

Midocean University
Management college
Master of Project Management



**Exploring the Relationship Between Participant Training, Knowledge, and the
Effectiveness of Risk Management Workshops in Project-Based Industries**

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2024

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Acknowledgments

More possible people than I can possibly wish to thank here have contributed to the completion of this thesis.

I wish to express my special appreciation to my supervisor Dr. Asma Abuanzeh. Without her inspiration, support and encouragement, this work would never have come to fruition. I have been very fortunate to have her as my supervisor.

I also appreciate the generous help of all the respondents who participated in my survey.

My deep gratitude and appreciation also go to my family and my family-in-law. Their love, support, and constant encouragement gave me a great deal of strength and determination that helped me during the time of writing this research.

Abstract

This research investigates the impact of training and knowledge levels of participants on the effectiveness of risk management (RM) workshops within project-based industries, including construction, IT, and engineering. Risk management workshops are widely used to identify, analyze, and mitigate project risks; however, their effectiveness is often influenced by the participants' level of expertise and prior training. The study identifies a critical gap in the literature where human factors, such as participant preparedness, have been overlooked compared to the emphasis on technical tools and methodologies. By employing a mixed-methods approach, the research combines quantitative data from structured questionnaires with qualitative insights gathered through participant interviews. The population consists of professionals actively involved in risk management practices, including project managers, risk analysts, and engineers.

The study's objectives include assessing the relationship between training levels and workshop outcomes, evaluating the influence of participant knowledge on risk analysis, and examining the effectiveness of different training interventions in enhancing participants' understanding of RM principles. The research framework integrates theories such as Adult Learning Theory and Competency Theory to examine how knowledge and training interventions influence workshop outcomes. The findings reveal statistically significant correlations between participants' prior knowledge and the effectiveness of risk identification, analysis, and mitigation during workshops.

Results indicate that workshops with participants who possess higher levels of prior knowledge and training show improved outcomes in risk assessment and decision-making processes. Additionally, the study highlights the importance of tailored training interventions, suggesting that industry-specific and targeted programs significantly enhance participant performance compared to general risk management training.

Practically, the research provides actionable recommendations for organizations to design effective training modules that enhance cross-disciplinary collaboration and participant engagement in RM workshops. By optimizing the preparedness of workshop participants, the study contributes to reducing project delays, minimizing costs, and increasing overall project success rates. This study also underscores the importance of continuous professional development and knowledge sharing as vital components of successful risk management practices, advocating for a shift from purely technical approaches to incorporating human elements for better workshop outcomes.

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List of Abbreviation

RM:	Risk Management
DRR:	Disaster Risk Reduction
IRVM:	Integrated Risk and Value Management
CBDRM:	Community Based Disaster Risk Management
FMEA:	Failure Mode and Effect Analysis
PMBOK:	Project Management Body of Knowledge
VM:	Value Management
IRVM:	Integrated Risk Value Management
ABM:	Agent Based Modeling
CSN:	Constrain Satisfaction Network

1. CHAPTER 1: INTRODUCTION

1.1. Introduction

This section describes the important concepts regarding risk management (RM). It also talks about many tools and techniques which are used commonly in RM, specifically on their relevance and limitations in different phases of a project. Moreover, it reviews recent literature on the increasing use of risk management workshops, including their methodologies. Additionally, the chapter identifies a significant research gap in the literature which is followed by the study's main objectives and sub-objectives. The research objectives are then followed by research questions which highlight the main focus of this research.

1.2. Risk Management Workshops

Risks are inevitable, particularly in the dynamic construction industry (Forbes et al., 2008). In order to accomplish the goals and objectives of a project, it is necessary to proactively manage risks. Risk management (RM) is a critical strategy for optimizing decision-making. RM has the potential to mitigate the likelihood of potential hazards and their potential consequences, as well as to optimize the probability of chances (Karunathilake et al., 2020). The efficiency of both the venture and the organization can be improved by converting downside risk to upside risk through the use of a successful risk management application. The literature contains a number of RM procedures that have been proposed by professional bodies and researchers (Goh et al., 2013). Professional organizations have implemented systems to address challenges associated with its execution, as RM is of paramount importance. PMI (2004) implemented a five-step risk management framework that encompassed risk planning, risk recognition, risk evaluation, risk response, and risk control and monitoring (Benjamin et al., 2006). Simultaneously, AS/NZS (2004) introduced an RM process that encompasses the following: context establishment, risk recognition, examination, assessment, interventions, monitoring, and communication (Wong et al., 2020). Despite the differences in individual RM processes, they consistently incorporate risk identification, analysis, and response. The full benefits of RM should be realized by applying it in a systematic and exhaustive manner at all stages of the project's life cycle. Additionally, the appropriate selection of risk management instruments and techniques is crucial for the effective execution of risk management.

1.3. Tools and Techniques used for RM

The efficiency of RM in achieving project objectives can be enhanced by the prudent application of appropriate tools and techniques. In the construction and engineering sector, a diverse array of instruments and methodologies are accessible for risk management. The application of these tools and techniques in the construction and engineering industry has been the subject of numerous studies (Goh et al., 2013; Zhu et al., 2021). Checklists, brainstorming, probability impact matrices, subjective judgment, decision tree assessments, sensitivity assessments, and Monte Carlo simulations are the most frequently employed methods and tools (Abdelmageid, 2020). The selected RM tools and techniques must be compatible with the allocated resources and must also be in accordance with the project objectives. A single technique may not

be suitable for all circumstances, and it may not be pertinent to every phase of an RM procedure (Akhavan et al., 2021). Despite the availability of numerous instruments and techniques, a literature review revealed that only a limited number of them are actively employed. Inventories, case-based approaches, and ideation are the most frequently employed risk identification methodologies. In the evaluation and analysis of risk, subjective judgment, intuition, and experience are frequently employed (Glette-Iversen et al., 2022).

1.4. Recent Literature on Risk Management Workshops

Risk management has become a vital component of organizational strategies across various industries, with workshops playing a significant role in ensuring a practical understanding of risk management processes (Hubbard, 2020). Over the years, research has shown that workshops tailored to risk management not only enhance organizational capabilities but also promote collaborative approaches to identifying, assessing, and mitigating risks. A few studies have discussed various dynamics of risk management workshops on the effectiveness of risk management (Settembre-Blundo et al., 2021).

A recent innovation in risk management training is the use of gamification techniques. Schönbohm and Jülich (2016) explored the application of gamified risk management workshops in German SMEs. The authors found that integrating gaming elements into the workshop format significantly improved participant engagement and understanding of risk management principles. The study concluded that gamification makes the traditionally complex subject of risk management more accessible and interactive, thereby increasing its applicability in real-world scenarios. The workshop model discussed included interactive role-playing and simulations, enhancing the practical skills of participants, especially in identifying and mitigating risks (Schönbohm & Jülich, 2016).

Barnaby (1984) researched the use of applied risk management tools within extension workshops in agriculture, focusing on the need for practical, hands-on methods in teaching risk management. The study showed the challenge of teaching theoretical risk concepts to farmers, who typically have little exposure to statistical and probabilistic thinking. By using applied workshops, which incorporated real-world examples from agricultural operations, the workshops bridged the gap between theory and practice. This practical approach allowed participants to better understand and manage risks associated with crop yields, weather events, and market volatility (Barnaby, 1984).

Abd-Karim and Lowe (2011) explored the concept of integrated risk and value management (IRVM) workshops in the context of large infrastructure projects in the UK. Their case studies showed how the simultaneous consideration of value and risk provided a comprehensive decision-making framework. The workshops allowed project teams to assess both the value drivers and risk factors in infrastructure projects, ensuring that decisions were not only cost-effective but also resilient to risks (Abd-Karim et al., 2011). Steynor et al. (2016) investigated the use of co-exploratory risk workshops in addressing climate-related risks in urban areas of Africa. Their research showed the value of interdisciplinary collaboration in risk management workshops. The workshops brought together participants from government, academia, and non-governmental organizations to collaboratively assess climate risks and develop risk mitigation strategies (Steynor et al., 2016).

Goh and Abdul-Rahman (2013) focused on the application of risk management workshops in public construction projects. The case study on a public construction project demonstrated how workshops ensured collaborative risk assessment, enabling more effective risk mitigation strategies and ultimately leading to smoother project delivery (Goh et al., 2013).

Awareness programs and workshops have been recognized as effective tools for disaster risk reduction (DRR). In their case study from Tamil Nadu, India, Asharose et al. (2015) demonstrated how workshops focusing on community-based disaster risk management (CBDRM) were used to educate local populations about potential risks and mitigation strategies. These workshops included participatory risk assessments that empowered communities to take ownership of their risk management strategies. By engaging local populations directly in the workshop process, the study highlighted how risk management workshops can be used to build more resilient communities in disaster-prone areas (Asharose et al., 2015).

1.5. Literature Gaps in the Application of Risk Management Workshops

Some of the more established RM methods and tools utilized in the construction sector today include failure modes and effect analysis (FMEA), decision tree examination, Monte Carlo simulation, sensitivity examination, and program and evaluation reviews (PERTs). However, these methods have limitations. For example, in order to be used effectively, these complex quantitative analyses - like FMEA and Monte Carlo simulations - often need a high degree of data confidence (Zeng et al., 2007). However, the majority of risk management strategies fall short in meeting the demands of recognizing, evaluating, and handling risks within a logical framework. When checklists and brainstorming are the only methods used, risks cannot be prioritized or evaluated by evaluating the likelihood and consequences of the risks. Because the only foci in PERT's sequence diagram of networks are project operations and events, the tool's use is thus restricted to time-associated concerns. While sensitivity analysis has shortcomings in identifying the best party to manage risks and in establishing suitable responses to risks, decision tree analysis excels in putting the implications of risk occurrence into practice. However, sensitivity analysis can only be used to a certain extent to evaluate the combined impact of several risk factors; it cannot indicate the likelihood that a risk will materialize (Perry & Hayes, 1985). According to Tang et al. (2007), it is necessary to methodically look at the general characteristics of RM from the viewpoints of different project participants (Tang et al., 2007). A workshop serves as one of the comprehensive ways that can offer a forum for different project stakeholders to have an integrated RM practice, as only a few techniques and tools can enable project teams to include the demands of proactive communication in their practice. An RM workshop offers a more thorough and uniform RM approach that concurrently takes into account risk planning, recognition, evaluation, and reaction by integrating a variety of tools, including brainstorming, checklists, probability impact matrices, subjective judgment, and risk registers. However, there aren't much research that look at using a workshop as a risk management technique. The use of a workshop as a productive forum in the early phases of RM was covered by Wood and Ellis (2003). All members of the project team can get together during the workshop to have a concentrated and intense discussion about potential risk problems (Wood & Ellis, 2003). Getting the team together in one location creates a creative atmosphere for discussing possible project hazards. According to Simister (2007), a workshop setting fosters creative thinking and gives participants a chance to examine other points of view that they may dismiss out of sight if they would be working alone.



Figure 1: Human Impactful for risk management workshops

Impactful human characteristics for risk management workshops with participant knowledge and prior training at the top (Authors own elaboration).

1.6. Study Problem

Risk management workshops in project-based industries, such as construction, IT, or engineering, are designed to identify, assess, and lessen project risks. However, the effectiveness of these workshops is not completely dependent on the content or the facilitation process. The participants' level of training and prior knowledge directly influences how risks are identified, analyzed, and addressed. Individuals who are well-trained and knowledgeable about the project, industry-specific risks, and risk management tools can give better contributions, meaning more effective decision-making. Without sufficient training, participants may not be able to accurately assess risks or propose viable mitigation strategies, making the workshop less effective. Professionals with varying levels of experience, expertise, and familiarity with risk management practices usually attend workshops. Prior training can serve as a critical tool to bridge these knowledge gaps, which also ensures that participants engage at a higher level and contribute more meaningfully. For example, while an engineer may have deep technical expertise, they may not have a formal understanding of risk management principles, which can lead to ineffective participation. Prior knowledge and training can ensure that participants are on the same page, optimizing workshop outcomes.

Research has shown a link between risk management maturity and project success, but what is often overlooked is how participant preparation - both training and pre-existing knowledge - helps this maturity. Risk management is not just a procedural activity; it requires the active engagement of participants who understand not only the risks but also the project's context, the business environment, and potential risk reduction strategies.

Existing literature, on risk management workshops, as described above predominantly focuses on the processes, tools, and methodologies used in workshops. However, little attention has been paid to the human factors involved in these processes, particularly how the training and

knowledge levels of workshop participants impact the outcomes. This lack of focus on the human element leaves an important gap in understanding how to optimize these workshops from a participant-preparation perspective.

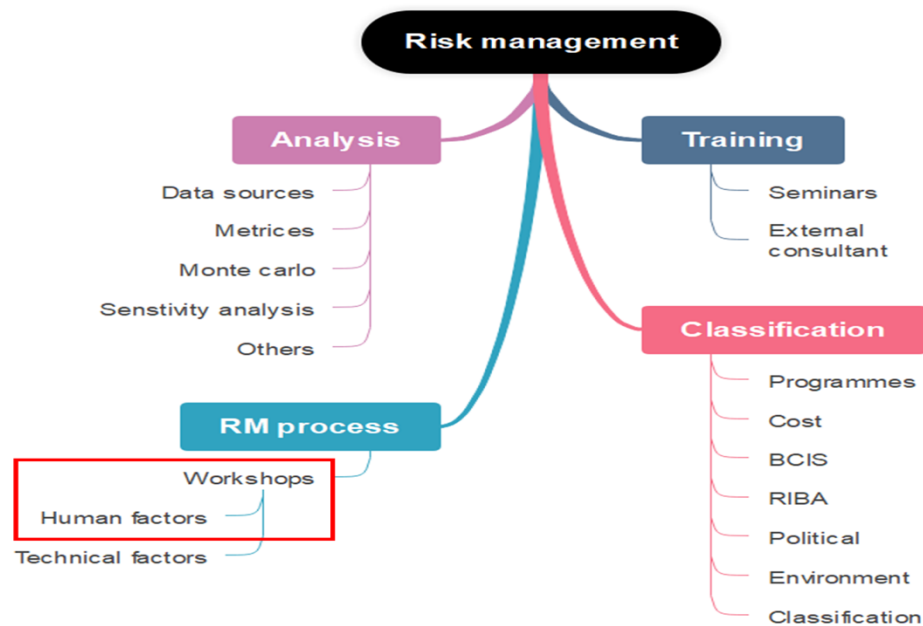


Figure 2 : Risk management Human Factors

1.7. Importance of Study

Scientific Importance:

1. This study will try to look into an important gap in the field of risk management literature by studying the impact of participant training and knowledge on the effectiveness of risk management workshops, a topic that has been largely overlooked in existing research.
2. This study will add into the scientific knowledge on the domain of human elements in the successful implementation of risk management workshops, which could potentially influence the success of risk management processes, shifting the focus from purely technical aspects to the role of participant preparedness.
3. The study wants to enrich the existing theoretical bases of risk management practices in project-based industries by potentially incorporating an important element into effective risk management strategies.
4. By providing empirical data on how training interventions affect workshop outcomes, this research helps develop evidence-based approaches to improve risk management strategies.

Practical Importance:

1. The study will be a source of guidance for designing targeted training programs that could improve the ability of the participants to identify as well as reduce risks, meaning a better successful project management.

2. By ensuring that participants are better prepared for risk management workshops, the research can help project-based industries avoid delays, reduce costs, and increase the likelihood of project success.
3. The study can help to customize training to handle the unique risk profiles of different project-based industries. This could lead to the development of industry-specific training modules that equip participants to handle risks more relevant to their particular sector.
4. Project-based industries mostly involve professionals from various different backgrounds (e.g., engineers, financial experts, managers). The research will be helpful in determining how training can enhance cross-disciplinary understanding, making sure that participants from different fields can collaborate in a better way during workshops with improved outcomes.
5. By pinpointing the specific areas where participants lack knowledge or training, the study can help organizations avoid generalized, costly training programs. Instead, they can focus resources on filling the most critical knowledge gaps, making training more efficient and cost-effective.

1.8. Objectives of The Study

Main Objective:

To investigate the link between participant training, knowledge, and the effectiveness of risk management workshops in project-based industries, and how these factors impact risk identification, analysis, and reduction.

Sub-Objectives:

1. To assess how participant training impacts the effectiveness of risk management workshops in improving risk identification and reduction.
2. To understand the role of participant knowledge in contributing to the success of risk management workshops, particularly in risk analysis domain.
3. To evaluate the effectiveness of knowledge level and different types of training interventions in enhancing participants' understanding of risk management principles and their ability to apply them during workshops.
4. To make the outcomes widely known for the stakeholders and organizations for effective risk management decisions.

1.9. Study Questions

Following are the research questions for this study. What is the impact of participant knowledge and training on the effectiveness of risk management workshops in improving risk identification and reduction.

1. What is the role of participant knowledge in contributing to the success of risk management workshops, particularly in risk analysis domain.

2. What is the effectiveness of different types of training interventions in enhancing participants' understanding of risk management principles and their ability to apply them during workshops.
3. To make the outcomes widely known for the stakeholders and organizations for effective risk management decisions.

1.10. Summary

Risk management is important for the success of projects. Many RM tools and techniques have been developed; their effectiveness often depends on how well they are applied in practice. Workshops have been shown to be a critical platform for addressing risks collaboratively, in a way that allows participants to engage in identifying and lessening risks. However, the effectiveness of these workshops is influenced not only by the processes and tools used but also by the preparedness of the participants themselves. This section has brought attention to the role of human factors - specifically, participant training and knowledge (which have been mostly overlooked in previous studies) - in the success of risk management workshops. Although there is a lot of literature on RM processes and methodologies, there is also a big gap in understanding of training and prior knowledge of participants affects the identification, analysis, and management of risks. This chapter tries to focus on the human element and makes the stage for investigating how targeted training interventions can enhance the efficacy of RM workshops.

2. CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

Several researchers have studied the effectiveness of risk management workshops and impact of different human factors in its effectiveness. Siew Goh et al. (2013) explored the effectiveness of risk management workshops in enhancing project risk management within the construction industry, focusing on RM workshops as a systematic and practical approach to managing risks. The study provides empirical evidence through a case study of a public construction project. This research is valuable because it moves beyond traditional, statistical forms of generalization and employs analytical generalization, a concept discussed by Yin (2011), allowing findings to be applied to similar contexts through logical extension. The findings validated previous studies by Wood and Ellis (2003) and Simister (2007), which emphasized that workshops significantly enhance risk understanding, facilitate team consensus, and improve decision-making by encouraging lateral thinking. The research confirmed these assertions, demonstrating how RM workshops serve as an effective platform for knowledge exchange and relationship building among stakeholders, ultimately leading to more effective risk management.

One of the key strengths identified was the RM workshop's ability to create an energetic and focused environment, particularly beneficial for fragmented project teams. The workshops facilitated close interactions, enabling an in-depth analysis of risks from different stakeholders' perspectives. This collaborative approach ensured that risks were evaluated comprehensively, taking into account the joint efforts of all participants rather than individual risk appetites, consistent with Wyk et al. (2008), who emphasized the importance of theory-practice convergence in risk management.

Several strengths of RM workshops were highlighted, such as improved communication between stakeholders, better alignment on roles and responsibilities, and collective intelligence gained through brainstorming sessions. The workshops were seen as opportunities for stakeholders to express their views on project risks, share knowledge, and achieve consensus on major risks. This demonstrates that RM workshops are effective not only as risk identification tools but also as mechanisms for building a shared understanding across diverse project teams.

However, the study also identified several limitations of the RM workshops that are relevant for future research. A major drawback was the resource-intensive nature of workshops, requiring significant time, money, manpower, and planning. Prolonged sessions tended to become less productive, and discrepancies in defining certain risk-related terms led to inconsistencies in risk evaluation. These findings align with previous studies that suggest RM techniques often face practical barriers in implementation, such as insufficient stakeholder commitment and resource constraints (Aven, 2016). Additionally, gaps in communication meant that the outputs of the workshop were not effectively disseminated to all stakeholders, reducing the overall impact of the RM initiative.

Another challenge observed was the lack of a structured follow-up mechanism for monitoring risks after the workshops. While the workshops succeeded in identifying and analyzing risks, the subsequent phases of risk management, such as treatment and monitoring, were

inadequately addressed. This lack of follow-up reduced the overall effectiveness of the workshops, as many agreed actions and decisions were not implemented. This finding is consistent with the broader RM literature, which emphasizes that continuous monitoring and control are essential components of effective RM (Hillson, 2003).

In the context of Southeast Asia, the study noted that RM workshops could significantly enhance construction industry practices, particularly where RM practices are less developed. The findings suggest that the introduction of RM workshops can substantially improve understanding and application of RM in projects, thus contributing to better construction performance. This adds value to existing knowledge by providing empirical evidence of the feasibility of RM workshops in regions with less established RM practices.

The overall conclusions drawn suggest that RM workshops are a promising tool for enhancing project risk management, especially in their capacity to facilitate risk identification, analysis, and shared understanding. Despite limitations, such as the need for substantial resources and the potential issues with prolonged sessions, the workshops provide a structured approach to RM, particularly beneficial in industries like construction that involve numerous stakeholders with varying risk exposures. The study also emphasized the need for improved communication and follow-up mechanisms to ensure effective implementation of RM strategies identified during workshops.

However, the paper highlights several limitations in the workshop's execution, notably in the areas of incorporating positive risks, risk planning, monitoring, control, and communication. The results, while valuable, should be considered indicative rather than conclusive. Future research is needed to build on this foundational work. Specifically, there is a call for additional studies to investigate the practical applications of RM workshops, aiming to validate and refine their effectiveness in managing risks. By expanding the sample size and employing rigorous scientific methodologies, subsequent research can address the identified limitations, ultimately enhancing the understanding of how RM workshops can improve risk management practices.

Schönbohm and Jülich (2016) explored the effectiveness of gamified risk management workshops in small and medium-sized enterprises (SMEs) in Germany. The study aimed to determine whether game elements such as points, leaderboards, and time limits could motivate participants and enhance their engagement in risk management processes. The authors tested five hypotheses related to the potential benefits of gamification in risk management, including motivation, the influence of cognitive biases, decision-making improvement, structured process implementation, and practical knowledge application. The study's findings supported most of the hypotheses. Game elements were found to drive competition and enhance motivation among participants (H1). Although participants responded positively to these game mechanics, the impact of receiving and giving feedback (H2) was less prominent. The authors observed that feedback did not significantly motivate participants, which they suggested may depend on the social orientation or competitive nature of the group. Nevertheless, discussions among teams improved decision-making (H3), with participants expressing that group discussions enhanced their understanding of risks and minimized cognitive biases, such as groupthink and authority bias.

The workshop's structured design, incorporating gamified elements, facilitated a clear and replicable risk management process (H4). Participants appreciated the structured approach, with the use of levels and leaderboards helping break down the process into manageable steps. This made the risk management process more engaging and comprehensible for participants. The study

also highlighted that participant valued the safe learning environment provided by the workshop, where they could apply risk management tools without fear of failure, thus improving their practical knowledge (H5).

While the study provided valuable insights, the authors acknowledged certain limitations, including a small sample size, potential bias due to researcher observation, and the lack of a control group. Despite these constraints, the results indicated that gamification has the potential to enhance risk management processes in SMEs by improving engagement, knowledge retention, and decision-making. The study concluded by recommending further research with larger sample sizes and the exploration of long-term effects of gamified risk management workshops.

In the context of risk management workshop literature, this study contributes to understanding how gamification can be used as an innovative tool to address challenges in traditional risk management workshops.

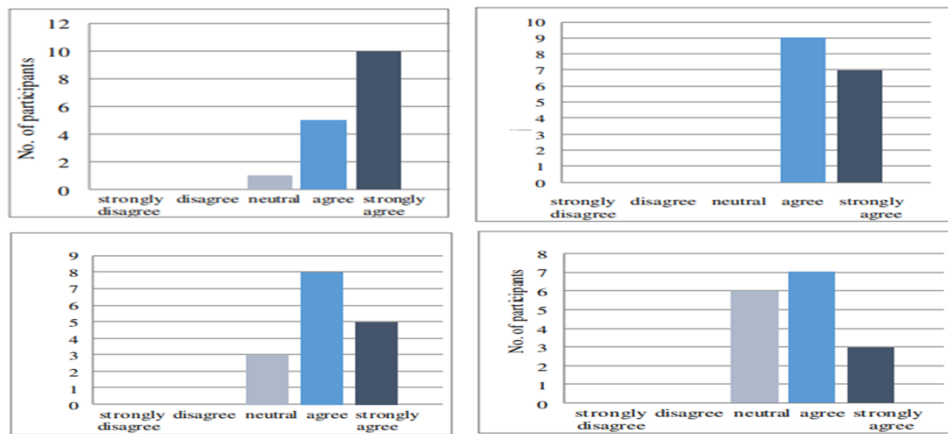


Figure 3: Responses of participants

Responses of participants after the workshop on (a) effectiveness of workshop, (b) the discussions in and between the groups improved general decision making, (c) Got knowledge in workshop, (d) enhanced my skills towards risk management.

Tavakolan and Mohammadi (2017) explored the application of risk management workshops within the context of large construction projects, using the Ahwaz Urban Railway project in Iran as a case study. Their study highlights the significance of RM workshops in identifying, assessing, and responding to risks in complex construction environments.

The study outlined the comprehensive approach used in their risk management workshop. The workshop incorporated brainstorming sessions, fuzzy failure mode and effect analysis (FMEA), and multiple-choice questions to identify and prioritize risks, as well as determine appropriate responses. This method enabled project stakeholders to systematically assess various risk factors such as likelihood, impact, and detection rates, allowing for a better understanding of the risks facing the project. The combination of these techniques - particularly the inclusion of fuzzy sets - was designed to address some of the shortcomings of traditional RM methods, such as the inability to account for the interdependence of risks and the lack of detection capabilities in failure mode analysis.

One of the key contributions of the workshop model presented by Tavakolan and Mohammadi is its ability to foster a collaborative environment. By involving key stakeholders in the RM process, including contractors, consultants, and owners, the workshop helped align

perceptions of risk across different parties. This collaborative aspect was particularly important in a project as complex as the Ahwaz Urban Railway, which involved multiple parties and high levels of uncertainty. Through group discussions and collective decision-making, the workshop not only improved the identification of critical risks but also enhanced communication and team cohesion, which are essential for the successful management of large-scale projects.

Despite the strengths of the workshop model, Tavakolan and Mohammadi acknowledge several limitations in their study. One of the main challenges identified is the time and resource investment required to conduct such workshops. Gathering key stakeholders and maintaining their engagement throughout the process can be costly and time-consuming, which may limit the feasibility of this approach in smaller projects or organizations with limited budgets. Additionally, the workshop was constrained by time, preventing a full implementation of the Project Management Body of Knowledge (PMBOK) RM framework, particularly in the areas of risk monitoring and controlling. This limitation suggests that while workshops can be effective for risk identification and assessment, they may not be as useful for long-term risk tracking and management.

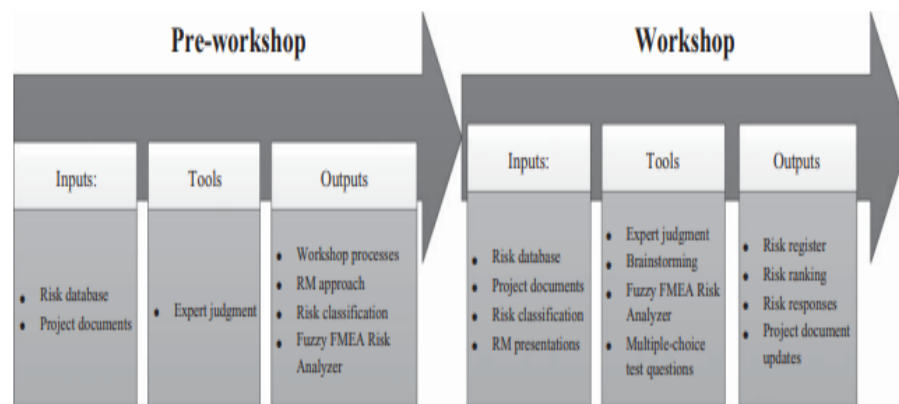


Figure 4: future direction

In terms of future direction, Tavakolan and Mohammadi suggest that further research is needed to validate the effectiveness of RM workshops in different contexts. While their study provides valuable insights into the application of workshops in the construction industry, the generalizability of their findings to other industries or project types remains unclear. Additional case studies across different sectors could help determine whether the benefits of RM workshops - such as improved communication, better risk identification, and enhanced stakeholder engagement - are universally applicable or specific to certain types of projects.

The study also points to the need for better tools and methodologies for risk monitoring and controlling in RM workshops. While the authors successfully demonstrated the use of fuzzy FMEA for risk assessment, they did not provide a robust solution for ongoing risk management throughout the project lifecycle. Future research could focus on developing integrated tools that combine risk identification, assessment, and monitoring into a single framework, making it easier for project managers to track risks over time and adjust their mitigation strategies as needed.

The success of the workshop relied heavily on the skills of the facilitators, particularly in guiding discussions, managing time effectively, and keeping participants engaged. Future studies

could explore the role of facilitation in greater detail, examining how different facilitation styles or techniques influence the outcomes of RM workshops. Additionally, developing standardized training programs for facilitators could help improve the consistency and quality of RM workshops across different projects and industries.

Abd-Karim et al. (2011) explored the integration of risk management and value management (VM) through the use of Integrated Risk and Value Management (IRVM) workshops. The study focused on four case studies from infrastructure projects in the UK, including projects in the rail and water industries. The authors argue that RM and VM are complementary processes that, when combined, can optimize project outcomes by reducing risks and enhancing value. Despite the wide use of RM and VM individually, their joint application remains underexplored, particularly in the infrastructure sector. The methodology adopted in the paper revolves around case studies and the implementation of IRVM workshops, which utilized brainstorming, risk identification, and quantitative risk assessment techniques. These workshops brought together multi-disciplinary teams and followed structured processes such as the job plan. The goal of these workshops was to increase collaboration among stakeholders, identify potential risks, and explore value improvement opportunities. The case studies involved infrastructure projects such as carriage washer renewal, station enhancement, water treatment, and wastewater incineration projects, all of which faced complex risks and value challenges.

Findings from the study show that IRVM workshops can effectively manage risk and value considerations simultaneously. For example, in the water treatment project, the IRVM workshop identified key business risks and generated options to mitigate these risks while enhancing project value. Similarly, the station enhancement project saw the use of brainstorming techniques to identify key risks and value improvements, leading to cost savings and a clearer understanding of project constraints. However, the study also identifies several limitations. The most significant limitation is the heavy reliance on the availability of time and resources, which makes IRVM workshops less feasible for smaller projects or organizations with limited budgets. Additionally, the authors note that while the workshops were effective in the identification and assessment of risks, they were less successful in ongoing risk monitoring and controlling throughout the project lifecycle. This suggests that the IRVM process, while beneficial in the early stages of project development, might require complementary tools for later phases.

In terms of future directions, the authors recommended further research on standardizing the IRVM process across different industries and project types. They argue that IRVM workshops could benefit from more structured guidelines to ensure consistency in their application. Moreover, additional case studies in sectors other than infrastructure would help validate the broader applicability of the IRVM approach.

In their 2015 study, Asharose et al. explored the role of awareness workshops as an educational tool for risk management within the context of community resilience. The authors emphasized the critical role of education in empowering communities, particularly in vulnerable areas like Tamil Nadu, India, where disasters are frequent. Asharose et al. begin by recognizing that the impacts of disasters differ by location and community vulnerability, suggesting that education should be localized and tailored to the specific risks faced by a community. To this end, their research underscores the importance of community-based approaches in disaster education, as these methods are more effective in engaging at-risk populations. The authors also draw attention to the gap between available knowledge and its dissemination, advocating for the use of educational tools like workshops to bridge this divide.

The article focuses on a case study from Devanampattinam, a coastal village in Tamil Nadu that was heavily affected by the 2004 Indian Ocean tsunami and subsequent cyclones. The workshop, which aimed to educate participants on DRR and mitigation strategies, involved a range of activities including lectures, field trips, and group discussions. The methodology was designed to not only transfer knowledge but also to engage participants in the creation of their own disaster response strategies, such as hazard maps and evacuation plans. The study's findings indicated a significant improvement in participants' understanding of risk management and preparedness. For example, before the workshop, only 53% of participants recognized the receding of seawater as a natural warning sign of a tsunami. After the workshop, 100% of participants answered this question correctly. Similarly, awareness of flood insurance schemes rose from 0% to 90% by the workshop's conclusion. In the broader context of disaster education, Asharose et al. stressed the importance of sustained efforts. They argued that workshops, while effective, are not a one-off solution. Building a disaster-resilient community requires long-term engagement and the establishment of local DRR groups to ensure continuity in risk reduction activities. The authors also highlighted the need for collaboration between local governments, NGOs, and educational institutions to ensure that DRR education is both comprehensive and sustainable.

Walls et al. (2010) explored the application of stakeholder engagement in food risk management through a detailed evaluation of an iterative workshop approach. The study highlighted the growing need for broader stakeholder involvement in policy decisions, particularly in areas involving complex risk management like food safety. The authors recognized that while the benefits of public engagement are often assumed, there is little empirical evidence to support the efficacy of these processes. Consequently, their research aimed to provide a rigorous evaluation of a stakeholder engagement initiative, filling a gap in the literature by critically assessing the impact of such engagements on policy development and decision-making.

The authors underscore the broader societal trend towards more inclusive decision-making, where traditionally, policy decisions were made by accountable agents such as politicians and experts. This shift, from a "deficit model" of communication - where information flows unidirectionally from experts to the public - to a more interactive model involving a wider array of stakeholders, is argued to restore public trust in policy-makers. However, this transition presents practical challenges. The authors highlight the lack of clarity in best practices for stakeholder engagement and call for more structured and critical evaluations.

In their study, the authors adopted a multi-method, multi-criteria approach to evaluate two workshops conducted as part of the European Union-funded SAFEFOODS project. These workshops sought to gather stakeholder feedback on a novel food risk management model, designed to increase transparency and stakeholder involvement in the risk analysis process. The workshops were held in 2005 and 2007 and involved participants from a variety of sectors, including industry, regulatory bodies, and consumer advocacy groups.

The key focus of the article was the methodology used to evaluate the workshops. Drawing from previous work by Rowe and Frewer (2000), the authors applied a normative framework based on five criteria: representativeness, influence, transparency, resource accessibility, and task definition. Each of these criteria was meticulously assessed through participant questionnaires, observer ratings, and informal discussions, offering a comprehensive evaluation of the stakeholder engagement process. The criterion of representativeness examined whether the workshop participants were a fair representation of the broader community affected by food risk management. While participants generally agreed that the workshops were representative, the

study observed under-representation of key groups such as retailers and national food safety authorities, which could affect the legitimacy and buy-in of the risk management model.

Influence, another critical criterion, concerned whether the participants felt their input would genuinely impact the SAFEFOODS model. While participants were optimistic, the study highlighted the challenge of ensuring that stakeholders' contributions are effectively incorporated into policy decisions. The authors also addressed the issue of transparency, noting that while the workshops were designed to be open and inclusive, some participants felt unclear about the objectives and processes at play. This suggests that greater efforts are needed to clarify roles, expectations, and outcomes in future stakeholder engagements.

The criterion of resource accessibility revealed that participants felt they had adequate information and resources to contribute meaningfully, though improvements were noted between the first and second workshops, with more timely dissemination of materials and better-prepared discussion sessions. Task definition was another area where improvements were seen between the two workshops. Participants in the second workshop reported greater clarity on their role in evaluating the risk management model, though there were still concerns about the practical application of the model without detailed case studies.

The iterative nature of the workshops, where feedback from the first session was used to refine the second, demonstrated the importance of adaptive learning in stakeholder engagement. The evaluation provided key recommendations for future engagements, including better representation of stakeholders, more structured facilitation of discussions, and clearer definitions of tasks and objectives.

Bellora-Bienengräber et al. (2023) explored the effectiveness of risk assessments in risk workshops by examining the role of calculative cultures, which are organizational attitudes toward using and interpreting analytical risk assessment techniques. They specifically compared two calculative cultures: quantitative enthusiasm and quantitative skepticism. Quantitative enthusiasm considers risk assessments as accurate numerical representations of reality, while quantitative skepticism views these assessments as learning tools that help shape judgments, especially when dealing with complex or hard-to-quantify information.

The methodology used in this study involved agent-based modeling (ABM) to simulate risk workshops. In these simulations, participants, modeled as agents, exchanged risk-related information and adjusted their risk assessments based on the evolving discussion. The ABM approach allowed the authors to simulate cognitive processes, which were modeled using ECHO, a constraint satisfaction network (CSN). This network captured how individuals make sense of the information, prioritize it, and form judgments based on their cognitive model. The authors contrasted workshops dominated by quantitative skepticism, where judgments are more flexible and holistic, with those dominated by quantitative enthusiasm, where participants rely on more rigid, numerical evaluations.

Their findings showed that the prevailing calculative culture in an organization has a substantial impact on how effective risk workshops are. In environments dominated by quantitative skepticism, risk assessments tend to stagnate, leading to lengthy discussions that may not necessarily improve the accuracy of risk evaluations. However, these cultures also allow for better understanding of complex risks, particularly those difficult to quantify. By contrast, quantitative enthusiasm cultures encourage a more gradual refinement of risk assessments based on probabilistic models, where discussions proceed in a more structured and steady manner. This

calculative culture provides a more straightforward path to evaluating risks, although it might overlook qualitative insights.

The study also found that prioritizing participants who express concern about particular risks (often high-risk items) improved the accuracy of assessing those high risks but led to the overestimation of low risks. Furthermore, the researchers found that discussions in workshops dominated by quantitative skepticism were more susceptible to sudden, unpredictable shifts in opinion, especially when new information contradicted previously held beliefs.

The limitations of the study are primarily tied to its reliance on simulations rather than real-world workshops. The ABM model focused on assessing a single risk at a time, meaning that the complexity of managing multiple, interrelated risks was not fully explored. Additionally, the study did not take into account organizational dynamics such as individual motivations, hidden agendas, or power structures, which can influence the outcomes of real-world risk workshops. The authors also noted that the simulations were limited to synchronous discussions, so their findings may not apply to asynchronous environments (e.g., risk assessments done via email).

In terms of future directions, the authors suggest that future research should explore how mixed calculative cultures - where organizations might exhibit traits of both quantitative skepticism and quantitative enthusiasm - affect risk workshop outcomes. They also recommended investigating how asynchronous workshops or dispersed participants affect risk assessments, as time delays and selective attention to information might significantly alter discussions. Additionally, more empirical studies are needed to validate their findings, especially through field studies in organizations with diverse calculative cultures. Research could also explore the effects of individual personality traits, such as introversion or extroversion, on the dynamics of risk workshops. Finally, the authors highlight the need to study the broader implications of calculative cultures beyond risk workshops, potentially extending their research to other organizational decision-making processes.

2.2. Building the Research Gap

The literature surrounding risk management workshops provides a fragmented understanding of how such interventions contribute to project outcomes, particularly in the areas of risk identification, analysis, and reduction. While multiple studies demonstrate the utility of RM workshops in enhancing collaboration and improving decision-making, they tend to either focus heavily on the technical aspects or emphasize surface-level engagement techniques, leaving a significant gap in exploring the human factors - particularly participant training and knowledge - that underpin workshop effectiveness.

One dominant theme in the literature is the focus on structured methodologies within RM workshops, which often overlooks the role of participant knowledge. Tavakolan and Mohammadi (2017), for example, used fuzzy failure mode and effects analysis (FMEA) to structure RM workshops for large-scale construction projects. However, their emphasis on technical assessment tools limits the understanding of how well participants grasp and apply risk management principles. On the other hand, Schönbohm and Jülich (2016) explored the gamification of RM workshops in SMEs, enhancing engagement through interactive, game-based methods. However, the study did not delve into whether this increased engagement translated into a deeper understanding of risk management concepts or improved long-term outcomes in risk reduction. In contrast, Abd-Karim et al. (2011) combined RM with value management (VM) in workshop

settings, demonstrating how cross-disciplinary approaches can enhance the effectiveness of risk identification processes. While the integration of RM and VM provided a more comprehensive risk analysis framework, the study implicitly assumed that participants had sufficient baseline knowledge to engage meaningfully in these activities, an assumption that has yet to be thoroughly tested in the literature. Finally, many studies, including Goh et al. (2013), validated RM workshops as tools for enhancing collaboration and improving team consensus in risk identification. However, these studies often rely on simulations or hypothetical scenarios, with limited application in real-world project-based industries.

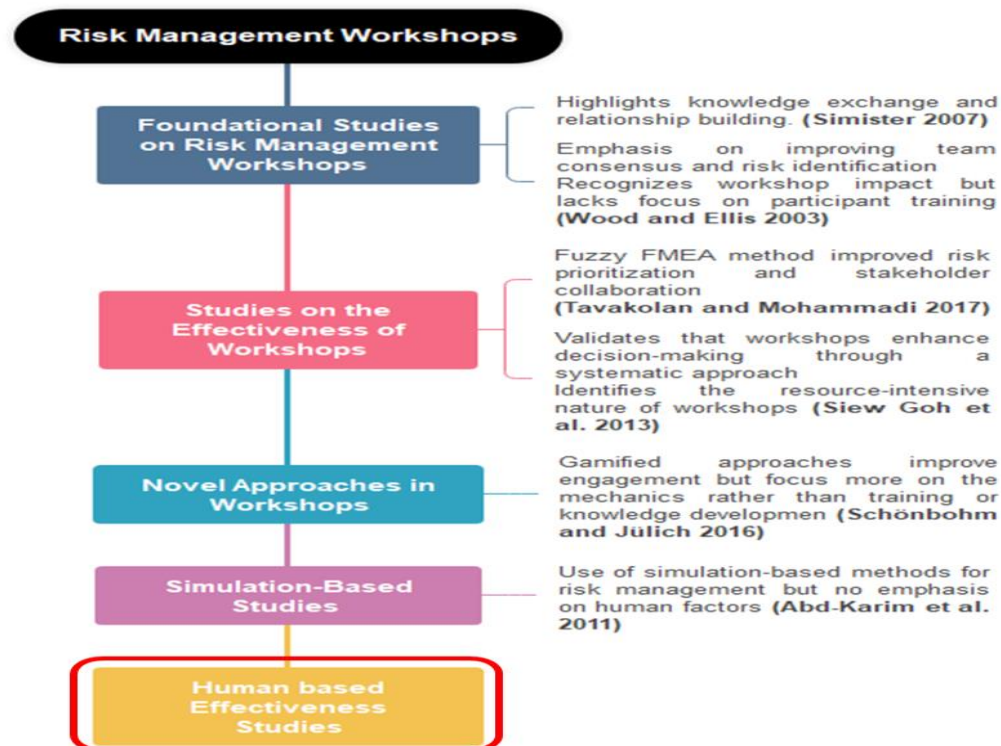


Figure 5: Human Effectiveness

Collectively, the literature shows that RM workshops are effective tools for improving risk identification and enhancing collaboration, but the emphasis has often been on the technical or engagement aspects without delving into human factors including the critical role of participant knowledge and training. Schönbohm and Jülich (2016) highlighted the importance of engagement but did not connect it to long-term learning outcomes. Tavakolan and Mohammadi (2017) provided technical rigor through FMEA but neglected how participants' knowledge influences the effectiveness of these methods. Abd-Karim et al. (2011) integrated multi-disciplinary approaches but left unexamined how training impacts cross-disciplinary collaboration in RM workshops.

Thus, the current study tries to tackle these gaps by investigating the relationship between participant training, knowledge, and the effectiveness of RM workshops, aiming to enhance not only the understanding of how these factors influence risk identification but also how they impact risk reduction and analysis in complex, project-based environments.

Table 1: Building the Research Gap

Author	Title	Methodology	Findings	Limitations	Future Direction
Wyk et al. 2016	Effectiveness of Risk Management Workshop	Case study approach using passive observation, interviews, and documentation reviews to assess the RM workshop's effectiveness in managing project risks.	RM workshops facilitate communication, consensus-building, and proactive risk management among project team members. They enhance understanding of project risks and improve overall RM performance regarding time, cost, and quality.	Limitations in risk planning, risk monitoring, and communication were noted. The results are indicative rather than conclusive due to limited generalizability.	Further research is needed to validate the effectiveness of RM workshops, particularly through a larger sample size and rigorous methodologies. Studies should aim to address limitations and explore mechanisms for improved RM practices.
Schönbohm, A. & Jülich, A. (2016)	On the Effectiveness of Gamified Risk Management Workshops – Evidence from German SMEs	Quasi-experimental action research, focus groups, surveys, observations	Gamification enhances risk management in SMEs by improving engagement, motivation, and decision-making. Game elements like points and leaderboards	Small sample size (16 participants), potential participant and observer bias, lack of control group, no consideration of age or gender factors.	Larger sample size studies, long-term effects of gamification, different player types' impact, IT-supported interaction formats.

			were motivating. Discussions minimized cognitive biases and improved decision-making.		
Tavakolan & Mohammadi (2017)	Risk Management Workshop Application: A Case Study of Ahwaz Urban Railway Project	Case study, risk management workshop using fuzzy FMEA, brainstorming, and multiple-choice techniques.	RM workshop facilitated collaboration among stakeholders, identified critical risks, and enhanced team communication. Fuzzy FMEA allowed nuanced risk assessment.	High resource and time investment required for conducting workshops, did not fully implement PMBOK RM framework, and lack of consideration of risk interrelationships.	Future research should explore risk interdependencies, incorporate positive risks (opportunities), validate workshops across different industries, and develop better risk monitoring tools.
Abd-Karim et al. (2011)	Integrating Risk and Value Management using IRVM Workshops: Case Studies in Infrastructure	Case studies, IRVM workshops, brainstorming, risk identification, quantitative risk assessment.	IRVM workshops effectively integrated RM and VM, reducing risks while improving value. Case studies	Resource and time-intensive, making it less feasible for smaller projects. Limited effectiveness in risk monitoring and controlling	Standardization of IRVM process across industries, further research on broader applicability, and use of advanced decision-making

	Projects in UK		demonstrated cost savings and better project outcomes.	throughout project lifecycle.	tools like scenario planning.
Bellora-Bienengräber et al. (2023)	The effectiveness of risk assessments in risk workshops: the role of calculative cultures	Agent-based modeling (ABM) with ECHO (constraint satisfaction network), simulations of risk workshops comparing calculative cultures.	Quantitative skepticism leads to longer discussions and sudden shifts in opinion, while quantitative enthusiasm results in gradual changes; prioritizing concerned participants improves high-risk assessments but overestimates low risks.	Single risk focus, no consideration of organizational dynamics or asynchronous environments; results are based on hypothetical simulations rather than real-world scenarios.	Research on mixed calculative cultures, asynchronous risk workshops, broader studies in different industries, and exploration of individual traits in risk workshop dynamics.
Asharose, Saizen, & Chakkalathundiyl, (2015)	Awareness Workshop as an Effective Tool and Approach for Education in Disaster Risk Reduction: A Case Study	Conducted a one-day workshop in a coastal village; included lectures, field trips, group discussions, hazard mapping,	Significant improvement in disaster awareness (e.g., recognition of tsunami warning signs increased from 53% to 100%);	Limited participation of men; small sample size (30 participants out of a village population of 9,000); economic constraints	Suggests sustained, long-term efforts through local DRR groups; calls for continued education and the establishment of disaster

	from Tamil Nadu, India	and pre/post-evaluation tests.	increased awareness of flood insurance and alternative livelihoods.	hindered broader participation.	management clubs in schools.
John Walls, Gene Rowe, Lynn Frewer	Stakeholder engagement in food risk management: Evaluation of an iterated workshop approach	Multi-method, multi-criteria evaluation using participant questionnaires, observer ratings, and informal discussions. The evaluation framework was based on five key criteria: representativeness, influence, transparency, resource accessibility, and task definition.	The evaluation demonstrated that stakeholder workshops could improve transparency & inclusiveness of risk management processes. There was an increase in participant satisfaction between the first and second workshops, especially regarding resource accessibility and influence. The workshops provided useful feedback for refining the food risk model.	Some stakeholder groups were underrepresented, such as retail and food safety authorities. Additionally, the workshops lacked detailed case studies, which limited the practical application of the proposed model. The facilitation in some sessions allowed dominant participants to overshadow others. The independence of the evaluation could have been stronger, as one author had a dual role.	Future engagements should ensure broader stakeholder representation, use detailed case studies to clarify practical applications, and improve the transparency of how participant input impacts decision-making. Independence in evaluation processes should also be emphasized, and micro-dynamics such as power imbalances in group discussions need further investigation.

2.3. Theoretical Literature

For the study on how training and knowledge levels of participants in risk management workshops impact the outcomes, many theoretical areas can guide this particular research. These areas provide the main theories and concepts that talk about the focus of the study and help frame the approach to understanding the phenomena. Here's an outline of potential theoretical areas that could be relevant:

1. Adult Learning Theory (Andragogy):

- **Premise:** Adult learning theory, as articulated by Malcolm Knowles, says that adults are self-directed and expect to take responsibility for decisions. Adult learning programs must accommodate this characteristic. This theory can help explain why and how the level of training impacts the effectiveness of risk management workshops, as it suggests that adults integrate learning with their existing knowledge base and practical experience.
- **Application:** Examining how training programs for risk management align with adult learning principles could provide insights into their effectiveness in enhancing participant engagement and learning outcomes.

2. Competency Theory:

- **Premise:** Competency theory talks about the skills and behaviors that can lead to successful performance in a job role. In the direction of risk management, specific competencies related to risk identification, analysis, and mitigation are critical.
- **Application:** This theory can be used to assess which competencies are most impacted by training and knowledge levels, and how these competencies influence the success of risk management workshops.

3. Knowledge Management Theory:

- **Premise:** This theory states the processes of creating, sharing, using, and managing the knowledge and information of an organization. It emphasizes the value of shared knowledge as a resource.
- **Application:** The theory can be applied to know how knowledge sharing in workshops affects risk management practices and outcomes, and how the depth of individual knowledge contributes to the collective knowledge pool.

4. Group Dynamics Theory:

- **Premise:** Group dynamics theory explores the behavioral and psychological processes occurring within a social group. In the context of workshops, how group members interact can significantly affect the learning environment and the outcomes of group activities.
- **Application:** Understanding the dynamics in risk management workshops can help identify how participant training and knowledge levels influence group interactions and decision-making processes.

5. Behavioral Decision Theory:

- **Premise:** This theory examines the decision-making processes used by individuals, particularly the biases and heuristics that influence judgments. It is relevant in understanding how people perceive and respond to risks.
- **Application:** Exploring how training and knowledge impact participants' decision-making in risk management can elucidate how biases are mitigated or exacerbated in workshop settings.

6. Systems Theory:

- **Premise:** Systems theory states that understanding the interdependent structures of dynamic systems is essential to understanding the system as a whole. This can be applied to organizational practices and learning environments.
- **Application:** Applying systems theory to risk management workshops could help analyze how various elements (such as training, knowledge, organizational culture, and workshop design) interact to produce outcomes.

These theoretical frameworks provide main basis for analyzing how training and knowledge influence the effectiveness of risk management workshops. They not only guide the development of your research questions and methodology but also help in interpreting the results within a broader conceptual context.

3. CHAPTER 3: METHODOLOGY

3.1. Introduction

This chapter provides research design as well as methodology which is used in this study, and that is related to correlation between the training and knowledge levels of participants and the effectiveness of risk management workshops. The study will use a mixed-methods approach, by combining quantitative and qualitative research to know the relation between key variables and the outcomes of the workshops. The design of the study, which includes the population, sampling strategy, data collection procedures, and analysis methods, is presented in detailed manner. This approach makes it able to do a comprehensive study of how participant training and knowledge impact the effectiveness of risk identification, analysis, and mitigation during the workshops.

3.2. Research Design

The research design is a comprehensive blueprint that directs the conduct of a study. It outlines the research's framework, including the methods for data collection, analysis, and interpretation in order to address the research questions and accomplish the study's objectives (Huntington-Klein, 2021). This chapter highlights the methodological approaches, and specific design selected for this research, which investigates the correlation between knowledge and training level of participants and its impact on the outcomes of the risk management workshop. The method employed in this investigation is **mixed method including both quantitative and qualitative research**, as the objective is to evaluate hypotheses through numerical data as well as qualitative discussion (Harkness, 2023). **Quantitative methods** are particularly well-suited for research that aims to establish causality or assess theoretical models, as they involve the use of statistical techniques to analyze the connections between variables (Fotheringham, 1997). This study also includes quantitative research methods, as they enable the precise measurement of variables and the examination of causal relationships. The utilization of statistical methods ensures that the assessment is objective, generalizable, and replicable, thereby providing essential understanding into the impact of knowledge and training level of participants on the outcomes of the risk management workshop. The study will be based on **descriptive as well as inferential statistics**. This approach is appropriate as it allows for a detailed description of the current state of training and knowledge levels among workshop participants, and an analysis of how these variables influence workshop outcomes. The research will aim to describe the relationships between the independent variable (training and knowledge levels) and the dependent variable (effectiveness of workshop outcomes, such as risk identification, analysis, and mitigation). The research will involve the collection of **Primary Data** directly from the participants related to the effectiveness of risk management workshop. A questionnaire containing **closed and open-ended questions** will be administered in a **pre- and post-test form**. The following hypothesis will be tested in this particular study.

3.3. Study Hypotheses

In line with the objectives and research questions, we have formulated the following hypotheses.

Main Hypothesis:

- **H1:** There is a statistically significant relationship between the training and knowledge levels of workshop participants and the effectiveness of risk management workshop outcomes.

H0: There is no statistically significant relationship between the training and knowledge levels of workshop participants and the effectiveness of risk management workshop outcomes.

Sub-hypotheses:

1. **H1:** There is a statistically significant relationship between the level of training of workshop participants and their ability to accurately identify and prioritize risks.

H0: There is no statistically significant relationship between the level of training of workshop participants and their ability to accurately identify and prioritize risks

2. **H2:** There is a statistically significant relationship between the depth of knowledge of workshop participants and the effectiveness of risk analysis during workshops.

H0: There is no statistically significant relationship between the depth of knowledge of workshop participants and the effectiveness of risk analysis during workshops.

3. **H3:** There is a statistically significant relationship between the combination of training and practical experience and the formulation of effective risk mitigation strategies.

H0: There is no statistically significant relationship between the combination of training and practical experience and the formulation of effective risk mitigation strategies.

3.4. Research Framework

The model shows the relation between participants' prior knowledge, their training experience, and the effectiveness of risk management workshops.

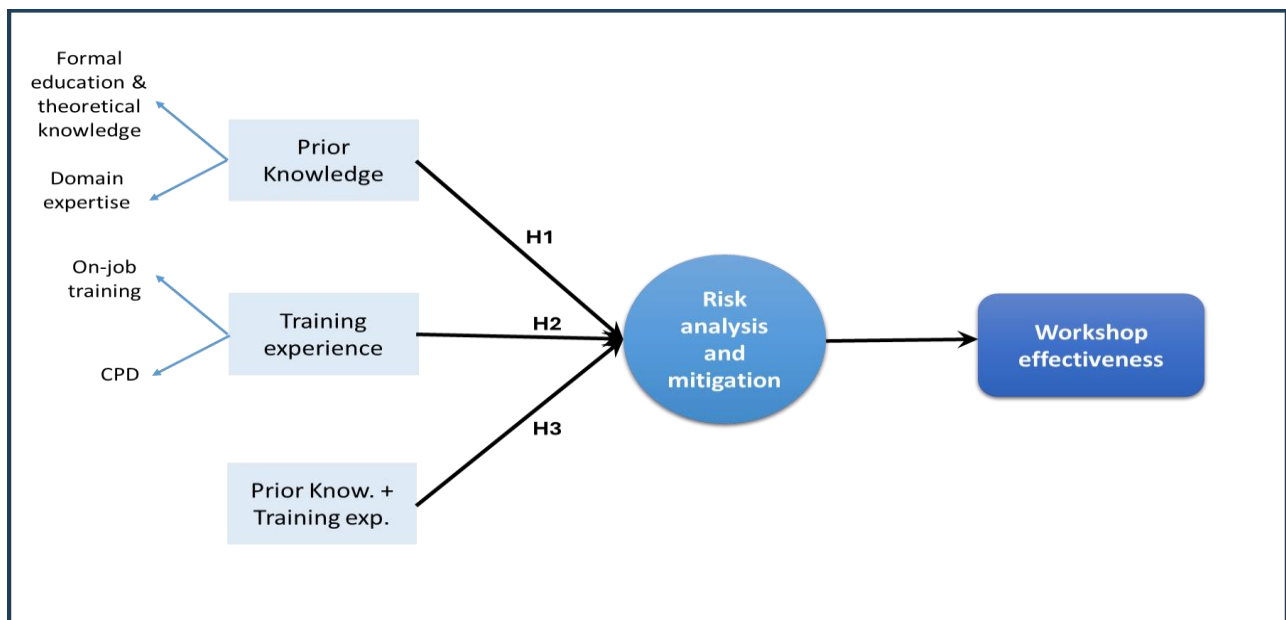


Figure 6: Workshop Effectiveness

The three primary variables include prior knowledge, training experience, and the combination of both, which influence participants' ability to conduct risk analysis and mitigation. This, in turn, has an impact on the overall effectiveness of the workshops. Participants' prior knowledge means the information and understanding they bring into the workshops before any formal training. Their training experience is relevant to the learning they get through structured programs or workshops. The combination of prior knowledge and training experience is believed to make a rise in the participants' capacity for risk identification, analysis, and mitigation. Risk analysis and mitigation work as intermediary outcomes in the model.

3.5. Population of the study

The study population consists of a group of subjects specifically chosen for gathering, assessing, and analyzing research data (Arias-Gómez et al., 2016). Given the large size of the target population, collecting data from every individual is impractical due to time and cost constraints. As a result, the researcher must implement a sampling technique to manage this challenge. The population of this study will be based on the individuals actively involved in risk management processes relevant to the project-based industries. The target population is related to the professionals who are working at different levels, including project managers, risk analysts, team leaders, and other stakeholders who are directly or indirectly engaged in risk management activities. The study specially focuses on individuals who are participating in risk management workshops, seminars, or training sessions, as they are best positioned to provide information about the effectiveness of these interventions. These participants must have experience with risk management practices and also have a level of familiarity with the key concepts involved.

3.6. Sample Size Determination

The sampling strategy refers to the approach used to select a particular group of individuals from whom research data will be gathered (Sharma, 2017). In this study, respondents are carefully chosen using a suitable sampling technique, making the study noteworthy for its use of random sampling. This method is considered the simplest and most frequently employed in social science research, especially when working with large populations. Random sampling is known for generating less biased data in a shorter period compared to other sampling techniques (Olken & Rotem, 1995). The sample size for this study will be determined based on the need to ensure statistical power and representativeness of the target population. Given the diverse nature of project-based industries, a stratified random sampling method will be employed. This method ensures that participants are selected from different strata (i.e., industry, role, experience level) to accurately reflect the population's diversity. Hence, the present study's sampling computation included around 380 participants, as determined by the following formula:

$$n = \frac{z^2 \times \hat{p}(1 - \hat{p})}{\varepsilon^2}$$

$$n' = \frac{n}{1 + \frac{z^2 \times \hat{p}(1 - \hat{p})}{\varepsilon^2 N}}$$

Where

- z is the Z score

- ϵ is the margin of error
- N is the population size
- $\hat{p}$ is the population proportion

3.7. Data Collections procedures

The data for this study will be collected through a structured questionnaire which will be based on different aspects of participant training, knowledge, and the effectiveness of risk management workshops. The questionnaire will include both closed and open-ended questions to get quantitative and qualitative data. Closed-ended questions will utilize a Likert scale format (e.g., ranging from 1 to 5, where 1 indicates "Strongly Disagree" and 5 indicates "Strongly Agree") to quantify participant responses. In addition, open-ended questions will allow participants to tell their experiences, providing richer qualitative information. These questions will focus on participants' personal reflections on the training and workshop experiences, suggestions for improving future workshops, and specific challenges encountered during risk management tasks. The questionnaire will be administered to participants who have recently attended risk management workshops, and will be distributed electronically via email using an online survey platform to facilitate easy access and response collection. Participants will be assured that their responses will be kept anonymous and confidential, with data reported in aggregated form to protect individual identities.

3.8. Study Determinants

Participant Training: This determinant shows the type and quality of training received by participants prior to the workshops. It tells how comprehensive training influences participants' ability to engage with workshop content effectively and apply risk management principles.

Knowledge Level: This determinant finds the existing knowledge of participants regarding risk management concepts and practices. It reflects the link between participants' prior knowledge and their success in applying what they learn during the workshops.

Workshop Effectiveness: This determinant evaluates how well the workshops facilitate learning outcomes. It includes measures of improvements in risk identification and reduction capabilities among participants post-workshop.

Types of Training Interventions: This determinant considers the various training methods employed, such as hands-on exercises, case studies, or theoretical discussions, and their effectiveness in enhancing understanding and application of risk management principles.

3.9. Method of Analysis

After collecting the data, the analysis will be aligned with the study's questions and objectives. The data used to evaluate the conceptual model will be analyzed through non-parametric testing. Commonly used software tools for statistical analysis include SPSS. The validity of the measurement scale will be assessed by examining its convergent and discriminant validity. Furthermore, the reliability of the scale will be evaluated through an analysis of its indicators and internal consistency. Confirmatory factor analysis will be conducted to determine

the appropriate number of components, while correlation analysis will be used to investigate the relationships between the influencing factors. Independent t-tests and Analysis of Variance (ANOVA) will also be performed.

For the analysis of the interview data, the researcher will review, refine, and organize participants' responses to categorize them for coding. NVivo version 15.0 will be utilized to develop themes and code the qualitative data collected. The analysis will commence once a sufficient number of responses have been gathered and processed.

3.10. Ethical Considerations

Informed consent will be obtained from all participants, and confidentiality will be maintained throughout the study.

4. CHAPTER PRACTICAL STUDY

4.1. Demographical Analysis

What is your gender?

Table 2: What is your gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	89	78.1	78.1	78.1
	female	25	21.9	21.9	100.0
	Total	114	100.0	100.0	

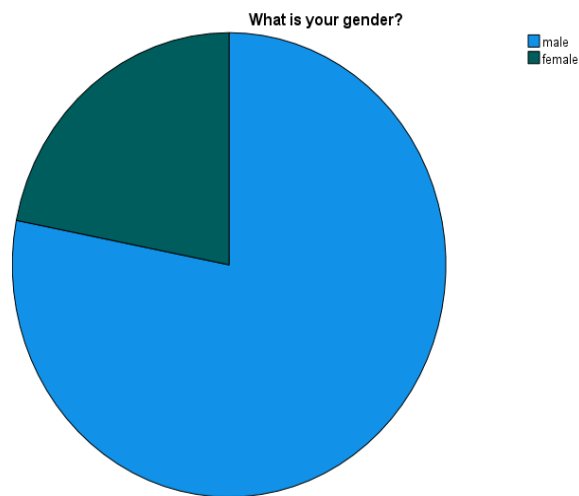


Figure 3: Gender Classification

The table displays the dispersion of gender responses among 114 respondents. Of these, 89 respondents were male and 25 respondents were females. This makes it very influential in determination of results by having more male respondents as opposed to the female ones. The two columns valid percent and the percent are the same because there is no missing or invalid data, all

the 114 responses were acceptable. The cumulative percent shows that all the respondents have been covered in this assessment with males dominating this study sample.

What is your age range?

Table 3: Age Range

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20 – 30 years old	49	43.0	43.0	43.0
	31 – 39 years old	35	30.7	30.7	73.7
	40- 49 years old	27	23.7	23.7	97.4
	50- 59 years old	3	2.6	2.6	100.0
	Total	114	100.0	100.0	

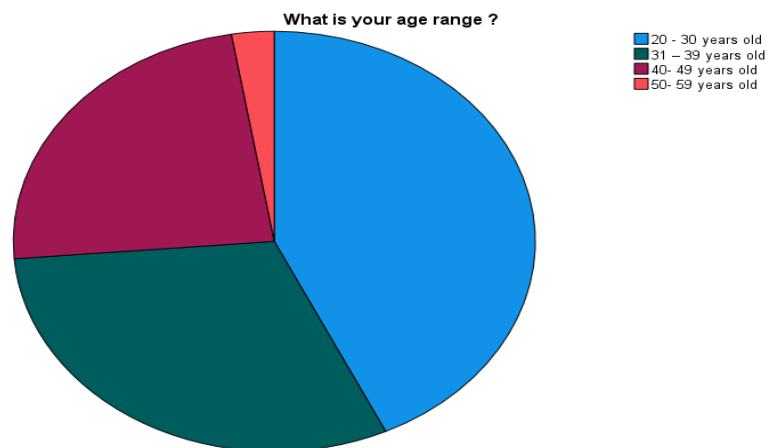


Figure 7: Age Classification

The above table gives the age distribution of the respondents in different age groups meant according to the table. The largest number of respondents belongs to the age group of 20-30 years with an equal share of 49 or 43.0%. The second biggest group is comprised of respondents between 31-39 years old, where 35 respondents or 30.7% are reckoned to be. The other age group is respondents aged between 40-49 years with 27 (23.7% occupants), and the smallest is 50-59 years old respondents with only 3 (2.6%) respondents. It shows that majority of respondents, 73.7% are

below 40 years of age which proves that the survey has a youthful appeal. The cumulative percent column also tells that by the age group other than 60 or above 60 years all the respondents are covered completely.

What is your Education Level?

Table 4: Education Level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Diploma	30	26.3	26.3	26.3
	Bachelor's	68	59.6	59.6	86.0
	Masters	12	10.5	10.5	96.5
	PHD	4	3.5	3.5	100.0
	Total	114	100.0	100.0	

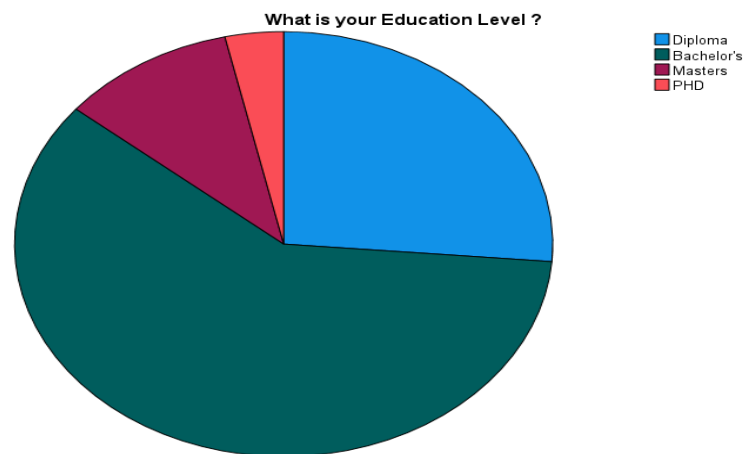


Figure 8: Education Level

The table which follows presents the demographic breakdown according to educational attainment of the respondents. The level of education most frequently represented among the participants is a Bachelor's degree: 68 respondents (59.6%). The respondents with a Diploma only follow with 30 (26.3%). Fewer have achieved a Master's degree, only 12 of the participants

(10.5%), and the least, a PhD degree with 4 respondents (3.5%). The cumulative percentage of the responses in education level shows that respondents up to Master's level are 96.5%, and all other respondents are at PhD level. This speaks of a respondent pool comprised mainly of undergraduate level education.

What is your Experience Level?

Table 5: Experience Level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	5 years	42	36.8	36.8	36.8
	6-10 years	29	25.4	25.4	62.3
	11-20 years	28	24.6	24.6	86.8
	More than 21 years	15	13.2	13.2	100.0
	Total	114	100.0	100.0	

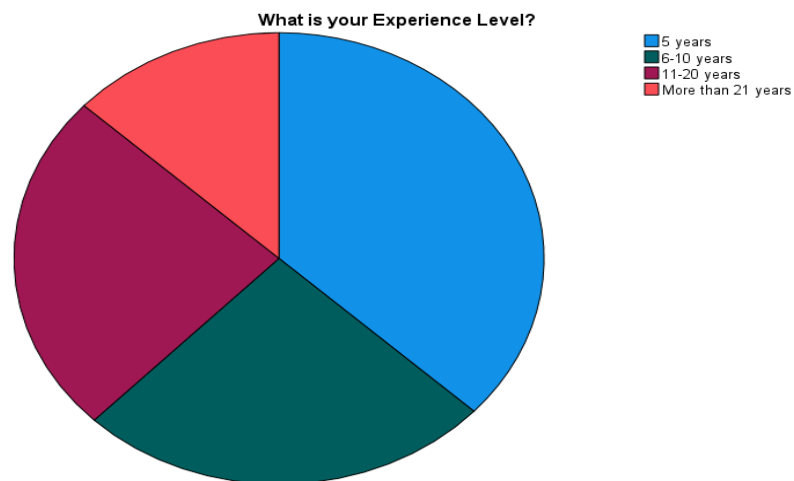


Figure 6: Experience Level

The table of experience level shows that the largest percentage, 36.8%, served that they are have a working experience of 5 years, 25.4% for 6 to 10 years. Those with a working experience of 11- 20 years were 24.6% while 13.2% had been with the organization for more than 21years.

The total percent reveal that,81.8% of respondent have experience of 20 years or less. From this distribution, it is clear that the survey has a relatively young workforce, whereby majority of the participants has served the organization for less than a decade. The data can be also regarded as indicating some directions that can concern the professional growth and support of mentors for staff members in the organisation.

What is your current Job?

Table 6: Current Job

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Project Manager	12	10.5	10.5	10.5
	Team Lead	25	21.9	21.9	32.5
	Engineer	29	25.4	25.4	57.9
	Other	48	42.1	42.1	100.0
	Total	114	100.0	100.0	

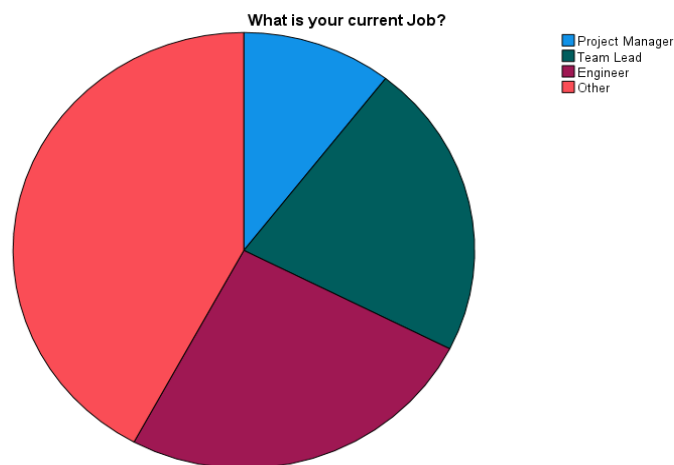


Figure 9: Job Classification

The table shows the current position of respondents as indicated in the study. Out of the 114 participants, 10.5% confined to the Project Managers while 21.9% were a Team Lead. Our largest group was Engineers at 25.4% of the respondents. In particular, exactly 42.1% of participants stated the type of their occupational activities as “Other” as shown in the table above. Overall percent reveals that majority of respondents belongs to Engineer and Team Lead positions

which indicates technical basis of the employees. Both its dispersion and this distribution indicate that employees classified under the “Other” job classifications could require more specific role descriptions in their workplace.

4.2. Descriptive Analysis

Table 7: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
What is your gender?	114	1.0	2.0	1.219	.4156
What is your age range ?	114	1.0	4.0	1.860	.8711
What is your Education Level ?	114	1.0	4.0	1.912	.7110
What is your Experience Level?	114	1.00	4.00	2.1404	1.06328
What is your current Job?	114	1.00	4.00	2.9912	1.03476
I'm familiar with risk management principles (e.g. risk identification, analysis and mitigation)?	114	1.0	3.0	1.298	.5474
I assess knowledge of common risk management tools (such as risk matrices and decision trees)	114	1.0	3.0	1.316	.5374
Have you often applied risk identification techniques to real-world projects?	114	1.00	3.00	1.3684	.61346
I am confident in my ability to analyze and assess risks in the project?	114	1.0	3.0	1.281	.5239
Have you had any formal education or certifications in risk management (eg, PMI-RMP)?	114	1.0	4.0	1.395	.6465
Have you undergone risk management training on the job in the past?	114	1.0	5.0	1.605	.8160
I am evaluating myself for the effectiveness of the previous training I received in preparing you for risk management from (very effective).	114	1.0	5.0	1.746	.9389

I am with familiar risk management principles (such as risk identification, analysis and mitigation).	114	1.0	5.0	1.474	.7066
I have a good understanding of how to identify potential risks in a project.	114	1.0	5.0	1.544	.7424
I am confident in my ability to assess the likelihood and impact of risk.	114	1.0	4.0	1.535	.7429
I am familiar with different risk management tools and techniques (eg, risk matrices, decision trees).	114	1.0	4.0	1.632	.7197
I have experience in applying risk management techniques in real-life projects.	114	1.0	4.0	1.658	.7623
I am comfortable prioritizing risks based on their potential impact on project outcomes.	114	1.0	4.0	1.605	.8160
I am familiar with how qualitative and quantitative methods are used for risk analysis.	114	1.0	3.0	1.535	.6807
I have received a formal education or certifications related to risk management.	114	1.00	4.00	1.5263	.70661
I have participated in workshops or seminars on risk management in the past.	114	1.00	4.00	1.4825	.68139
I have received on-the-job training in risk management practices.	114	1.00	4.00	1.4649	.64052
The previous training I received helped me prepare me enough to identify project risks.	114	1.00	3.00	1.4825	.61302
My previous training helped me prepare me enough to conduct a risk analysis.	114	1.00	3.00	1.4649	.64052
My previous training has helped me develop effective risk mitigation strategies.	114	1.00	4.00	1.4737	.70661

I have participated in Continuing Professional Development (CPD) programs related to risk management.	114	1.00	4.00	1.3860	.68497
Valid N (listwise)	114				

In the above given table, the descriptive analysis of the various variables with relevance to risk management principles and practices is shown for 114 respondents. The descriptive statistics are the number of subjects (N), minimum, and maximum values and means and standard deviations of scores on each variable (Hair, 2015).

The constant and reciprocal involvement of the variable “What is your gender?” reveals a mean of 1.219 which suggest imbalance in gender ratio in the sample in favor of one gender over the other. Since the scale of measurement is 1 to 2, the value set at 0.4156, signifies a low degree of variation within the respondents regarding gender. The mean for the age range variable is equaling 1.860, while the majority of the participants are presumably young and holding professional position. Consequently, we get a relatively moderate value of 0.8711 which signifies that age varies to a moderate extent thus suggesting that the ages of the sample included a good mix of ages. On average, the participants could be assumed to have at least a certain level of formal education, which is at the undergraduate level as per the mean of 1.912. Having the standard deviation of 0.7110. In case of educational level testifies to the fact that there are some differences within this or that branches, or, in other words, many respondents have similar educational background, yet they are not absolutely identical within this given type of qualifications. Experience level, based on the mean of 2.1404 suggests that most of the respondent have average experience that may range from 6-10 years of experience. The subject standard deviation of 1.06328 clearly indicates that, among the participants, some have relatively higher or lower experience. The mean of working positions of respondents is 2.9912, and it means that most of the workers are placed in the middle range between the entry and senior positions. The relative standard deviation of 1.03476 indicates the presence of a wide variety of jobs represented by the sample from junior to the top managerial positions (Hall & Savas-Hall, 2023).

Several variables capture the level of awareness and confidence the respondents have in risk management principles. For instance, the mean of 1.298 of the scores relating to familiarity with risk management principles means that the respondents have a good level of comfort and knowledge when the minimum and maximum scores possible are 1.0 and 3.0, respectively. The result of standard deviation of 0.5474 imply low variability hence inferring that most of the respondents are equally confident with the understanding of these principles. Concerning the evaluation of acquired knowledge about basic risk management instruments, the average rating is 1.316, which means respondents have a mid level of understanding of the topic. The students were not very variant with an average standard deviation of 0.5374 while low variation implies that the training programs offered provide adequate introduction on these tools. Regarding the application of risk identification techniques, the respondents had a mean of 1.3684 which suggests their prior exposure to the practical application of the various risk identification techniques demonstrated in this study. The standard deviation of 0.61346 reflects moderate amount of variation in the use of these techniques, essentializing the fact that the respondents are not equally as proficient with these techniques in the service of their organizations. The scores given for confidence in risk assessment

were 1.281 for the extent to which respondents are confident about risk analysis and assessment with the standard deviation being 0.5239 which is indicative of fairly high overall confidence of the sample. This might mean that most of the participants in the training and educational sessions are able to prepare for the risk assessment functions. Concerning the variable regarding the educational level of the respondents in risk management as well as their training for the risk management, the mean value is 1.395. This means that even though most of the respondents do have some level of formal training in risk management, no more than that has gone to seek a certified training. The standard variation of 0.6465 means that the levels of formal training received vary moderately. The mean score for the applicability of previous training in risk management as rated by the respondents is 1.746 denoting the respondents' perception on effectiveness of training. It can be seen that the observed standard deviation of 0.9389 indicates much variability in how effective training programs were perceived to be.

According to the descriptive statistics, the profile of the audience seems generally adequate for the purpose of risk management with participants providing declarative knowledge in the field and to an extent procedural knowledge with rather diverse levels of experience and certification. According to the data presented on the analysis of the respondents, the training and the skills in risk management as well as associated concepts seem to be familiar yet have potential for improvement. It is possible to use the information provided by this table to design focused training activities and reveal the possible directions in which extra help and resources could be provided to improve the general qualification of the employees in applying risk management procedures (Illowsky & Dean, 2017).

4.3. Correlation Analysis

Correlations

Table 8: Correlations

		PriorKnowledgeRel eRelated	PriorTrainingRel ated	PriorKnowle dge	Trainingexperie nce
PriorKnowledgeRel ated	Pearson Correlation	1	.754**	.785**	.774**
	Sig. (2-tailed)		.000	.000	.000
	N	114	114	114	114
PriorTrainingRelate d	Pearson Correlation	.754**	1	.780**	.716**
	Sig. (2-tailed)	.000		.000	.000
	N	114	114	114	114

PriorKnowledge	Pearson Correlation	.785**	.780**	1	.843**
	Sig. (2-tailed)	.000	.000		.000
	N	114	114	114	114
Trainingexperience	Pearson Correlation	.774**	.716**	.843**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	114	114	114	114

Correlation is significant at the 0.01 level (2-tailed).

The provided correlation table showcases the relationships between four key variables: Prior Knowledge Related, Prior Training Related, Prior Knowledge and Training experience among a population of 114 respondents. All the correlation coefficients found are accompanied by significance values (p-values), thus enabling a determination of the strength and statistical significance of the relationships. Two-tailed correlations are presented with asterisks if they are found as significant at the 0.01 level (Jamieson & Govaart, 2023).

1.Prior Knowledge Related: To measure this variable the respondents are asked hypothetical questions regarding their understanding of risk management principles before they were trained on the subject.

2.Prior Training Related: This variable has to do with the earlier training background of the respondents regarding risk management.

3.Prior Knowledge: This means risk management knowledge the person has irrespective of whether he or she has professional experience in the area.

4.Training Experience: This variable determines the overall experience of the respondents concerning training organizing in risk management aspect.

The correlation coefficient between Prior Knowledge Related and Prior Training Related is 0.754 and the significance test gives a $p = 0.000$. This strong positive correlation indicates that the respondents who further rated their prior knowledge about risk management will also have been trained harder. This relationship points to the need to incorporate prior knowledge into the training experiences, as stated by the authors that it might be better to train participants where they have prior information. Prior Knowledge Related is strongly related to Prior Knowledge coefficient which equals to 0.785 ($t = 8.981$, $p = 0.000$). This implies that the respondents who had richer prior knowledge develop and maintain the ability to self-report high knowledge of risk management principles. This study underscores the importance of pre-training knowledge measurement to adjust content appropriately: that is, to ensure that training corresponds to participants' total knowledge base. There is also a moderate positive relationship of 0.780 ($p = 0.000$) between Prior Training Related and Prior Knowledge. This means that those respondents who have gone through training are likely to have had prior information about risk management.

This proves that on one hand, the interaction between formal learning and prior knowledge enables the general understanding to be enhanced. This means that training interventions should enrich what is already in the participants' knowledge base in order to have better stock taken and hence be applied effectively. The relationship between Prior Knowledge and Training Experience as at $p = 0.000$ is 0.843 signifying a very strong positive linear relationship. A similar trend is observed in responses from those with augmented prior knowledge, which show that they received more significant training experience. This result is consistent with the theoretical premise that training familiarity may enhance risk management knowledge and indicate that good training employ prior learning for enhanced understanding. The Pearson correlation between Training Experience and Prior Training Related is 0.716, $t = 10.067$, $p = 0.000$. This positive correlation also implies that the respondents with more completed training experience appear to likely complete prior training concerning risk management. This goes a long way into revealing that these training experiences actually build up the individual's capacity and total expertise in the corridor discipline. Last of all, the Training Experience and Prior Knowledge Related are positively correlated where by the correlation coefficient is 0.774, which is statistically significant ($p=0.000$). This finding reveals the impact of training on the strengthening of specific subject areas of knowledge.

Therefore, the correlation table shows significant, and high values of co-relation between the variables used in this study. From the data it can be determined that prior knowledge, training experiences, and related training are all linked such that they affect each other in a manner that improves overall understanding of risk management principles among respondents (Lederman et al., 2023). These results imply that the status quo training paradigm must incorporate aspects such as the participants' prior knowledge and their past training activities into the learning process in order to maximize learning outcomes. The strong correlation coefficients stress that only those with a powerful fundamentals of risk management would be in a better position to gain more advanced training that ensures an endless cycle of learning. In summary, the results derived offer important implications for the development of training interventions that can enhance knowledge and skills in risk management to a very large extent.

4.3.1. T-Test

Sample of Statistics

Table 9: One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error
PriorKnowledgeRelated	114	1.3158	.49113	.04600
PriorTrainingRelated	114	1.5819	.69810	.06538

PriorKnowledge	114	1.5689	.58021	.05434
Trainingexperience	114	1.4687	.56937	.05333

Sample of Test

Table 10: One-Sample Test

Test Value = 0						
	t	df	Sig. tailed)	(2-Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
PriorKnowledgeRelated	28.605	113	.000	1.31579	1.2247	1.4069
PriorTrainingRelated	24.194	113	.000	1.58187	1.4523	1.7114
PriorKnowledge	28.872	113	.000	1.56892	1.4613	1.6766
Trainingexperience	27.541	113	.000	1.46867	1.3630	1.5743

Sample Effect of Sizes

Table 11: One-Sample Effect Sizes

			95% Confidence Interval	
	Standardizer ^a	Point Estimate	Lower	Upper
PriorKnowledgeRelate d	Cohen's d	.49113	2.283	3.072
	Hedges' correction	.49442	2.268	3.051
PriorTrainingRelated	Cohen's d	.69810	1.917	2.612
	Hedges' correction	.70277	1.904	2.595
PriorKnowledge	Cohen's d	.58021	2.306	3.100

	Hedges' correction	.58409	2.686	2.290	3.079
Trainingexperience	Cohen's d	.56937	2.579	2.195	2.961
	Hedges' correction	.57319	2.562	2.181	2.941

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation.

Hedges' correction uses the sample standard deviation, plus a correction factor.

The provided tables present the results of a statistical analysis assessing four variables. The 114 respondents have given their responses for Prior Knowledge Related to Training, Prior Training Related, Prior Knowledge, and Training Experience data. The evaluation contains one sample orders, one sample tests, and effect size assessments that explain the correlation between these factors (Bryman & Bell, 2015).

The One-Sample Statistics table summarizes the sample size (N), mean scores, standard deviations, and standard errors for each variable: For Prior Knowledge Related variable we have a mean of 1.3158 and standard deviation 0.49113. Large error bar also imply huge standard deviation while small error bars mean small standard error of mean, SEM, (0.04600) which is a good sign in the sense that the mean we have got for the variable is close to maximum point estimate in the population. Prior Training Related has a higher mean of 1.5819 and standard deviation of 0.69810. The obtained SEM of 0.06538 represent more variation of the training related knowledge among respondents. Prior Knowledge has a mean of 1.5689 and a standard deviation of 0.58021. The SEM of 0.05434 indicates that the mean is a precise estimate of the true population mean. Training Experience has an average score of 1.4687, standard deviation of 0.56937 and SEM of 0.05333 proving that while there is some variation in the responses, the mean score is a good indicator of the sample. These means suggest that respondents overall estimate there is a moderate level of prior knowledge and training experience in risk management.

The One-Sample Test table evaluates whether the means of these variables significantly differ from a test value of 0 (Taherdoost, 2022). In Prior Knowledge Related, the t-value is 28.605 p-value of 0.000 suggest that the mean is significantly larger than 0. The mean difference is significant 1.31579 and lies within the 95% confidence interval of (1.2247, 1.4069) reiterating significant perception of knowledge related to risk management. Prior Training Related yields a t-value of 24.194 and p-value of 0.000, proved, the study also revealed a significant mean difference is 1.58187 and, at a 95% confidence interval of 1.4523, 1.7114. This is a useful indication of prior training and its effectiveness in shaping knowledge and risk management solutions. Prior Knowledge has a t-test of 28.872, $p < 0.05$, mean difference = 1.56892 and CI = (1.4613, 1.6766). This attests to the understanding that respondents perceived a relatively high level of prior knowledge. Last, Training Experience has the t value 27.541 with the p value 0 = 0.000 this mean difference of 1.46867 with the confidence interval of 1.3630, 1.5743 which shows that respondents are confident with their training experiences.

The One-Sample Effect Sizes table includes Cohen's d and Hedges' correction, which provide measures of effect size for each variable: Cohen's d of 0.49113 of Prior Knowledge Related shows that the study has a moderate effect. The Hedges correction is somewhat larger and

equals 0.49442, which proves again the sufficient sample size as well as the consistency of effects. Training is highly associated with perceived knowledge, with a large effect size using Prior Training Related Cohen's d of $=0.69810$, and Hedges' correction of 0.70277 . In Prior Knowledge we have a Cohen's d equal to 0.58021 , which denotes a moderate effect; nevertheless Hedges corrected this coefficient to 0.58409 further confirming the results. Training Experience has a Cohen's d of 0.56937 and hedges correction of 0.57319 which means that training experience has moderate effect, hence it was established that there is significant difference in perceived knowledge level due to training experience.

The results of this statistical analysis indicate that there is considerable support to suggest that the means for all four variables are significantly greater than zero, signifying the respondents perceived competence with respect to their prior knowledge and training experiences which show a manipulating scripts, controlling the delivery of content and feedback, setting up tutorials, and applying media present. It is also evident that no measure achieved a p -value of more than 0.05 in any of these analyses, and this affirms that these results are quite realistic across all the measures used herein. Hence, this work opens the way for further analysis of how prior knowledge and training experiences relate to overall competence in risk management.

4.3.2. ANOVA Test

ANOVA

Table 12: ANOVA

		Sum Squares	of df	Mean Square	F	Sig.
PriorKnowledgeRelated	Between Groups	18.491	13	1.422	16.226	.000
	Within Groups	8.766	100	.088		
	Total	27.257	113			
PriorTrainingRelated	Between Groups	32.420	13	2.494	11.011	.000
	Within Groups	22.649	100	.226		
	Total	55.069	113			
PriorKnowledge	Between Groups	29.238	13	2.249	25.553	.000
	Within Groups	8.802	100	.088		
	Total	38.040	113			

The provided ANOVA table presents an analysis of variance for three variables: Current Knowledge Related, Training Related, and Prior Knowledge. Again, each variable's F ratio and probabilities are analyzed concerning whether mean differences exist across groups or not, within group indicated by 'Between Groups'. The table also consist of the sum of squares, degree of freedom (df), Mean square, F-statistic and Sig. (significance level) (Terrell, 2012). In the case of the Prior Knowledge Related variable, the sum of the squares between groups is 18.491 suggesting a significant differentiation between the mean scores of the compared groups. The between-groups degrees of freedom is 13 and the sum of squares for this variation is 18.642, and thus the mean square is calibrated by equally dividing the sum of squares with the degrees of freedom, which in this case is 1.422. The F-statistic for this variable is 16.226, By using these critical values, this parameter provides a highly significant ratio of the variance between the groups as compared to the variance with in the groups. The obtained p-value is shown to be 0.000, which position is distinctly below typical alpha level of 0.05 thus implying that the differences in group means are indeed statistically significant. This result means that at least one of the groups is statistically significant with other in terms of prior knowledge relating to the variable in study. In the case of Prior Training Related, the sum of squares between groups is 32.420 also indicating a large variance among the different groups of means. The degrees of freedom remain the same equal to 13, and the mean square value equal 2.494 stresses more the observed differences. The empirical F-statistic equals 11.011, which is also high; nevertheless, it is somewhat smaller than that for Prior Knowledge Related, which denotes a slightly weaker, though still present, significance of the variance ratio. The p-value as you can see here is 0.000 which again presents us that there is a significant difference in means across the groups. Slightly, this finding suggests that the level of prior training profoundly affects how the participants estimate their training acquired information. Finally, the ANOVA table calculated for Prior Knowledge gives the sum of squares between the groups equal to 29.238. This also implies that the group means differ significantly from one another as in the case of the other variables. These are unchanged at 13 for degrees of freedom and 2.249 for mean square. F-statistic for Prior Knowledge is 25.553, which is way above the other two variables, indicating overall largest variation of group mean to group variance. The significance level here is also given as 0.000 hence supporting the fact that the means differ significantly Here the results also depend on the alpha level set which has a difference in means = 0.000. This means that the kind or type of characteristics or experiences that define these groups affect the amounts of prior knowledge the groups possess in different ways.

Thus, for all these variables, analysis of variance showed significant differences of the means between the groups with extremely low probabilities, which indicated the significance of the differences. According to the F-statistics, all these variables confirm that the variance of means between the groups is considerably higher than the variance within groups. The facts of consistency in all the variables indicate that prior knowledge and training dep accurately determine perceived competence of the participants. This discussion enables identification of relationships between prior knowledge, training, and overall preparedness as analyzed with regard to the study. The data suggests that educational 'gains' or variations in the training that is delivered is likely to result to significant differences in the participant's perception of knowledge and experience. This information could be vital for designing programs to increase the participants' skill and knowledge base according to the level of training and prior knowledge in the participants.

4.4. Discussion

Based on the use of a mixed approach, the qualitative data has helped to extract that the research framework for this study revolves around three primary variables: participants' prior knowledge, their training experience, and the combination of both (Adeoye-Olatunde & Olenik, 2021). These variables therefore had significant roles in assessing the general success of risk management workshops in industries that were project based. The variables have been identified with the intent to study how they affect these kindergarten participants in issues of risk identification analysis and management, which are considered as mediating variables in the model. In the context of the framework, it was important to know what participants knew before participating in the workshops and how the knowledge acquired in the structured training during or before the workshops helped enhance their performance in addressing risks. The model envisioned that sometimes, prior knowledge or training experience on its own may still not be sufficient to maximize participant efficiency. Nonetheless, the coexistence of both elements in the study was expected to help improve the participants' ability to engage in risk management practices.

Participant Prior Knowledge

The first variable was prior knowledge which dealt with the information, knowledge, and experience participants had before entering the risk management workshops. This prior knowledge that the participants had could have resulted from their academic learning, practical experience in their respective fields or organizations or other exposure to risk management practices prior to the training and development of the workshop (Eid & Asutay, 2019). The findings of the study, also supported by the qualitative data, indicated that participants with previously acquired knowledge proved more capable of understating the nuances of the risk management discussions and more self-assured in the identification of the risks. Participants were able to engage in the risk management processes fast during the workshop due to their past knowledge. It also offered some level of familiarity with the subject matter, which gave more potential for analysis and refined decision-making during the workshops (Grossoehme, 2014). The information offered confirmed the idea of prior subject acquaintance, which helped the participants, as opposed to people with limited or no experience in risk management topics, to predict basic risks or recognize certain problems at the planning stages. This was particularly evident when the participants were estimating project-specific risks; their knowledge within the industry or past experiences working on similar projects aided problem-solving.

Training Experience

The second variable, training experience, included the knowledge participants attained formally through training, be it prior or during the workshops. This variable covered theoretical concepts taught in training sessions, practical models, and live simulation activities conducted in workshops. The study revealed that respondents that received extensive training and educational sessions on risk management received better at using formal frameworks to assess and manage risks. The major findings from the qualitative data included the fact that the training approach helped the participants to use a systematic approach in risk analysis and management. It also ensured that their identification and mitigation followed standard processes that similar tools with methodologies learned during the training (McNeil, Frey, & Embrechts, 2015). After the training session, the frameworks that were presented were helpful most especially to the participants when

evaluating different risks in as far as presenting mitigation measures that are most suitable given the current industrial standards. Participants who had previous experience with particular risk management instruments, including risk registers, risk probability matrix, and risk prioritization approaches, were observed actively participating in the practical exercises. These participants could make much of it to recognize important risks faster and suggest measures with reference to the application of best practices. The qualitative data also supported the quantitative analysis where the participants who had prior formal training also expressed more confidence as they found themselves applying techniques learned during the training when holding workshops (Ugwu & Eze, 2023).

The Combination of Prior Knowledge and Training

The prior knowledge-interaction experience variable was deemed the most significant factor influencing the total effectiveness of the subjects in risk management workshops as the third variable. The theoretical premise for the study argued that, more so than participants possessing one faculty only, those possessing both extensive background knowledge and formal training would prove superior at-risk recognition, assessment, and management. In consideration of the qualitative data, the findings revealed that students with good knowledge and training outperformed others in workshops. It was therefore possible for the participants to integrate their assessment of risks –based on past experiences– with the formal risk management tools acquired during their professional training (der Vegt, Essens, Wahlström , & George, 2015). This combination allowed them to consider risks from multiple perspectives and look at them from the practical point of view, as well as from the point of view of theoretical knowledge. The mixed approach data showed that the participants who performed the risk assessment with a combination of prior knowledge and training were not only faster in recognizing the risks, but also more accurate in evaluating the implication of these risks. Prior knowledge enabled users to make decisions based on the similarities to previous experiences, while training also gave them means to evaluate these risks rationally and make sure that chosen methods of risk management are both possible and effective (Hafsa, 2019). This combination affected positive changes in the views of the participants who were usually assigned to engaging in the discussion and leading those who were inexperienced in risk management in the workshops.

Risk Identification, Analysis, and Mitigation as Intermediary Outcomes

In this regard, risk identification, analysis, and mitigation were found to be intermediary outcomes who directly affected the overall impact of the risk management workshops. These outcomes were considered as important stages in which participants used their existing knowledge and practical experience. It was also evident from the data that those participants who had good training and knowledge about different risks were more likely to frame good risks. They could easily identify risks which should be dealt with early in the workshop stage; this means that important risks were already separated out and highlighted. The results of this research revealed that the subjects who integrated pre-existing knowledge with scripted training demonstrated enhanced ability of risk identification than comprehensive accuracy index. Moreover, it was identified that the risk analysis becomes more elaborate and accurate when done by the participants with the both knowledge of prior training and experience. These participants used the risk assessment techniques learnt during training to rate the risk likelihood and the risk impact of each identified risk, thus providing additional depth to our comparison. This made it easier to sift through potential risks because all the pertinent risks were looked into at a deeper and more comprehensive level. Last, the mitigation strategies developed by the participants who had

previous experience and training were also more practical and adequate. These strategies used a combination of down-to-earth solutions based on experiences together with theories that one was exposed to in their training. Therefore, the mitigation plans formulated in these workshops were even expanded to reduce risk impacts on the project.

4.5. Recommendations

Based on the findings of this research, the relationship between participant training, knowledge, and the effectiveness of risk management workshops in project-based industries has been explored in depth. To further optimize the outcomes of these workshops, several recommendations have been formulated.

1. Enhance Pre-Workshop Participant Assessment

The first recommendation is the implementation of a comprehensive and precise assessment mechanism to determine the knowledge level of the participants as well as their training backgrounds before entering the workshops. From the result of the study, it is clear that previous experience has a significant influence on the general outcome of risk management workshops since attendees who have more knowledge on risk management are more likely to contribute significantly. If the organizer identifies their knowledge level in advance, the content and format of the sessions can be adjusted to meet the needs of the participants in case of lack of knowledge (Suter, 2006). The assessment should include a combination of self-evaluation surveys, interviews, and knowledge-based tests. This will enable the facilitators to produce groups according to the expertise level of the participants and produce training programs that suit the level of the group. This way, the effectiveness of workshops could be increased in the context of the systematic reduction of knowledge gaps and the maximization of individual participants' impact on the risk management conversation.

2. Develop Customized Training Programs

According to the mixed approach embraced in the study, it has been possible to find that from the qualitative data collected that it is not practical to have universal training program for the participants since this only cater for individual's differential familiarity levels about the course to be taught. It is, therefore, suggested that training programs should be designed to accommodate the needs of the participants. Individuals with an extensive background in the topic can be provided with additional sections that would cover such topics as risk management approaches and other complex risk assessment techniques. Conversely, participants who lack experience or knowledge should undergo basic training that would include an overview of risk management before advancing to the complex structures (der Vegt, Essens, Wahlström, & George, 2015). Customization can be done where participants are grouped according to subsets found within the assessment results. By so doing, all the participants will undergo training that will accord with the current knowledge and experience they hold thus making all of them be as effective as possible in the events that are to be conducted in the workshops.

3. Incorporate Practical, Firsthand Learning

Make the training programs and the workshops as practical as possible with a twist of the firsthand approach. The existing studies have established that the man who integrates his prior

knowledge with practical experience possesses a greater ability to identify, analyze, and manage risks. Overall, it is suggested that workshops should be designed in a way that incorporates realistic exercises and activities which can be precisely utilized after completing the training program (McNeil, Frey, & Embrechts, 2015). These exercises should ensure that everyone engages in the group to complete the risk management assessment of a constructed project, and the consequential outcomes and resolutions. This practical exposure will not only enhance the theoretical knowledge but also enable the participants to get to know about the experience of other participants and ideas. In addition, it helps to guarantee that the topics explored during the workshops are relevant to future projects, thus providing increased training potential and value.

4. Encourage Knowledge Sharing and Peer Learning

There should be open dissemination of information and students should be encouraged to learn from their colleagues in the workshops. The more experienced participants should be engaged to help those with limited experience and understanding of risk management processes. This collaborative learning approach needs to enhance the quality of participation of the participants besides improving the general engagement of the participants in the given workshops. To support this, workshops using direct observation could involve the initiative-taking arrangement of peer learning sessions where participants of varying expertise are assigned to work jointly with dedicated tasks. In such sessions, there are always experts who can provide information on how to identify and analyze risks, while novices benefit from the experience and help in risk management. Availing all the participants' knowledge could help in enhancing the dynamics of the workshops and thus improving on the achievement of the laid down risk management objectives.

5. Implement Continuous Learning and Follow-Up Programs

Risk management workshops should not be viewed as one-off training activities but rather as on-going processes within a learning cycle. Among the suggestions made in the study, there is the suggestion to develop follow-up programs that would remind them of the teachings that participants received during the workshops. This can be done through follow-up workshop training, short online courses, and periodic seminars where participants are encouraged to review the materials covered and provide an update on how the learned skills have been implemented in their projects (Hubbard, 2020). Learning retention and feedback initiatives can assist the participants in the continuous learning process and make sure they remain current with the techniques used in the risk management workshops. Moreover, these programs can continue to offer help to its participants, enabling them to ask for guidance and council from the facilitators of the workshop as well as their fellow participants should they come across novel issues that are relevant to their projects.

6. Utilize Advanced Technology Tools in Risk Management

It is suggested that workshops ensure that they adopt higher technological equipment to facilitate their risk management processes based on the discovery in this study. Application and occupancy software, project management tools, and data visualization technologies can be employed to enhance the risk assessment part of the participants. Through such workshops, the participants become conversant with these tools hence enhancing risk management in project related organizations (Suter, 2006). These recommendations aim to enhance the effectiveness of risk management workshops in project-based industries by focusing on pre-assessment, customized training, practical learning, continuous education, and the use of advanced tools.

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6. Appendices

A. Survey Questionnaire

This study utilized a comprehensive survey questionnaire divided into sections to gather both demographic and professional information from participants. The sections include:

1. Personal Information:

- Job title, industry, years of experience, employment status, gender, age, education level, and training experience.

2. Prior Knowledge Related:

- Questions assessing familiarity with risk management principles, knowledge of risk management tools, and experience in applying risk identification techniques.

3. Training Experience:

- Questions on formal education or certifications, participation in workshops or seminars, and the effectiveness of previous training in preparing participants for risk management tasks.

B. Descriptive Statistics

- **Gender Distribution:** Majority of respondents were male (78.1%), while females accounted for 21.9%.
- **Age Range:** Predominantly aged 20-30 years (43%), followed by 31-39 years (30.7%).
- **Education Level:** Most respondents held a Bachelor's degree (59.6%), followed by Diploma holders (26.3%).
- **Experience Level:** Majority had 5 years of experience (36.8%), with fewer participants having more than 21 years (13.2%).

C. Data Analysis Methods

1. Quantitative Analysis:

- Statistical software (SPSS) was used to assess relationships between variables, employing descriptive statistics, correlation analysis, and inferential tests like ANOVA.

2. Qualitative Analysis:

- NVivo software facilitated the coding and thematic analysis of open-ended responses.

D. Ethical Considerations

The research ensured participants' anonymity and confidentiality, emphasizing informed consent and data protection measures. Survey responses were aggregated for analysis to protect individual identities.

F. Questionnaire Link

<https://forms.gle/euKp9v8TX1PyckLS7>

Questionnaire

"Exploring the Relationship Between Participant Training, Knowledge, and the Effectiveness of Risk Management Workshops in Project-Based Industries"

Questionnaire No. ____1____

Main Module

Survey Questionnaire

Risk Management Workshops

This survey is a vital part of our ongoing research project focused on investigating the relationship between participant training, knowledge, and the effectiveness of risk management workshops in project-based industries. By participating in this survey, you are contributing to the advancement of our understanding of this critical issue and helping to develop strategies that enhance the impact of risk management initiatives. Your insights are invaluable, and we greatly appreciate your time and participation. Please be assured that your responses will be treated with the utmost confidentiality.

“The researcher will take every care to remove any identifying material from the responses you provide as early as possible. Likewise, individuals' responses will be kept confidential by the researcher and participants will not be identified in the reporting of the research.”

Section A: Personal Information

A01: Details of respondent

Table 13: Details of respondent

1	2	3	4	5	6	8	9
Job title	Industry	Job experience	Emp status 1.Part time	Gender	Age	Highest education	Training experience

1- Project Manager		(In years)	2.Full time	1.Male	(In years)		(In months)
2- Risk Analyst			3. Casual	2.Female	15-30	1. Basic	
3- Engineer			4.Others (please specify)	3.Non-binary/other	31-50	2.Undergrad	
4- Other (please specify)				4.Perfer not to say	50-65	3.Postgrad	
					65+	4.PhD	

Section B: Questionnaire

B01: Prior Knowledge Related

1. **How familiar are you with risk management principles (e.g., risk identification, analysis, mitigation)?**
 - 1-Not familiar at all
 - 2-Slightly familiar
 - 3-Familiar
 - 4-Quite familiar
 - 5-Very familiar
2. **Rate your knowledge of common risk management tools (e.g., risk matrices, decision trees):**
 - 1-Not at all
 - 2-Very low
 - 3-Low
 - 4-Normal

- 5-Very High
- 3. **How often have you applied risk identification techniques in real-world projects?**
 - 1-Never
 - 2-Sometimes
 - 3-Often
 - 4-Very often
 - 5-Always
- 4. **How confident are you in your ability to analyze and assess risks in a project?**
 - 1-Not confident
 - 2-Slightly confident
 - 3-Confident
 - 4-Very confident
 - 5-Extremely confident

B02: Prior Training Related

- 5. **Have you received any formal education or certifications in risk management (e.g., PMI-RMP)?**
 - Yes
 - No
- 6. **Have you undergone on-the-job risk management training in the past?**
 - Yes
 - No
- 7. **Rate the effectiveness of previous training you've received in preparing you for risk management from 1 (Not effective) to 10 (Very effective)**

B03: Section 1: Prior Knowledge

Table 14: Prior Knowledge

Statements	Strongly Disagree	Disagree	Partially Disagree	Partially agree	Agree	Strongly Agree
1. I am familiar with the principles of risk management (e.g., risk identification, analysis, mitigation).	£	£	£	£	£	£
2. I have a good understanding of how to identify potential risks in a project.	£	£	£	£	£	£
3. I am confident in my ability to assess the likelihood and impact of risks.	£	£	£	£	£	£
4. I am knowledgeable about various risk management tools and techniques (e.g., risk matrices, decision trees).	£	£	£	£	£	£
5. I have experience applying risk management techniques in real-world projects.	£	£	£	£	£	£
6. I am comfortable prioritizing risks based on their potential impact on project outcomes.	£	£	£	£	£	£
7. I am familiar with how to use qualitative and quantitative methods for risk analysis.	£	£	£	£	£	£

B02: Section 2: Training Experience

Table 15: Training Experience

Statements	Strongly Disagree	Disagree	Partially Disagree	Partially agree	Agree	Strongly Agree
1. I have received formal education or certifications related to risk management.	£	£	£	£	£	£
2. I have participated in risk management workshops or seminars in the past.	£	£	£	£	£	£
3. I have received on-the-job training in risk management practices.	£	£	£	£	£	£
4. My previous training has adequately prepared me for identifying project risks.	£	£	£	£	£	£
5. My previous training has adequately prepared me for conducting risk analysis.	£	£	£	£	£	£
6. My previous training has adequately prepared me to develop effective risk mitigation strategies.	£	£	£	£	£	£
7. I have participated in continuous professional development (CPD) programs related to risk management.	£	£	£	£	£	£

Thank you, for your cooperation and being a part of this Questionnaire.

المستخلص

يبحث هذا البحث في تأثير مستويات التدريب والمعرفة للمشاركين على فعالية ورش عمل إدارة المخاطر داخل الصناعات القائمة على المشاريع، بما في ذلك البناء وتكنولوجيا المعلومات والهندسة. تُستخدم ورش عمل إدارة المخاطر على نطاق واسع لتحديد مخاطر المشروع وتحليلها والتخفيف منها؛ ومع ذلك، فإن فعاليتها غالبًا ما تتأثر بمستوى خبرة المشاركين وتدريبهم السابق. وتحدد الدراسة فجوة حرجية في الأدبيات حيث تم التغاضي عن العوامل البشرية، مثل استعداد المشاركين، مقارنة بالتركيز على الأدوات والمنهجيات التقنية. من خلال استخدام نهج مختلط الأساليب، يجمع البحث بين البيانات الكمية من الاستبيانات المنظمة والرؤى النوعية التي تم جمعها من خلال مقابلات المشاركين. يتكون المجتمع من محترفين يشاركون بنشاط في ممارسات إدارة المخاطر، بما في ذلك مديري المشاريع ومحلي المخاطر والمهندسين.

وتشمل أهداف الدراسة تقييم العلاقة بين مستويات التدريب ونتائج ورشة العمل، وتقييم تأثير معرفة المشاركين على تحليل المخاطر، وفحص فعالية التدخلات التدريبية المختلفة في تعزيز فهم المشاركين لمبادئ إدارة المخاطر. يدمج إطار البحث نظريات مثل نظرية تعلم الكبار ونظرية الكفاءة لفحص كيفية تأثير تدخلات المعرفة والتدريب على نتائج ورشة العمل. تكشف النتائج عن وجود ارتباطات ذات دلالة إحصائية بين المعرفة السابقة للمشاركين وفعالية تحديد المخاطر وتحليلها والتخفيف من حدتها خلال ورش العمل.

تشير النتائج إلى أن ورش العمل مع المشاركين الذين يمتلكون مستويات أعلى من المعرفة السابقة والتدريب تظهر نتائج محسنة في تقييم المخاطر وعمليات صنع القرار. بالإضافة إلى ذلك، تسلط الدراسة الضوء على أهمية التدخلات التدريبية المخصصة، مما يشير إلى أن البرامج الخاصة بالصناعة والمستهدفة تعزز بشكل كبير أداء المشاركين مقارنة بالتدريب العام على إدارة المخاطر.

من الناحية العملية، قدمت في البحث توصيات قابلة للتنفيذ للمؤسسات لتصميم وحدات تدريبية فعالة تعزز التعاون متعدد التخصصات ومشاركة المشاركين في ورش عمل إدارة المخاطر. ومن خلال تحسين استعداد المشاركين في ورشة العمل، تساهم الدراسة في تقليل تأخيرات المشروع، وتقليل التكاليف، وزيادة معدلات نجاح المشروع بشكل عام. تؤكد هذه الدراسة أيضًا على أهمية التطوير المهني المستمر وتبادل المعرفة كمكونات حيوية لممارسات إدارة المخاطر الناجحة، وتدعو إلى التحول من الأساليب التقنية البحتة إلى دمج العناصر البشرية للحصول على نتائج أفضل لورش العمل.

استكشاف العلاقة بين تدريب المشاركين والمعرفة وفعالية ورش عمل إدارة المخاطر في الصناعات القائمة على المشاريع

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