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Appraising Risk Management Strategies in Construction Small and Medium-Sized Enterprises: A Sector-Specific Analysis

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ABSTRACT

The small and medium-sized enterprises (SMEs) within the construction industry hold the greatest potential for increasing the construction industry's capacity and general economic development in any country. However, the SMEs face high risks associated with the construction industry which can deter their survival, growth, and sustainability in the sector. Therefore, this study evaluates the risk management strategies among the construction small and medium enterprises (CSMEs) intending to enhance project outcomes. The study utilized a cross-sectional survey research design using a questionnaire data instrument to elicit information regarding the subject of risk management. 202 construction professionals from different CSMEs in Lagos State participated in the study. The result showed that expert judgment, risk analysis, and checklist analysis were identified to have registered significant awareness by the CSMEs. However, this high level of awareness did not translate to high usage of risk management strategies. Thus, since awareness alone is insufficient to drive implementation, this study recommends fostering continuous awareness of risk management practices to enhance their adoption among CSMEs. This may be accomplished by encouraging continuous awareness and education through industry seminars, case-based training, and focused workshops that highlight the application of risk management strategies by CSMEs in actual projects. Besides, creating peer-learning networks, disseminating success stories centered on CSMEs, and incorporating useful risk management information into CSME development initiatives will be beneficial. Furthermore, aid from the government agencies and professional associations in the form of mentorship, and simpler tools can promote regular use and enhance comprehension among CSMEs.

Keywords: *construction businesses, construction small and medium enterprises, expert judgment, project performance, risk management strategies*

1.0 INTRODUCTION

Small and medium-scale enterprises (SMEs) represent the backbone of most economies. They connect to the grassroots and employ a large number of personnel which solves issues of poverty and unemployment. Accordingly, Ditta (2023) describes SMEs as a group comprising 1-249 employees. Meanwhile, Nosike and Akwuobi (2022) describe SMEs as companies with operating assets of less than $500,000. Their role is crucial in the industrial development of many nations, which provides a veritable means of employment and is usually labor-intensive (Adegboyega et al., 2019; Manzoor et al., 2021). Construction Small and medium-sized enterprises (CSMEs), on the other hand, are crucial to economic growth because they provide employment and the necessary infrastructure for the sector. Egwunatum and Oboreh (2022) buttressed that CSMEs dominate the construction sectors in both industrialized and developing nations. Nonetheless, their low resources, unstable market circumstances, and the complexity of construction projects make them very vulnerable to risks. Unlike multinationals or larger organizations, CSMEs sometimes lack specific departments or advanced technologies to handle risks efficiently (Simeon, 2024).

Simeon et al. (2025) buttressed that large-sized construction enterprises are considered established firms and are less susceptible to project risk involving environmental and legislation, as opposed to CSMEs, which are more susceptible to risk due to having fewer resources as they take up small projects. Oladimeji and Ojo (2012) add that large construction companies, as opposed to SMEs, control a significant portion of the industry's overall workload, while a sizable number of CSMEs share a relatively small portion of the nation's construction workload. This implies that to secure their expansion and survival, CSMEs must effectively manage the few construction contracts they receive. Simeon and Soyingbe (2023) note that construction projects are always identified with risks that are meant to be properly managed. Moreover, failure to identify and manage such risk could lead to an adverse effect on the project outcome. The inability to effectively and efficiently manage construction risks can pose serious threats to project objectives and may lead to project failure and abandonment in the long run.

Construction firms, either large or small, are generally exposed to construction risk; it is how they handle it that may differ. Liao et al. (2021) buttressed that construction projects consist of various stages, including design, construction, operation, and maintenance. Each phase of construction projects is often faced with design, execution, financial, safety, legal and contractual, political, environmental, schedule, technology, supply chain/procurement, force majeure/acts of God, reputation, and security risks (Simeon et al., 2025). Al-Hashimi and Masuri (2022) add that since risks in building projects can arise at any time, controlling risks in construction projects has been highlighted as a critical step in achieving project goals in terms of timing, cost, quality, safety, and environmental sustainability. Therefore, there is a need to apply different risk management practices for timely and effectual management of the risk which would prevent adverse effects on construction projects in the long run. Risk management practices enable project stakeholders to exert maximum control over project deliverables (Shukurullayevna, 2021).

Risk management is critical for successful construction projects, especially for small and medium companies (SMEs) (Renault et al., 2018). Key risk management practices include identifying project goals, resource needs, risk identification, response planning, assessment, and monitoring (Renault et al., 2018; Appiah, 2020). Common risks in building projects are poor design, financial concerns, and delays in permits (Moinuddin & Yogeswari, 2021). Risk occurrences frequently lead to poor delivery, quality concerns, and project delays (Appiah, 2020). While risk management techniques are routinely employed, particularly in risk identification and quantification, there is a need to enhance specific practices. Despite the benefits of using risk management strategies in construction projects, El-Sayegh (2014) identified managers' comprehension of approaches, identifying relevant methods, and difficulties in getting probability estimates as the barriers to successful risk management implementation. Besides, Tang et al. (2007) highlight barriers to the application of risk management practices in construction by SMEs as no incentive for better risk management; lack of risk consciousness; inappropriate risk allocation; and insufficient ongoing project information, and awareness. Continuous learning and adaptation are vital to optimize risk management efficiency in building projects (Appiah, 2020).

Due to the importance of CSMEs and the necessity to effectively manage construction risks, it is imperative to evaluate the risk management strategies among small and medium-scale construction businesses that ensure their survival and sustainability in the construction industry. The objectives of this study are to compare the level of awareness with the level of usage of risk management strategies used by CSMEs, to evaluate the challenges facing the effective implementation of risk management strategies by CMSMEs, and to investigate the notable impact associated with the use of risk management strategies on construction project performance among CSMEs. The study is significant because it improves CSME resilience by discovering effective risk management measures that ensure sustainability, financial success, and a competitive edge in construction projects.

2.0 CONCEPTUAL FRAMEWORK FOR THE STUDY

A conceptual framework is usually used as a tool in explaining or illustrating complex concepts in a simple way. It also serves as a tool to guide inquiry (i.e., research questions, methods, and data analysis). In this regard, the conceptual framework for the study, as shown in Figure 1, presents in a simple way how the impact of risk on project performance can be assessed. The conceptual framework, which seeks to identify and assess the risk impact on project performance, is a product of modifications of previous models by Charette (1989), Williams (1996), Akintoye et al. (2001), Royer (2000), Odeyinka (2003), Carbone and Tippett (2004), Kalisprasad (2006), Gamez (2009), and Simeon et al. (2025) on risk assessment, as well as Naoum (1994), Chan (1996) and Ankrah (2007) on factors affecting project performance. The conceptual framework for the study is hinged on independent variables (i.e., risk factor), dependent variables (i.e., cost and time performance), risk measure/risk level, and project characteristics. Independent variables are project risks, which are classified into seven groups, namely: economic, design, construction, client-related, managerial, natural, and political/sociocultural risks. Classifications of risk factors in this study are an adaptation of classifications by Edwards and Brown (1998), Smith and Bohn (1999), El-Sayegh (2008) and Simeon et al. (2025). Dependent variables in the conceptual framework are the project performance variables of cost, time, quality, safety and operation. The conceptual framework is based on the premise that the project risks are responsible for bringing about changes in established project objectives such as project cost and time at completion.

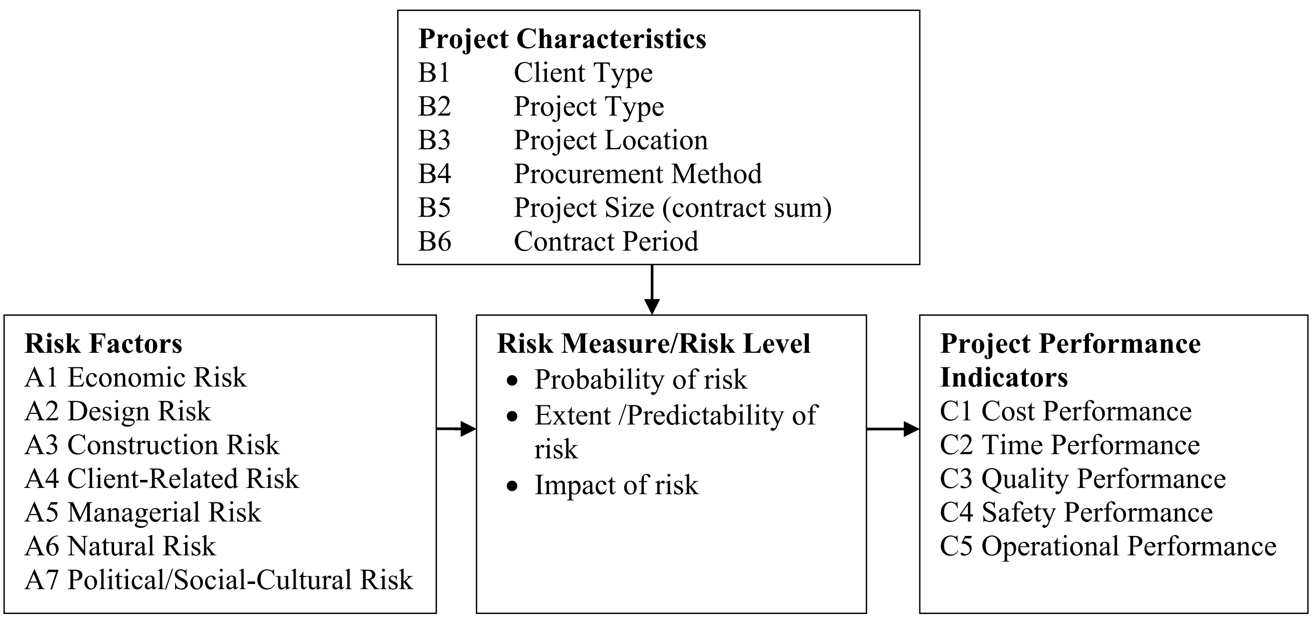

Figure 1. Conceptual framework for assessing impact of risk factors on performance on construction projects

3.0 RESEARCH METHODOLOGY

A cross-sectional survey method was deemed most suitable for this study, as it allows for the systematic collection of data from respondents through a research instrument. This approach was selected for its capacity to provide a comprehensive and detailed examination of the key research questions. The study population consisted of construction professionals, including architects, builders, quantity surveyors, and engineers employed by CSMEs. These core professionals were selected as the target population due to their active involvement across all phases of construction projects, from inception to completion, as well as their roles in the construction and maintenance of buildings, as established by Simeon et al. (2023a). The study was conducted in Lagos State, based on the rationale that approximately 75% of Nigerian construction companies are either headquartered or maintain operational branches there. Lagos State is also termed a megacity and Nigerian's commercial centre with a vast number of completed and ongoing construction projects within the State (Simeon et al., 2024). Most SMEs find Lagos State viable to practice their construction business.

There is presently no comprehensive list of CSMEs in Lagos State. As such, a purposive sampling technique was used to select the key built environment professionals that constituted the study's population. According to this method, which belongs to the category of non-probability sampling techniques, sample respondents were selected based on their knowledge, relationships, and expertise regarding a research subject. Purposive sampling was employed in this study, as it enabled the researcher to deliberately select participants who were most likely to provide relevant and in-depth data based on their professional characteristics. To determine an appropriate sample size, a total of 250 construction professionals, comprising architects, builders, quantity surveyors, and engineers from selected CSMEs in Lagos State, Nigeria were selected to participate in the study. The number was considered adequate and representative enough to inform this sample as stipulated by rules of thumb, Roscoe (1975) which suggests that a sample size which is more than 30 and less than 500 is appropriate for the research.

Self-structured questionnaire instrument was adopted in this study. The reason for adopting a self-structured questionnaire is that questionnaires are extremely flexible and could be used to collect data from the respondents on any research phenomenon under study from a large or small number of people. It was also adopted for an adequate explanation of the variables used for the study, especially in testing the hypotheses and establishing the relationship between the variables. This research instrument was designed to capture the demographic data of the respondents and their opinions with respect to the research questions. The questionnaire was divided into five sections from Sections A - E. Section A sought to obtain information regarding the respondents' demographic profile. Section B of the research instrument obtained information on the respondents' level of awareness of risk management strategies. In measuring the variables of this objective, a 5-point Likert scale as proposed by Oladiran and Simeon (2023) was adapted for this objective where 1 connotes 'No Awareness', 2 'Slight Awareness', 3 'Moderate Awareness', 4 'High Awareness', and 5 'Full Awareness'. In measuring the variables of Section C which assesses the level of usage of risk management strategies, an ordinance scale of 1-5 was adapted from Simeon et al. (2023b) and used to measure the level of usage of risk management strategies using 1 connotes 'Never', 2 'Rarely', 3 'Sometimes', 4 'Often', and 5 'Always'. In measuring the variables of Section D which sought to evaluate the challenges facing the implementation of risk management strategies, an ordinance scale of 1-5 was adapted from Simeon and Oladiran (2023) using 1 connotes 'Not Significant', 2 'Slightly Significant', 3 'Moderately Significant', 4 'More Significant', 5 'Most Significant. Moreover, Section E which sought to assess the impact of risk management strategies on construction project performance was measured on a 5-point Likert scale using 1 connotes 'No Impact', 2 'Low Impact', 3 'Moderate Impact', 4 'High Impact' and 5 'Very High Impact'. A pre-test utilizing a pilot study, excluded from the actual research, with similar characteristics to the study sample was conducted to determine the clarity of the items and consistency of the responses. To enhance the reliability of the instrument the appropriate English terms were added to the questionnaire to facilitate the respondents' comprehension of these terms. For this pilot study, a total of twenty (20) questionnaires were administered to some of the respondents. The pre-test scores were calculated and a reliability score was obtained. The result showed that the reliability scale test for the items of the questionnaire score is shown in Table 1.

Table 1. Reliability Statistics of Instrument

S/N	Objectives of the study	Cronbach's Alpha
1	Level of awareness of risk management strategies	0.921
2	Risk management strategies utilized	0.952
3	Challenges facing the implementation of risk management strategies	0.904
4	Impact of risk management strategies on construction project performance.	0.928

The result from Table 1 showed that all the independent variables are reliable. This is because the scores obtained exceeded the minimum alpha value of 0.7. According to the rules of thumb in Cronbach's Alpha Coefficient size the higher the Cronbach's Alpha, as in this pilot survey, the higher the reliability coefficient. This means that all the independent variables are considered good and reliable since they fall within Cronbach's Alpha range of 0.9. This infers that the research instrument used for the study is therefore reliable, as it is more than the generally accepted reliability score of 0.7. The structured questionnaire was self-administered to the targeted respondents. A total number of 250 questionnaires were self-administered to the targeted respondents among the CSMEs in Lagos State. From the 250 questionnaire instruments distributed, 219 (87.6%) questionnaires were returned while only 202 (80.8%) questionnaires were adequately filled, free of errors, and deemed valid for the data analysis. Despite the high response rate, non-response bias cannot be totally eliminated. It is assumed that there were no significant differences between those who did not respond and respondents that could have influenced the results. Nonetheless, caution should be exercised when extrapolating the findings beyond the study's sample. The statistical tools deployed for the analysis include frequency distribution, percentages, mean score, ranking, principal component analysis, and correlation matrix. Statistical Packages for Social Sciences (SPSS) and Microsoft Excel are the software used to aid the analysis.

4.0 RESULTS AND DISCUSSION OF FINDINGS

This section presents the analysis and discussion of the findings of this study. The analysis comprised the personal characteristics of the construction professionals, the firms' characteristics and objectives of the study in terms of awareness measurement, risk techniques utilized, challenges, and impact of using risk management techniques.

4.1 Demographic characteristics

The study investigated the profile of the respondents represented within the small and medium-scale construction businesses. To provide an insight into the credibility of the responses gathered. The summary result of the characteristics is presented in Figure 2. The demographic details contained the educational degrees of the construction professionals, professional qualification, discipline, work industry experience, position within the small and medium scale construction business, and information regarding the firm in terms of staff strength and highest contract sum engaged.

The results from Figure 2 showed that 158 (78.2%) of the construction professionals had a Bachelor's degree (B.Sc/B.Tech/B.Eng.) while only 44 (21.8%) out of them had proceeded to the Master level (M.Sc/M.Tech/ M.Eng.) in their educational endeavors. It is ascertained from the result, that the construction professionals are educationally inclined, and are presumed to have been equipped with knowledge dealing with the phenomenon under study and are fit to give valid opinions useful in generalizing the phenomenon. Further analysis in Figure 2 showed the discipline of each of the construction professionals. In the result, 30 (14.9%) of the respondents are Civil Engineer, 75 (37.1%) of the respondents are Mechanical Engineer, 15 (7.4%) of the respondents are Electrical/Electronics Engineer, 15 (7.4%) of the respondents are Builders, 7 (3.5%) of the respondents are Quantity Surveyors, 45 (22.3%) of the respondents are Architects while 15 (7.4%) of the respondents indicated other construction related professions such as Land Surveyors, Geologists, and Contractors. In addition, each of the construction professionals had one form of professional affiliations as indicated in Figure 2. While some were members of the Nigerian Institute of Architects, NIA (22.3%), a large part of the construction professionals belonged to the Nigerian Society of Engineers, NSE (29.7%). The study showed that the construction professionals had other professional qualifications such as Project Management Institute (PMI), member of the

Nigerian Institute of Building (MNIOB), member Nigerian Institute of Structural Engineers (NISE), and member of Nigerian Institute of Management (NIM).

In terms of construction experience, 128 (63.4%) of the construction professionals had below 10 years of experience, 67 (33.2%) of the respondents had between 10-20 years of work industry experience while only 7 (3.5%) of the respondents had between 21-30 years work industry experience. In addition, the construction professionals had various positions within the small and medium-scale construction businesses. These positions were key positions critical to tackling risks during construction projects from within the firm. To ascertain the size of the construction firms, the range of the highest value in construction contract sum handled by the construction businesses showed that 30 (14.9%) of the construction professionals had handled construction projects worth between 5-20 million naira, 38 (18.8%) had handled within the range of 21-50 million naira, 60 (29.7%) had handled within the range of 51-100million naira while 74 (36.6%) of the construction professionals had worked on construction projects that had a contract sum of 200million naira and above. The staff strength of the small and medium scale construction businesses showed that 30 (14.9%) of the construction professionals worked in construction firms that had less than 10 working staff, 67 (33.2%) had 10-40 working staff, 30 (14.9%) had 41-50 working staff and 75 (37.1%) of the construction professionals worked in construction businesses that had between 51 to 299 staff. The information included in the demographic is viewed as very important as regards the study and needs to be considered in assessing the credibility and eligibility of the respondents in expressing related opinions on the issues raised.

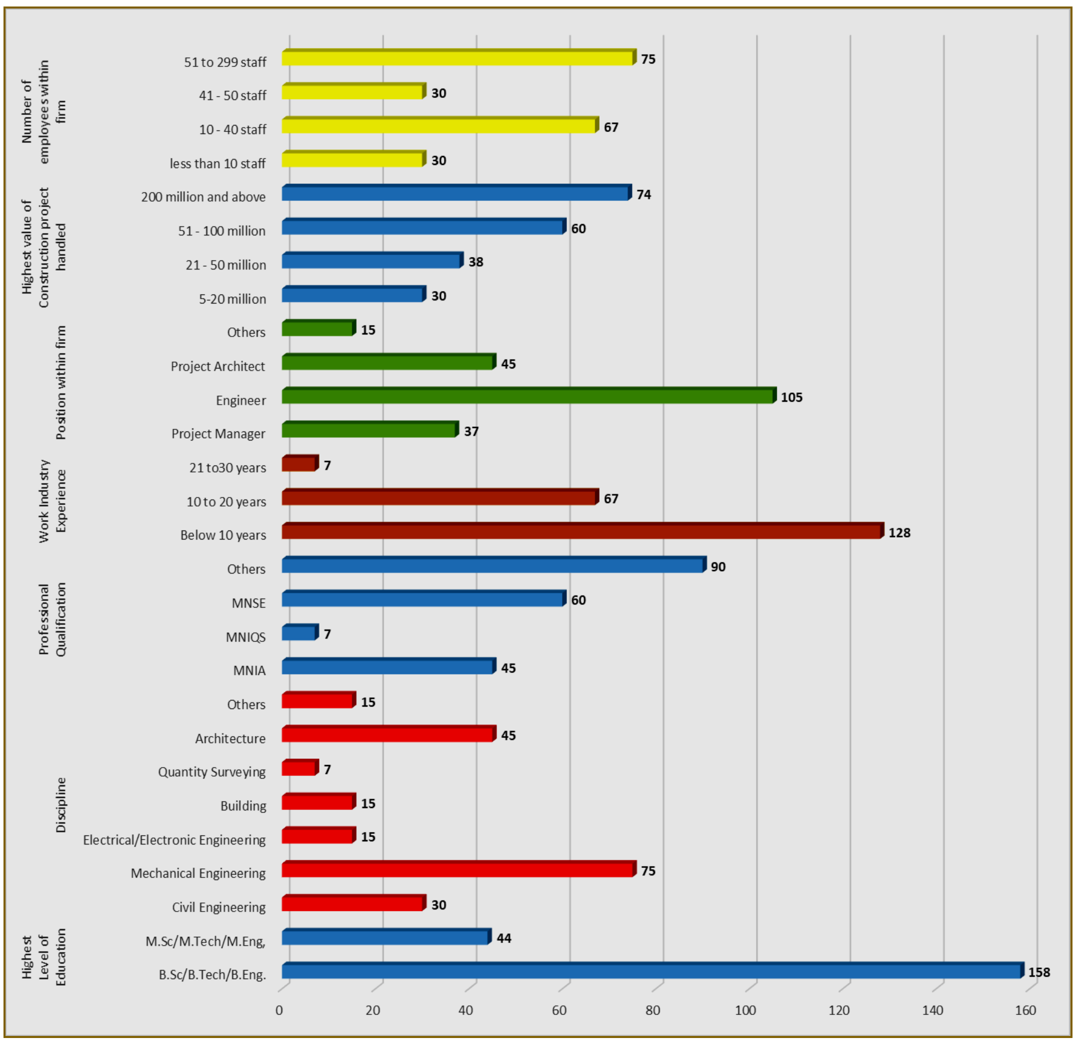

Figure 2. Summarized Demographic Characteristics of Respondents.

4.2 Level of Awareness and Usage of Risk Management Strategies

The study examined the levels of awareness and usage of risk management strategies among small and medium-scale construction businesses. This section compares the mean scores of both variables to determine whether a higher level of awareness corresponds to increased usage. A 5-point Likert scale was used in measuring the two questions in the data instrument used. Table 2 shows the mean score and ranking index of the level of awareness and the level of usage of risk management strategies by small and medium-scale construction businesses. The risk management strategies were broken down into risk identification techniques, qualitative risk analysis techniques, quantitative risk analysis techniques, risk response planning techniques, and risk control techniques.

From Table 2, there are diverse risk identification techniques, however, expert judgment, risk analysis, and checklist analysis were identified to have registered significant awareness by small and medium-scale construction businesses. However, this high level of awareness did not translate into a high level of usage of risk management strategies. Only risk analysis, which is a risk identification technique, showed both high awareness and high usage among small and medium-scale construction businesses. The highest-ranked risk identification techniques used among CSMEs include root cause analysis, and risk analysis, while information-gathering techniques ranked 3rd among the risk identification techniques. The reason for this may be because root cause analysis, risk analysis, and information gathering techniques are among the common and traditional methods of risk management practices while the Delphi technique is a modern risk management practice and more suitable for large-scale projects.

The top three risk identification techniques, namely root cause analysis, risk analysis, and information-gathering methods, are widely used by construction professionals because they are direct, practical, and easily integrated into daily operations. These methods make use of common tools and encourage collaborative discussions, which makes them accessible even in settings with limited resources. In contrast, the Delphi technique is the least used, as its dependence on expert panels, structured rounds of feedback, and time-consuming nature is often considered impractical or costly in fast-paced and resource-constrained construction environments.

The findings of this study conflict with the result of the survey conducted by El-Sayegh (2014), which identified checklists, brainstorming, assumption analysis, and root cause identification as mostly used risk identification methods and by implication registered a profound high level of awareness of risk management practices, while Delphi technique and influence diagrams technique registered low awareness and consequently low use among construction firms. Also, Tipili and Yakubu (2016) outlined an industrial checklist, interviews with key project participants, historical data from previous similar projects, and brainstorming techniques as the most commonly used techniques to identify risks in construction projects.

The highest-ranked qualitative risk analysis technique in terms of level of awareness and level of usage is expert judgment. Expert judgment as a qualitative risk analysis technique is an important concept in which judgment is made based on issues related to construction activities certified by an expertise that has been acquired in a specific construction knowledge area. The fact that expert judgment belongs to the ‘soft’ side of project risk management makes it common and respondents have been familiar with it and as such, it ranked very high. The results of these findings are similar to the findings of El-Sayegh (2014). In El-Sayegh's (2014) study, most companies relied on engineering judgment and experience when applying qualitative risk analysis techniques to manage project risks. These results also confirm the findings of Akintoye and MacLeod (1997) that risk analysis and management in construction depend mainly on intuition, judgment, and experience and that formal risk analysis and management techniques are rarely used due to a lack of knowledge and doubts about the suitability of these techniques for construction industry activities. Whereas, Bahamid and Doh (2017) outlined that the core qualitative analysis techniques are brainstorming, expert judgment, cause and effect diagrams, and checklists. In support of this study, Gajewska and Rophel (2011) also noted the awareness of qualitative techniques and risk management practices such as risk probability and impact assessment, probability/impact risk rating matrix, risk categorization, and risk urgency assessment is low. The reason for this agreement could be an indication that CSMEs are yet to embrace fully new techniques.

In quantitative risk analysis techniques, interviewing techniques, data gathering & representation techniques, and value analysis techniques ranked 1st, 2nd, and 3rd respectively. This negates the actual techniques used among small and medium-scale construction firms. In that, the highest-ranked quantitative risk analysis techniques used in CSMEs include expert judgment, cost risk analysis, and expected monetary value (EMV) analysis. Contrary to the findings of this study, El-Sayegh (2014) identified expected monetary value (EMV) and probability distribution techniques as quantitative techniques of risk management practices that registered more use and by implication higher level of awareness than interviewing, data gathering and representation and value analysis. However, it is also noteworthy to know that Tipili and Yakubu (2016) agreed with the findings of this study that interviews with experts also registered a profound level of awareness among other risk management practices. In the study by Bahamid and Doh (2017), the core quantitative analysis techniques are decision tree analysis, expected monetary value, fault tree analysis, fuzzy logic, probability distributions, and sensitivity analysis which are contrary to the findings in this study.

The level of awareness of status meetings as a risk response planning technique in CSMEs is highly pronounced when compared with all other risk response planning techniques. Whereas, the highest-ranked risk response planning technique used is technical performance measurement. Status meetings are used as a means of reporting progress regarding a project thereby creating a platform for successful project delivery. This is one of the most valuable tools for project managers to establish the status of a project. The goal is to take stock of what has been accomplished, what is due to be completed, and what roadblocks or challenges are anticipated. On the other hand, technical performance measurements provide insight into the unfolding of any deviations that may exist, such as differing functionalities, from what was planned for the project. Technical performance measurements help us to identify and forecast the degree of success in achieving the scope of work taken up as part of the project. This is often considered when the execution of project work is underway, allowing for adequate monitoring of project performance; and the identification of variance therefore, corrective measures can be taken to guide against project failure. The CSMEs are noted to be putting this to use in projects handled by them. Bahamid and Doh (2017) opined that concerning risk response the acceptable mitigation steps of treating risk must be employed once the project risks have been known and analyzed. According to the authors, these mitigation steps are based mostly on the nature and potential consequences involved in the risk. They further stated that the main objective is to increase the level of control of risk, reduce the negative impact of the risk, and remove as much as possible the potential impact. This contribution does not agree with the findings of this study in that this study identified status meetings as the highest-ranked risk planning technique and the purpose is to ensure a project stays on track and to give key players in project delivery the chance to intervene early if problems arise. However, El-Sayegh (2014) noted that SM construction enterprises are aware of status meetings as a risk response planning of risk management which was referred to as a team meeting/special meeting.

The highest-ranked risk control technique is avoidance. This technique is designed to deflect as many threats as possible to avoid the costly and disruptive consequences of a damaging event. This approach minimizes vulnerabilities which can pose a threat as regards handling a project. Whereas, among the risk control techniques that are used by CSMEs, loss prevention was the most utilized technique. Loss prevention is a technique that limits rather than eliminates risk in construction projects. In the survey conducted by Berg (2010) in Germany, there is a similarity with the findings from this study. Other studies in support of the high level of awareness of risk control techniques include El-Sayegh (2014), Tipili and Yakubu (2016), and Bahamid and Doh (2017). The mean scores from risk control techniques were high compared with other categories of risk management strategies. The reason for this may be that many CSMEs prefer to use these common and traditional approaches rather than using statistical, and mathematical models and techniques aimed at managing risks on large-scale projects. In concluding this section, Gwangwava et al. (2014) outlined that few SMEs in the construction sector are risk aware and they usually focus on “loss control” programs in areas of fire, safety, security, health, and quality assurance.

Table 2. Compare means on the level of awareness and usage of risk management strategies.

Risk Management Strategies	Level of Awareness		Level of Usage	
	Mean Score	**Ranking Index**	**Mean Score**	**Ranking Index**
Risk identification Techniques				
Expert judgment	3.85	1	3.66	5
Risk Analysis	3.66	2	3.93	1
Checklist analysis	3.63	3	3.52	6
Brainstorming	3.59	4	3.33	9
Interviewing	3.44	5	3.78	4
Information gathering techniques	3.37	6	3.85	3
Assumption analysis	3.22	7	3.26	11
Root cause analysis	3.22	7	3.93	1
SWOT analysis	3.10	9	3.52	6
Diagramming techniques	2.88	10	3.33	9
System or process flow charts	2.81	11	3.11	12
Influence diagrams	2.63	12	3.45	8
Delphi technique	2.54	13	2.51	13
Qualitative Risk Analysis Techniques				
Expert judgment	3.73	1	3.62	1
Risk categorisation	3.63	2	2.89	4
Risk probability and impact assessment	3.59	3	3.22	2
Risk urgency assessment	3.48	4	2.96	3
Probability and impact matrix	3.11	5	2.85	5
Quantitative Risk Analysis Techniques				
Interviewing	3.51	1	3.10	9
Data gathering & representation techniques	3.49	2	3.45	6
Value Analysis	3.44	3	3.07	10
Probability distributions	3.34	4	3.03	11
Cost risk analysis	3.33	5	3.66	2
Quantitative risk analysis & modelling techniques	3.30	6	3.49	5
Modelling & simulation	3.26	7	3.26	7
Expert judgment	3.03	8	3.89	1
Risk Premium	2.89	9	3.11	8
Schedule risk analysis	2.85	10	3.52	4
Decision Tree	2.84	11	2.59	13
Expected Monetary Value analysis (EMV)	2.81	12	3.55	3
Sensitivity analysis	2.70	13	2.82	12
System Dynamics	2.30	14	2.07	15
Fuzzy logic / fuzzy set theory	1.70	15	2.08	14
Risk Response Planning Techniques				
Status meetings	3.85	1	3.51	2
Technical performance measurement	3.63	2	3.74	1
Risk reassessment	3.51	3	3.29	3
Variance and trend analysis	3.25	4	2.85	4
Risk audits	3.00	5	2.70	5
Reserve analysis	2.51	6	2.66	6
Risk Control Techniques				
Avoidance	3.63	1	3.85	2

Risk Management Strategies	Level of Awareness		Level of Usage	
	Mean Score	Ranking Index	Mean Score	Ranking Index
Loss Prevention	3.55	2	4.00	1
Loss Reduction	3.41	3	3.11	5
Separation	3.18	4	2.92	6
Diversification	2.93	5	3.22	3
Duplication	2.78	6	3.11	4

4.3 Challenges associated with effective implementation of risk management strategies

This study evaluated the challenges facing the implementation of risk management practices among CSMEs in the study locations. To achieve this objective, fifteen (15) challenges were identified from previous studies such as Tang et al. (2007), and El-Sayegh (2014). The mean score rating of the challenges is presented in Table 3.

From Table 3, Human/organization resistance to change from existing practices, and risk management techniques require the availability of sound data to ensure confidence and lack of accepted industry model for risk analysis ranked 1st, 2^{nd,} and 3rd respectively. It thus suffices to predict that among the primary issues that constitute serious challenges to the implementation of risk management practices in CSMEs are issues related to resistance to change from existing practices, availability of sound data, and lack of accepted industry models for risk analysis. The CSMEs seem not to be willing to shift base from the traditional means of going about construction and the inherent risks that may affect construction processes. The resistance to changing from existing practices has its root cause to be both the clients and the construction organizations. Sometimes, organizations decline to diversify, while in some instances the client has always refused the application of modern concepts in projects. Either way, this resistance from both ends culminates in a critical challenge that has always limited the implementation of risk management practices in construction projects. Furthermore, the lack of reliable data often undermines confidence, even though such data is essential for building trust in both the client and the organization regarding the implementation of risk management practices in projects. The data is meant to give a clue on the surrounding factors that require attention, help to decipher which practice best suits the prevailing situation, and then serve as a guide in the implementation. In the absence of reliable data, implementing risk management becomes a significant challenge, as effective implementation depends on data availability to achieve project efficiency. An additional concern is the lack of an accepted industry model for risk analysis, which has hindered the adoption of risk management practices in construction. Risk analysis is essential for understanding the potential impact of risks on construction projects and for developing strategies to mitigate those risks. Therefore, the absence of a widely accepted industry model for risk analysis poses a considerable barrier to effective risk management.

Table 3. Challenges facing the implementation of risk management practices

Challenges	Mean Score	Rank	Remark
Human / organization resistance to change from existing practices	3.85	1	Agree
Risk management techniques require the availability of sound data to ensure confidence.	3.70	2	Agree
Lack of accepted industry model for risk analysis.	3.59	3	Agree
Lack of expertise in the implementation of risk management techniques	3.55	4	Agree
Lack of information needed for implementing risk management process	3.48	5	Agree
Lack of management acceptance to implementation of risk management / Attitudes of management	3.41	6	Agree
Lack of uniformity/standardization in risk communication among professionals	3.33	7	Agree

Challenges	Mean Score	Rank	Remark
Lack of awareness about risk management	3.26	8	Agree
Lack of familiarity with risk management techniques and procedure	3.18	9	Agree
Lack of availability of user-friendly risk management software	3.14	10	Agree
Lack of time for implementing risk management process.	2.89	11	Undecided
Most of the construction projects are not large enough to require the implementation of risk management techniques.	2.82	13	Undecided
High cost of implementing risk management techniques	2.63	13	Undecided
Risk management in commercial terms is not always viable on every project.	2.55	14	Undecided
Doubts about the applicability of the techniques to the construction industry	2.45	15	Undecided

4.4 Principal Component Analysis (PCA) of Challenges facing the implementation of risk management practices

To further understand the classification of the challenges CSMEs face in utilizing risk management techniques, PCA was used. Table 4 shows the PCA of challenges facing the implementation of risk management practices among small and medium-scale construction businesses. In the PCA result in Table 4, three (3) components were classified based on the analysis and titled accordingly. The components are titled information constraints, standard & financial constraints, and human factor constraints.

Risk management techniques as it were, have their attributed cost, in essence, there is a definite cost the implementation attracts and when the willingness to incur this cost is lacking, it becomes a challenge. However, in the event of sufficient cash flow, the cost to be incurred in implementing risk management practices does not raise a challenge. Furthermore, the commercial viability of risk management is difficult to measure, making it hard for clients to recognize its value. As a result, clients are often unwilling to incur costs for something that does not appear immediately necessary. However, the true value of risk management lies in its contribution to project success, by facilitating construction processes and mitigating potential risks, it supports the successful delivery of projects. Doubts about the applicability of the techniques to the construction industry is another area of challenge that discourages the implementation of risk management in projects, and this is where the availability of data functions. If data were available, it could be used in eradicating doubt while proving the efficacy of the applicability of the techniques to the construction industry. Justifying this result, the cost of implementing risk management techniques, availability of data, and applicability of practices though very important in driving the notion for the application of risk management practices are not the only barriers to risk management implementation. Most times, the technical knowledge is lacking, the willingness to shift towards new approaches is absent and fear of not recording success in the adoption of the practices as a result of inexperience are issues that pose challenges to the adoption of risk management practices. Furthermore, it could be asserted that the CSMEs generally are resistant to change; rather than embrace change, are tied to the traditional approach often being used in the past. Once familiar with a particular practice, the willingness to explore other techniques is not always there.

From the information constraint, Bahamid and Doh (2017) identified challenges facing the implementation of risk management practices in construction projects including less know-how and awareness among the project stakeholders. Hosseini et al. (2016) suggested the inclusion of risk management in the education and training subjects of construction practitioners and CSMEs. Hosseini et al. (2016) further recommended support from managers, team working and effective communication to with the resistance to change and human factors. These findings are also similar to the result of the survey conducted by El-Sayegh (2014), which ranked managers' understanding of the techniques, finding suitable risk management methods, and difficulty in obtaining estimates and assessment of probability as the challenges facing the implementation of risk management practices in CSMEs. Goh and Abdul-Rahman (2013) also in agreement with these findings, concluded that resistance to change and the satisfaction of contractors with the current management system are believed to be the main challenges facing the implementation of risk management practices in CSMEs. Gwangwava et al. (2014) identified several major challenges to implementing risk management practices in SMEs: a lack of competent employees to identify and manage risks, insufficient resources to outsource audit services to minimize risk impact, and the tendency for risk management to rely solely on the beliefs of the owner or manager. Rostami et al. (2015) confirmed time and budget limitations as the key barriers to training which in turn is responsible for poor implementation of risk management practices. Furthermore, Akintoye and MacLeod (1997) showed that professionals' quantitative background, education, and training are major challenges facing the implementation of risk management practices in CSMEs.

Table 4. PCA of Challenges facing the implementation of risk management practices

Components	**Dimension**		
	1	**2**	**3**
Lack of accepted industry model for risk analysis	**-.948**	-.029	.047
Lack of time for implementing risk management process	**-.773**	-.078	-.105
Lack of information needed for implementing risk management techniques	**.756**	-.421	.381
Lack of awareness about risk management	**.727**	-.455	.392
Most of the construction projects are not large enough to require implementation of risk management techniques	**.720**	.672	.120
Risk management in commercial terms is not always viable on every project	**.720**	.672	.120
Risk management techniques require the availability of sound data to ensure confidence	**-.687**	-.500	.345
Doubts about the applicability of the techniques to the construction industry	**.596**	-.485	.425
Lack of uniformity/ standardization in risk communication among professionals	-.315	**.803**	.365
High cost of implementing risk management techniques	-.252	**.789**	.292
Lack of management acceptance to implementation of risk management/ attitudes of management	-.345	**-.564**	.202
Lack of availability of user-friendly risk management software	.151	-.146	**.873**
Lack of familiarity with risk management techniques and procedure	-.223	-.212	**.843**
Human organization resistance to change from existing practices	-.649	.305	**.673**
Lack of expertise in the implementation of risk management techniques	-.078	.385	**.623**

Variable Principal Normalization.

4.5 Impact of Risk Management Strategies on CSMEs Project Performance

This study posits that the utilization of risk management strategies would influence project performance among CSMEs. A total of twenty-eight (28) impacts of risk management practices on construction SME project performance were identified from previous studies in Akintunde (2003), Visser and Joubert (2008), and Oladimeji and Ojo (2012). These project performances were categorized under cost, time, quality, schedule, operational performance, and safety. The mean score rating of the impact of risk management practices on construction SME project performance is presented in Table 5.

Table 5 shows that there are varying impacts associated with the project performance of cost, time, quality, schedule, operational performance, and safety. On average, the use of risk management strategies had a high impact on project performance. Besides, the decision rule for interpreting the mean scores of the impact of risk management strategies on construction SMEs project performance was assessed using the scale: $1.00 \leq MS < 1.5$ represents 'no impact (NI)', $1.50 \leq MS < 2.5$ represents 'low impact (LI)', $2.50 \leq MS < 3.00$ represents 'moderate impact (MI)', $3.00 \leq MS < 4.00$ represents 'high impact (HI)' and $4.00 \leq MS \leq 5.00$ represents 'very high impact (VHI)'.

4.5.1 Cost Performance

In Table 5, market competition was well understood and ranked 1st under cost performance. The construction environment is highly competitive and this needs to be well understood, otherwise, construction firms may fizzle out of business in no time. Project performance demands are increasing daily, despite the potential risks inherent in construction projects. Clients expect that projects get completed and delivered within the budgeted rate. The application of risk management techniques has a distinct impact on projects by providing insight into potential challenges and guiding actions to mitigate threats that could hinder the successful completion or delivery of a project within the allocated budget. In this way, the risks of project abandonment or delays are reduced, allowing for improved project performance despite the threats posed by potential risks. Market competition has also to be properly understood such that it does not have a wrong effect on construction activities to the extent that the project gets affected, recording failure in the long run. Rework costs were well managed and were the least ranked cost objective because the attention of risk management practice is mostly focused on mitigating risks rather than managing issues related to rework costs. If potential risks had been well identified, and well managed, there may not be a reason for incurring costs on rework. As it were, the application of risk management does not seem impactful on the rework cost of projects. The justification of this bothers the party that bears the financial burden of rework, should that occur. Often, rework issues are passed on to clients or end users, even though they could have been identified and prevented during the construction stage. Such issues are frequently overlooked, which contributes to the long-term decline in project performance.

4.5.2 Time Performance

Table 5 illustrates that poor time management in construction projects would always have adverse effects on projects. Time is an important factor in projects and needs to be duly recognized and aligned with by construction participants. However, the application of risk management practices as it were, in projects, requires that time be apportioned to project activities, such that techniques required in mitigating the effects of risks are well demystified and construction processes flow smoothly. Nonetheless, there is a cogent need for proper time management as techniques are applied in mitigating risks; otherwise, there may be a need for an extension of time to bring projects to completion.

4.5.3 Quality Performance

From Table 5, the utilization of a quality checklist was regarded as a major impact of risk management strategies on project performance. This study showed that risk management practices foster the use of quality checklists in monitoring construction activities while ensuring that projects conform to acceptable standards. Therefore, the use of inferior contents may not be considered, as this could jeopardize the efforts invested towards mitigating risks. In addition, the contractor's quality assurance system is enhanced through the use of risk management strategies. By considering construction risks, quality standards to be met are carefully outlined with the implications if not reached.

4.5.4 Schedule Performance

As shown in Table 5, labor availability was well managed as a result of using risk management techniques. It, therefore, implies that the application of risk management practices in projects does have a unique way of managing efficiently the available labor in actualizing the project performance. To mitigate risks in construction projects, ensuring labor availability in key strategic roles and fulfilling essential project tasks is crucial. Therefore, this could be regarded as an impact traceable to the application of risk management practices. Risk has to be managed using the right means and applying the right techniques if it would not have an adverse effect during construction.

4.5.5 Operational Performance

In Table 5, the highest ranked impact in performance objective is the operational performance data (metrics) that were predictive of the final project outcomes. This is because the possibility of project recording success could readily be identified from the initial phase of implementation by the use of operational performance data (metrics). This is considered a huge impact on the CSMEs. On the contrary, most time, the project performance may not readily be ascertained until the completion and delivery stage of project construction. Therefore, project performance data (metrics) updates were accurate throughout the life of the project and ranked low not being justified as that which is impacted by the application of risk management practices.

4.5.6 Safety Performance

Sometimes in the past, the project objectives were limited to cost, time, and quality. Recently, project objectives have been extended to cover safety, scope, and so on. Goh and Abdul-Rahman (2013) opined that safety risks as well as financial risks as a way to affect other project objectives of project cost, time, and quality. This study in Table 5 showed that overall project safety performance was met based on baseline goals, targets, or expectations involving the organization's total recordable injury rate as a result of using risk management strategies. By applying risk management practices overall project safety performance can be guaranteed, thereby safeguarding the available labor from construction hazards.

Table 5. Impact of risk management practices on project performance

Project Objectives	Mean Score	Rank	Remark
Cost			
Market competition was well understood.	3.44	1	High impact
Overall Project cost performance was met based on baseline goals, targets, or expectations.	2.97	2	Moderate impact
Budget contingencies were well managed.	2.93	3	Moderate impact
Net profit targets were met.	2.78	4	Moderate impact
Rework costs were well managed.	2.66	5	Moderate impact
Time			
Poor time management in construction projects always has adverse effects on the project	3.85	1	High impact
Ineffective time management leads to overruns of the project	3.55	2	High impact
Time overruns are the extra time required to finish a given construction project beyond its original planned duration	3.44	3	High impact
Ability to control time-phased budget plan	3.37	4	High impact
Time management makes sure the project meets the time duration within budget and according to specification	3.30	5	High impact
Quality			
Utilization of quality checklist	4.11	1	Very High Impact
Contractor's quality assurance system	4.04	2	Very High Impact
Availability of defined quality metrics	4.00	3	High impact
The extent of conforming to the quality management plan	3.97	4	High impact
Quality management plan	3.82	5	High impact
Schedule			
Labor availability was well managed.	3.85	1	High impact
Overall Project schedule performance was met	3.78	2	High impact
Facilities availability was well-managed	3.70	3	High impact
Material availability was well-managed	3.63	4	High impact
Schedule float management was optimized.	3.22	5	High impact
Performance			
The performance data (metrics) were predictive of the final	3.26		High impact

Project Objectives	Mean Score	Rank	Remark
project outcomes		1	
Project operational performance goals were met	3.07	2	High impact
Project performance data (metrics) were in good alignment with informal customer feedback	3.00	3	Moderate impact
A formalized method was established for managing project performance data (metrics).	2.92	4	Moderate impact
Project performance data (metrics) updates were accurate throughout the life of the project	2.85	5	Moderate impact
Safety			
Overall project safety performance was met based on baseline goals, targets, or expectations involving the organization's total recordable injury rate	3.48	1	High impact
Project safety performance was commensurate with the experience levels of the craft	3.18	2	High impact
Overall project safety performance was met based on baseline goals, targets, or expectations involving the organization's lost or restricted workday rate.	3.18	2	High impact

5.0 CONCLUSIONS

This study evaluated the risk management strategies among small and medium-scale construction businesses. The study showed that expert judgment, risk analysis, and checklist analysis were identified to have registered significant awareness by CSMEs. However, this high level of awareness did not translate to high usage of risk management strategies. Only expert judgment, a quantitative risk analysis technique was within the high level of awareness and usage among small and medium-scale construction businesses. This finding implies a gap between awareness and implementation, implying that awareness is insufficient to motivate execution. Organizational culture, a lack of desire, insufficient resources, or perceived complexity can all inhibit experts from putting their knowledge into action, reducing the success rate of risk management initiatives. The major challenges facing the implementation of risk management practices among small and medium-scale construction businesses include human/organization resistance to change from existing practices, risk management techniques requiring the availability of sound data to ensure confidence, and lack of accepted industry models for risk analysis. The results on human and firm aversion to change from established methods implies a major obstacle to risk management implementation, as it prevents the implementation of new procedures, technologies, or mindsets required for proactive risk detection and mitigation. This reluctance is frequently motivated by a fear of the unknown, a preference for established habits, or a lack of understanding about the advantages of risk management. As a result, CSMEs may continue to rely on reactive strategies, become more vulnerable to project risks, and experience lower overall performance and resilience. Furthermore, the challenges were categorized as information constraints, standard and financial constraints, and human factor constraints.

In addition, the study also assessed the impact of risk management practices on the performance of CSME projects from multiple perspectives. From a cost perspective, the findings revealed that market competition was well understood. This suggests that CSMEs recognize market rivalry as a critical factor influencing strategic decisions, driving innovation, and enhancing responsiveness to client needs and industry trends. From a time perspective, the findings indicated that poor time management in construction projects consistently leads to adverse outcomes. This implies that project teams may lack adequate planning, coordination, or monitoring capabilities, resulting in delays and inefficiencies. Consequently, there is a clear need for improved scheduling practices, targeted training, and enhanced time management strategies to boost project performance and meet deadlines. From a quality perspective, the use of quality checklists was highlighted. This indicates that professionals in CSMEs prioritize structured tools to ensure compliance with standards, minimize errors, and maintain consistency. It reflects a proactive approach to quality assurance and a commitment to continuous evaluation throughout the construction process. From a scheduling perspective, the findings showed that labor availability was effectively managed. This suggests that project teams efficiently align workforce supply with demand, reducing delays and improving overall efficiency. It reflects effective planning, resource allocation, and flexibility, all of which support timely project completion. From a performance perspective, the findings demonstrated that operational performance data were predictive of final project outcomes. This indicates that metrics such as cost management, adherence to schedules, and efficient resource usage serve as early predictors of a project's ultimate results. Monitoring these parameters is therefore vital for proactive risk management and promote project success. Finally, from a safety perspective, the study found that overall safety performance met baseline goals and targets, such as the organization’s total recordable injury rate. This suggests that safety protocols were effectively implemented, standards were upheld, and a strong safety culture was maintained. These factors positively influence risk management, workforce awareness, and overall project planning.

Based on the findings of the study, the recommendations for policymakers, construction professionals, and CSMEs are as follows:

a) Creation of continuous awareness of the use of risk management practices in projects by CSMEs, thereby improving the level of use by CSMEs. As the study has shown, there is a need to engage construction professionals in practical training as regards risk management strategies. This can be accomplished by encouraging continuous awareness and education through industry seminars, case-based training, and focused workshops that highlight the application of risk management strategies by CSMEs in actual projects. Also, the creation of peer-learning networks, disseminating success stories centered on CSMEs, and incorporating useful risk management information into CSME development initiatives will all be beneficial. Furthermore, aid from agencies of government and professional associations in the form of mentorship and continuous professional development (CPD), incentives, and simpler tools can promote regular use and enhance comprehension among CSMEs.

b) CSMEs need to have a risk management culture entrenched in their business model. This would help mitigate the resistance to change from workers within the firm in terms of using risk management strategies on construction projects. This can be accomplished by determining which factor, e.g., cost, time, quality, and safety that are considered as most important during project planning. This can be done by carrying out a thorough risk-performance impact assessment to allow for the customization of risk management techniques, which may include increasing controls, monitoring efforts, and resources in high-impact areas while preserving baseline measures in other areas.

c) In order to encourage diverse use of risk management strategies, risk management plans should be made mandatory as pre-qualification and contract documents while bidding/tendering for construction projects by construction firms. This can be accomplished by adding mandatory risk management clauses to tender rules and procurement regulations. A thorough risk management strategy should be required from the bidders as part of their pre-qualification and contract paperwork, according to regulatory agencies or project owners. Furthermore, preparing project consultants and procurement officers to examine and implement these guidelines will guarantee adherence and promote the industry-wide use of proactive risk management techniques.

d) As shown in the study, risk management strategies have different impacts on construction performance and the sustainability of small and medium construction businesses in getting more projects/jobs. Therefore, there is a need for drivers from the government in order to sustain the sector. This can be accomplished if the government implements regulations that promote risk management techniques to provide efficient building performance.

e) There is a need for an active information database on risk management in the construction industry that can assist construction professionals with data and standards to develop a comprehensive risk management model for their construction projects. This may be accomplished by establishing a unified, industry-supported digital platform that gathers, curates, and updates risk-related data from previous and current construction projects. In order to direct risk modeling, the platform should have industry-specific benchmarks, classification schemes, and standardized templates. Moreover, the database's continued relevance, usefulness, and widespread usage will be guaranteed by frequent updates, professional access, and connection with training initiatives.

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