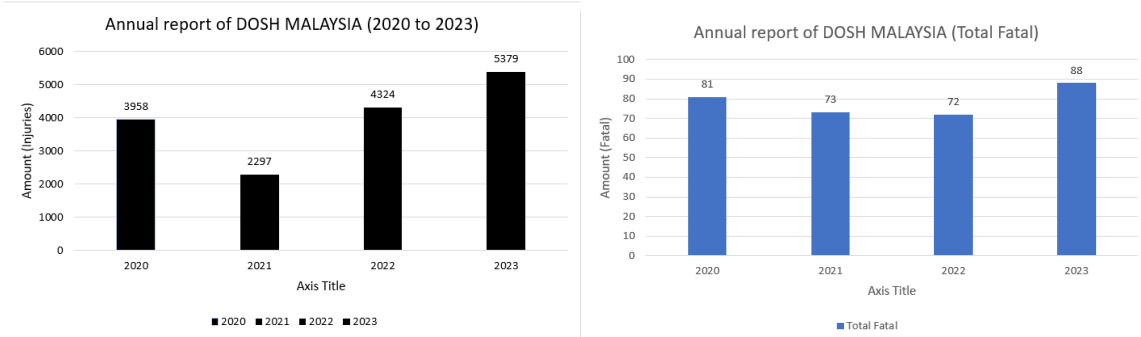


Fig. 1 *Annual Report of Total Injuries and Total Fatal from 2020 to 2023*

This study focuses on Contractor who was registered with CIDB in Petaling, Selangor as shows from Figure 2. The total population G7 Contractor in Petaling is 1323, so the sampling size will be 302 respondents. Out of this amount, 30 percent of the respondents or 91 contractors random to take part in the study. Primary data will be collected using the questionnaire method and secondary data will be sourced from journals, articles, books, newspapers, and online documents on digital tools. The respondents were given a questionnaire by a link of Google Form through social media like WhatsApp, and Email. SPSS was employed to conduct statistical analyses on the data with the aim of identifying key patterns and relations.

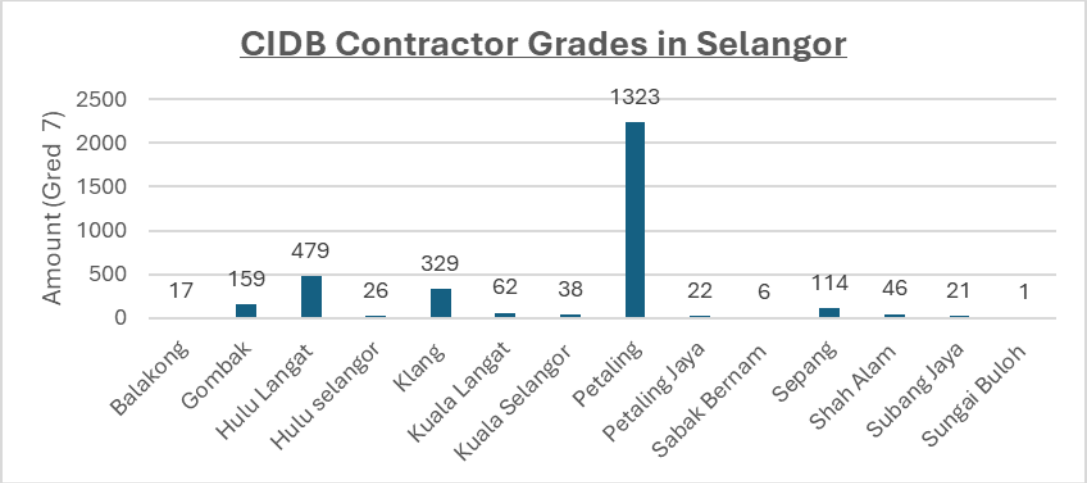


Fig. 2 *CIDB Contractor Grades in Selangor (Source: CIDB Malaysia)*

2. Literature Review

The construction industry is known to be one of the most dangerous sectors all over the world because of the large number of occurrences of deaths, injuries, and even death (Haupt *et al*., 2016). The complexity of the process, the dynamic environment, the presence of various contractors, and the use of machinery are all contributing factors (Nikolić & Cerić, 2022). In the country of Malaysia, especially in a region such as Selangor, the number of construction projects is slowly increasing, thus the need for effective methods of risk reduction (Ahmad & Ismail, 2022).

2.1 Risk Management

Risk management in development refers to a structured process for determining certainty, calculating, and limiting potential events or circumstances that may give negative feedback to the project's objectives, such as safety, cost, time, and quality (Smith *et al*., 2020). In the context of coaching, risk management is essential for minimizing workplace hazards and ensuring employee safety. Risk identification, risk assessment, risk response design, monitoring and continuous improvement are some of the primary indicators that are affected by this process. The well-executed risk management enables project managers to create a plan that increases project satisfaction and results (JaiSai *et al*., 2023).

2.2 Construction Safety

Construction safety refers to a cluster of practices and cultures aimed at ensuring the welfare and safety of workers within the construction field. With construction activities and operations inherently dangerous, the need to apply construction safety is critical to create a safe environment within the workplace (Him, 2023).

2.2.1 Common Construction Hazard

These are some of the most common occupational hazards faced in the construction industry, including accidents such as falls from heights, hits from falling objects, electric shock, and exposure to hazardous materials. In most cases, it could be worsened through a lack of proper training, poor management at sites, and not adhering to the safety guidelines (Dei, 2016). Indeed, studies in Malaysia consider falls from height and striking accidents as the top cause of accidents in the construction industries. Such hazards require thorough assessments and the adoption of an approach to control them for the monitoring of the workplace environment continuously for safety (Idoko *et al*., 2024).

2.2.2 Legal and Regulatory Framework

Through the Occupational Safety and Health Act 1994 (OSHA 1994) and the Factories and Machinery Act 1967 (FMA 1967), it has been identified that Malaysia has strict range concerning work in construction (Koh *et al*., 2022). This act gives an employer the directive to ensure that the safety, health, and welfare of the workers are met through performing the necessary construction-related health and safety actions (Tamers *et al.,* 2020). In addition, the Occupational Safety and Health Regulations 2024 emphasize the importance of promoting safety during the period of increasing design and planning of construction projects. The Occupational Safety and Health Department (DOSH) is responsible for enforcing this regulation, and failure to do so may result in severe penalties, such as fines and penalties (Aziz, 2019).

2.2.3 Importance of a Safety Culture

Aside from following the law, it is crucial to improve the quality of safety by implementing a strong safety culture in the development organization (Newaz *et al*., 2018). Positive safety practices include proactive safety practices, open communication on safety concerns, and mutual support for safety among all relevant parties. Research has shown that a good safety culture has contributed to an organization experiencing fewer accidents and overall better performance. Continuous training, management involvement, and the inculcation of safety principles in organizational behavior remain part of Malaysia's safety practice. For example, the identified study in Malaysian manufacturing industries on safety culture recognizes an urgent need for structured tools with which to measure and grow the positive attitude of the safety culture.

2.3 Problems Faced by the Contractor towards Implementing Risk Management in Construction Safety in Selangor

All these factors interfere with risk management and reduce the level of construction safety (Maliha *et al*., 2021).

2.3.1 Lack of Awareness & Training

A lack of understanding between the workforce and the management represents one of the main sources of exposure to risks. It emphasizes the divide between the level of present safety knowledge and the need level of the actual skills that must be applied to deal with the site risks. However, lack of awareness and proper training among construction workers and supervisors causes many risks for contractors (Amoah & Bikitsha, 2021). Besides that, Untrained workers are often unaware of how to handle risks or follow specific safety rules (Adeyemi *et al*., 2020). Training is often too simple and fails to address new or evolving site risks (Schulman, 2020).

2.3.2 Organizational Weaknesses

Organizational failures within Malaysia, such as cash-flow problems and late payments, immediately affect safety quality. It explains how financial insecurity prevents smaller firms from investing in appropriate safety tools and modern management systems. Financial problems such as delayed payments and difficulties with cash flow often result in slow work and poor quality for organizational (Moshood *et al*., 2020). Small businesses may not be able to afford state-of-the-art safety tools and management systems (Shaikh *et al*., 2021).

2.3.3 Poor Communication leads misunderstandings

A lack of communication in the construction industry in Malaysia translates to a lack of understanding, which in turn hampers safety. The hierarchical structure and the language barrier existing for the foreign workforce can work as an obstacle to proper communication and the passage of vital information. Poor communication in the construction industry in the MENA region is mainly caused by language barriers, unclear instructions (Suleiman, 2022). Besides that, Strict hierarchical structures and a lack of a common language among foreign workers hinder the flow of information (Abdul-Aziz, 2001).

2.3.4 Lack of Coordination Increases Risk of Project Failures

Lack of coordination among different teams involved in projects poses a serious risk about risk management. This implies that the lack of coordination among different teams eliminates the clarity of allocation and sharing of information pertaining to safety among the teams involved. This is more common in projects that are very huge with a high number of subcontractors. Faces have a problem of interdepartmental collaboration complexity and duplication of roles, as well as coordination problems among numerous agencies (Christensen & Ma, 2020). Apart from that, lack of coordination causes poor management of risk and translates to failed projects (Chileshe & Kikwasi, 2014).

2.3.5 Technological Limitations

The reliance on manual and outdated methods is still one of the challenges. This is why the high cost of implementation, and the absence of professionals to implement new tools such as BIM and AI is deterring the implementation of new approaches in the name of safety management. The biggest barriers are high costs, lack of technical skills, and resistance to change within the industry (Delgado *et al*., 2020). However, Use of paper-based systems that are prone to errors keeps the rate of accidents high in the smaller companies (Parsamehr *et al*., 2022).

2.3.6 Behavioral Resistance Prevents Safety

Personal attitudes concerning safety procedures cause non-compliance. Some workers may undervalue risks at the work site or view safety procedures as hindrances to production. If the attitudes of these workers conflict with the emphasis on safety, it will compromise the safety environment. Workers disregard rules as they underestimate hazards or perceive safety measures as a constraint on productivity (Peng *et al*., 2023).

2.3.7 Cultural Barriers Difficult Prevent Safety

The multi-cultural dynamics in the Malaysian construction industry also contribute to various beliefs and values that may constitute a barrier to the safety processes. The elements of misunderstandings, inconsistent application of safety, and commitment to team-based safety goals are the effects of various beliefs Cultural differences in the workplace inhibit and cause misunderstandings and ineffective team commitment (Fayyaz *et al*., 2025).

2.3.8 Lack of Leadership Commitment

Successful risk management clearly relies on effective leadership. If the management views safety as a secondary concern, after cost and then time, the measures proposed in safety will be nothing but a symbol. This will make it difficult to build a proactive safety culture. This lack of leadership commitment creates an environment in which safety is viewed as a secondary concern, indicating that the risk management system is being carried out effectively (Basahel *et al*., 2021).

2.4 Impact of Risk Management Implementing on Construction Safety

The lack of a good safety plan at work can lead to more accidents and fatalities for workers. It was impacting the risks towards workers and the company (Ahmed *et al*., 2021).

2.4.1 Increased Workplace Accidents & Fatalities

Lack of effective risk management causes more injuries and fatalities directly. It underlines the importance of updating risk assessments when there are changes on-site to avoid mitigating some newly arising hazards. Lack of proper implementation, inadequate follow-up, or failure to describe the current risk assessment as a response to the site changes can be used to mitigate the damage to the house or to mitigate emerging risks (Famakin *et al*., 2020).

2.4.2 Non-Compliance Penalties & Legal Liabilities

Contractors also risk severe legal repercussions for neglecting to adhere to Malaysian safety regulations such as OSHA 1994. This includes the possibility of hefty fines and lawsuits from affected parties. If the contractor is unable to meet this requirement, they may be subject to fines, prosecution, or even be taught (Liao & Hsieh, 2021). The case law has demonstrated that employers can be used to counteract injuries caused by homes that can be destroyed or destroyed, especially if there is a long-term risk assessment that is carried out (Friedman & Ladinsky, 2021).

2.4.3 Accident Increased Project Costs

The construction accident can cause massive financial problems. It is what makes the difference between direct medical expenses and the possible inflated costs of inquiry fees and rework. If safety failures occur, companies will respond with silent financial costs, such as legal fees, compensation claims, and medical expenses (Brauer *et al,* 2022). The indirect costs of safety problems are usually higher than the direct cost of healthcare (Dahalan *et al*., 2022).

2.4.4 Delays Significantly Raise the Total Project Cost

Safety events cause stopping work, causing delays to project schedules. Cost escalation is experienced because of increased overheads, standby, and storage of material. The rising costs of construction projects are often brought about by the delays in constructions since longer periods mean higher overheads, labour, and equipment rents as well as the cost of storing materials (Sanni-Anibire *et al*., 2022). In Malaysia, most project delays are directly equivalent to high-cost overruns and financing rates (Norul Izzati, 2019). The contractors are subjected to heavy liquidated damages (LD) for delays in project completion caused by safety concerns (Viles, 2020).

2.4.5 Loss of Stakeholder Trust

Safety incidents can hurt the reputation of companies. A bad reputation will make it hard for them to obtain project financing. In addition, they will lose customers on future business transactions. Loss of trust in stakeholders is a direct result of a project's internal problems, such as a repeated safety incident, an increase in costs, or a weak risk (Tien *et al*., 2021). Damage to reputation results in problems with accessing finances for projects, as well as with business development (Thakor & Merton, 2024). A high commitment to safety provides a buffer for the firm's reputation and financial strength within the context of stakeholders (Strahorn, 2015).

2.4.6 Reactive Safety Culture

The reactive strategy is more about dealing with the aftermath than prevention. Then, a cycle of repairing and analyzing has a goal in mind to get through a level of safety for a long period of time, but this cycle cannot. Organizations practicing damage control lack implementation of lasting measures for enhancing safety (Corrigan *et al*., 2019).

2.4.7 Productivity Collapse

Unattended risks cause stoppages in work and inefficiency. Safety problems are identified among the most important factors that determine overall contractors' success in Malaysia. Risk of safety failure causes the entire project productivity to come to a complete halt (Yap *et al*., 2020). Safety is the most important unresolved issue in determining the success of the project in the Malaysian market (Assaad & El-Adaway, 2020).

2.5 The Suggest Improvement for Risk Management Implementing on Construction Safety

It becomes important to establish a safety culture by teaming up, learning from the past, as well as following regulations to ensure the prevention of incidents and promote construction safety (Jiang *et al*., 2020).

2.5.1 Digital Risk Management Tools

The use of digital technology integration makes it possible to have a proactive safety approach on sites. Using IoT and automation, contractors can gather data on hazards and monitor environmental factors like dust and vibrations. Digital technology enables proactive analysis of safety using real-time data (Afzal *et al*., 2021). IoT sensors assist in the monitoring of some of the environmental concerns, such as temperature and humidity, to identify danger (Chen *et al*., 2022). Digital technology is now an essential part of risk-reducing measures in constructing buildings, especially in the context of Malaysian construction industry settings (Low *et al*., 2020).

2.5.2 Behavior-Based Safety Programs

BBS focuses on the psychological and behavioral issues of safety: observing and changing worker habits enables organizations to implement safety from the grassroots, nipping the causes of unhealthy site practices at their roots. BBS provides employees with the tools to manage their own work-related risks and promotes safety from below (Rashid *et al.,* 2022). Besides that, adapting BBS to the local operational context increases participation of the multicultural workforce (Devi *et al*., 2022).

2.5.3 Enhanced Training Helps Workers Perform Tasks More Safely

To enhance safety knowledge by training is a necessary aspect in reducing risks. However, going beyond general training to specific training encourages workers to understand emerging risks while performing difficult tasks with improved precision even in a site setting that aims to reduce accidents. Comprehensive safety training programs give the necessary skills to the workers to encounter actual site conditions (Jiang *et al*., 2020). Specific training for the administrator and employees is also important in limiting human error during critical procedures (Adeyemi et al., 2020). However, a more diverse workforce retains safety training more effectively when modern training methods are incorporated, for example, through simulation learning (Yap *et al*., 2024).

2.5.4 Improved Communication Increases Overall Safety Awareness

The risk can be reduced if there is an efficient flow of information that is related to contractors and employees. For example, the culture of reporting 'near mis' incidents without fear of punishment is enhanced, and corrective actions should be taken even before the accident occurs. Open communication can encourage the reporting of unsafe acts, enabling measures to prevent these acts before they occur (Olanrewaju, 2017). Briefings and written instructions ensure common understanding and help comply with safety (Fiah *et al*., 2022).

2.5.5 Leadership Engagement

It with an active role from top management also encourages safety as a value. Such managers who frequently attend safety briefings and invest funds around prevention clearly have more than mere compliance at heart. Leadership involvement in safety briefings and incident reviews greatly enhances safety values (Suresh *et al*., 2019).

2.5.6 Promoting a Safety Culture

Accountability at all levels is very important in a strong safety culture. Leadership must be active, mentoring establishes safety as a value equal to meeting deadlines and being productive. A top-down approach shows safety is an organizational priority of equal importance compared to project productivity (Amiri & Shaafi, 2020).

2.5.7 Utilizing Wearable Technology for Enhanced Construction Worker Safety

Smart devices also act as frontline protection to monitor workers' health and whereabouts. This form of technology works well when it's high hazard, such as working at heights and near machinery. There are also smart devices that are designed to prevent slips and falls. This smart device. Wearables may be capable of transmitting vital signs such as heart rate to alert their supervisors of worker fatigue or distress (Zhang *et al*., 2015). However, intelligence helmets and GPS life jackets are accident preventers because they ensure constant awareness of the environment (Rane *et al*., 2023).

3. Research Methodology

This chapter offers details of the methodologies, approaches, and strategies employed to achieve the research goals. The research methods selected are to carry out a well-structured and systematic investigation, with a definite format for reaching the research goals. This chapter also offers an overall impression of the research process, with the inclusion of an evaluation of the methods utilized, a flowchart of the work process of the research, and an overview of the entire research methodology.

3.1 Research Approach

The quantitative research methodology adopted in this study enabled it to gather quantifiable data in the form of risk management and construction safety among contractors (Patel *et al*., 2019). Structured questionnaires have been selected as a primary instrument to obtain uniformed answers. This approach assisted the researcher to learn the patterns and associations amid the issues contractors experience and the effects of risk management actions on site safety.

3.1.1 Research Design

The research design is quantitative study, which is considered appropriate to determine patterns and relationships between implementation of risk management and safety outcomes in the construction industry (Asenahabi & B, 2019). The design will allow the researcher to objectively quantify the data and relationships between variables. A descriptive survey was conducted in getting the views of the G7 contractors about their safety practices and risk management experiences.

3.1.2 Literature Review Method

To develop a strong theoretical framework, extensive literature review was undertaken. The secondary data were gathered through peer-reviewed journals, academic books, government publications, online articles and reports of related organizations like CIDB and DOSH. The literature review was used in the design of the questionnaire, and it offered vital information on the current safety systems, risk implementation challenges and good practices internationally (Asenahabi & B, 2019).

3.1.3 Quantitative Research Method

The research employed a quantitative research design, which was structured using distribution of self-administered questionnaires (Creswell & Creswell, 2017). The instrument used was a 5-point Likert scale to determine the degree of agreement or disagreement of the respondents to the statements which were based on risk management and construction safety. This was an effective way of gathering a huge amount of information in a short period of time and getting uniformity of responses to enable statistical treatment.

3.1.4 Literature Review Method

Table 1 *shows the research methods and interviewees for each objective*

Objectives	Data Collection Method	Respondent
To investigate the problems faced by the contractor towards the implementing of risk management to enhanced construction safety in Selangor.	Quantitative Method: Questionnaire	G7 Contractor
To identify the impact of implementation of risk management towards construction safety in Selangor.	Quantitative Method: Questionnaire	G7 Contractor
To suggest the improvement of risk management implementation in construction safety.	Quantitative Method: Questionnaire	G7 Contractor

The online questionnaire was designed through Google Forms to collect data. The survey was shared using online platforms like WhatsApp, and Email to enhance access and response. The questionnaire was intended to be brief, precise, and divided into sections that followed the objectives of the research according to table 1, which were problems, impacts, and improvements of risk management approach.

3.2 Data Collection

Data collection was with both primary and secondary sources. The primary data was collected with the help of the questionnaire that was sent through Google Forms and shared in WhatsApp, Instagram, and Email. Secondary data were obtained through journals, books, articles, reports, and online sources, and they served to give background knowledge and give credence to the survey findings.

3.2.1 Primary Data

Primary data collection is crucial to ensure that the research is well-founded and supported by solid evidence. Data sources include primary and secondary data. Data and information are collected through Google Form questionnaires and interviews. Participants will rate the questions on a scale of 1 to 5, with 5 representing from strongly disagree to strongly agree (Saunders *et al*., 2023). The information is analyzed using SPSS, a statistical software for social sciences. SPSS is comprehensive statistical software that can reduce complexity and facilitate data understanding. The use of structured questionnaires as a primary data collection method is well-established in construction safety research.

3.2.2 Secondary Data

The secondary data were obtained based on the already published works, such as academic journals, books, newspaper articles, and online sources. These documents offered additional data that put the main information into perspective and helped to analyze the results in the context of the entire discussion of construction safety in Malaysia

3.3 Data Analysis

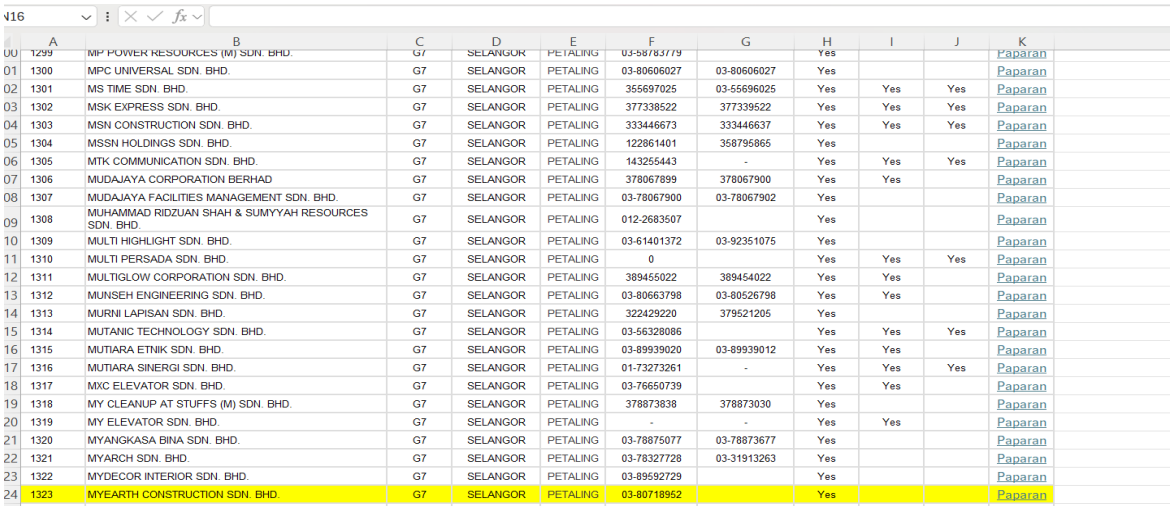
Data analysis refers to the systematic application of logical and statistical methods to describe, explain, condense, summarize, and evaluate data. In this research the sample is a total of 302 contractors out of the total population of 1323 G7 contractors in the Petaling District of Selangor and the calculation was made using the Krejcie and Morgan (1970) method. A total of 91 responses out of this sample were collected (30% of the total) chosen randomly out of the G7 contractors in the Petaling District, Selangor. The data for this study were analyzed using the Statistical Package for Social Sciences (SPSS).

3.3.1 SPSS Statistics

The Statistical Package for Social Sciences (SPSS) was used to analyze the responses obtained. Central tendencies and trends in the data were determined through descriptive statistical techniques including frequency distribution and mean scores. The correlation analysis was performed to evaluate the connection between the problems faced with risk management approach effectiveness (Pallant, 2020).

3.3.2 Microsoft Excel

Preliminary data processing was done in Microsoft Excel where data cleaning, sorting and visual representation in form of charts and graphs were created (Rumsey, 2021). Microsoft Excel to narrow down the list of contractors to those in the specific Petaling district of Selangor, the list was reduced to 1,323 contractors as shown on Figure 3. Thus, the study sample will be these 1,323 operative G7 contractors in the Petaling district, Selangor.



	A	B	C	D	E	F	G	H	I	J	K
00	1299	MP POWER RESOURCES (M) SDN. BHD.	G7	SELANGOR	PETALING	03-58783779		Yes			Paparan
01	1300	MPC UNIVERSAL SDN. BHD.	G7	SELANGOR	PETALING	03-80606027	03-80606027	Yes			Paparan
02	1301	MS TIME SDN. BHD.	G7	SELANGOR	PETALING	355697025	03-55696025	Yes	Yes	Yes	Paparan
03	1302	MSK EXPRESS SDN. BHD.	G7	SELANGOR	PETALING	377338522	377339522	Yes	Yes	Yes	Paparan
04	1303	MSN CONSTRUCTION SDN. BHD.	G7	SELANGOR	PETALING	333446673	333446637	Yes	Yes	Yes	Paparan
05	1304	MSSN HOLDINGS SDN. BHD.	G7	SELANGOR	PETALING	122861401	358795865	Yes			Paparan
06	1305	MTK COMMUNICATION SDN. BHD.	G7	SELANGOR	PETALING	143255443	-	Yes	Yes	Yes	Paparan
07	1306	MUDAJAYA CORPORATION BERHAD	G7	SELANGOR	PETALING	378067899	378067900	Yes	Yes		Paparan
08	1307	MUDAJAYA FACILITIES MANAGEMENT SDN. BHD.	G7	SELANGOR	PETALING	03-78067900	03-78067902	Yes			Paparan
09	1308	MUHAMMAD RIDZUAN SHAH & SUMYYAH RESOURCES SDN. BHD.	G7	SELANGOR	PETALING	012-2683507		Yes			Paparan
10	1309	MULTI HIGHLIGHT SDN. BHD.	G7	SELANGOR	PETALING	03-61401372	03-92351075	Yes			Paparan
11	1310	MULTI PERSADA SDN. BHD.	G7	SELANGOR	PETALING	0		Yes	Yes	Yes	Paparan
12	1311	MULTIGLOW CORPORATION SDN. BHD.	G7	SELANGOR	PETALING	389455022	389454022	Yes	Yes		Paparan
13	1312	MUNSEH ENGINEERING SDN. BHD.	G7	SELANGOR	PETALING	03-80663798	03-80526798	Yes	Yes		Paparan
14	1313	MURNI LAPISAN SDN. BHD.	G7	SELANGOR	PETALING	322429220	379521205	Yes			Paparan
15	1314	MUTANIC TECHNOLOGY SDN. BHD.	G7	SELANGOR	PETALING	03-56328086		Yes	Yes	Yes	Paparan
16	1315	MUTIARA ETNIK SDN. BHD.	G7	SELANGOR	PETALING	03-89939020	03-89939012	Yes	Yes		Paparan
17	1316	MUTIARA SINERGI SDN. BHD.	G7	SELANGOR	PETALING	01-73273261	-	Yes	Yes	Yes	Paparan
18	1317	MXC ELEVATOR SDN. BHD.	G7	SELANGOR	PETALING	03-76650739		Yes	Yes		Paparan
19	1318	MY CLEANUP AT STUFFS (M) SDN. BHD.	G7	SELANGOR	PETALING	378873838	378873030	Yes			Paparan
20	1319	MY ELEVATOR SDN. BHD.	G7	SELANGOR	PETALING	-	-	Yes	Yes		Paparan
21	1320	MYANGKASA BINA SDN. BHD.	G7	SELANGOR	PETALING	03-78875077	03-78873677	Yes			Paparan
22	1321	MYARCH SDN. BHD.	G7	SELANGOR	PETALING	03-78327728	03-31913263	Yes			Paparan
23	1322	MYDECOR INTERIOR SDN. BHD.	G7	SELANGOR	PETALING	03-89592729		Yes			Paparan
24	1323	MYEARTH CONSTRUCTION SDN. BHD.	G7	SELANGOR	PETALING	03-80718952		Yes			Paparan

Fig. 3 *Show the numbers of G7 contractors after Microsoft excel filters*

3.4 Respondent

This section describes the characteristics of the respondents who participated in this research. The focus of this research is on G7 contractors registered with the Construction Industry Development Board (CIDB) of Johor, Malaysia, as they are key stakeholders directly affected by fluctuations in material prices for commercial office building projects.

3.4.1 Population Size

The target population in this research was 1,323 CIDB registered contractors in Petaling district of Selangor. Petaling was chosen because it is one of the areas with high construction activity and a high population of Grade 7 contractors, which makes it a good area to study safety practices.

3.4.2 Sample Size

For this study, Selangor is chosen due to the total value of work done is the third highest in Malaysia. The population estimation was derived using Table 2 with the formula suggested by Krejcie and Morgan (1970). As indicated by the data, there are 1,323 G7 contractors in the Petaling District, Selangor and 302 contractors will represent the sample size of the study. Out of this amount, 30 percent of the respondents or 91 contractors were chosen at random to take part in the study.

Research in Management of Technology and Business Vol. 7 No. 1 (2026) p. 478-498

Table 2 *Determine the sample size for the population (Krejcie & Morgan, 1970)*

N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size. *S* is sample size.

Source: Krejcie & Morgan, 1970

3.5 Likert Scale

Table 3 *Likert Scale Used for Each objective*

Scale	1	2	3	4	5
Description	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

Inside the questionnaire, the researcher prepared the closed-ended questions such as multiple choice and five points Likert-scale to be answered by the respondents. The 5 point-Likert Scale can be determined by Table 3.

3.6 Pilot Test

The findings of the pilot test are summarized using Table 4 that shows the Cronbach's Alpha of each section of the questionnaire. Section B, the problems of the contractors in applying risk management in construction safety in Selangor registered a Cronbach's Alpha of 0.806 with 8 items. Section C, which is concerned with determining the impacts of risk management implementation on the construction safety in Selangor, recorded Cronbach's Alpha of 0.835 using 7 items. Meanwhile, section D seeks to suggest improvement the implementation of risk management in construction safety in Selangor received the Cronbach's Alpha value of 0.900 with 7 items. These results all exceed 0.8 and hence it means that the items on the questionnaires have high internal consistency and reliability. Thus, the tool is deemed to be very effective in data collection in research.

3.7 Cronbach's Alpha

Table 4 *Result of Cronbach's Alpha*

Section questionnaire	Item	Question item	Cronbach's Alpha
Section B	To investigate the problems faced by the contractor towards the implementing of risk management in construction safety in Selangor.	8	0.806
Section C	To identify the impact of the implementation of risk management towards construction safety in Selangor.	7	0.835
Section D	To suggest the improvement of risk management implementation in construction safety in Selangor.	7	0.900

Cronbach's alpha is known as an important measurement for reliability tests. It is to justify whether the question in the questionnaire is reliable or not. Cronbach's alpha ranges from 0.0 to 1.0 and the closer value to 1.0 indicates a greater internal with all the variability in test scores are reliable variance. These results all exceed 0.8 and show as Table 4 and hence it means that the items of the questionnaires have high internal consistency and reliability. Thus, the tool is deemed to be very effective in data collection in research.

4. Data Analysis and Results

Descriptive statistics are used to examine questions of research regarding risk management implementation within construction safety. This chapter presents a comprehensive discussion and analysis of the findings derived from a quantitative questionnaire survey among G7 contractors in Petaling District, Selangor. In all, 200 questionnaires were distributed through Google Forms, while a total of 91 responses were achieved. This research with 30% from sample size required.

4.1 Part A: Demographic Respondents

Table 5 *Summary of demographic respondents based on characteristics*

Demographic	Category	Frequency	Percentage (%)
Gender	Male	71	78
	Female	20	22
	Total	**91**	**100**
Age	26 - 30 years old	1	1.10
	31 - 35 years old	3	3.30
	36 - 40 years old	26	28.60
	41 years old and above	61	67
	Total	**91**	**100**
Education Level	SPM/STPM	14	15.4
	Diploma	6	6.6
	Bachelor's	8	8.80
	Master's	12	13.20
	PHD	51	56
	Total	**91**	**100**
Years of Experience	Less than 5 years	17	18.70
	5-10 years	20	22
	11-20 years	17	18.70
	More than 20 years	37	40.70
	Total	**91**	**100**
Company Size	Less than 50	33	36.30
	Medium (50-150)	28	30.80
	Large (More than 150)	30	33
	Total	**91**	**100**
Occupation	General Manager	1	1.10
	Project Manager	24	26.40

	Site Engineer / Project Engineer	19	20.90
	Quantity Surveyor	22	24.20
	Safety and Health Officer (SHO)	16	17.60
	Construction Supervisor / Site Supervisor	7	7.70
	Procurement Officer	2	2.20
	Total	**91**	**100**
Type of Company	Sole Proprietorships	2	2.20
	Limited Liability Partnerships	10	11
	Partnerships	44	48.40
	Public Limited Companies (Berhad)	3	3.30
	Private Limited Companies (Sdn Bhd)	32	35.20
	Total	**91**	**100**

Referring to Table 5, the total number of respondents is 91. Of these, there are 71 male and 20 female respondents. In addition, 61 of the respondents are aged 41 years and above, followed by 26 respondents who fall between the ages of 36 to 40 years. At the same time, there are 3 respondents in the age bracket between 31 to 35 years and 1 respondent in the age bracket of 26-30 years old. Subsequently, it shows that the respondents represent G7 contractors in the Petaling District, Selangor. It focuses on that district without representation from other areas. The sample size illustrates that respondents are taken from G7 grade contractors. Still, the respondents are 51 for the level of PhD study, making most of the respondents. The respondents for the level of Master's are 12 in number. The respondents for the bachelor's level are 8 in number, then the diploma level with 6 respondents, and finally 14 respondents have the level of SPM-STPM. None of the respondents have lower levels.

The list of the experience in years of the respondents shows that a greater number of the respondents have experienced more than 20 years, which has a frequency of 37 and a percentage of 40.7%. This follows a category of 5-10 years, which has a frequency of 20 or a percentage of 22%, and the category <5 or 11-20 years, which has a frequency of 17 or a percentage of 18.7%. This signifies a very experienced group needed to generate valid views about risk management in construction safety. Table 5 represents the company sizes according to the number of employees. Firms with less than 50 employees have the largest share at 33 respondents or 36.3%, followed by 30 respondents or 33% for large ones with more than 150 employees, and 28 respondents or 30.8% for the medium ones with 50-150 employees. This balance across sizes in the survey therefore includes small firms to major contractors in Selangor.

Then, most of the respondents are occupation Project Manager, amounting to 24 respondents. Secondly, 22 respondents from the occupation Quantity Surveyor. The respondents of Site Engineer/Project Engineer are 19 respondents. Safety and Health Officer (SHO) follows with 16 respondents, Construction Supervisor/Site Supervisor with 7 respondents, Procurement Officer with 2 respondents, and General Manager with 1 respondent. Most of the respondents are from Partnerships, with a total of 44 in all. It is followed by Private Limited Companies (Sdn. Bhd.) with 32 respondents, Limited Liability Partnerships with 10, and Public Limited Companies (Berhad) with 3, and Sole Proprietorship with 2. No foreign companies were recorded.

4.2 Part B: To investigate the problems faced by the contractor towards the implementing of risk management in construction safety in Selangor

Table 6 *The problems faced by the contractor towards the implementing of risk management in construction safety in Selangor*

No	Item	Mean	Standard Deviation	N	Ranking
1	Poor communication among project teams	4.51	0.634	91	1
2	Cultural barriers among workers	4.48	0.748	91	2
3	Lack of safety awareness and training among workers	4.46	0.923	91	3
4	Organizational weaknesses hinder your risk management efforts	4.42	0.774	91	4
5	Lack of commitment from top leadership	4.36	0.692	91	5
6	Technological limitations prevent you from adopting modern safety tools	4.32	0.838	91	6
7	Lack of coordination between teams	4.15	0.893	91	7
8	Behavioral resistance prevents workers from following	4.10	0.883	91	8

	safety procedures effectively	
9	Other ideas about the problems faced by contractors in implementing risk management for construction safety in Selangor	>Contract is executed by many sub-contractor just bare minimum rates, just like walking on knife, generally the client and main contractor not allowing sum to the subcontractor for implementing proper safety procedures but in papers all the risks pass to subcontractor.

Refer to Table 6 data was collected from G7 contractor, which identifies poor communication among project teams as the most critical problem in Rank 1, with Mean 4.51. This could be interpreted by saying that breakdowns in the dissemination of information lead to misunderstandings and the dangers of safety on the site. Cultural barriers among the workers make it difficult to maintain consistent safety practices in Rank 2, with mean 4.48, indicate that diversities in personal habits and backgrounds make it challenging for contractors to enforce standardized measures of safety.

Lowest Ranked problem is behavioral resistance prevents workers ranked as the least problem in Rank 8 with Mean 4.10. A lower mean score indicates that the willingness of workers to follow safety procedures is there, provided they are guided accordingly.

Other ideas about the problems faced by contractors are about revealing a "budgetary" where small contractors are legally responsible for safety but are not given the financial resources to pay for it. Operating at "bare minimum" rates creates a high-pressure environment where financial survival often takes priority over safety investments.

4.3 Part C: To identify the impact of the implementation of risk management towards construction safety in Selangor

Table 7 *The impact of the implementation of risk management towards construction safety in Selangor*

No	Item	Mean	Standard Deviation	N	Ranking
1	Accidents increase overall project expenses	4.53	0.582	91	1
2	Delays significantly raise the total project cost	4.51	0.732	91	2
3	Non-compliance with safety laws results in penalties and legal liabilities	4.43	0.688	91	3
4	Neglecting safety measures leads to a collapse in productivity	4.42	0.635	91	4
5	Reactive safety culture weakens proactive risk prevention	4.32	0.885	91	5
6	Poor safety management leads to increased workplace accidents and fatalities	4.29	0.873	91	6
7	Safety issues significantly damage stakeholder trust	4.21	0.900	91	7
8	Any other ideas about the impact of the implementation of risk management towards construction safety in Selangor	> Risk management gives a clearer structure for safety work.			

According to Table 7, the data collected from G7 contractor, which identifies accidents increasing overall project expenses is the most severe consequence of safety failure at Rank 1 with an average of 4.53. This means that accidents result in immediate economic costs such as medical expenses, damage to equipment, and compensatory payment. This is trailed by Delays significantly raise the project cost at Rank 2 with an average of 4.51.

The least-ranked effect relates to safety issues, which significantly affect the safety issues significantly damage stakeholder trust in Rank 7, with an average of 4.21. Although the average shows a strong degree of agreement, it appears in the final list since the contractors are more worried about the financial and operational problems at the time compared to the long-run problems.

Other concepts concerning the impacts of risk management at Selangor Besides the ranking, experts have pointed out that the need for implementing risk management is a great need to apply risk management to ensure construction safety.

Research in Management of Technology and Business Vol. 7 No. 1 (2026) p. 478-498

4.4 Part D: To suggest the improvement of risk management implementation in construction safety in Selangor

Table 8 *The improvement of risk management implementation in construction safety in Selangor*

No	Item	Mean	Standard Deviation	N	Ranking
1	Behavior-based safety programs	4.43	0.688	91	1
2	Utilizing wearable technology	4.37	0.879	91	2
3	Enhanced training helps workers perform tasks more safety	4.27	0.942	91	3
4	Promoting a stronger safety culture	4.25	0.873	91	4
5	Stronger leadership engagement	4.24	0.972	91	5
6	Implementing digital risk management tools	4.19	0.855	91	6
7	Improved communication increases overall safety awareness	4.15	0.879	91	7
8	Other ideas about the improvement of risk management implementation in construction safety in Selangor	> To improve safety, workers need to change their attitude and mindset. > Improvement should start with stronger commitment from everyone…			

Referring to Table 8, it can be observed that the suggested way to improve construction safety is through behavior-based safety programs in Rank 1, with a mean of 4.43. This emphasizes that there is a strong consensus on the shifting of individual attitude and habit as the most important step. The ranked second most effective improvement was the utilization of wearable safety technology in Rank 2, with Mean 4.37, which offers real-time monitoring to safeguard workers on site.

Rank 7 is improved communication increases overall safety awareness, with a mean of 4.15. While the respondents still agreed highly in communication, still the core necessity, scored a bit lower than technology and behavioral programs.

Other suggestions on risk management improvement in Selangor Qualitative feedback from contractors highlighted that for real safety transformation to take place, there needs to be a shift away from mere paperwork. "For safety to improve, the attitude and mindset of workers have to change. Companies must also apply risk management seriously and not because of documentation”.

5. Discussion and Conclusion

5.1 Conclusion

This chapter deals with the general findings obtained from this study and formulates some conclusions relating to the three study objectives on the implementing risk management in construction safety concerning the state of Selangor. This chapter will integrate the quantitative findings obtained from the questionnaire survey and the previously mentioned literature to describe how risk management approach is presently being practiced, the challenges being in implementing risk management by the construction sector, and how safety can be enhanced in construction sites. This chapter will offer some recommendations to the construction sector, the construction industry, and universities.

5.2 Objective 1: To investigate the problems faced by the contractor towards the implementing of risk management in construction safety in Selangor

The discussion of the results shows that contractors are experiencing several significant in trying to apply a risk management approach to improve construction safety. Poor communication among project stakeholders involved in the project, such as site managers, supervisors, and workers, is identified as the main problems with ranked first, with mean 4.51. In discussion of this chapter, Fiah et al. (2022) have stated that poor communication is considered the source of safety failure in the Malaysian context. The reason this factor ranked highest is because communication acts as a foundation for the effectiveness of safety protocols and hazard identifications in its absence.

Moreover, the lack of safety awareness and knowledge in construction among workers was identified to be another critical problem in ranked 3rd with mean 4.46. In most cases, the lack of safety awareness is directly linked to a lack of training and knowledge of the appropriate risk management strategies. Abdul-Aziz (2001)

recognizes the critical problem of safety awareness with a construction industry's heavy dependence on the services of a diverse pool of untrained foreign workers, making the process of safety information diffusion difficult.

On the other hand, behavioural resistance by employees was also found to be the lowest among the identified problems and was ranked 8th, with a mean of 4.10. Pidgeon (1991) does emphasize the impact of human psychology factors and risk-taking activities associated with safety. However, the findings seem to indicate that employees within the Selangor construction industry are not deliberately resisting safety. It is a symptom that can be observed to be a result of the higher-ranked issues identified, such as a lack of instructions, poor communications, and a dearth of organizational structure. Hence, the findings highlight that to manage risk in the construction industry, contractors need to improve organizational structures and communications to bring about a better safety culture.

5.3 Objective 2: To identify the impact of the implementation of risk management towards construction safety in Selangor

The findings from the study show that a risk management approach directly impacts construction safety performance. A risk management approach enables risks to be identified much in advance and thus allows managers to take steps to prevent their occurrence, yielding safety working conditions. According to the study findings, the most significant influence identified is the accidents that raise the overall project cost in ranked 1st, with a mean of 4.53. Therefore, it entirely concurs with the statement of Azman et al. (2019), where costs associated with accidents include administrative disruption, and loss of productive time will significantly diminish a project's profit margin.

Moreover, the impact of project delays in rank 2nd, with mean 4.51 is an important issue, described by Dahalan et al. (2022) as "a productivity collapse affecting the whole project timeline." Conversely, any accident in risk management can result in extreme negative consequences, such as the increased occurrence of workplace injuries, apart from the damage to equipment or materials.

At the other end of the scale, the damage stakeholders trust ranked 7th with a mean of 4.21. Contrary to Subramanian et al. (2019) explanation that reputation is essential as the key factor in long-run expansion and winning future contracts, results show that in current circumstances, contractors in Selangor consider more urgent but concrete risks such as financial risk rather than non-concrete outcomes in terms of reputation.

5.4 Objective 3: To suggest the improvement of risk management implementation in construction safety in Selangor

The results of this research enable the proposition of a set of improvements that could enhance the process of implementing risk management approach in construction safety. Of these improvements, the implementation of behavior-based safety programs was the most agreed-upon strategy for improving safety management approach in the construction industry. This ranking is indicative of great consensus in the literature; for instance, Zhang et al. (2024) expressed that safety cannot be achieved with mere documentation. Rather, it must be about changing the mindset of workers and creating individual accountability.

In relation to behavioral changes, the finding emphasizes the value of improving safety training. The need for continuous training was identified to improve the workers' level of knowledge and understanding of hazards, risk assessment, and safe work practices. Moreover, the use of technology and technology-enabled systems, such as wearable technology and digital safety management systems, was identified to be of a high ranking in the study ranked 2nd, with mean 4.37. This is in line with the findings of Yap et al. (2024) in relation to the level of industry need in relation to the monitoring of hazards in real-time and improving the level of organized documentation systems.

Besides that, improving communication overall was ranked the lowest of the suggested improvements. Ranked 7th and mean 4.15. This is much lower than expected since poor communication was seen in Objective 1 as the number one problem. It can be assumed that industry professionals believe by providing advanced training and digitized monitoring, for example, as set and tangible interventions, the root causes of poor communication will be resolved naturally and more effectively.

5.5 Research Limitation

This research also takes cognizance of certain immanent limitations which might have influenced the generalizability of its findings. Firstly, this research was conducted utilizing a cross-sectional study in which Google Forms surveys were administered to G7 construction sector players within Selangor, which might be vulnerable to response bias due to its propensity to include socially acceptable responses instead of what exists site-wise from a safety perspective. Additionally, its geographical focus within Selangor also hampers its external validity, implying that its findings might not be applicable under different geographical environments.

Thirdly, as this research was hindered by time limitations, its focus was curbed to G7 contractors only, shutting its eyes to distinct financial difficulties of smaller-grade players (players belonging to G1 to G6). Finally, as this research is based on its quantification methodology, which is grounded within professional perceptual assessment rather than actual site-wide observations over time, it fails to do complete justice to the site-wise safety risks.

5.6 Recommendation to the construction industry

In response to the findings of this paper, several suggestions are made to enhance application of risk management approach in the construction safety in Selangor.

5.6.1 Construction player

Safety as a constituent of project management should be a priority to the construction players, such as contractors and management teams at the site. Healthy distribution of funds towards safety training, safety equipment, and risk management activities are to be provided. The safety meetings and risk assessments need to be held regularly to discover possible threats and adopt the necessary risk management strategy. The construction players are also encouraged to embrace teamwork and open communication to increase safety awareness among construction site workers.

5.6.2 The construction industry

The regulatory authorities and professional organizations ought to reinforce safety regulation and enforcement mechanisms at the industry level. The industry stakeholders can also collaborate to facilitate the best practice and enhance the level of safety. Innovation and use of modern safety technologies should also be embraced in the construction industry to facilitate effective risk management approach implementation within the project.

5.6.3 University

Universities are important institutions involved in training upcoming professionals on safety aspects by incorporating risk management modules within their training programs. This aspect should not only focus on theory but should also include hands-on training on site visits, case studies, and experiences tailored to prepare students on site. Partnerships between academic institutions and sector experts, for example, guest lecturer/technology presentations, are vital, covering new safety technologies, for example, digital safety, to expose students to safety innovations on site.

Acknowledgement

This research was conducted as part of the academic requirements of Universiti Tun Hussein Onn Malaysia (UTHM). The author would like to express sincere appreciation to the supervisor and faculty members for their guidance, support, and valuable feedback throughout the completion of this study.

Conflict of Interest

The author declares that there is no conflict of interest regarding the publication of this paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design****: Kee Yong Joo, Zailawati Khalid;* ***data collection****: Kee Yong Joo, Zailawati Khalid****; analysis and interpretation of results****: Kee Yong Joo, Zailawati Khalid;* ***draft manuscript preparation****: Kee Yong Joo, Zailawati Khalid, Norliana Sarpin, Aina Mardia Sallehuddin, Hilyati Sabtu@Othman. All authors reviewed the results and approved the final version of the manuscript.*

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