IMPACT OF TECHNOLOGY ADOPTION AND STAKEHOLDER COLLABORATION ON RISK MANAGEMENT EFFECTIVENESS IN FAST-TRACK CONSTRUCTION PROJECTS: KNOWLEDGE SHARING AS A MEDIATOR

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ABSTRACT

Construction is one of the main industries in the United Arab Emirates that contributes to national economic development. A large portion of the economic expansion in the UAE is directly fuelled by the construction industry. It is widely recognised for its infrastructure development initiatives, encompassing expansive developments, transit networks, and skyscrapers, which necessitate prompt completion under rigorous timelines. To guarantee successful completion, these projects must be completed with adequate risk management procedures due to their fast pace, which carries inherent risks and obstacles. Managing risks in such circumstances necessitates a deep understanding of all variables that may impact risk management effectiveness. Therefore, this study examines the impact of technology adoption and stakeholder collaboration on risk management effectiveness in fast-track construction projects using knowledge sharing as a mediator. The study used a quantitative methodology in which data were collected through a self-administered questionnaire. Theories of diffusion of innovation, reasoning action, and planned behaviour were also employed in the study. SPSS software was used to assess the demographic information of the respondents, which was also performed at the initial stages of data analysis. PLS-SEM analysis has also been used to measure validity and reliability of data. The study showed that there is a significant relationship between technology adoption and stakeholder collaboration on risk management effectiveness in fast-track construction projects. Additionally, knowledge sharing significantly mediates the relationship between technology adoption and employees' risk management effectiveness. The study's conclusions can help stakeholders to make well-informed decisions about innovations and technology investments.

Keywords: Technology Adoption, Stakeholder Collaboration, Risk Management Effectiveness, Fast - Track Construction Projects, Knowledge Sharing.

ABSTRAK

Pembinaan adalah salah satu industri utama di Emiriah Arab Bersatu yang menyumbang kepada pembangunan ekonomi negara. Sebahagian besar daripada pengembangan ekonomi di UAE secara langsung didorong oleh industri pembinaan. Ia diiktiraf secara meluas sebagai inisiatif pembangunan infrastrukturnya, merangkumi pembangunan yang luas, rangkaian pengangkutan, dan pencakar langit, yang memerlukan penyelesaian segera dalam jadual masa yang ketat. Untuk menjamin penyelesaian yang berjaya, projek-projek ini mesti diselesaikan dengan prosedur pengurusan risiko yang mencukupi kerana pembinaan pantas membawa risiko dan halangan yang wujud. Mengurus risiko dalam keadaan seperti ini memerlukan pemahaman mendalam tentang semua pembolehubah yang mungkin mempengaruhi keberkesanan pengurusan risiko. Oleh itu, kajian ini mengkaji kesan penggunaan teknologi dan kerjasama pihak berkepentingan terhadap keberkesanan pengurusan risiko dalam projek pembinaan pantas dengan menggunakan perkongsian pengetahuan sebagai perantara. Kajian ini menggunakan metodologi kuantitatif di mana data dikumpulkan melalui soal selidik yang diisi sendiri oleh responden. Teori penyebaran inovasi, tindakan berfikir, dan tingkah laku terancang juga digunakan dalam kajian ini. Perisian SPSS digunakan untuk menilai maklumat demografi responden, yang juga dilakukan pada peringkat awal analisis data. Analisis PLS-SEM juga telah digunakan untuk mengukur kesahan dan kebolehpercayaan data. Kajian menunjukkan bahawa terdapat hubungan yang signifikan antara penggunaan teknologi dan kerjasama pihak berkepentingan dengan keberkesanan pengurusan risiko dalam projek pembinaan pantas. Selain itu, perkongsian pengetahuan secara signifikan menjadi pegantara hubungan antara penerapan teknologi dan keberkesanan pengurusan risiko pekerja. Kesimpulan kajian ini boleh membantu pihak berkepentingan membuat keputusan yang tepat tentang inovasi dan pelaburan teknologi.

Kata Kunci: Penerimaan Teknologi, Kerjasama Pemegang Kepentingan, Keberkesanan Pengurusan Risiko, Projek Pembinaan Pantas, Perkongsian Pengetahuan.

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LIST OF ABBREVIATIONS

AI	Artificial Intelligence
AJB	Al Jaber Building
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BIM	Building Information Modelling
BIM	Building Information Modelling
CMAR	Construction Management-at-Risk
GCC	Gulf Corporation Council
GDP	Gross Domestic Product
IPD	Integrated Project Delivery
ISO	International Standardization Organization
KM	Knowledge Management
KS	knowledge Sharing
OC	Organizational Culture
PRM	Project Risk Management
RM	Risk Management
RME	Risk Management Effectiveness
SC	Stakeholder Collaboration
SEM	Structural Equation Modelling
SPSS	Statistical Package for the Social Sciences
TA	Technology Adoption
TPB	Theory of Planned Behaviour

TRA Theory of Reasoned Action

UAE United Arab Emirates

UAVs Uncrewed Aerial Vehicles

CHAPTER ONE

INTRODUCTION

1.1 Introduction

This section provides backdrop of the study by describing the function and significance of the construction sector in the United Arab Emirates, as well as its present difficulties and the gaps in the literature. Despite the growing use of new technology and teamwork, it draws attention to problems including project delays, cost overruns, and inadequate risk management procedures. The conversation lays the groundwork for determining the research question and the justification for looking at knowledge sharing as a mediating element in enhancing the efficacy of risk management.

1.2 Background of the Study

The construction sector is recognized as one of the most substantial industries in the United Arab Emirates (UAE). Nevertheless, it is distinguished by its complex and versatile characteristics, which have progressively expanded in magnitude. Oil discoveries in the UAE in the 1960s greatly stimulated the construction industry and enabled the region to meet its infrastructure requirements. Over time, the UAE has evolved into a vibrant nation driven by enthusiastic commercial and tourism endeavours. As a result, the country actively involved itself in large-scale construction projects and successfully attracted foreign construction companies to participate in these endeavours. The building sector in the UAE enjoys strong government support and draws significant investments owing to its crucial role in the country's economy (Tomh, 2022; El-Khatib et al., 2023).

The economic diversification initiatives implemented by the government of the United Arab Emirates (UAE) have been successful in reducing the country's dependence on hydrocarbon revenues. An example of such a strategy entails the allocation of oil revenue towards the enhancement of other industries, particularly in financing diverse initiatives such as housing, development, and infrastructure and enticing foreign investment (El-Amine, 2023).

Construction Sector: The construction industry encompasses the activities involved in the design, creation, and implementation of physical structures and infrastructure projects within the economy. Construction involves a diverse array of tasks, spanning from building homes, offices, factories, and civil structures to developing infrastructure, including roads, bridges, airports, and utilities. The construction industry is crucial for stimulating economic growth, generating job prospects, and facilitating the creation of physical environments that cater to societal demands (Paulraj et al., 2021).

Construction Industry: The construction industry comprises the enterprises, institutions, and experts engaged in the strategic conceptualization, execution, and administration of constructed surroundings. The stakeholders involved in construction projects include many professionals such as architects, engineers, contractors, developers, suppliers, and consultants. They work together to successfully execute construction projects of different sizes and difficulty levels. The construction industry operates within the wider construction sector and is influenced by legislative frameworks, market dynamics, and technological breakthroughs that define its methods and results (Hillebrandt, 2000).

Construction Project: Construction projects are described as specialized undertakings aimed at creating, modifying, or improving physical structures or infrastructural assets within a given scope, budget, and schedule. These projects usually consist of organized operations, such as feasibility studies, design development, procurement, construction, and commissioning. Project management concepts and procedures lead to these activities. Construction projects exhibit various dimensions, characteristics, and objectives, encompassing minor restorations and extensions and significant undertakings, such as high-rise buildings, roads, and urban infrastructure networks (Lingard & Shooshtarian, 2017).

Building Sector: The building sector refers primarily to the construction industry segment that deals with strategic planning, architectural design, construction, and ongoing management of residential, commercial, institutional, and industrial structures. It includes actions associated with constructing buildings meant for people, businesses, and communities to live in, work in, or use. The building industry substantially impacts the physical environment, affecting aspects such as urban development, environmental friendliness, and overall well-being.

Sami et al. (2022) argue that the construction sector in the United Arab Emirates has experienced steady expansion and is expected to make substantial progress in infrastructure development. The United Arab Emirates has experienced a constant and gradual increase in its GDP, which reflects the significant emphasis placed on domestic buildings. The construction industry's contribution to the Gross Domestic Product (GDP) rose from 10.3% in 2011 to 11.5% in 2021 (Ajmal et al., 2022).

Zahmak et al. (2020) and Al-Ameri et al. (2020) found that construction investments in the Gulf Corporation Council (GCC) member states amounted to almost AED 3 trillion in 2017, representing roughly thirty-three percent of the total value of all finished construction projects. The construction sector in the United Arab Emirates is undergoing a transformation into a technologically sophisticated region as part of its 2025 Vision (Al-Ameri et al., 2020). The company has a workforce of almost 2 million employees, representing around 7.2% of the total workforce, making a significant contribution to a stable economy (Sharif et al., 2022).

Construction projects in the UAE often need more relaxed deadlines and financial constraints due to the commercial and marketing techniques employed by private sector developers. Despite being vital to the UAE economy, this industry faces substantial barriers to expansion, such as insufficient project financing, project completion delays, and cost overruns (Zahmak et al., 2020). These challenges have a significant influence on the overall economy of the nation as well as the construction industry.

The United Arab Emirates construction sector of the UAE is expanding tremendously due to the government's efforts to encourage economic diversification and technical advancement. Despite some advancements in risk management strategies to improve project quality in the United Arab Emirates (Al-Hashimi & Masuri, 2022), most infrastructure projects still surpass their budgets, and many even fail during construction because of insufficient risk management tactics (Bayer, 2022). The project duration experienced a substantial increase, resulting in a decrease in value and failure to meet the client's expectations. Compared to other industries, the construction industry in the United Arab Emirates is more intricate and susceptible to risks. Therefore, it is crucial to have adequate risk management in place (Cherian, 2020).

Over the past decade, the building sector in the UAE has undergone significant expansion. However, a substantial number of project management professionals require more professional risk management training and academic degrees in project management, as evidenced by the delays and cost overruns observed in most projects (Al-Hosani et al., 2020). A study conducted by Ajmal et al. (2022) suggested that to enhance the comprehensiveness and accuracy of project risk assessments, the project team must undergo formal training in project risk management (PRM) procedures and standards (Crispim et al., 2019). Large construction organizations in the United Arab Emirates have incurred significant financial losses in residential projects due to inadequate project sequencing. This issue was highlighted in a study by Alteneiji et al. (2020). Furthermore, construction delays are a common problem in civil engineering projects (Viles et al., 2020).

UAE fast-track building is an intelligent way to accomplish the nation's ambitious development goals and satisfy the continuously changing demands of a dynamic market. As a hub for economic activity, tourism, and infrastructure development, the UAE relies on fast-track construction methods to deliver essential projects and to support economic growth. In a world of ambitious urbanization, iconic architecture, and mega-events like Expo 2020, fast-track construction helps developers and stakeholders seize opportunities, reduce project timeframes, and boost competitiveness. However, the UAE's socio-economic and environmental backdrop makes fast-track development difficult due to strict regulations, intense weather, and logistical issues. Project planning, risk management, and stakeholder participation must be integrated to ensure that expedited project timelines do not compromise project safety, quality, or sustainability.

Fast-track building methods drive innovation, resilience, and economic growth in the UAE, which is a worldwide construction and infrastructure development leader (Koelemaij, 2022). Construction projects can benefit from using risk management procedures that involve evaluating, analyzing, planning, and controlling risks (Motaleb, 2021). The UAE necessitates a robust framework for mitigating risks (Ullah et al., 2021) specifically tailored to minimize the various types and magnitudes of hazards in the nation's construction industry, especially concerning its expedited projects.

1.3 Problem Statement

Although the building sector demands significant manpower, it also plays a crucial role in the employment landscape of the country. According to Hirschmann (2020), the construction industry employs 1.463 million individuals, accounting for 9.57% of the total workforce. The building industry, which contributes to the country's economic growth and employment opportunities, is frequently criticized as a complex and hazardous sector with a negative reputation (Yap et al., 2020). The construction sector is regarded as a highly hazardous business due to its dynamic, intricate, and distinctive characteristics, as well as the involvement of several perilous jobs (Oswald et al., 2020). Consequently, construction workers are subjected to several safety hazards that may lead to death, lifelong disability, or injuries when working in such a perilous setting (Mariam et al., 2021). Neale and Gurmu (2021) found that production restrictions in the construction industry frequently result in workers prioritizing efficiency at the expense of safety. This, in turn, increases the likelihood of accidents and decreases workers' adherence to safe practices.

However, there are evaluations being made regarding quality and safety management systems in the construction business (Abioye et al., 2021). Population expansion, urbanization, infrastructural development, and economic diversification have boosted the UAE’s construction industry. Policymakers, investors, and others must understand UAE’s construction patterns. This understanding helps them learn about the industry's evolving nature and identify areas in which technological advances might improve efficiency, sustainability, and innovation (Saradara et al., 2023).

In the early 2000s, the UAE began modernizing and improving Dubai and Abu Dhabi. This time saw a surge in construction, highlighted by the world's tallest buildings, the Burj Khalifa, and the Palm Jumeirah, an artificial island group. These massive projects transformed the city's skyline and made the UAE a global leader in design, engineering, and construction (De Jong et al., 2019). The mid-2000s saw solid economic development, favourable government policies, and increased foreign capital input into the building industry. After the 2008-2009 global financial crisis, UAE development projects slowed and were delayed or cancelled. Due to funding issues, many developers suspended or reduced projects (Carolillo et al., 2013). In reaction to the crisis, the UAE government boosted the economy and building industry. Infrastructure spending, property developer incentives, and overseas investor strategies are included. The building industry recovered slowly but more sustainably than before the crisis (Hvidt, 2013).

After 2010, the UAE’s building sector became more diverse and environmentally friendly. In addition to notable projects, infrastructure, transit, renewable energy, and sustainable urban planning were prioritized. The government moved to create a knowledge-based economy, reduce oil dependence, and improve residents' quality of life (Asif, 2016).

Technological advances have influenced UAE construction in recent years. Innovative technologies like BIM, drone technology, 3D printing, and prefabrication streamline processes, increase efficiency, and improve project results. Building Information Modelling (BIM) helps designers and project managers collaborate, reduces errors and enhances decision-making throughout the project. Drones are used in site surveys, progress tracking, and safety inspections to save time and money (Balasubramanian et al. 2021).

Moreover, the COVID-19 pandemic has expedited the implementation of digital technologies and remote working methods in the construction sector. Due to movement and onsite activity limitations, organizations have resorted to utilizing virtual collaboration tools, cloud-based platforms, and mobile applications to oversee projects and maintain uninterrupted operations. This digital transformation process has not only improved the ability to recover quickly from difficulties, but also emphasized the significance of moving quickly and adjusting to unexpected problems (Casini, 2021).

Infrastructure developments, urban expansion, and preparations for Expo 2020 are expected to keep the UAE's construction industry growing. However, stakeholders must monitor and address emerging issues like sustainability, legal changes, and geopolitical risks. Technology is essential for realizing the sector's potential and providing a modern, resilient, and sustainable built environment in the UAE (Yehia & Pinnington, 2020). AI and robotics have revolutionized building projects and improved efficiency, production, and safety. AI-driven construction planning and scheduling solutions optimize resource allocation and reduce risks using historical project data and current site conditions.

Robotics, mainly 3D printing, has enabled the rapid manufacturing of complicated architectural pieces onsite, exhibiting automation and customization. Another use is in autonomous construction vehicles with AI-powered navigation systems. These vehicles make the excavation and material transport more precise and independent. AI-powered predictive maintenance systems are also helpful for monitoring equipment and decreasing downtime by predicting potential faults. AR and VR technologies boost project efficiency by providing immersive visualizations for design reviews and client presentations. These examples demonstrate how technology may transform the construction industry and improve productivity, sustainability, and innovation (Almarzooqi, 2019).

Complexity in construction encompasses architectural design, structural requirements, and material standards. To support massive glass panels, ensure structural integrity, and maximize natural light, glass building design involves intricate engineering. Steel buildings are lightweight but strong; therefore, manufacturing, shipping, assembly, seismic resilience, and fire safety must be planned. Green roof and passive solar designs complicate energy, environmental, and regulatory compliance. These examples show how complicated building projects are and how many challenges industry experts face in producing resilient and prosperous constructed environments (Abu-Jdayil et al., 2019).

Design-build and fast-track construction differ in terms of project delivery, risk allocation, and stakeholder involvement. Fast-track construction combines design and construction to finish and occupy projects quickly. Prefabricated components, modular construction, and lean management have accelerated and shortened projects. In contrast, design-build methods plan and document before construction, although project deadlines may be extended.

High-risk fast-track projects require close collaboration between architects, engineers, contractors, and clients to satisfy changing design needs and mitigate hazards. Fast-track and traditional methods have merits and cons; therefore, project goals, restrictions, and stakeholders should select the optimal technique (Petrosyan, 2020). The stakeholders involved in construction projects consist of a wide range of entities that are essential for the project's successful completion. Consultants, such as architects and engineers, offer specialized knowledge and skills in design and technical areas (AbuMoeilak et al., 2023).

Developers are responsible for initiating and supervising projects, overseeing financial issues, and ensuring the projects align with market expectations (El-Sayegh et al., 2021). Banks and financial institutions play significant roles in project financing by providing funds and economic instruments to support construction operations (Al-Khoori & Hamid, 2022). Contractors are responsible for carrying out construction tasks and overseeing the allocation of labour and resources at the construction site (Chou & Pramudawardhani, 2015). Regulatory organizations and government agencies enforce building codes and regulations to ensure compliance and maintain public safety (Mpofu et al., 2017). Material suppliers play a crucial role in construction by providing the necessary resources and equipment for project execution (Elshaboury et al., 2022). Finally, the design and functioning of a project are influenced by end-users and occupiers, who are stakeholders that must consider their demands taken into account for the project to be successful (Lu et al., 2017).

Fast-track construction begins work before design completion, speeding up project timetables. This method requires quick decision making and early material procurement, typically using preliminary design concepts and technical requirements to start a building.

Design-build, on the other hand, finishes the design before the building. This sequential procedure provides thorough planning and documentation but may delay project completion. Fast-track initiatives use flexible design and collaborative decision-making to quickly reduce risks and solve problems. Fast-track construction promises faster project completion and flexibility, but it requires extensive stakeholder cooperation and rigorous project management to ensure quality and project goals within tight deadlines. Traditional design-build processes use upfront design development and contractual agreements, which provide more assurance but may limit project adaptability.

One of the main industries in the United Arab Emirates is construction (Cherian, 2020). A large portion of the economic expansion in the UAE is directly fuelled by the construction industry. The construction sector in the UAE is responsible for 70% of all ongoing infrastructure projects, according to the ABiQ (2022) report. The UAE's construction sector is estimated to be worth USD $ 90 billion. Furthermore, fast-track construction projects that are distinguished by strict deadlines, limited funding, and intricate deliverables have proliferated, particularly in areas of the world that are developing rapidly, such as the United Arab Emirates (UAE). The UAE is widely recognised for its audacious infrastructure development initiatives, encompassing expansive developments, transit networks, and skyscrapers, which frequently necessitate prompt completion under rigorous timelines. To guarantee successful completion, these projects must be completed with adequate risk management procedures due to their fast pace, which carries inherent risks and obstacles. Managing risks in such circumstances necessitates a deep understanding of all variables that may impact risk management effectiveness (Alzoubi, 2022).

The following Table 1.1 summarizes the key trends and challenges being faced by the construction industry in UAE.

Table 1.1

Trends and Challenges Faced by the Construction Industry in UAE

Period	Industry Trend	Main Challenges	Reference
2000s	Modernization of Mega Projects in Dubai & Abu Dubai	Project Timeline Delays and Cost Over Runs	De Jong et al. (2019)
2008-2009	Financial Crisis	Shortage of Resources and Funds, Project Cancellations	Carollilo et al. (2013)
2010-2015	Sustainability	Weak and Inadequate Risk Management Mechanisms	Hvidt (2013) Asif (2016)
2016-2020	Development Projects and Smart City Concepts 2020	Inadequate Collaboration and weak technological adoption	Almarzooqi (2019); Balasubramanian et al. (2021)
2020-2022	COVID-19	Digital tools integration and knowledge sharing	Casini (2021)
Onwards	UAE Vision 2025	Limited technological integration and inadequate collaboration, and risk management	Alzoubi (2022)

The majority of Middle Eastern nations have begun to embrace digitization (Saleh & Manjunath, 2020); the UAE is the country that is tackling digital disruption the most effectively. Artificial Intelligence (AI), analytics, and robotic process automation are among the newest technologies that have seen increased adoption in Dubai and the Middle East in recent years. These technologies have helped these regions rethink their business models to achieve notable cost and operational efficiencies. However, there are certain obstacles that businesses in the United Arab Emirates and the Middle East face in their efforts to go digital and remain competitive in the contemporary global marketplace (Zarrouk et al., 2021).

Similarly, stakeholders are important to the planning, management, and execution phases of megaprojects (Ashkanani & Franzoi, 2022). Over the course of the project, they made a significant contribution to decision-making. Decisions about investments must be approved by all parties involved and require large sums of money with strong support from the government and international banks (Zhao et al., 2022). According to Bahadorestani et al. (2020), the greatest outcomes of megaprojects come from improving stakeholder satisfaction and creating value. Thus, good collaboration, successful alignment, and involvement of stakeholder objectives are critical for megaproject success.

Likewise, fast-track building projects depend heavily on knowledge sharing for success (Rasul et al., 2021). Facilitating the transmission of knowledge and experience across stakeholders can enhance the efficacy of risk management. Stakeholders can see possible hazards and create plans to reduce them by sharing their knowledge and experiences. This can lessen the possibility of fast-tracking construction projects that experience delays, cost overruns, and other problems.

Although the relationship between knowledge sharing as a mediator and the efficacy of risk management in accelerated construction projects has not been directly studied (Ahlfänger et al., 2022), several related studies have highlighted the significance of knowledge sharing in project management (Lee et al., 2021). For instance, Shehzad et al. (2022) discovered that knowledge management procedures acted as a partial mediating factor in the association between frugal innovation and collaborative culture in Pakistani manufacturing and service companies. In a similar vein, the Project Management Institute (2013) emphasized the significance of information exchange and collaboration among project managers (Moradi et al., 2020). However, another study discovered that friendly relationships at work and job happiness had a favourable impact on knowledge sharing, which in turn had a positive impact on service innovation (Bhatti et al., 2020).

While the existing literature provides insights into individual aspects of risk management or technology adoption in construction (Wang et al., 2020), there is a gap in comprehensive studies that integrate multiple factors affecting risk management effectiveness in UAE fast-track construction projects (El Baba, 2019). Thus, there is a need for a holistic investigation that examines the integrated and combined impacts of technology adoption, stakeholder collaboration, and knowledge management on risk management outcomes. Therefore, this study aims to address this gap by examining how these factors collectively influence risk management effectiveness in fast-track construction projects within the UAE, which will contribute to enhancing understanding and potentially improving risk management practices in this dynamic construction environment. Due to the complex linkages between technology and stakeholder relations, fast-track construction projects in the United Arab Emirates encounter a multitude of obstacles in attaining effective risk management.

The degree to which stakeholder participation, technology usage, and all these factors affect risk management efficacy is still not well understood. The creation and application of thorough risk management plans suited to the requirements of UAE fast-track construction projects are affected by this knowledge gap. The identified issue highlights the necessity of conducting thorough research that incorporates these crucial elements to clarify their combined impact on the efficacy of risk management in fast-track construction projects in the United Arab Emirates, with knowledge sharing acting as a mediator. By tackling this issue, more specialized frameworks and strategies can be developed to improve risk management procedures in the special setting of the UAE's rapid building projects. Above the given problem, the research questions for the study are as follows:

1.4 Research Questions

1. Does the adoption of technology have a significant impact on enhancing risk management effectiveness in fast-track projects within the UAE?

2. Does stakeholder collaboration influence the reduction of risk management effectiveness in fast-track projects within the UAE?

3. Does knowledge sharing act as a mediating factor in the relationship between technology adoption, stakeholder collaboration, and risk management effectiveness within fast-track projects in the UAE?

1.5 Research Objectives

1. To examine the impact of technology adoption on enhancing risk management effectiveness in fast-track construction projects within the UAE.
2. To assess the influence of stakeholder collaboration on mitigating risk management effectiveness in fast-track construction projects within the UAE.
3. To investigate the role of knowledge sharing as a mediator in the relationship between technology adoption, stakeholder collaboration, and risk management effectiveness within fast-track construction projects in the UAE.

The study offers insights into the ways in which technology, stakeholder collaboration, knowledge sharing, and overall risk management practices are interconnected.

1.6 Research Hypotheses

Objective 1 hypothesis

Null Hypothesis (H0): There is no significant relationship between technology adoption and risk management effectiveness in fast-track construction projects within the UAE.

Alternative Hypothesis (H1): There is a significant relationship between technology adoption and risk management effectiveness in fast-track construction projects within the UAE.

Objective 2 hypothesis

Null Hypothesis (H0): Stakeholder collaboration does not significantly influence risk management challenges in fast-track construction projects within the UAE.

Alternative Hypothesis (H1): Stakeholder collaboration significantly influences risk management challenges in fast-track construction projects within the UAE.

Objective 3 hypothesis

Null Hypothesis (H0): Knowledge sharing does not mediate the relationship between technology adoption, stakeholder collaboration, and risk management effectiveness in fast-track construction projects within the UAE.

Alternative Hypothesis (H1): Knowledge sharing mediates the relationship between technology adoption, stakeholder collaboration, and risk management effectiveness in fast-track construction projects within the UAE.

These hypotheses provide testable propositions that can be empirically investigated to validate or refute the relationships between the variables in the study.

1.7 Significance of the Study

This research study has its deeper and significant theoretical perspective that will support to understand the risk management effectiveness in fast-track constructions projects with technological integration and stakeholders' collaboration. Following the Baron and Kenny (1986) framework for mediation, the key relationship and the mediation shall be studied with the support of Diffusion of Innovation Theory (DOI) that will bridge the gap especially in the UAE context.

As far as the practical standing is concerned, this research shall set forward the way for the policy makers and stakeholders like project managers, industry practitioners and big firms. With the aim to cut cost overruns, decrease project delays, while enhancing overall project outcomes, the study highlights the significance of technology adoption and stakeholder collaboration.

It also highlights the necessity of structured mechanisms of knowledge sharing. The findings can be used to inform strategic investments in digital technologies like UAVs, AI, and Building Information Modelling (BIM), as well as to improve stakeholder collaboration. Additionally, by helping to create industry standards and policies that support UAE Vision 2025, the insights will support competitiveness, innovation, and sustainable growth in the construction industry.

With the PLS-SEM utilization, this research shall be significant in testing dual approach of direct and mediated relationship among the key variables in accordance with the complex nature of this research study. Earlier researches on this domain in field were descriptive and the methodological approach of this research shall pave ways and bring forward the evidence in multiple constructs with the help of validated measurement scales. Apart from this, the key significance of this research is its replicable design with high reliability and validity that scholars can also opt in future for investigating the risk management practices.

It is critical to understand how the effectiveness of risk management is affected by technology adoption, stakeholder involvement, and information accessibility. The results of this study can help establish more resilient and flexible risk-response strategies that are especially suited to the particular difficulties posed by fast-track building projects. In fast-track construction, efficient risk management is essential for the success of the project and its timely completion. In the UAE construction industry, the study can help minimize uncertainties, lessen potential disruptions, and improve project outcomes by identifying the elements that have a substantial impact on risk management effectiveness. Improved resource allocation and cost control are the result of improved risk management techniques. By comprehending the significance of technology, coordination, and information availability in risk reduction, construction companies may deploy resources more effectively and minimize possible losses stemming from unanticipated hazards.

The conclusions of the study can help stakeholders to make well-informed decisions about innovations and technology investments. By identifying the technologies and collaborative practices that have the biggest effects on risk management, investments can be made specifically in areas where the highest returns are expected. Forming associations between different variables and the efficacy of risk management (RM) can aid in the development of industry standards and best practices. This might raise the standards for risk management in the UAE's construction industry, increasing project success rates, and enhancing the sector's standing.

By offering empirical data and insights into the intricate interactions between technology, teamwork, information accessibility, and risk management in expedited construction projects, the study will advance academic knowledge. It might provide a starting point for more studies and academic projects in this area. The study's overall significance stems from its potential to advance knowledge of the variables influencing RM in fast-track construction projects in the UAE. This could ultimately lead to better project outcomes, enhanced practices, and advancements in how the construction industry approaches risk management in accelerated projects.

1.8 Scope of the Study

The scope of the study encompasses a thorough investigation and evaluation of multiple interrelated variables in the context of fast-track construction projects in the United Arab Emirates (UAE). The purpose of this study is to examine and comprehend how the following factors interact to affect the efficacy of risk management.

Examining adoption rates, types of technology used, and their effects on risk identification, assessment, and mitigation measures are all part of the impact of technology integration within fast-track projects in the United Arab Emirates. The study includes an evaluation of stakeholder collaboration by looking at the roles, communication styles, and ways in which collaboration affects the risk management for contractors, subcontractors, project managers, and other pertinent entities by assessing the dynamics of cooperation amongst stakeholders in UAE fast-track construction projects.

Moreover, examining the relationship between technology adoption, stakeholder collaboration, and risk management effectiveness in light of knowledge sharing as a mediator involves comprehending the ways in which knowledge utilization and dissemination affect risk management tactics in expedited construction projects. In conclusion, the aim of this research is to improve risk management procedures in UAE fast-track construction projects by offering insightful analysis and recommendations grounded in empirical data.

1.9 Operational Definition of Terms

1.9.1 Technology Adoption

According to Alaloul et al. (2020), technology adoption involves incorporating new technology innovations or systems into current habits, processes, or surroundings by individuals, organizations, or society. It encompasses the recognition, acknowledgment, and application of technology to meet specific requirements, enhance productivity, and accomplish strategic goals within a particular setting. The operational indications for technology adoption encompass factors such as the degree of usage, frequency of utilization, level of expertise, and perceived value of the technology among users or stakeholders. Furthermore, variables such as education, assistance systems, and the corporate environment might impact the speed and scope of technology implementation.

1.9.2 Stakeholder Collaboration

Freeman (2010) defines stakeholder collaboration as the proactive involvement, cooperation, and contact between individuals, groups, or organizations with a vested interest or participation in a particular project, initiative, or endeavour. It involves sharing information, resources, and viewpoints to accomplish shared objectives, resolve disagreements, and improve decision-making processes. Operational indicators of stakeholder collaboration encompass factors such as the frequency and depth of communication, the amount of mutual trust and respect, the extent of engagement in decision-making, and the degree of alignment towards agreed objectives. Furthermore, elements such as openness, inclusiveness, and receptiveness to feedback from stakeholders assist in promoting successful cooperation and establishing enduring connections between stakeholders.

1.9.3 Knowledge Sharing

Knowledge sharing is the act of exchanging, disseminating, and transferring information, expertise, and insights among individuals, groups, or organizations in a specific context. Knowledge sharing is the deliberate or organized exchange of knowledge assets, such as best practices, lessons learned, and tacit knowledge, to promote learning, problem-solving, and innovation. Operational indicators of knowledge sharing encompass factors such as the frequency and modes of communication, availability of information repositories or platforms, and level of involvement and interaction among those who contribute and receive knowledge. Efficient dissemination of knowledge encourages cooperation, improves decision-making, and promotes organizational learning and flexibility (Argote, 1999; Huber, 1991).

1.9.4 Risk Management Effectiveness

Risk management effectiveness can be defined as the extent to which a systematic and proactive method of detecting, evaluating, reducing, and monitoring risks accomplishes the desired goals within a particular project, program, or organizational setting. It involves the capacity to predict, examine, and react to possible dangers or opportunities, reducing adverse effects on project goals, resources, and stakeholders while increasing the achievement of opportunities. Operational indicators of risk management effectiveness encompass the precision and inclusiveness of risk identification, effectiveness of risk mitigation strategies, promptness of risk response actions, and overall unity of risk management activities with project objectives and limitations. Furthermore, factors such as the organization's willingness to take risks, ability to recover quickly, and capacity to adjust to changing circumstances demonstrate its capability to effectively handle and traverse uncertainty in the long run (Hopkin, 2018).

1.10 The Organization of the Thesis

This study is organized into numerous pivotal chapters. Chapter 1 provides the fundamental structure, outlining the background, problem description, objectives, research questions, and hypotheses of the study.

Furthermore, it includes valuable information about the importance and extent of the research and clarifies the definitions of crucial terminology essential for comprehending the following discussion. Chapter 2 provides an in-depth examination of the relevant literature, scrutinizing previous research and academic writings about the main concepts studied. This chapter also presents hypotheses based on theoretical frameworks, establishing a theoretical basis for the investigation. Chapter 3 provides a detailed explanation of the research design and methodology, including the specific approach used for collecting data, strategies used for sampling, and process for determining the sample size. In addition, this chapter provides a comprehensive explanation of the tools and methods used to gather data, as well as the anticipated strategies for analysing the data. Furthermore, it includes valuable information on implementing a preliminary study, emphasizing its significance in improving research procedures and guaranteeing data accuracy for further studies. Chapter 4 discusses how data have been analysed using SmartPLS, especial emphasis has been given to measurement model and structural model of the collected data. Chapter 5 discussed discussion of key findings, contribution of the study and suggestions for future studies.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter includes previous studies on risk management, its importance in the construction industry, technology adoption, stakeholder collaboration, and the mediating role of knowledge sharing. Furthermore, this chapter also presents the relationship between the understudy variables, followed by the hypotheses of the study and the theoretical framework.

2.2 Fast-track Construction

The construction industry has increasingly used fast-track construction approaches because they can accelerate project schedules while ensuring high quality and cost-effectiveness (Mpofu et al., 2017). This approach utilizes concurrent design and construction phases, enabling construction operations to begin before the completion of the design process (Pan & Zhang, 2023). Fast-track construction accelerates project timescales, allowing stakeholders to take advantage of market opportunities and achieve early investment returns (Rasul et al., 2021).

Nevertheless, the execution of expedited buildings presents numerous obstacles. The heightened project intricacy from the overlapping phases and schedule compression is a significant obstacle. The intricate nature of the project may result in increased demands for coordination among many project stakeholders, such as architects, engineers, contractors, and subcontractors (Do et al., 2022).

Efficient project management strategies and strong stakeholder collaboration are essential for overcoming these problems and guaranteeing successful project results

(Arefazar et al., 2022). Furthermore, the expedited method requires a proactive approach to manage risks, handle problems, and minimize project delays. Potential hazards linked to fast-track construction may encompass alterations in design, uncontrolled expansion of project scope, resource limitations, and unforeseen site circumstances (Al-Hajji & Khan, 2016). Implementing comprehensive risk assessment and mitigation strategies, together with efficient communication and coordination across project teams, is crucial for overcoming these difficulties and guaranteeing project accomplishment (Borghesi & Gaudenzi, 2012). In summary, fast-track construction has the potential to expedite project delivery and improve competitiveness. However, meticulous planning, coordination, and risk management are necessary to address these issues and achieve the desired project goals.

2.3 Technology

The construction business has been transformed by technological breakthroughs, leading to efficiency, productivity, and safety enhancements throughout different stages of projects (Ferreira et al., 2021). Building Information Modelling (BIM) has become a potent tool for strengthening cooperation, improving coordination, and reducing mistakes across the project lifecycle (Olanrewaju et al., 2022). BIM allows stakeholders to perceive project elements in a simulated setting, thereby promoting enhanced decision making, identification of conflicts, and design optimization.

In construction applications, drones and uncrewed aerial vehicles (UAVs) have become increasingly popular due to their ability to perform site surveying, progress monitoring, and safety inspections (Israr et al., 2021).

Uncrewed Aerial Vehicles (UAVs) offer immediate and up-to-date aerial information and images, enabling project teams to evaluate site conditions, monitor advancements, and detect possible dangers more effectively than conventional approaches. Moreover, progress in prefabrication technologies and modular construction techniques has facilitated the swift production and integration of building components away from the construction site (Liu et al., 2020). Prefabrication provides a multitude of advantages, such as decreased construction duration, enhanced quality management, and heightened on-site safety. In contrast, modular construction offers more adaptability and expandability, resulting in expedited project completion and minimized waste production.

Although there are many advantages to adopting technology in the construction industry, there are still obstacles to overcome, such as the hurdles to embracing technology and problems with data interoperability (Bello et al., 2021). Common obstacles impeding the widespread implementation of technology in the construction industry include resistance to change, scarcity of experienced labour, and compatibility concerns across various software platforms. To tackle these difficulties, it is essential for industry players such as governments, academics, and technology suppliers to work together to encourage innovation, education, and standardization in the adoption and deployment of technology.

Ultimately, technology is essential for propelling innovation and revolutionizing building business. By embracing cutting-edge technologies and implementing a proactive strategy to integrate them, the construction sector can improve project outcomes, enhance efficiency, and foster sustainable growth.

2.4 Delivery System

Different project delivery systems in the construction sector have distinct features, benefits, and consequences for project results (Elghaish et al., 2020).

Conventional approaches, such as design-bid-build, entail distinct design and construction agreements, which clarify project duties but may result in longer project durations (Moon et al., 2020). On the other hand, design-build and construction management-at-risk (CMAR) methods encourage cooperation between project stakeholders from the beginning, resulting in quicker project completion and potential financial benefits (Smith, 2023). Integrated project delivery (IPD) emphasizes collaboration and shared risk/reward among project participants, enabling the alignment of project goals and objectives (Deep et al., 2021). The IPD approach promotes the early engagement of essential stakeholders in project decision-making and planning processes, including owners, designers, contractors, and subcontractors. This cooperative method promotes a culture characterized by trust, openness, and responsibility, resulting in enhanced project results and client contentment.

The choice of a suitable delivery system is contingent upon several criteria, such as project intricacy, magnitude, financial resources, and owner preferences (Elghaish et al., 2020). When choosing a delivery system, it is essential to carefully analyse the unique requirements and objectives of the project, as each system has advantages and limits. Furthermore, engaging in continuing assessment and consistently enhancing project delivery processes is crucial for effectively responding to evolving market dynamics and meeting stakeholder expectations. Project delivery methods are crucial for determining project results and influencing stakeholder experience. Adopting collaborative delivery approaches and cultivating a culture of partnership and innovation can increase efficiency, mitigate project risks, and improve the overall project success in the construction industry.

This extensive literature analysis emphasizes the importance of fast-track construction, technology, and delivery methods in influencing the structure of the construction industry. The statement highlights the importance of employing creative methods, working together, and constantly adjusting to new technologies and delivery methods to fulfil changing project requirements and stakeholder needs.

2.5 Project Using Fast-Track Approaches, Its Advantages, and Disadvantages.

Example 1: Burj Khalifa is in Dubai, United Arab Emirates (UAE).

Burj Khalifa, situated in Dubai, United Arab Emirates, is a renowned skyscraper with the title of the highest structure globally. The construction of Burj Khalifa utilized expedited construction technologies to hasten the project timeline and achieve ambitious completion goals. The implementation of a fast-track construction approach facilitated the swift progress of the Burj Khalifa project, resulting in early completion and occupancy of the building. The developers achieved a competitive edge by finishing the project before the scheduled time. This led to the attraction of investors and tenants who were keen on occupying high-status offices and residential spaces. The early construction of Burj Khalifa enabled revenue generation by selling and leasing business and residential units, thereby maximizing the returns on investment for project partners. The timely completion of Burj Khalifa enabled revenue creation through the sale and leasing of business and residential units, maximizing returns on investment for all parties involved in the project.

Fast-track construction can result in increased costs due to the requirement for quicker procurement, overtime labour, and accelerated project management activities. The condensed timeline linked to expedited construction may jeopardize the implementation of quality control and assurance procedures, resulting in construction flaws or operational problems. The expedited construction process presents safety hazards to workers and construction staff due to condensed schedules, heightened workloads, and the possibility of safety protocol oversights.

Table 2.1

Advantages and Disadvantages of Fast-track Construction

Advantages	**Disadvantages**
Expeditious Schedule: The fast-track construction approach enabled swift project progress, leading to early completion and occupancy of the Burj Khalifa.	Rising Expenses: Accelerated timelines increased costs due to rapid procurement, overtime labour, and intensified project management activities.
Market Advantage: Completing the project ahead of schedule provided a competitive edge in the market and strengthened the project's global reputation.	Quality Control Issues: The compressed schedule reduced the time available for quality checks, increasing the risk of defects and operational issues.
Investor and Tenant Attraction: Early completion attracted investors and high-profile tenants eager to occupy prestigious office and residential spaces.	Safety Hazards: The rushed schedule and heavy workloads raised safety risks for construction workers and site personnel.
Revenue Generation: The timely completion enabled early sales and leasing of units, generating immediate income for developers.	Coordination Challenges: Overlapping design and construction phases created communication gaps and design modification issues.
Maximized Return on Investment: Early occupancy and operational readiness allowed for quicker financial returns and long-term profitability.	Resource Strain: Continuous high-speed operations led to worker fatigue and equipment overuse, affecting productivity and durability.

2.6 Risk Management

Risk management is defined as the process of identifying, assessing, and controlling threats based on earnings and capital. RM is associated with the evaluation and prioritization of risks by which the economical application of the resources to minimize, monitor, and control can be done properly. According to Gao et al. (2018), risks can come from many resources, including uncertainty and threats from project failure. These include legal liabilities, credit risks, accidents, and natural disasters. The root cause of these risks can be uncertain or unpredictable. As opined by Ostad-Ali-Askari (2022), various strategies are significant for managing threats, by which the probability of the threat can be overcome.

The potential consequences of the threat must be properly examined, by which the risk management standards can be properly criticized in terms of no measurement improvement on risk. In the case of effective risk management, the prioritization process must be properly followed, by which the risks with the greatest probability can be handled first. Certain risks, which have a lower probability of occurrence, must be handled in descending order (Ostad-Ali-Askari, 2022).

According to Ostad-Ali-Askari (2022), the intangible risk management process is one of the effective processes of risk management by which the 100% probability of risk occurrence can be ignored owing to the lack of identification ability. The relationship risks mainly appeared with ineffective collaboration, and the engagement of the risk can be an issue by which cost-effectiveness can be decreased. One of the holistic methods of risk management is enterprise risk management, by which the anticipated risk associated with the organization can be managed effectively. It is necessary for every business to overcome risk management as it is becoming more complex in modern organizations (Jakka, Yathiraju, & Ansari, 2022).

Various principles of risk management have been formulated by the International Standardization Organization (ISO). As stated by Jakka et al. (2022), in the organizational context, most organizations are affected by environmental factors, including technological, legal, and social factors.

2.7 Risk Management Effectiveness in Construction Sector

RM is a core attribute of construction projects in the current construction sector. Risk management is involved in matching the capital needs of the project in the industrial context by running the building construction system. RM in construction project management is one of the comprehensive and systematic ways of analysing and responding to the risks by which the project objectives can be achieved.

There are certain benefits of risk management that are significant for using resources adequately (Love et al., 2022). It has been found in most of the literature that building construction projects are complex, and uncertainty is present in construction projects. Therefore, today's construction sector focuses on analysing risk management as one of the major features, which is crucial for achieving project success. These building construction projects are unique, and risks arise from various sources. As construction projects are complex and dynamic and involve a feedback process. The risks can be associated with the skills and experiences that create various problems and confusion for project managers and contractors. The costs of the risks involved with the construction sector are, even though risk management helps the participants of the projects to minimize the negative impacts of the building construction project. It is significant for overcoming the challenges related to construction projects.

Construction project managers must focus on three aspects: time, cost, and quality outcomes (Zhang et al., 2022).

Various risk management methodologies and models can be used in construction projects. It is necessary to identify and classify the sources of the risks then conduct the risk assessment analysis to control and monitor the risks. According to Alzoubi (2022), the risk management method is very important in the construction sector, as it helps to observe and determine the risks associated with decision making in terms of the coordination and economical application of resources. To control and minimize the impact of the probability of risks in construction projects, it is necessary to prepare for unavoidable problems.

As opined by Grant (2023), the proactive process of risk management is crucial for indicating a new reactive framework which is necessary for the building construction industry to practice risk management. The literature also signifies that the core principle of risk management is effective for quantitatively assessing risks (Grant, 2023). It is also important to monitor the risks by which the risk performance of the organization can be monitored.

2.8 Risk Management Effectiveness in UAE's Constriction Industry

Efficient risk management is fundamental for the successful planning and delivery of construction projects. Most construction companies in the UAE respond to various risks by adopting different risk management practices. According to Bascon et al. (2023), some common and significant risks prevalent in the UAE's construction sector include sudden changes in price or inflation, shortage in materials and resources, and inadequate labour supply. Risk management is involved in ensuring the health and safety of employees in construction work.

The UAE ensures the provision of full health and safety to employees while working in specific jobs.

Therefore, it can be said that the employees can freely work because of the high-level health and safety to them. Owing to the nature of construction work, employees working in this sector in the UAE operate naturally in areas with potential safety and health hazards. While most risk management practices prove highly effective within the UAE's construction sector, implementing or applying risk management processes to identify, assess, quantify, and mitigate risks faces several barriers, which directly hinders the capability of construction companies to deal with and avoid detrimental risks successfully.

Alzoubi (2022) found that managers' inadequate understanding of risk management technique, difficulty in gathering relevant estimates and assessing probability, and finding most suitable risk management method are the primary barriers to successful implementation of risk management strategy in the construction sector. According to Bascon et al. (2023), risk management planning receives considerable attention and focus in the UAE's construction sector. Construction project teams hold several planning meetings to define risks, identify management activities, and develop suitable risk management plans to deal with different types of risks. Some major risk identification activities prevalent in the UAE's construction sector include preparing risk registers, developing procedures to identify risks, and encouraging participation in risk identification.

As mentioned by Lee et al., (2023), most construction corporations in the UAE rely on a host of quantitative risk management tactics to deal with different types of risk-harming project activities. Relying on the risk matrix is a core quantitative practice that enables construction companies to respond to risks successfully. Risk ranking and prioritization is another major strategy for dealing with various types of risks.

Evidence shows that professionals in the construction sector use risk tolerance, timeframe, impact, and probability to assess the priority of risks and the most suitable strategy for successful mitigation. Construction companies in the UAE also utilize different quantitative risk analysis activities to successfully eradicate risks. Given the plethora of project risks in the construction sector, companies operating in the UAE market indulge in different quantitative techniques to identify achievable and realistic costs, schedules, scopes, and targets for addressing risks.

According to Lee et al., (2023), decision tree is a common risk management strategy used by companies in the UAE's construction sector that aids in successful risk response planning. This strategy enables corporations to identify and analyse possible solutions and outcomes to ensure a successful response to all risks. Some companies in this sector also rely on primary and backup strategies to manage risks efficiently and ensure positive outcomes for their business. In cases where risks are unknown, UAE-based construction firms typically use general contingency measures to deal with risks successfully.

Lee et al., (2023), opine that the experience and expertise of project managers serve as a vital factor affecting risk management strategy adopted by construction firms. Some common risk management tools and techniques used by companies operating in the UAE's construction industry include the Delphi technique, checklist analysis, brainstorming, root cause identification, SWOT analysis, influence diagrams, cause and effect diagrams, process or system flow charts, and assumption analysis. However, Tomh (2022) discussed that in the case of extreme or severe risks affecting construction projects in the UAE, companies primarily tend to rely on corporate and personal experience and engineering judgment of project managers and professionals. In such cases, the use of brainstorming and checklist analysis was relatively low.

Thus, amidst the high level of complexity and competition in the UAE's construction sector, most corporations adopt distinct, tactical, and suitable risk-management strategies to eradicate and avoid risks successfully. However, it is important to mention here that international companies operating in the UAE's construction sector adopt risk management strategies more often than local companies. Thus, it is necessary to train employees on how to save themselves from risk if it happens.

According to the findings gathered by previous scholars, the major risk management strategies are discussed in detail below.

2.8.1 Risk Acceptance

Risk acceptance is the first and foremost risk-management strategy that follows the principle that a risk must be accepted first to mitigate it successfully. In cases where a particular risk is unlikely to occur and the risk impact is insignificant, accepting the risk is the most effective response. Börger et al., (2023) stated that risk acceptance does not necessarily reduce or prevent risk. Rather, it enables organizations facing the risk to deal with it efficiently and establish necessary contingency plans to avoid similar risks in the future. In certain situations, the cost of mitigating risk tends to exceed the cost of risk itself. In such scenario's, accepting risk is the most fruitful option. Timing plays a significant role in this context. Risk acceptance is used as a risk management strategy only in cases where the risk does not pose imminent threats or affect a corporation's strategic outlook. However, Jiang (2023) argues that the approach to risk acceptance as a risk management strategy involves a certain degree of gambling.

2.8.2 Risk Transfer

The second common risk management strategy is risk transfer, which involves transferring a risk to an external party or vendor via contracts (San-Jose et al., 2022). In this case, the external party or vendor assumes responsibility for addressing and managing the risk on the company's behalf. Transferring a risk does not help eradicate it. Rather, the responsibility of mitigating risk shifts from the organization to another party. This risk management strategy follows an outsourcing approach and enables the organization facing risk to continue with core operations without having to deal with the risk first-hand. Companies using this risk management tactic often adopt a hedging strategy to protect important assets and investments in business. Lack of training and expertise to deal with risks influences organizations to adopt risk transfer as a risk management strategy.

2.8.3 Risk Avoidance

According to San-Jose et al., (2022), risk avoidance is a major risk management strategy that involves not taking any actions that might generate or increase risks. The underlying approach of this risk-management strategy is to eliminate the possibility of a risk occurring. Risk avoidance, therefore, entails removing the probability of a risk becoming a reality or posing a significant threat to business goals and processes. Avoiding a risk serves as the best option when a particular product, process, or decision presents potential risks to the success of the organization. Moreover, risk avoidance also serves as a beneficial risk management strategy in the case of faulty equipment in business. Risk avoidance should not be used to manage risks with high frequency or long-term threats.

2.8.4 Risk Reduction

Risk reduction is the most common risk-management strategy that entails adopting relevant actions and tactics to prevent or minimize the impact of risks. This risk-management strategy represents a common form of risk treatment that involves lowering the implications of risks. Nevertheless, adopting suitable actions or measures is vital to ensure that risks are manageable and mitigated successfully. According to Karmaker et al. (2023), risk reduction typically involves identifying risk, assessing possible solutions, developing a plan, taking strategic actions, and constantly monitoring results. However, researchers claim that risk reduction does not always prove to be a practical or possible risk management solution. However, this is the most used strategy for dealing with various risks in the business sector.

2.9 Variables and their Relationship

2.9.1 Dependent Variable

2.9.1.1 Risk Management Effectiveness

Risk Management Effectiveness (RME) is a mechanism to assess, monitor, and identify the risks of the projects. In the construction sector, this effectiveness is not restrained to this, but requires utmost efforts ranging from the real time planning to the budget considerations and schedule managements. As indicated before, the risk management is crucial and have been a vital element to determine the success or failure of the project. In UAE, the ongoing construction projects in the year of 2022 were valued as USD 90 Billion, whereas, 55% of the large-scale projects had weaker RME mechanisms that resulted in the delays and overruns (Hopkins, 2018).

Therefore, this makes the RME as a crucial element in this research to be studied for the empirical investigation. Risk Management is a process of measuring the risks that are linked with construction projects (Kaufmann & Kock, 2022). It includes risk identification, exposure, and risk acceptability. These ideas can also be applied to other industries (Jaber et al., 2021). Risk management plays a crucial role in decision-making processes because it provides decision-makers with qualitative and quantitative information.

Construction system simulations and aligning the project's capital requirements with the industry context are two ways to carry out risk management for construction projects. Simulations draw attention to potentially hazardous conditions and constraints on construction sites. Danger is expressed in qualitative terms when information is scarce or impossible to locate. In situations where data are easily accessible, risk can be expressed in numerical terms (Shojaei & Haeri, 2019).

It is crucial to understand that the hazards associated with construction vary based on the political, cultural, economic, and social climate of the location. For instance, the building business is expanding rapidly in the United Arab Emirates, where numerous enormous and intricate projects are currently underway. However, these initiatives have also increased risks and burdened the sector greatly. El-Sayegh et al. (2020) emphasized the hazards in the construction industry in the United Arab Emirates and stated that identifying and evaluating potential risks in a project is a crucial first step in risk management. Every project involves some level of risk, but many project managers are not sufficiently equipped to identify or adequately address them. It is further highlighted that risk management takes time and offers no assurance of success; it is not possible for project managers to identify each potential risk.

The best approach is to determine the most significant risks and then put measures in place to control them. Scholars further classified project risks as either internal or external, depending upon the risk's origin (El-Sayegh et al., 2020). Fast-Track is a planning technique that shortens project duration by combining tasks that would typically be finished under a conventional contract. The greatest amount of time can be saved by overlapping the design and construction processes (Willumsen et al., 2019). Therefore, the relationship between activity overlaps and risk needs to be assessed to develop a more effective risk management strategy for fast-track projects (El Baba, 2019).

Studies have found that applying the fast-track approach involves more than just hurrying; it is a completely different methodical approach from the typical way to accomplish project goals (Rasul et al., 2021). In today's world of increasing globalization, risk is hard to avoid, as it has become an inevitable aspect of daily existence. Our lives are full of great risks. One such high-risk sector is the construction industry. Avoiding risk, which would have seemed to be the most economical course of action, was not equivalent to effective risk management. This option is worthless from an economic standpoint because activities that do not present risks are not profitable and do not offer any real benefits. Furthermore, what is potentially profitable is risky (El-Sayegh et al., 2021).

Risk is defined as an event that occurs in macro and micro contexts, impacts objectives, and has the potential to have a positive or negative impact. A risk is an unforeseen event that could negatively affect the project's objectives and course of action if it materializes. A risk that benefits your project is considered positive and a risk that harms it is considered negative.

It is crucial to distinguish between positive and negative risks, with negative risks frequently requiring significant reduction and management (Niyafard et al., 2023). While some risks can be anticipated in advance, some are unknown, so project and risk managers need to be on the lookout because they can lessen the risk or its effects (Rasul et al., 2021).

Moreover, scholars have claimed that scientific and rigorous methodologies and techniques are needed to evaluate and analyse risks as interconnected systems. The degree of transformation, lead time, modifiability, and connection of constructed components are some of the factors that influence the sensitivity of construction activities to upstream design modifications. Risk identification and assessment are essential steps in the risk management process, regardless of the application, disaster risk reduction, supply chain management, construction projects, banking, or finance (Amir & Khaled, 2023). Construction projects frequently face many complications. These can include disputes that arise from within the project, like disputes between employers and contractors, or outside the project, like objections from the community. Limited collaboration and communication among all stakeholders have been a significant challenge in the last few decades when it comes to construction projects. Thus, efficient and effective risk management is necessary to ensure the success of construction projects (Niyafard et al., 2023).

2.9.2 Independent Variables

2.9.2.1 Technology Adoption

Technological adoption in the 21st century is not limited to the extent of tools like Building Information Modelling (BIM), Artificial Intelligence (AI), and drones.

But it has an essential core perspective of integration into daily life tasks of project management practices. Scholars argue that the success of the technological adoption is dependent on the organization's readiness, employee skills, and the higher management support. In the world of fast-track projects, the technological adoption is crucial as it requires the information flow in real time with effective resource allocation. While the scholars in various sectors believes that the technological adoption can lead to enhanced efficiency and advantage (Alaloul et al., 2020, Saeidi et al., 2019). Following the Vision 2025 goal, digital adoption is speeding up in the United Arab Emirates. By 2030, it is anticipated that more than 75% of large-scale projects would use BIM (Al-Ameri et al., 2020). The importance of looking at technology adoption in this study is highlighted by industry statistics that show that approximately 60% of businesses continue to have difficulty with integrating technology because of high prices and a lack of competence (Balasubramanian et al., 2021).

Nowadays, information technology (IT) drives the globalisation of markets and goods, boosts service dynamics, monetary-financial, and informational flows, and frequently serves as the foundation for improving productivity and efficiency (Zahra et al., 2019). Thorough and prompt use of IT managers can avoid resource waste, pointless tasks, and most importantly, ineffective decision-making. Furthermore, technology is one of the most important organizational process assets for boosting growth and productivity. The literature has emphasised how crucial IT competencies, skills, and abilities are to a company's success. IT positively and significantly moderates RM's effect of risk management on competitive advantage (Saeidi et al., 2019).

According to scholars, project managers can promptly respond to potential hazards or comprehend current opportunities because of the sophisticated features of IT.

Thus, to take advantage of opportunities that form the cornerstone of project success, organisations can carry out a number of tasks due to this organisational capability, including search, discovery, acquisition, absorption, and application of knowledge about resources, opportunities, and the configuration of current resources. It has been observed that a significant portion of project success has been attributed to management abilities, risk management, and IT (Niyafard et al., 2023; Nawaz et al., 2019).

Furthermore, it was observed that the construction project can be completed on schedule and with high quality by adopting technology. Project planning, management, and time optimisation all require consideration of the likelihood of an event occurring and how it will affect the construction period. To achieve active management of project risks and active schedule control, implementing risk control measures by considering technological advancements can lessen the impact of risk incidents on project targets (Xie & Yang, 2021).

The European Construction Sector Observatory (2021) states that factors such as increased productivity, increased competitiveness, meeting market demands, regulatory compliance, cost reduction, administrative burden reduction, and corporate social responsibility are the major forces behind the adoption of digital technologies in construction projects. The prominent barriers related to technology at the project level are low technical quality and technology complexity.

Similarly, in the Vietnamese oil and gas sector, the lack of technological advancement and inefficient technology adoption, appropriate construction methods, and adequate resources were highlighted as the reasons for project delays, overruns, low productivity, and poor quality. Furthermore, building projects related to oil and gas are frequently large and intricate.

High-tech, innovative, and intricate construction techniques are needed for them. Conflicts between domestic and foreign contractors stem from disparities in knowledge that hinder project success (Van et al., 2019). Furthermore, technology can support risk management in business from different angles, including information gathering, risk analysis, risk monitoring, and risk information and communication.

Furthermore, an effective IT system facilitates decision making with the least amount of interference and database availability. Furthermore, risk modelling and analysis serve as the foundation for decision-making in the management of organisational risk. Utilizing technology also gives managers the ability to assess, model, and manage risks, obstacles, and opportunities that show potential for the organization. This is due to the fact that risk managers cannot carry out their duties in an effective manner without the use of cutting-edge technology for data processing and storage, in addition to spreading helpful information throughout the global community (Arabshahi et al., 2021).

2.9.2.2 Stakeholder Collaboration

Stakeholder collaboration is one of the key factors that influence the success of the project in the construction industry. Scholars argue that due to diversity of the stakeholders and players in the sector, this factor is quite crucial in liaison with the contractors, consultants, project managers, governmental organisations, and the users to remain on one platform and coordinated (Freeman, 2010). And due to lack of this, the project turns into delays, over costing, risks, and improper implementation on account of the inadequate collaboration.

El-Sayegh et al. (2021) have reported that 72% of the project sites have been delayed, suffered and encountered disputes because of weak stakeholder collaborations.

Although stakeholder collaboration is importance to complete fast-track construction projects however, risk management is yet to be studied.

The construction industry is the most vulnerable to risks. Therefore, the industry requires a systematic approach to risk management. The success of a construction project can be influenced by the role and performance of different contracting parties and project participants at each stage. Project execution involves a specific group of people. These comprise the owner, developer, or client, followed by the consultants (architects, service engineers, quantity surveyors, and civil/structural engineers), and the contractor. These stakeholders are important to the project at every stage of the cycle. Scholars from Nigeria have highlighted that the construction sector has not historically been one that ensured the successful completion of projects. This is because of the industry's availability of uncontrolled risks, which render it a threat-prone and unpredictable sector. A successful risk management team consists of multiple individuals with the requisite qualities and experience to promote, direct, create, oversee, and continuously enhance the risk management procedure (Nnadi et al., 2018).

In addition, uncertainty in understanding the problem is inevitable in multi-stakeholder settings, such as risk management. Research has indicated that to improve supply chain performance by cutting lead times, shortening project durations, and boosting operational efficiency, cooperation and integration among stakeholders based on real-time information sharing as well as commitment management are essential components in addressing the issues in construction supply chains.

From the standpoint of stakeholders, supply and demand risks are external to a company but are part of the internal supply chain network, whereas process and control risks are internal to an organisation. Environmental risks expose stakeholders to potentially serious consequences even though they are external to the supply chain. The client, designer, manufacturer, transporter, assembly subcontractor, government, and main contractor are among the stakeholders (Alzoubi, 2022).

In business and society research, as well as related streams of literature, the concept of stakeholder engagement has become widely used. Due to its high applicability in comprehending and elucidating the relationships that exist between organisations and stakeholders, including workers, clients, suppliers, rivals, local communities, and citizens, as well as the diverse consequences that arise from these relationships, the construct has gained popularity. The significance of stakeholder participation in critical organisational functions, including value creation, strategic planning and decision-making, innovation, learning and knowledge creation, accounting and reporting, corporate social responsibility (CSR), and sustainability, has been highlighted by research (Kujala et al., 2022).

Moreover, it is emphasised that one of the primary causes of the failure of numerous building projects worldwide is the inadequate management of stakeholder relationships. Furthermore, one of the main reasons infrastructure projects fail is the lack of effective stakeholder engagement (Yang et al., 2018).

2.11.2.3 Knowledge Sharing

Apart from this, knowledge sharing is increasingly seen as an essential practice that links corporate resources to successful results. To improve decision-making, creativity, and problem-solving, it entails project stakeholders exchanging explicit and implicit information (Argote, 1999).

Sharing information helps to mitigate risks in the construction sector by ensuring that stakeholder contributions and technical advancements are used efficiently. Adopting

AI or BIM, for instance, without procedures for information exchange among stakeholders may not result in better outcomes, but organized sharing platforms increase the influence of technology and teamwork (Shehzad et al., 2022). According to research conducted in the United Arab Emirates, knowledge transfer is still uneven even with significant investments in building technology. Nearly 48% of the enterprises polled identified inadequate documentation and knowledge retention as the key obstacles (Ajmal et al., 2022). Because of this disparity, information exchange is an essential tool for describing how cooperation and technology enhance the efficacy of risk management in UAE projects.

2.10 Relationship Between Variables and Hypotheses Development

The following section provides the relationship between the different variables being studied in this research. This section is followed by a hypothesis proposal for each relationship.

2.10.1 Relationship Between Risk Management Effectiveness, Technology Adoption, Stakeholder Collaboration, and Knowledge Sharing

Effective risk management is impossible without effective information technology. IT plays a crucial role in today's trade and business environments. Businesses can use IT to spread news and information regarding a range of events, develop novel goods and services, seize business opportunities, and create innovative and adaptable business plans. Furthermore, in the ever-evolving modern world, IT is viewed as a tool for increasing competitive advantage (Saeidi et al., 2019).

According to Luo et al. (2019), risk management teams should include all relevant parties, including clients, project managers, designers, cost consultants, contractors, end users, and occasionally outside organisations. The efficiency of communication between different parties determines how effective each party is. Each stakeholder needs to collaborate with others to guarantee that the project's objective and client's satisfaction are achieved. Risk management is a key component of construction project management. Planning, recognizing, evaluating, creating risk-handling plans, monitoring, and control are all parts of risk management. Every stakeholder is expected to be involved in preventing risk in their activities because risk is an inevitable part of construction activities. Risks arise when incorrect information is given to consultants, and incorrect assumptions are made during briefings (Santoro et al., 2019).

The primary challenge associated with knowledge sharing (KS) pertains to the dissemination of knowledge among different departments (Tajpour et al., 2022). Scholars, like Kucharska and Rebelo (2022), categorized KS into three primary groups: technology, organizational, and individual. Effective factors influencing KS at the individual level are primarily associated with elements such as lack of trust and communication skills; at the organizational level, these factors include lack of organizational culture (OC) and resources; and at the technological level, they appear to be correlated with elements such as inadequate training and inefficient information technology systems and processes.

In construction projects, there are various risk management tools and techniques. The revised techniques of risk management used in construction projects are significant for identification and assessment, which is associated with the nature of the project (Zhang et al., 2022).

The discussion of the problems of managing the risks and uncertainty in the construction project due to the risks can also impact the supply chain process, which can increase the risks and uncertainty in the agile management based on the construction sector. As highlighted by many scholars, there are numerous factors involved in risk management effectiveness; therefore, the current study proposes hypotheses in the following section.

2.10.2 Relationship Between Technology Adoption and Risk Management Effectiveness

The process a decision maker goes through to decide whether to accept an innovation is referred to as adoption in the innovation literature (Chen et al., 2019). Three main perspectives–socioeconomic conditions of the industry (macro level), psychological effects on the individual level, and managerial perspective at the company (intermediate level)–have been used to study technology adoption. However, these perspectives are not mutually exclusive. The managerial perspective is valuable because it acknowledges that vendors, by providing relevant services or enabling the dissemination of information about new technologies, are important agents in the process of innovation diffusion and adoption (Xie & Yang, 2021). The managerial perspective conceptualizes the adoption process as having distinct stages, which is another significant advantage (Sepasgozar et al., 2018). The adoption process, for instance, can be characterized in three main phases: initiation, adoption decision, and implementation (Wang et al., 2020).

As is frequently the case with IT adoption, Sepasgozar et al. (2018) discovered that the adoption of modern construction equipment technology starts with a project-based need rather than the availability of a technology. Additionally, the results demonstrate that, in contrast to the adoption of IT technologies, vendors typically participate early in the process to initiate a specific solution for the customer. This is usually done in response to specific customer needs that are well-defined and involve close collaboration with the customer over an extended period of time. At this early stage, vendors' experience and implicit knowledge of prior technology use with various customers are crucial. Vendors are better able to customize and tailor the adoption process to fit the needs of their customers when they are able to comprehend those needs at a tacit level in addition to a technical one and can draw from past experience with those needs (Ganbat et al., 2018).

The coordination and development of a digital information repository regarding a building project is known as building information Modelling (BIM). To produce high-quality construction documents, predict performance, estimate costs, plan construction, and ultimately manage and operate the facility based on BIM functionalities, this type of information can include cost, schedule, fabrication, maintenance, energy, and 3D models. As a result, it can be used to mitigate construction risks (Alirezaei et al., 2022). Similarly, throughout the project lifecycle, including planning, design, and construction management, BIM technology is essential. By using BIM, the project team can collaborate through information management to enable adequate project monitoring, which in turn enables effective project execution and the achievement of predetermined milestones.

Moreover, it has been indicated that adopting BIM technology has proven challenging due to training requirements and interoperability. The use of BIM in many construction projects has been hampered by the need for cultural change because construction companies that work on massive projects typically have trouble adjusting to change (Darko et al., 2020).

A risk arises when the owner makes changes in the design that increase the possibility of overtime or when there is inadequate communication between the design team and the owner. By adopting new technologies, companies can benefit from completing a project faster than in traditional modes. Scholars agree that BIM supports demands such as cost savings without sacrificing the quality of work because it eliminates discrepancies, reduces double work, and creates a paperless environment that is more sustainable (Alzoubi, 2022).

Consequently, technology is one of the most important organizational process assets for boosting development and productivity. The significance of IT skills, capabilities, and competencies for business success has been emphasized by many scholars (Niyafard et al., 2023). A study conducted by Saeidi et al. (2019) affirmed that IT positively and significantly moderates the effect of risk management on competitive advantage. In a similar vein, it has been said that project managers can quickly respond to potential threats or recognise opportunities due to the sophisticated features of IT. Therefore, in order to take advantage of opportunities that form the cornerstone of project success, organisations can carry out a number of tasks because of this organisational capability, including search, discovery, acquisition, absorption, and application of knowledge about resources, opportunities, and the configuration of current resources (Rodríguez-Espíndola et al., 2022; Olaniyan, 2019). In view of this, the current study proposes the following hypothesis.

H1: There is a significant relationship between technology adoption and risk management effectiveness in fast-track construction projects within the UAE.

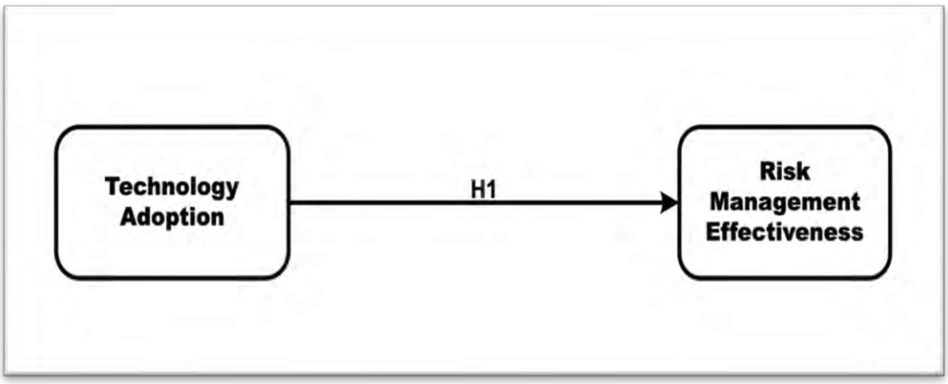

Figure 2.1: Technology and Risk Management Relationship

2.10.3 Relationship Between Stakeholder Collaboration and Risk Management Effectiveness

In construction, risk mitigation is a crucial endeavour that necessitates participation from all parties involved, such as suppliers, builders, designers, and owners (Bahadorestani et al., 2020). For safety management in construction to be successful, input from all stakeholders must be obtained during both the design and construction phases. The alignment of risk perceptions among stakeholders is essential for effective risk mitigation.

Differences in viewpoint, experience, and interests make it challenging for stakeholders involved in infrastructure projects to reach a consensus on risk mitigation. Involving stakeholders is essential because it lessens resistance and gathers the required resources. One of the primary causes of stakeholders' limited involvement is typically attributed to the existence of a tight contract resulting from limited technocratic treatment of risk (Figueiredo et al., 2021).

Additional justifications offered for this limited participation include the technical nature of these projects and the fact that negotiations involve delicate financial transactions that prohibit the participation of other stakeholders. If this claim about the limited involvement of stakeholders is accurate, public-private partnerships stand out from the majority of other emerging forms of governance because one of their most notable characteristics is almost always noted to be the wider involvement of different stakeholders (Wojewnik-Filipkowska & Węgrzyn, 2019). There is also a strong emphasis on the benefits of stakeholder involvement in the governance literature, which views governance as a more horizontal form of steering involving a variety of stakeholders. These benefits include reducing veto power, improving the substance and inventiveness of proposals and solutions, and strengthening democracy (Osei-Kyei & Chan, 2018).

Moreover, Nederhand and Klijn (2019) investigate whether and how stakeholder involvement affects the outcomes of public-private partnership projects. The findings revealed that while stakeholder involvement does not always translate into higher-performing projects, it does lead to more innovative projects. Similarly, an experimental study by Zhao et al. (2016) examined how stakeholders perceive risk in the construction industry. They mentioned that stakeholders included engineers, contractor's/safety professionals, and architects whose risk perceptions ranged from low to high. The results indicate that designers have become more knowledgeable about the safety of building construction; however, in contrast to builders, they have more difficulty achieving a consensus on perception (Zhao et al., 2016; Wijethilake & Lama, 2019).

It has been confirmed that there is always a risk involved in building projects. Risk management must be performed well if construction projects are to succeed (Wang et al., 2021). Complex issues pertaining to stakeholders are commonly encountered in construction projects.

These issues can include disagreements between clients and contractors, as well as opposition from outside parties like the impacted community. The stance of a stakeholder regarding a project can range from supporter to opponent (Nnadi et al., 2018). Scholars have suggested five distinct stakeholder stances regarding projects: no commitment, active support, passive opposition, active opposition, and active support. The different and typically conflicting interests and concerns among project stakeholders go hand in hand with the diversity of stakeholders (Wang et al., 2021).

Additionally, the fragmented nature of construction projects, with multiple stakeholders involved throughout the design and construction phases, makes this endeavour challenging. During the construction phase, stakeholders are frequently singled out as the only ones responsible for implementing safety protocols. All stakeholders must agree and work together for effective risk management; however, this kind of integration is challenging to achieve (Cherian, 2020; Vijayan & Sharma, 2020). Hence, the study proposes the following:

H2: There is a significant impact of stakeholder collaboration on the risk management effectiveness.

Figure 2.1: Stakeholder Collaboration - Risk Management Effectiveness

2.10.4 Mediating Role of Knowledge Sharing with Variables

Knowledge sharing is defined as the act of making knowledge available to others within an organization (Silva de Garcia et al., 2022); it has been recognized as an important element in innovation as it has a direct impact on risk management effectiveness (Ye et al., 2022). KS is considered a significant obstacle that has been identified in the domain of knowledge management (Sun et al., 2022). As stated by Reddy et al. (2022), an organization cannot effectively manage its risks unless it manages its knowledge. Project failure may arise due to several factors, including inadequate knowledge sharing among team members, inability to acquire necessary knowledge as the project develops, or receiving information at improper times

(Tummalapudi et al., 2022). Indeed, in the absence of KS as a mediator of risk communication among project team members, risk management could potentially encounter inefficiencies and ineffectiveness (da Silva et al., 2022). Previously, it was accepted that knowledge sharing, and risk management effectiveness must be effectively linked to enhance the execution of construction projects (Shayan et al., 2022).

Scholarly investigations within the construction sector have highlighted the significance of knowledge sharing in enhancing the efficiency of risk management and organizational performance (Olan et al., 2022). Nevertheless, with the use of effective communication, structural and relational elements also contribute to the success of knowledge-sharing contributions (Zhang et al., 2022). In particular, tacit knowledge exchange has a substantial effect on the success of construction firms (Hwang, 2022). Finally, fostering an atmosphere that promotes and welcomes knowledge sharing, specifically at the operational level, is vital for its risk management effectiveness (Naderi et al., 2022).

2.10.4.1 Knowledge Sharing and Technology Adoption

Knowledge can be defined as the dissemination of expertise, wisdom, and skill sets among personnel (Lopez-Fresno & Savolainen, 2019). Knowledge sharing as a mediator encompasses a collection of behaviours, such as helping others by exchanging knowledge (Obrenovic et al., 2020). Nguyen et al. (2020) identified four primary motivators for individuals to share their knowledge within an organisation: (1) adherence to hierarchical order for information, (2) informal collaborations among team members to share organisational information, (3) information exchange through casual collaborations between individuals, and (4) sharing of information within training networks comprised of deliberate discussions among representatives and a subject. Additionally, it encompasses substantial investments in time, resources, and effort, as learners cultivate the motivation to assist one another in gaining knowledge. It results in the mediation of KS between the adoption of technology at the individual and organizational levels (Obeso et al., 2020). In summary, knowledge sharing imparts valuable insights into the adoption of new technologies, while it can stimulate the development of novel approaches and tactics to address challenges and introduce innovation into risk management effectiveness (Abualoush et al., 2022).

H3: There is a significant impact of technology adoption on the knowledge sharing.

2.10.4.2 Knowledge Sharing and Stakeholders

Knowledge sharing serves as the foundation for all stakeholders throughout the project process (Imam & Zaheer, 2021). Stakeholders can constitute a knowledge system in terms of knowledge sharing that helps stabilize relationships among members effectively (Du et al., 2019). Knowledge sharing is facilitated by communication, trust, dedication, and other factors (Ouakouak & Ouedraogo, 2019).

Constructive communication has a beneficial effect on the production and assimilation of information (Sollitto & Cranmer, 2019). Knowledge sharing has been used as a mediator in different domains, for example, big data and firm performance (Ferraris et al., 2019), SMEs, and competitive advantages (Arsawan et al., 2022). In the context of fast-track construction projects, this study posits that the relationship between stakeholder collaboration and risk management effectiveness is mediated by knowledge sharing. Effective stakeholder communication and mutual trust are crucial preconditions for knowledge sharing, which strengthens affective collaboration among stakeholders through knowledge sharing (Liu et al., 2020). By cultivating positive relationships based on communication, trust, and dedication, stakeholders increase their exposure to a wider range of knowledge to handle risk management effectively. In view of the above literature, the current study proposes the following:

H4: There is a significant impact of stakeholder collaboration on the knowledge sharing.

H5: There is a significant impact of knowledge sharing on the risk management effectiveness.

H6: Knowledge sharing significantly mediates the relationship between technology adoption and the risk management effectiveness.

H7 Knowledge sharing significantly mediates the relationship between stakeholder collaboration and the risk management effectiveness.

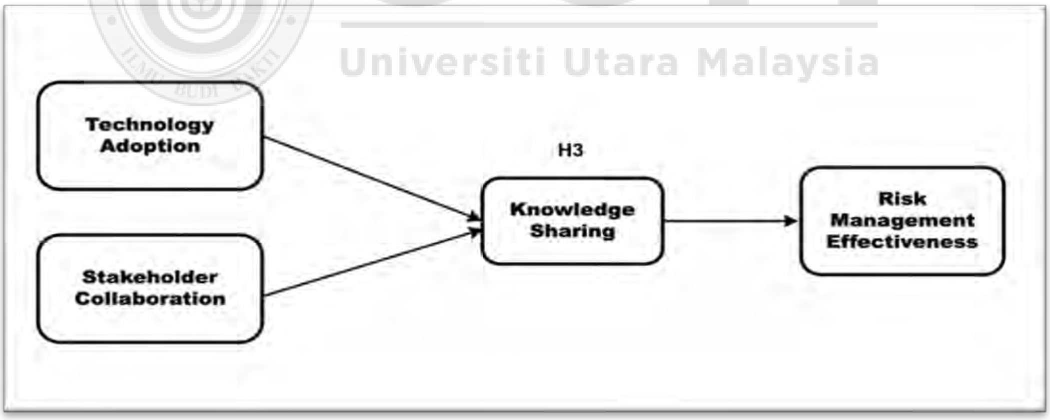

Figure 2.2: Knowledge Sharing – TC –SC – RME

2.11 Underpinning Theories

2.11.1 Diffusion of Innovation Theory

During the 1960s, the renowned American academic Everett Rogers introduced the innovation diffusion theory, which is a conventional explanation of the phenomena of propagation and diffusion. According to this view, innovation is a fundamental social process, and media may progressively persuade individuals to accept novel concepts, products, and things. Innovation can take the form of a fresh concept, social practice, or something entirely new; social networks facilitate the spread of innovation (Rogers & Adhikarya, 1979). Additionally, he held the view that the dissemination of communication is a critical and essential element during this era of societal transformation. Rogers postulated the features of the proliferation of new technologies, and the rate of their diffusion is primarily influenced by five elements (Rogers, 2003). Relative advantage pertains to the extent to which consumers perceive a benefit from utilizing innovation. They typically materialize in the form of economic benefits, enhanced operational effectiveness, or additional advantages.

Compatibility pertains to the degree to which the implementation of an invention aligns with the pre-existing values, prior experiences, and requirements of prospective adopters (Rogers & Adhikarya, 1979). Complexity refers to the degree to which consumers encounter challenges in comprehending and implementing novel concepts (Rogers et al., 2014). Observability deals with the degree of discernibility and dissemination that can be achieved regarding the outcomes of an innovation. Trialability pertains to the degree to which a novel concept or idea can be executed and evaluated on a limited scale prior to its mass application. Extensively implemented in Western nations, the diffusion of innovation theory has effectively predicted and elucidated the proliferation of numerous novel technologies (Bharadwaj & Deka, 2021).

This research utilizes the diffusion of innovation theory as its foundational framework to offer theoretical assistance in comprehending risk management effectiveness in the UAE adopting technology for fast-track projects. According to Golding et al. (2008), a consensus exists among scholars about the suitability and validity of the Diffusion of Innovation Theory as a framework for analysing the technological adoption process. Additionally, it has been acknowledged that this theory has been applied to assess technology adoption at both the individual and organizational levels (Okour et al., 2021). Rogers' theory is widely referenced in most of the research on the spread of innovations because of its attempt to elucidate the determinants that impact the adoption of new innovations and the processes by which they are distributed (Miller, 2015). According to Yuen et al. (2021), a significant contribution of the diffusion of innovation is the innovation decision process, which provides guidance for determining whether to adopt or reject a particular technology.

The model provides producers with instructions regarding which aspects of their inventions should be taken into account to facilitate the acceptance of the intended adopters. According to Rogers, the adoption rate is influenced by the following five primary factors: 1) the nature of the social system, (ii) the perceived features of the innovation, (iii) the sort of innovation decision, (iii) the communication channels, and (iv) the amount of the change agent's promotion (Rogers & Adhikarya, 1979).

Diffusion of Innovation Theory, which investigates how, why, and at what rate new ideas and technology spread across cultures, organizations, and societies, is indeed linked to several aspects of project management (Greenhalgh et al., 2005), such as technology adoption, stakeholder collaboration, and risk management effectiveness in fast-track construction projects.

The Diffusion of Innovation Theory emphasizes the stages that individuals or organizations go through when adopting new technologies. Adopting innovative technology in fast-track construction projects can have a substantial impact on project efficiency and quality (Javed et al., 2022). It is critical to understand the rate and way stakeholders (such as project managers, engineers, and labour) adopt and apply these technologies. By understanding how diverse stakeholders perceive and respond to innovation, diffusion theory can help predict and manage these difficulties.

The role of numerous stakeholders in the adoption process is highlighted by diffusion theory. Effective stakeholder collaboration is critical for introducing new technology and addressing associated risks (El Khatib et al., 2022). Understanding how different stakeholders perceive and accept innovation can help them communicate, coordinate, and collaborate more effectively, eventually improving the efficacy of risk management.

The adoption of new technology can bring both benefits and risks. Diffusion theory aids in understanding stakeholders' risk perceptions of emerging technologies. Assessing and minimizing possible risks associated with technology adoption and stakeholder collaboration are all part of effective risk management. A thorough understanding of how innovations diffuse, and impact stakeholders can aid in the development of risk management strategies. The successful integration of innovation into project management practices in fast-track construction projects depends on recognizing the interplay between these elements. Effective risk management strategies frequently include developing a culture that promotes innovation adoption, addressing stakeholder concerns, and guaranteeing collaboration among all parties involved.

In conclusion, the Diffusion of Innovation Theory principles provide valuable insights into the dynamics of technology adoption, stakeholder collaboration, and risk management effectiveness in fast-track construction projects, allowing project managers to navigate these complexities more effectively and make informed decisions.

The theoretical framework in figure 2.1 shows risk management effectiveness as the dependent variable, technology adoption and stakeholder collaboration as the independent variables, and knowledge sharing as a mediating variable in this study. The study proposes four hypotheses.

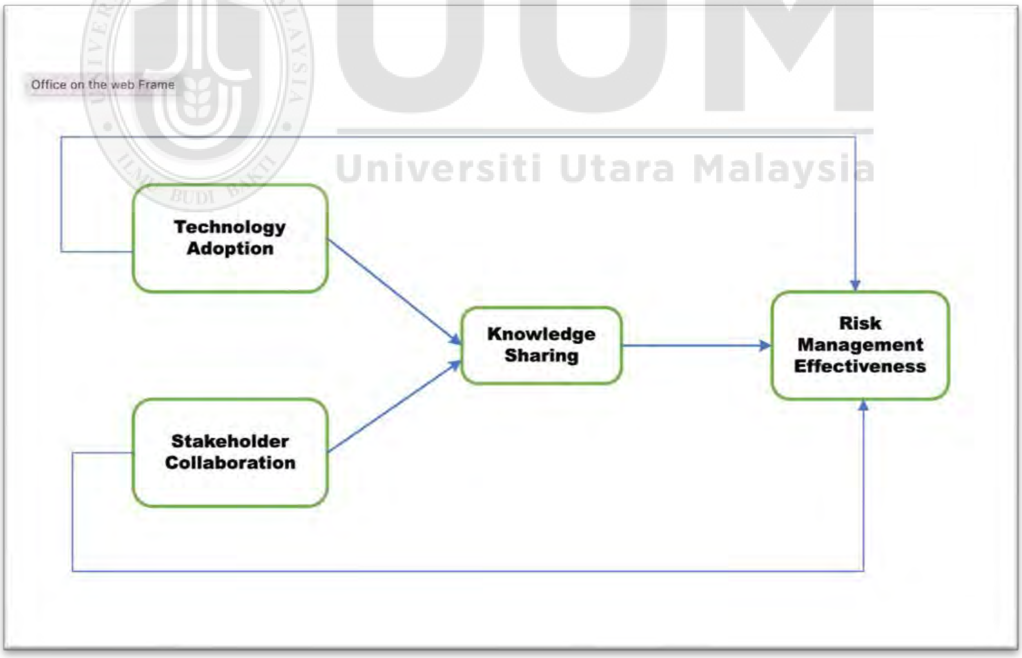

Figure 2.3: Framework of the study

2.12 Summary of Hypotheses

The following section provides a summary of the proposed hypotheses.

H1. There is a significant impact of technology adoption on the risk management effectiveness.

H2. There is a significant impact of stakeholder collaboration on the risk management effectiveness.

H3. There is a significant impact of technology adoption on the knowledge sharing.

H4. There is a significant impact of stakeholder collaboration on the knowledge sharing.

H5. There is a significant impact of knowledge sharing on the risk management effectiveness.

H6. Knowledge sharing significantly mediates the relationship between technology adoption and the risk management effectiveness.

H7. Knowledge sharing significantly mediates the relationship between stakeholder collaboration and the risk management effectiveness.

2.13 Summary of Chapter

This chapter reviews the existing literature on risk management effectiveness, technology adoption, stakeholder collaboration, and the mediating role of knowledge sharing. The chapter provides a summary of the existing literature on the subject and variables. The chapter is further divided into a brief introduction of risk management effectiveness, the importance of variables, and their relationship with each other, followed by the development of hypotheses for the study. The chapter also explained the underpinning theories following the conceptual framework for the current study.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

Understanding the objectives and research questions of the study requires a thorough analysis of the research methodology that was used, which is presented in this chapter. The current study set out to determine how risk management effectiveness can be increased by leveraging technology adoption, stakeholder collaboration, and knowledge sharing. This chapter outlines the study's plan of execution. The research design, study population, sampling strategy, instrumentation, validity and reliability of the research instruments, data collection methods, and data analysis techniques used to test the hypotheses will also be covered. It also provides an explanation of the research framework. Moreover, the study was quantitative in nature. The researcher used the survey method to collect the data. This chapter covers the analytical techniques used to determine the relationship between technology adoption, stakeholder collaboration, and the role of knowledge sharing as a mediator.

3.2 Research Design

The research approach helps the researcher to make the effective format or structure of its own study. Based on this case, the research can be completed through two different research approaches. The first research approach is inductive and the second is deductive. As per the topic requirement, the researcher chose a deductive approach to finish the research (Gupta & Gupta, 2022). The deductive research approach helped the research to develop hypotheses from the theories. In addition, the deductive approach helped the researcher investigate existing theories about risk management.

The research tries to identify the potential risks that might affect the construction projects of the UAE currently or in the future. Moreover, the research has chosen the research approach to analyse the major context of the research related to the assessment of the risk management effectiveness in fast-track projects. The research design was selected based on the research ideology that, when assessed using pertinent techniques, is thought to be appropriate for the goal of the study analysis. With the help of research design, the researcher can demonstrate the research topic more effectively. The research design includes hypothesis development, data collection, and data analysis to formulate results as an outcome of the collected data. The aim of this research is to clarify the causal relationships between technology adoption and stakeholder collaboration, with a mediating effect of knowledge sharing on risk management effectiveness on fast-track projects in the construction industry of the UAE.

In addition, to accomplish its goals, this study employs a quantitative research methodology based on survey data. It is claimed that the survey research methodology is suitable for obtaining a descriptive explanation of an investigation with the goal of testing a hypothesis (Fowler, 2013). The quantitative technique is perfect for determining the expected causal relationship between research variables because of its formal and systematic nature. It can identify the interaction effects between variables by using numerical statistical values with a high degree of certainty (Creswell, 2016). The subsequent sections provide a detailed explanation of the research design, including the unit of analysis, target population, sampling technique, measurements, and instruments.

3.3 Sampling Unit

Data will be collected from people connected to different departments within the organization. This study uses individuals as the unit of analysis. The goal was to resolve the issues raised in the previous chapter's problem statement. This study examines how technology adoption, stakeholder collaboration, and knowledge sharing affect risk management effectiveness in fast-track projects in the UAE. In the context of the subject, the aforementioned quantitative methodology is considered valid. To obtain pertinent data, the current study will concentrate on gathering data from employees of a construction company based in Fujairah, UAE.

The rationale behind choosing the Fujairah as the focal region because it has witnessed significant construction growth in recent years, particularly in infrastructure and port-related projects, yet remains underrepresented in prior empirical studies compared to Dubai and Abu Dhabi. This setting provides a suitable context to explore knowledge sharing and risk management effectiveness in fast-track projects within a growing but less-studied emirate. Moreover, this methodology complies with the regulatory guidelines that have been put in place to allow the use of randomization techniques in the process of choosing samples from different managerial levels of the organization.

3.4 Population and Sample Size

The population for the current study must be defined according to the selection of the unit of analysis. The study population was defined as a subset of respondents who share similar characteristics (Sekaran & Bougie, 2010). The target population was a group of respondents who were scheduled for the study and whose opinions met the research objectives will be measured.

Population size refers to the group of individuals that are interested in taking part in the primary data collection method. The whole population cannot be chosen because this research is involved in gathering information or data from surveys. The current study's goal is to examine the various influences that affect risk management effectiveness during a fast-track project in the construction industry. Consequently, the population consists of architecture, civil/structural engineers, electrical engineers, mechanical engineers, project managers, construction managers, staff in quantity surveying, and the technical planning team of Al Jaber Building (AJB) located in Fujairah, UAE. AJB is one of the leading constructors in the UAE, which has been working since 1989 and has built several mega housing and recreational projects in the UAE for many years. Besides this competitive era, AJB is working to meet the requirements of technologically advanced construction projects, which makes this an appropriate sample for the current study. The study aims to ascertain how selected variables affect the process of risk management in the construction industry of the UAE.

3.4.1 Determination of Sample Size

As it would be impractical to survey the entire population in the field of study, a representative sample from the target population will be chosen for this research to ensure that the findings can be generalized to a larger population. The reliability of the results depends on how well the sample represents the broader population, as Marshall (1996) emphasized, making the selection of the study sample an essential step in any research project. As conducting a study requires a lot of time and effort, non-generalizable findings would require repeated research, which would impede the researcher's ability to gain more knowledge.

In addition, the number of respondents affected the study's size and sample composition. For the current study, a construction company, the AL Jaber Building located in Fujairah, UAE, was selected to collect data. The researcher first contacted the firm to obtain the total number of employees and division of technical departments. This public sector company has eight technical divisions with 7000 employees. From the studied literature, the researcher selected eight technical divisions whose employees were the most relevant to answer the research questions of the current study. The divisions include architecture, civil/structural engineering, electrical engineering, mechanical engineering, project management, construction management, quantity surveying, and technical planning teams. To secure a well-suited sample for the survey, these criteria were developed to reduce selection bias and guarantee that the selected respondents were appropriate and likely to provide accurate and dependable responses (Gaani, 2015).

The reason for selecting these professionals was that each of these respondents had experienced risk events or was a potential source of risk in the course of their work in fast-track projects. These are the major professionals in construction companies, as they can make changes and compromise a project by modifying its schedule (Remington & Pollack, 2007).

In addition, a research study must consider the appropriate sample size, but this is not always easy to do. Budgetary restrictions, scheduling conflicts, resource availability, and the requirement for statistical precision all have an impact on the sample size. The researcher also needs to determine how large a sample size is necessary to draw reliable conclusions. Several statistical techniques are available for precisely estimating the sample size in a research project, such as the table created by Krejcie and Morgan (VanVoorhis & Morgan, 2007) and established guidelines.

According to Hair et al. (2010), a sample size of 100 or fewer respondents is regarded as small, 100 to 200 respondents as medium, and more than 200 respondents as large.

According to Krejcie and Morgan's table (1970), the study's sample size for a population of at least 100,000 and a sample size of 384 or larger is appropriate. As a result, the current study will be carried out utilising the Krejcie and Morgan (1970) table as a guide. Scholars generally agree that a larger sample size improves the power of the statistical test, thereby addressing response rate-related concerns (Borenstein, Rothstein, & Cohen, 2001; Snijders, 2005). By conducting a statistical count of the managerial employees of the AlJaber Building located in the UAE, the researcher will determine the appropriate sample size for the current study by totalling the number of employees from the chosen company.

3.5 Sample Size

A subset of the population is called a sample (Leguina, 2015). Selecting an appropriate sample size is essential for such a study. First, in reality, it is not feasible to study the complete population. Second, samples are drawn from a broader population because the study's findings will be generalized. Furthermore, for the current study, a purposive sampling technique from the selected employees was utilized. Purposive sampling was applied to ensure that only respondents with relevant expertise and experience were included in the study (Rai & Thapa, 2015). A set of criteria were set up as follows:

1. The respondent must be a construction profession
2. The respondent must have at least two years of experience in the UAE construction industry.
3. The respondent must have direct or indirect involvement in risk management practices, technology adoption, or stakeholder collaboration.

Therefore, the proper sample size for this study was chosen using the population formula created by Krejcie and Morgan (1970). Based on the formula developed by Krejcie and Morgan (1970), the sample size for this study was 364. This is explained in the following section.

$$S = \frac{X^2 NP(1-P)}{d^2(N-1) + X^2 P(1-P)}$$

Where:

S – The required sample size.

X – The freedom of the desired confidence level which is (X= 3.841).

N – The population size this equalled (N=).

P – The population proportion which is assumed to be (P = 0.50)

d – The degree of accuracy (d= 0.05).

In this regard, the sample size was calculated in the following order:

$$S = \frac{(3.841)(7000)(0.50)(1-0.50)}{(0.50)^2(7000-1) + (3.841)(0.50)(1-0.50)} = 364$$

Therefore, using Krejcie Morgan's table (1970), which indicates 364 respondents, the questionnaire will be given to 364 selected respondents working in the AlJaber Building, UAE.

3.6 Sampling Technique

Sampling refers to the selection of a particular subject from a defined population based on specific criteria to represent the population. Sampling is categorized into two different types: probability and non-probability.

Probability sampling assumes that each element in the population has a probability of being selected (i.e., a non-zero chance of selection), also called random choices. According to Sekeran and Bougie (2010), probability sampling has five primary selection methods: simple random, systematic, stratified, cluster, and multistage.

On the other hand, non-probability sampling is a sampling approach based on the researcher's judgmental opinion. In other words, it is a sampling method in which the researcher's judgment is relied upon in determining and selecting the sampled item for evaluation and result testing. Purposive, snowball, incidental, judgmental, and quota sampling are examples of non-probability sampling. Therefore, for ease of generalizability, this study employed purposive sampling. Purposive sampling is a sampling method that is confined to precise kinds of persons who can make the required data available because they have it (Sekaran & Bougie, 2010). Purposive sampling can provide solid and reliable data despite its inherent bias (Bernard, 2002). In addition, to effectively target and include the appropriate audience from the desired demographic in accordance with the predetermined sample size, the current study will use purposive sampling. In survey research, using purposive sampling probability is crucial, particularly when working with a large target population. By reducing sampling errors, this method ensures that accurate and statistically significant data are collected (Sekaran & Bougie, 2010; Zikmund et al., 2010).

3.7 Data Collection Technique

Primary and secondary data are the two main types of data collected by researchers. Primary data is usually collected in order to solve an issue. It can be quantitative (surveys) or qualitative (case studies, focus groups, interviews, observations, and structured and semi-structured data).

Sanuders et al. (2009) stated that raw data and published summaries are common examples of secondary data. The data collection approach is an important step in any study design, where the opinions and beliefs of the target respondents are gathered for any topic. Every study required a unique set of techniques and protocols for data collection. Data collection methods include self-administered (in-person) or online communication tools, such as postal or electronic surveys (Cresswell, 2017).

Self-administered surveys were employed to collect data for the current study. There were several steps involved in gathering the data. The researcher will first obtain a letter of approval from the concerned department regarding the availability and details of the workers selected as a sample for the study. Additionally, the demographic and contact details of the respondents will also be obtained at this stage. The list of employees provided by the selected company was used to select respondents using purposive sampling. Lastly, the researcher will contact the concerned departments/departmental heads to obtain their consent for data collection. For the purpose of gathering data for the current study, questionnaires will be distributed among 364 selected professionals from the AL Jaber Building, UAE.

Each questionnaire also had a cover letter explaining the goal of the research attached to it before it was distributed to the participants. Respondents were reassured that the information they had submitted would be kept confidential and used solely for academic purposes. Because of these ethical standards, respondents felt more comfortable answering the questionnaire's questions honestly. Additionally, respondents will have ample time to complete the survey. At this point, with the researcher's help, respondents could address any questions they could have about the questionnaire.

3.8 Measurement Scale

In the present experiment, participants' replies to each assessment item were evaluated by Garland (1991) using the Likert scale, a commonly utilized paradigm within the field of business studies. The Likert scale is frequently employed in questionnaire surveys as a psychometric instrument to assess respondents' viewpoints on their degree of agreement with a measurement statement (Sudha & Baboo, 2011). Northrop (2018) asserted that the Likert scale is commonly utilized as a means of evaluating respondents' reactions to certain questions or statements using a five-point rating system. The standard Likert scale, consisting of five points, covers a spectrum of options ranging from strongly disagree (1), disagree (2), neutral (3), agree (4), to strongly agree (5).

Nevertheless, it is important to acknowledge that Likert scales with a range of four to nine points have been utilized in several academic disciplines. Currently, there is a lack of established criteria for establishing the ideal number of scale points to be utilized in business research. The current study involved the evaluation of assessment questions using a five-point Likert scale to encompass a range of response alternatives. The selection of this scale was based on its capacity to offer adequate differentiation and ease of comprehension for survey participants (Sekaran & Bogie, 2010).

Moreover, a considerable number of initial investigations of crisis accountability, reputation management, communication of charismatic leadership, and organizational credibility have used a five-point Likert scale. Elmore and Beggs (1975) contend, based on empirical evidence, that a five-point Likert scale consisting of five points has dependability equivalent to other scales. Additionally, their research suggests that increasing the number of points on the scale, such as extending it to seven or nine points, does not improve the consistency of the ratings.

The present investigation utilizes multivariate analytical techniques, specifically factor analysis and structural equation modelling (SEM). According to Chen (2007), the use of a five-point Likert scale is appropriate for these methodologies. Based on the aforementioned features, this study aimed to assess all factors using a 5-point Likert scale. Within this scale, survey inquiries are designated as degrees of concurrence, where a rating of 1 signifies a substantial level of disagreement, while a rating of 5 signifies a significant level of agreement.

3.9 Instruments and Measurements

Variables will be measured in order to provide assessments with standardization, adequacy, consistency, accuracy, and comparability. Thus, identifying variables that act as representations of constructs is part of the scaling process (Salisu et al., 2020). This study will specifically assess the relationship between technology adoption, stakeholder collaboration, and knowledge sharing with risk management effectiveness on fast-track projects in the construction industry in the UAE. Due to the nature of the data to be collected for this study, it was decided that a Likert scale is appropriate for all items and, as suggested by Greig et al. (2019), a five-point scale is appropriate and presents an opportunity for better results. Respondents were asked to rate each question on a five-point scale.

Table 3.1 provides the summary of adopted scales, total no. of items and the reliability value of each construct.

Table 3.1

Sources, Cronbach's Alpha Value and no. of items for All Variables

S.No	**Constructs**	**Source**	**Coefficient Alpha**	**No. of Items**
01	Risk Management Effectiveness:	Renault, Agumba, and Ansary (2018)	0.935	05
	1. Risk Identification			04
	2. Risk assessment			05
	3. risk response and action planning			06
02	Technology Adoption	Dubey et al. (2020), and Fosso-Wamba et al. (2020)	0.828	06
03	Stakeholder Collaboration	Yang et al. (2009)	0.8763	15
04	Knowledge Sharing	Park and Lee (2014)	0.920	06
Total no. of items = 47				

3.9.1 Dependent Variable

3.9.1.1 Risk Management Effectiveness

Moreover, the current study has one dependent variable, which is further divided into three dimensions: risk identification, risk assessment, and risk response and action planning.

To measure risk management and its dimensions, the scale from Renault, Agumba, and Ansary (2018) was adopted. Risk management has five items, including how the respondents describe risk levels, applicability, technological risks, and the impacts of risk on a firm and projects. The respondents were given five options ranging from strongly disagree (01) to strongly agree (05) to mark their responses. Similarly, Risk identification includes four items: identifying when and by which means the risk arises, developing a risk information desk, and physical inspection to identify risk. Moreover, the risk assessment included five items related to risk cause, duration, impact, and classification of levels of risk. Lastly, risk response and action planning include six items such as treatment options to mitigate risk, avoidance of risk, and implementation of risk management planning. For each item, respondents were given five options to mark their choices from strongly disagree (01) to strongly agree (05). Table 3.2 provides the details of items for the measurement of this construct.

Table 3.2

Indicators of Risk Management Effectiveness

Risk Management Effectiveness	
1)	I define the risk measurement criteria to be used, e.g., high/medium/low
2)	I define risk materiality, i.e., when risk is important
3)	I define risk time frame applicable to risk impact and risk probability, i.e., when risk is expected to occur.
4)	I clarify risk terminology, i.e., use of terms such as impact, consequence, probability/likelihood
5)	I determine the level of acceptable risk, i.e., the risk tolerance level of the firm.
Risk Identification	
6)	I develop risk information database, e.g., information gathering, risk history database.

7)	I identify how and why risk arises.
8)	I conduct present and future risk identification, e.g., develop risk register information quality, management techniques.
9)	I use physical inspection to identify the risk.
Risk Assessment	
10)	I determine the risk cause, risk duration, risk volatility.
11)	I determine the probability of the risk occurring, the impact, classification consistency, i.e., high/medium/low.
12)	I establish the risk profile, e.g., high probability/high impact, high probability/low impact.
13)	I assess risks by quantitative analysis methods, e.g., probability, sensitivity, scenario, simulation analysis
14)	I assess risks by qualitative analysis methods, e.g., direct judgement, comparing option, descriptive analysis.
Risk Response and Action Planning	
15)	I identify risk treatment options by avoiding risk.
16)	I identify risk treatment options by mitigating risk.
17)	I identify risk treatment options by retaining risk.
18)	I identify risk treatment options by transferring risk.
19)	I predefine actions to counter the identified project risks.
20)	I prepare and implement risk action plan.

3.9.2 Independent Variables

3.9.2.1 Technology Adoption

For technology adoption, the scale by Dubey et al. (2020) and Fosso-Wamba et al. (2020) has been adopted. This section includes six items related to how informed the firm is about technological advancement in the construction industry.

How much flexibility the firm shows in adopting new technologies, and how the firm is utilizing technology to mitigate and forecast the risk. The respondents will be given the opportunity to mark their responses using Likert scale from strongly disagree (01) to strongly agree (05). The Cronbach's alpha value of this scale was 0.828. Table 3.3 provides the details of items for the measurement of this construct.

Table 3.3

Indicators for Technology Adoption

Technology Adoption	
1)	My company is engaging in digital transformation
2)	My company has relevant sensors / technology to collect and sense information from multiple sources in real time
3)	My company employs technology solutions to transform data into a usable format, to help understand the collected information.
4)	My company employs technology solutions to use the data for making forecasts that will help prepare for the future.
5)	My company employs technology solutions to automate the processes relevant to data-driven decision making
6)	My company has strategies in place for workforce skills development, to effectively manage and use the technology solutions.

3.9.2.2 Stakeholders Collaboration

To determine the influence of stakeholder collaboration in fast-track construction projects, the scale by Yang et al. (2009) was adopted. The Cronbach's alpha value of the scale was 0.8763. The section has 15 items, such as identifying stakeholder roles, managing social responsibilities, statements related to project missions, predicting the influence of stakeholders, and assessing their behaviour and needs.

The respondents marked their choices using a five-point Likert scale from strongly disagree (01) to strongly agree (05). Table 3.4 provides the details of items for the measurement of this construct.

Table 3.4

Indicators for Stakeholder Collaboration

Stakeholder Collaboration	
1)	Managing stakeholders with social responsibilities (economic, legal, environmental and ethical)
2)	Formulating a clear statement of project missions
3)	Identifying stakeholders properly
4)	Understanding area of stakeholders' interests
5)	Exploring stakeholders' needs and constraints to projects.
6)	Assessing stakeholders' behaviour.
7)	Predicting the influence of stakeholders accurately
8)	Assessing attributes (power, urgency, and proximity) of stakeholders.
9)	Analysing conflicts and coalitions among stakeholders.
10)	Compromising conflicts among stakeholders effectively.
11)	Keeping and promoting good relationships
12)	Formulating appropriate strategies to manage
13)	Predicting stakeholders' reactions for implementing the strategies.
14)	Analysing the change of stakeholders' influence and relationships during the project process.
15)	Communicating with and engaging stakeholders properly and frequently

3.9.3 Mediating Variable

3.9.3.1 Knowledge Sharing

To determine the mediating role of knowledge sharing in this study, the scale by Park and Lee (2014) was adopted, which had a Cronbach's alpha value of 0.920. In this section, six items have been adopted related to sharing minutes of meetings in an effective way, project plans, project status, and distribution of technical documents, including manuals and training materials. The respondents will be asked to answer the questions by utilizing five-point Likert scale from strongly disagree (01) to strongly agree (05). Table 3.5 provides the details of items for the measurement of this construct.

Table 3.5

Indicators for Knowledge Sharing

Knowledge Sharing	
1)	I shared the minutes of meetings or discussion records in an effective way.
2)	I always provided technical documents, including manuals, books, training materials to each other.
3)	I shared project plans and the project status in an effective way
4)	I always provided know-where or know-whom information to each other in an effective way
5)	I tried to share expertise from education or training in an effective way.
6)	I always shared experience or know-how from work in a responsive and effective way

3.10 Questionnaire Design

A persuasive method for gathering data involves creating questionnaires. To ensure the study's relevance and correctness, the variables were tested (Sekaran & Bougie, 2016). The method for creating the questionnaires was dependent on the goals of the study. This necessitates setting up appropriate objectives and targets, comparing the questionnaire design with numerous studies, and using several questions to compute each variable.

The questionnaire items measured four different factors. Risk management effectiveness with three further dimensions is treated as the dependent variable in this study. Moreover, technology adoption and stakeholder collaboration are taken as independent variables, along with knowledge sharing as a mediating variable.

Furthermore, for the dependent variable, the researcher adapted 20 items in three different dimensions from Renault et al., (2018), however, these items measure the impact of risk management with Cronbach's alpha value of 0.935, Risk identification with Cronbach's alpha value of 0.825, Risk assessment with Cronbach's alpha value of 0.908, and Risk response and action planning with Cronbach's alpha value of 0.864. For the independent variable, respondents were asked about technology adoption in the construction industry. For this purpose, a total of six items from Dubey et al. (2020) and Fosso-Wamba et al. (2020) were adopted.

In addition, respondents will be asked how much influence stakeholders have on any project. Fifteen items on stakeholder collaboration in the construction industry were adopted from Yang et al. (2009). The Cronbach's alpha value for this scale was 0.8763. Lastly, to assess the mediating role of knowledge sharing, the scale by Park and Lee (2014) was adopted. This section includes six items related to the subject. The Cronbach's alpha value for this scale was 0.920.

Additionally, the author employed a range of metrics from several widely used sources of literature to measure the dependent, independent, and mediating factors in this study.

Excluding the demographic profile (gender, age, education, job title, work experience). The questionnaire consists of 47 items and will be used to measure the four selected research variables, in which the risk management variable consists of 20 items, 06 items for technology adoption, 15 items for stakeholder collaboration, and 06 items for knowledge sharing.

The questionnaire consisted of five sections. Section A collected the demographic information of the respondents. Section B includes questions to measure the effectiveness of risk management. Section C discusses the technology adoption. Section D is based on stakeholder collaboration. Finally, Section E consists of knowledge sharing on a five-point Likert scale, where 1 represents Strongly disagree, 2 represents Disagree, 3 is Neutral, 4 represents Agree, and 5 represents Strongly agree.

3.11 Pilot Study

The pilot study was conducted to determine whether the measurement instruments were suitable. Before real data collection, preparatory steps have been taken, and the reliability of the measurement tools has been evaluated in the pilot research (Sekaran & Bougie, 2010; Zikmund et al., 2010). A pilot study was conducted to ensure that the assessment tools showed consistent results when checked with participants from various backgrounds at various times and locations. Cronbach's alpha is a statistical test for reliability estimates (Hair et al., 2010). Cooper and Schindler (2014) stated that a pilot study should include a sample size of 25–100 participants. One hundred employees from the selected organizations in the UAE were selected to collect data for the pilot study.

The minimum threshold of 30 to 50 respondents that are often advised for pilot testing is exceeded by 100 respondents in an initial pilot survey (Johanson & Brooks, 2010). Stronger reliability estimates and more confidence in the measuring tool's refinement prior to the main research were ensured by selecting this bigger pilot sample.

This is a quantitative study which comprises of the survey for collecting quantitative data. Before conducting the formal study, the researcher conducted a pilot study to establish the reliability and validity of the scale of constructs that have been taken in this study as the necessity of assessing the reliability and validity indicated by Sekaran and Bougie (2016). To conduct the pilot study, the researcher decided to collect quantitative data from 100 respondents, whereas in the course of this study, it was found that only 80 out of 100 respondents returned filled questionnaires, whereas 20 respondents refused to fill their responses. Of these 80 filled questionnaires, six were found to have incomplete responses. Therefore, the researcher decided to exclude these incomplete questionnaires from the study; hence, the final pre-test sample comprised 74 respondents. Sekaran and Bougie (2016) established the necessity of conducting a pilot test as it enables the researcher to know about the possible problems that may be faced in the course of collecting and analysing the data collected for performing the formal study. Quintão et al. (2020) explain that there is a significant association between the validity and the reliability of the construct. Moreover, Quintão et al. (2020) also explained this in the sense that the validity highly affects the extent to which the scale is reliable. It means that validity must exist to achieve the desired level of reliability. In addition, Mohajan (2017) indicated that reliability is actually a sub-component of validity, and it is necessary to obtain it first to establish validity. As far as the sample size for a pilot study is concerned, the limited literature has explained the sample size calculation required for a pre-test study.

For instance, Conelly (2008) proposes that the pre-test sample should be 10 percent of the sample taken for the formal study. Whereas Viechtbauer et al. (2015) pointed out that the pilot study sample should be comprising of 9 percent of the formal sample. On the other hand, Hertzog (2008) provides a contingent view to researchers by arguing that there is no universal criterion for pre-test sample size. It depends upon different factors which need to be considered by the researcher. Table 3.1 is showing the demographic profile of respondents who have participated in the study while table 3.3 and 3.4 are displaying the results of construct reliability and validity of the scales of the constructs taken for this study.

3.12 Pre-test Demographic Profile of Respondents

The pre-test sample was collected to assess the scale of the constructs. The final sample consisted of 74 respondents. Demographically, the sample was defined on the basis of gender, age, educational level, marital status, and experience of respondents, as shown in Table 3.1. As per Table 3.1, the sample under consideration included 40 (54.1%) male and 34 (45.9 %) female respondents. As far as age wise distribution is concerned, most of the sample is populated with people aged between 31 and 35 years numbered around 20 (27.0 %), 19 (25.7 %) respondents are aged between 36 and 40 years, 14 (18.9 %) respondents are aged between 25 and 30 years, 8 (10.8 %) respondents are aged between 20 and 24 years, 6 (8.1 %) respondents are aged between 41 and 45 years, 4 (5.4 %) have an age equal to or more than 56 years, and the least number of respondents are aged between 46 and 50 years. Based on marital status, most of the sample is populated with married people, the frequency of whom is about 50 (67.6%); 21 (28.4%) people are single, whereas widowed and divorced make up a smaller portion of the sample comprising about 2 (2.7%) and 1 (1.4%), respectively.

The education level of the respondents is also shown in Table 3.1, according to which 42 (56.8%) respondents have a master's degree, 24 (32.4%) have a bachelor's degree, four (5.4%) have a PhD, three (4.1%) have passed high school, and one (1.4%) has a diploma. If we see the experience wise distribution of respondents, we can say that most of the people in our sample have an experience ranging from 6 to 10 years, figuring around 30 (40.5%), 20 (27.0%) respondents have an experience between 11 and 15 years, 15 (20.3%) have experience ranging from 1 to 2 years, 4 (5.4%) respondents have a job experience ranging from 16 to 20 years, 3 (4.1%) have an experience ranging from 3 to 5 years, and 2 (2.7%) have experience more than 20 years.

Table 3.6

Profile of Pre-test Respondents (n=74)

Demographic Variables	Categories	Frequency	Percentage
Gender	Male	40	54.1
	Female	34	45.9
Age	20-24 Years	8	10.8
	25-30 Years	14	18.9
	31-35 Years	20	27.0
	36-40 Years	19	25.7
	41-45 Years	6	8.1
	46-50 Years	3	4.1
	56 & Above	4	5.4
Educational Level	Higher School	3	4.1
	Diploma	1	1.4
	Bachelor Degree	24	32.4
	Masters	42	56.8
	PhD	4	5.4
Marital Status	Single	21	28.4

	Married	50	67.6
	Widowed	2	2.7
	Divorced	1	1.4
Experience	1-2 Years	15	20.3
	3-5 Years	3	4.1
	6-10 Years	30	40.5
	11-15 Years	20	27.0
	16-20 Years	4	5.4
	More than 20 Years	2	2.7

3.13 Pre-test Reliability & Validity

Assessing reliability and validity is a crucial part of the pre-test study as it enables the researcher to identify and deal with the potential problems that can be faced during the collection and analysis of data. To perform the pre-test reliability and validity analysis, Smart PLS was used for calculating the Cronbach Alpha values, composite reliability, and average values extracted (AVE) values for the given scale. Reliability is concerned with measuring the internal consistency of the items. The common measure for assessing internal consistency is Cronbach's alpha. Hair et al. (2014) argued that the value of Cronbach's alpha ranges from 0 to 1, values greater or equal to 0.70 indicates an acceptable level of internal consistency, or the scale is reliable by the researchers. Moreover, Nawi et al. (2020) and Hajjar (2018) argued that the acceptance level of reliability can vary from field to field. Smart PLS uses Cronbach's alpha, rho A, and composite reliability for assessing the internal consistency of items of the latent construct taken in the measurement model. Along with the reliability test, researchers need to assess the degree to which all items collectively explain the variance in defining the latent construct which is called average variance extracted (AVE). AVE was used to measure the validity of the construct (Hair et al., 2014).

In addition, Hair et al. (2014) defined the minimum threshold value for AVE as 0.50 or greater. In the pre-test part of the thesis, the reliability and validity values for scale items are exhibited in Table 3.2. Table 3.2 shows that the reliability and average variance extracted (AVE) values for all latent constructs lie above their threshold value. This means that all constructs included in the study possess a good level of reliability and validity.

Table 3.7

Reliability & Validity of Construct (n=74)

Constructs	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
KS	0.843	0.884	0.562
RME	0.967	0.970	0.618
SC	0.935	0.942	0.520
TA	0.885	0.912	0.635

3.14 Data Sorting and Analysis

The cover letter briefly describes the objectives and importance of this ongoing research. Furthermore, it offers participants a concise introduction to the study, thereby minimizing the likelihood of errors or misinterpretations when completing the questionnaire. Consequently, the researcher's contact information was made available for further inquiries. The present research survey was structured into four primary sections: the first section focused on risk management, the second section explored technology adoption, the third section investigated stakeholder collaboration, and the fourth section consisted of knowledge sharing. Additionally, demographic information was collected from the respondents, as mentioned in the questionnaire.

The current section describes the analytical strategy used in this study. The data analysis process included gathering the data, looking for any anomalies, testing for normality, reliability, and validity, and conducting confirmatory factor analysis, descriptive statistics, and correlations. The researcher used SPSS version 28 for the initial phase of the data input. In the interim, the researcher verified that the data entered accurately. SPSS was used for basic descriptive statistics such as mean, standard deviation, frequency, and percentage to profile and characterize the respondents. To investigate the variations and convergences among the perspectives held by survey respondents, statistical summaries such as mean and standard deviation has been utilized. For the final data analysis, Smart PLS 3.2 had also been used.

3.15 Statistical Analysis Procedures

The steps required to prepare the data before they can be evaluated are described in this section. Two distinct software tools, the Statistical Package for Social Sciences (SPSS) and analysis of structure, were used to implement the approach (smart PLS). A few crucial procedures were included in the SPSS data preparation phase, including data encryption, processing, and monitoring of any missing data, and validating, reliable, and normalcy tests. To complete the descriptive analysis, this procedure is required. The researcher used the SmartPLS structural equation model if the data are regularly distributed. To assess the model's applicability, a measuring model was created. After the model reached its fitness indices, SmartPLS analysed the results from another test to assess validity and reliability. The model must then be transformed into a structural model to be used for hypothesis testing. The next section contains information on these procedures.

The SmartPLS program was utilized for the coding and analysis of the data obtained in this study, contingent upon the research objectives and the statistical prerequisites of the quantitative method. The SmartPLS software was used to assess the first stage of data analysis in this study, which includes factor analysis, descriptive statistics, fundamental statistical assumptions, and data preparation for analysis (data entry and missing data). The researcher coded the information gathered from the survey and checked it for mistakes in data entry. Every survey item was subjected to statistical and graphical tests of normality, and constructs derived from the computation of the individual items such as kurtosis and skewness measurements as well as visual examination of the graphs were also examined. Additionally, principal component factor analysis was carried out to guarantee that every variant represents distinct constructions.

3.15.1 Convergent Validity

Convergent validity refers to the extent to which variables exhibit a substantial level of agreement or shared variance. According to Allson and Baskin (2009), this is a measure of the degree of association between one item and other things within a certain construct. The evaluation of convergent validity involves the examination of factor loadings, elimination of average variance, and composite reliability.

3.15.1.1 Unidimensional

The CFA achieved one-dimensionality when the measured items demonstrated satisfactory factor loadings for each latent construct. Therefore, it is advisable to eliminate the products that exhibit sluggish loading times from the model. According to a study conducted by Hair et al. (2010), it is recommended that variables associated with newly generated items be assigned a weight of at least 0.5.

While elements related to proven items should be assigned a weight of at least 0.60. According to Byrne (2013) and Hair et al. (2010), factor loadings with magnitudes of ±.50 or higher are often regarded as more important. However, factor loadings ranging from ±.30 to +.40 were deemed to fulfil the minimum criteria for assessing structure. According to previous studies (Hair et al., 2010; Igbaria, Iivari & Maragahh, 1995), it is recommended that the ideal loading values for each item should exceed -0.50 on one component and be at least -0.35 on other factors.

3.15.1.2 Average Variance Extracted (AVE)

To further establish convergent validity, it is recommended to calculate the average variance extracted (AVE) for each construct. The construct's average variance extracted (AVE) refers to the proportion of variation that can be explained by the measuring items. Convergence validity is attained when every component of a measurement model has statistical significance. The minimum acceptable value of the average number is 0.5. AVE is calculated using the following formula:

$$\text{AVE} = \frac{\sum_{i=1}^{n} \lambda i^2}{\sum_{i=1}^{n} \lambda i^2 + \sum_{i=1}^{n} Var(\varepsilon)}$$

Ɛ= Standardized factor lodgings

λ= Measurement error, which equals $1-\lambda_2$

3.15.1.3 Reliability

The accuracy of the above-mentioned measurement methodology in measuring the intended latent construct is referred to as reliability. The significance of subjecting a measure to a reliability test is underscored by researchers such as Hair et al. (2010) and Cavana et al. (2001).

This test assesses the consistency and stability of the measurement in capturing a specific concept, ensuring that it is free from errors and maintains consistency across time and different items in the instrument. Scholars agree that both validity and reliability analyses should be conducted concurrently, as reliability analysis is deemed essential in every scientific inquiry (Cavana et al., 2001; Hair et al., 2010). Gliem and Gliem (2003) recommended confirming the meaningfulness of measurement and reporting internal reliability (Cronbach's alpha coefficient) for all scales, especially when utilizing Likert-type forms. However, this would yield potentially erroneous statistical data. The following criteria were used to assess the reliability of the measurement model:

3.15.1.4 Internal Reliability

Internal reliability is the tone used to describe the stability and reliability of the measurement tool. Cronbach's alpha is the most typical and widely regarded internal consistency reliability (Cavana et al., 2001). According to Sekaran and Bougies (2010), the reliability test is deemed to be good when the alpha coefficient is 0.80, acceptable when it is 0.70, and poor when it is 0.60.

3.15.1.5 Composite Reliability

The term "composite reliability" (CR) refers to a measurement of a latent construct's internal consistency and dependability. When the CR score is 0.7 or greater, it denotes good reliability and internal consistency. Yet, if other measures of a model's construct validity are strong, a value in the range of 0.6 to 0.7 can be considered acceptable. This formula is used to determine the CR:

$$CR = \frac{(\sum_{i=1}^{n} \lambda_i)^2}{(\sum_{i=1}^{n} \lambda_i)^2 + (\sum_{i=1}^{n} \delta_i)}$$

3.16 Nomological Validity

The analysis of the strength, direction, and magnitude of the link between the constructs is conducted to ascertain nomological validity, which is employed to conceptually verify the measurement model (Spiro & Weitz, 1990). The alignment between the measuring model and the study's theoretical framework is crucial since it assures the nomological validity of the investigation. The CFA approach was used to construct structural models for latent variables that encompass both exogenous and endogenous factors (Lee, 2019). In SmartPLS, exogenous latent variables can be considered analogous to the independent variables in SPSS. This particular measurement model serves as the key determinant of the causes and effects that lead to alterations in the values of other latent variables. The endogenous latent variable, also known as the dependent variable, is influenced by both the direct and indirect effects of exogenous variables inside the measurement model (Marsh et al., 2009). Path diagrams are useful tools for visually representing the connections between exogenous and endogenous latent variables following the development of a structural model using these variables (Hair et al., 2010).

3.17 Hypothesis Testing using Structural Equation Model

3.17.1 Test of Direct Relationship (Correlation)

Once the measurement model has achieved an acceptable level of fit, it is considered appropriate for the purpose of conducting hypothesis testing. To evaluate the relationship between the endogenous and exogenous models, it is necessary to convert the measurement model into a structural equation model. The primary objective of this study was to assess the correlation between latent components. To do this, a structural equation model will be developed using first-order constructs. The route coefficient employed in this thesis to determine the hypotheses to be tested establishes a link between constructs.

3.17.2 Test of Indirect Relationship (Mediation)

The latent composite structural equation modelling (SEM) technique will be employed to evaluate the suggested mediation model. Baron and Kenny (1986) proposed the utilization of regression analysis as a suggested strategy. However, the Partial Least Squares (PLS) method was chosen because of its capability to evaluate measurement error (Hu & Bentler, 1999). The assessment utilizing SmartPLS comprises both structural and measurement models. Furthermore, the fitness indices proposed by Hu and Bentler (1999) were used to evaluate the adequacy of the model fit. The evaluation of the mediation model will be conducted using the bootstrap procedure in the study of mediation variables, as suggested by Shrout and Bolger. Additionally, the application of Baron and Kenny's (1986) causal steps approach (2002) is employed, utilizing the partial least squares (PLS) method. The approach employed in this study, which involves the analysis of both the direct and indirect impacts of mediator factors on the association between independent and dependent variables, is a valuable addition to the technique proposed by Baron and Kenny (1986). The estimation of the indirect impact of mediation factors will be conducted using a bootstrap technique, while the assessment of the size of mediation effects will be conducted using a direct effect process.

3.18 Summary of Chapter

This chapter provides a comprehensive discussion of the research methodology employed in the present investigation. This chapter provides an overview of the research design, encompassing the study's objective, methodology, unit of analysis, target population and sample, measurement of variables and instruments, and the questionnaire instrument. The subsequent section of the chapter delves into various data-analysis approaches. This is followed by a second section that presents a comprehensive review of the statistical analysis processes. Finally, the concluding section outlines the outcomes of the pre-test and pilot study.

CHAPTER FOUR

FINDINGS

4.1 Introduction

This chapter presents the results of the data analysis using SPSS and SmartPLS version 4. This chapter explains the descriptive statistics of the respondents, which is then followed by the assessment of normality and the preliminary analysis of the quantitative data. Moreover, this preliminary analysis is followed by the assessment of continuous variables using SmartPLS version 4, in which the measurement and structural models have been presented.

4.2 Response Rate

A total of 390 questionnaires were distributed to professionals employed at the Al Jaber Building (AJB) Construction Company. Of the 390 questionnaires intended to collect quantitative data from participants, 375 (96.15%) were returned, 345 were found to be completely filled, and 30 were found to be incompletely filled; hence, they were excluded from the study. A total of 345 questionnaires were used in this study. Hence, the response rate of the present study was 88.46%, which is quite good. This response rate was achieved through tremendous efforts by the researcher. Moreover, the questionnaires were self-administered, resulting in a good response rate. Table 4.1. shows the profile of 345 respondents who participated in the study.

Table 4.1

Profile of Pre-test Respondents

Demographic Variables	Categories	Frequency	Percentage
Gender	Male	247	71.6
	Female	98	28.4
Age	20 - 30	20	5.8
	31 - 40	52	15.1
	41 - 50	103	29.9
	51 - 60	169	49.0
Marital Status	Single	60	17.4
	Married	263	76.2
	Divorced	22	6.4
Educational Background	Diploma	38	11.0
	Bachelors	87	25.2
	Masters	220	63.8
Name of Position	Architecture	26	7.5
	Civil Engineering	43	12.5
	Electrical Engineering	69	20.0
	Mechanical Engineering	71	20.6
	Project Management	61	17.7
	Quality Surveying	29	8.4
	Technical & Planning Team	20	5.8
	Others	26	7.5
Current Work Experience	Less than 3 months	75	21.7
	3 - 12 months	119	34.5

	1 – 3 years	130	37.7
	More than 3 years	21	6.1
Work Experience in Organization	Less than 3 months	15	4.3
	3 - 12 months	42	12.2
	1 – 3 years	138	40.0
	More than 3 years	150	43.5

4.3 Data Coding

Before presenting the descriptive and inferential analyses, the researcher assigned codes to the data collected through questionnaires. The process of data coding took place after ensuring the absence of non-response bias. This means that the researcher confirmed that the data were free from any respondent-based bias. Moreover, data coding enables researchers to perform a glitch-free data analysis. Moreover, in this research, responses provided by the respondents were coded, and alphabetical codes were assigned to each variable under study. The codes assigned to the variables are listed in Table 4.2.

Table 4.2

Variables and Codes

Variables	Codes
Technology Adoption	TA
Stakeholder Collaboration	SC
Knowledge Sharing	KS
Risk Management Effectiveness	RME

4.4 Data Screening

Data screening in any research serves as an important part of data analysis, particularly when dealing with multivariate analysis.

This minimizes the chance of causing violations of assumptions required for conducting the multivariate analysis, and this also reduces the biases in the data. Moreover, it can be said that the process of data cleaning requires the researcher to check for any ambiguity in the data that leads to distortions in the results yielded by the data analysis. Before considering the inferential part of the data analysis, it is necessary to check the basic assumptions required for multivariate analysis. These assumptions include detecting and treating missing values, detecting outliers, and assessing data normality.

4.4.1 Missing Data

Detecting missing data in the dataset and treating them is a crucial and foremost part of data screening. Missing data refers to unfilled data in the questionnaire, which is intentionally or unintentionally left unfilled by the respondent (Hair et al., 2010). Missing values are the most common problem faced by researchers, especially when dealing with quantitative research, and the treatment of missing values is important before performing multivariate analysis (Hair et al., 2010). Moreover, Hair et al. (2010) state that if the occurrence of missing values is greater than 5%, it must be replaced with the horizontal or vertical mean, and if the occurrence of missing values exceeds 5%, then the whole case should be deleted. As mentioned in the previous section, 30 questionnaires were removed from our analysis because they contained more than 5% missing values. For safety, a dataset comprising 345 questionnaires was checked for missing values using SPSS. There were no missing data.

4.4.2 Outlier Detection

Hair et al. (2010) define outliers as values that lie far away from the mean value, which distorts the results drastically.

Moreover, Tabachnik and Fidell (2007) argue that outliers occur in the dataset for two possible reasons: one is due to the error occurring during data entry, while the second occurs in the multivariate case when more abnormal scores lie on two or more variables. Verardi and Croux (2009) believed that the presence of outliers distorts the beta coefficients in the regression; therefore, they must be removed from the dataset. Mahalanobis D2 was used to determine the presence of outliers in the given dataset. Mahalanobis D2 was calculated using linear regression in SPSS. The values were compared with chi-square using degrees of freedom df=3 with P< 0.001, because three predictors were used to decide on values for detecting the outliers. Therefore, based on df=3 with P<0.001, our cut-off value was 16.266. In the dataset, the maximum value of D2 was found to be 14.487, which lies below the cut-off level. This implies that there were no outliers in the dataset. Hence, all questionnaires (345) were considered for further analysis. It means that the formal data analysis brought a total of 345 questionnaires under consideration.

4.4.3 Normality Tests

The concept of normality refers to the shape of the data distribution, which assumes the shape of a bell that appears symmetrical in shape. The distribution curve is said to be normal when the edges of the curve are less occupied by the data, whereas most of the data are clustered around the centre, hence making it look like a bell (Hair et al., 2010). Hair et al. (2010) explained that when the data has a larger amount of fluctuation or is far away from being normal, it will affect the results of the analysis. Consequently, the outcomes will not be sufficiently reliable. Although the pilot study confirms that data were normally distributed, the integration of PLS-SEM in this study is applied based on the complex mediation model and prediction. Hair et al (2010) noted that PLS-SEM is the vital and suitable technique especially when the multiple constructs are involved including the mediation effects. Therefore, it has been given significance as compared to CB-SEM.

Data normality is a crucial factor which needs to be checked. Different researchers have proposed several methods for assessing the normality of the data; for example, data normality can be accessed via graphical and non-graphical methods. In this research, we employed Skewness and Kurtosis followed by the Kolmogorov-Smirnov and Shapiro-Wilk tests for normality.

4.4.3.1 Skewness and Kurtosis

Research conducted by Tabachnick and Fidell (2007) strongly recommends conducting the normality test of the data set, especially when the researcher is interested in performing data analysis in SPSS. Moreover, Hair et al. (2010) and Tabachnick and Fidell (2007) have emphasised statistical methods for the assessment of data normality. Skewness and Kurtosis are the most common statistical measures used by researchers. Hair et al. (2010) present that if the values of kurtosis and skewness are between ±1.96 at the 5% significance level and ±2.58 at the 1% significance level, it can be said that the given data follows the normal distribution. In connection with the importance of skewness and kurtosis, Kline et al. (2011) and Tabachnick and Fidell (2007) suggested that skewness values can be relaxed up to ±3.00, whereas kurtosis values can be relaxed up to ±10.00.

Table 4.3

Skewness & Kurtosis Results

Variables	N	Mean	Skewness	Std. Error	Kurtosis	Std. Error
TA	345	17.66	-0.003	0.131	-1.504	0.262
SC	345	45.50	-0.085	0.131	-1.633	0.262
KS	345	18.10	-0.053	0.131	-1.524	0.262
RME	345	60.41	-0.026	0.131	-1.679	0.262

Skewness and kurtosis tests were performed using the SPSS software. The results in Table 4.3 show that skewness had a maximum value of -0.085, and the maximum value of kurtosis was -1.679, which means that the data followed a normal distribution because our values lie in a normal range, as suggested by Hair et al. (2010) and Tabachnick and Fidell (2007). Thus, the data were suitable for further analysis.

4.4.3.2 Kolmogorov-Smirnov & Shapiro Wilk Test

Table 4.4

Results of Kolmogorov-Smirnov & Shapiro-Wilk Test

Variables	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	Df	Sig.
TA	0.160	345	0.000	0.908	345	0.000
SC	0.168	345	0.000	0.878	345	0.000
KS	0.161	345	0.000	0.905	345	0.000
RME	0.176	345	0.000	0.865	345	0.000

The Kolmogorov-Smirnov test was also used to assess statistical normality. The results in table 4.4 show that all results appear to be significant with probability values less than 0.05. In accordance with the study conducted by Pallant (2013), the results become significant when the sample size taken for the study goes above 200. Hence, in this case, it can be said that the given data are normal.

4.5 Descriptive Statistics

Table 4.5

Descriptive Statistics of all Variables

Variables	N	Min	Max	Mean	Std. Dev
TA	345	1	5	2.9435	0.98607
SC	345	1	5	3.0334	0.95596
KS	345	1	5	3.0169	0.98991
RME	345	1	5	3.0203	0.92679

The descriptive statistics concerning all constructs are given in Table 4.5. For calculating the descriptive statistics for variables, the researcher has brought the use of SPSS. The minimum, maximum, mean, and standard deviation values are listed in Table 4.5. To conduct this study, the researcher adopted a five-point Likert scale to capture responses from participants.

4.6 Goodness of Measurement Model

To perform further analysis using PLS-SEM, confirmatory factor analysis was performed using SmartPLS version 4. Figure 4.1 is illustrating the model developed for this study.

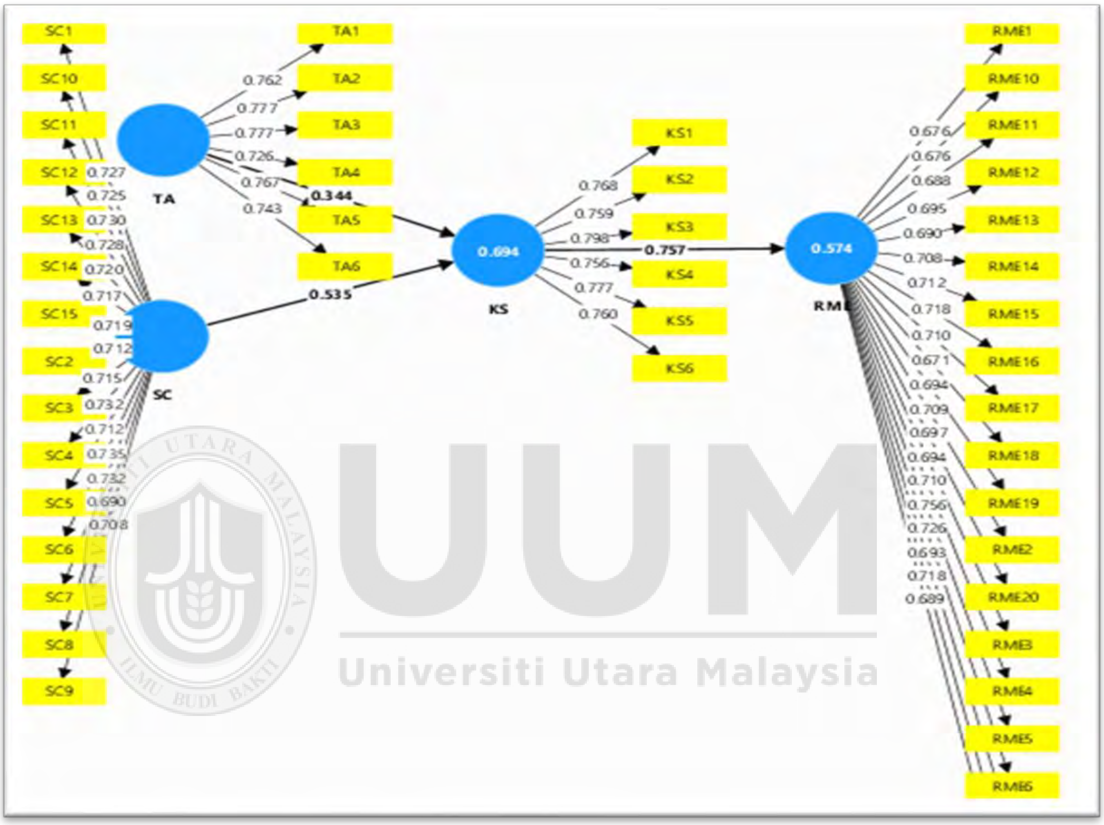

Figure 4.1: ***Research Model of the Study.***

4.6.1 Assessment of Measurement Model

The reliability of individual items can be assessed by checking the loadings they show on their latent constructs. The higher levels of loadings show the greater reliability of individual items, which means that the greater variance is explained by items in explaining their construct. If individual items show lower loading levels, this means that the power to explain the variance in the model is very small.

Moreover, to establish the overall measurement fit, the researcher assessed reliability and validity using PLS-SEM. Reliability was assessed using Cronbach's alpha and composite reliability; rho-A was also provided. Convergent validity was assessed using average variance extracted to measure the validity of the overall research model.

4.6.1.1 Reliability

Table 4.6

Reliability & Validity Results

Constructs	Cronbach's Alpha	Composite Reliability	rho-A	Average Variance Extracted (AVE)
TA	0.853	0.891	0.854	0.576
SC	0.934	0.942	0.934	0.519
KS	0.863	0.897	0.863	0.593
RME	0.946	0.951	0.946	0.500

Reliability measures the extent to which items yield consistent results when used to collect data. Researchers term this internal consistency, which is primarily measured using Cronbach's alpha. Cronbach's alpha depicts the reliability, which is obtained by examining the item inter-correlation. In PLS-SEM, reliability can be demonstrated by referring to Cronbach's alpha, composite reliability, and rho-A values. In explaining composite reliability, Hair et al. (2019) argue that composite reliability measures the construct reliability between 0 and 1 and the reliability can be labelled as excellent if the value of Cronbach's alpha and composite reliability range between 0.90 and 0.95, while the values between 0.7 and 0.90 are considered to be satisfactory and the values between 0.6 and 0.7 can be termed as the acceptable level of reliability.

4.6.1.2 Convergent Validity

Assessment of convergent validity is a very important part of the measurement model, which explains how much variance is explained by the items in defining their latent construct. Hair et al. (2016) argued that for items to be valid, the AVE values must be equal to or greater than 0.50. It means that for items that are convergently valid, they should explain the variance of at least 50% with their latent construct. As shown in Table 4.6, the AVE values of all constructs lie above the threshold level of 0.500, which means that the items have an acceptable level of convergent validity.

4.6.1.3 Discriminant Validity

The assessment of discriminant validity is also an important part of the measurement model assessment. This helps the researcher understand how the variables are different from each other or how the items are measuring their own construct conceptually being different from each other (Hair et al., 2010). Moreover, the researchers used two primary approaches to measure the discriminant validity of the constructs. The first involves the use of Fornell-Larcker Criteria to assess the degree of discriminant validity, whereas the second approach involves the use of Hetero-trait Mono-trait (HTMT) values. Using the Fornell-Larcker Criteria, the discriminant validity can be assessed by the diagonal values, which should be greater than the values lying on the horizontal or vertical places. For constructs to be discriminately valid, HTMT values should be less than 0.92 (Hair et al., 2017). Table 4.7 is showing the results of the Fornell-Larcker Criteria. According to Table 4.7, the square root of AVE does not appear to be greater than the correlation existing among variables, indicating that the variables do not differ significantly from each other. Whereas it cannot be said that constructs brought under study are not showing discriminant validity, an alternative approach of cross-loadings exists along with HTMT, which can prove the construct being discriminant valid (Hair et al., 2017). Moreover, it is evident from cross-loading Table 4.9 that items show greater loading in their own construct, implying that the given constructs are discriminant valid.

Table 4.7

Fornell-Larcker (Discriminant Validity)

Constructs	**KS**	**RME**	**SC**	**TA**
KS	0.770			
RME	0.756	0.702		
SC	0.806	0.791	0.720	
TA	0.765	0.814	0.786	0.759

Table 4.8

Hetero-trait Mono-trait – HTMT (Discriminant Validity)

Constructs	**KS**	**RME**	**SC**	**TA**
KS				
RME	0.836			
SC	0.895	0.839		
TA	0.888	0.902	0.878	

Table 4.9

Cross-Loadings (Discriminant Validity)

	KS	RME	SC	TA
KS1	**0.768**	0.584	0.613	0.589
KS2	**0.759**	0.557	0.599	0.562
KS3	**0.798**	0.601	0.667	0.641
KS4	**0.756**	0.586	0.627	0.585
KS5	**0.777**	0.604	0.628	0.588
KS6	**0.760**	0.560	0.584	0.565
RME1	0.539	**0.674**	0.563	0.537

RME10	0.497	**0.678**	0.525	0.574
RME11	0.527	**0.688**	0.520	0.591
RME12	0.462	**0.697**	0.522	0.536
RME13	0.492	**0.690**	0.506	0.526
RME14	0.512	**0.708**	0.563	0.565
RME15	0.535	**0.712**	0.556	0.573
RME16	0.553	**0.718**	0.580	0.600
RME17	0.589	**0.707**	0.578	0.575
RME18	0.497	**0.673**	0.540	0.579
RME19	0.572	**0.692**	0.583	0.573
RME2	0.500	**0.711**	0.540	0.592
RME20	0.532	**0.697**	0.562	0.562
RME3	0.513	**0.693**	0.557	0.543
RME4	0.543	**0.709**	0.566	0.546
RME5	0.586	**0.757**	0.647	0.645
RME6	0.575	**0.723**	0.564	0.577
RME7	0.518	**0.694**	0.521	0.583
RME8	0.532	**0.718**	0.554	0.575
RME9	0.524	**0.688**	0.528	0.553
SC1	0.556	0.561	**0.727**	0.542
SC10	0.540	0.534	**0.725**	0.524
SC11	0.618	0.555	**0.728**	0.567
SC12	0.596	0.574	**0.727**	0.558
SC13	0.554	0.547	**0.720**	0.553
SC14	0.589	0.537	**0.715**	0.539
SC15	0.574	0.572	**0.720**	0.591
SC2	0.560	0.531	**0.712**	0.546
SC3	0.581	0.603	**0.717**	0.583
SC4	0.644	0.640	**0.733**	0.632
SC5	0.597	0.605	**0.713**	0.583
SC6	0.565	0.564	**0.735**	0.583

SC7	0.605	0.574	**0.731**	0.546
SC8	0.555	0.566	**0.691**	0.579
SC9	0.555	0.563	**0.708**	0.557
TA1	0.603	0.653	0.623	**0.763**
TA2	0.607	0.639	0.590	**0.777**
TA3	0.594	0.594	0.624	**0.773**
TA4	0.519	0.585	0.540	**0.729**
TA5	0.541	0.561	0.566	**0.765**
TA6	0.607	0.660	0.628	**0.744**

4.7 Assessment of Structural Model

After assessing the measurement model, the researcher chose to assess the structural model using PLS-SEM to test the hypotheses.

4.7.1 Direct Path Analysis

This section is concerned with testing the direct relationships between the variables that have been placed in this model. Table 4.10 is showing the results of the direct path analysis.

Table 4.10

Direct Path Results

Hypoth-eses	Path	Beta Value	Std. Error	T-Value	P-Value	Confidence Intervals		
						Lower Limit (5%)	**Upper Limit (95%)**	**Decision**
H1	TA→ RME	0.443	0.057	7.754	0.000***	0.351	0.540	Supported
H2	SC→ RME	0.302	0.061	4.984	0.000***	0.207	0.404	Supported
H3	TA→ KS	0.344	0.055	6.238	0.000***	0.256	0.436	Supported
H4	SC→ KS	0.535	0.055	9.777	0.000***	0.443	0.622	Supported
H5	KS→ RME	0.174	0.054	3.226	0.001***	0.086	0.265	Supported

Note: ****Significant at 0.01 (1-tailed), **significant at 0.05 (1-tailed)*

Hypothesis 1: (TA→RME) There is a significant impact of technology adoption on the risk management effectiveness.

Bootstrapping was performed using PLS-SEM at the 95% confidence level. According to the results shown in Table 4.10, technology adoption has a significant impact on risk management effectiveness, as the p-value falls below 0.05, with a beta value of 0.443.

Hypothesis 2: (SC→RME) There is a significant impact of stakeholder collaboration on the risk management effectiveness.

Bootstrapping was performed using PLS-SEM at the 95% confidence level. According to the results shown in Table 4.10, stakeholder collaboration has a significant impact on risk management effectiveness, as the p-value falls below 0.05, with a beta value of 0.302.

Hypothesis 3: (TA→KS) There is a significant impact of technology adoption on the knowledge sharing.

Bootstrapping was performed using PLS-SEM at the 95% confidence level. According to the results in Table 4.10, technology adoption has a significant impact on knowledge sharing, as the p-value falls below 0.05, with a beta value of 0.174.

Hypothesis 4: (SC→KS) There is a significant impact of stakeholder collaboration on the knowledge sharing.

Bootstrapping was performed using PLS-SEM at the 95% confidence level. According to the results in Table 4.10, stakeholder collaboration has a significant impact on knowledge sharing, as the p-value falls below 0.05, with a beta value of 0.535.

Hypothesis 5: (KS→RME) There is a significant impact of knowledge sharing on the risk management effectiveness.

Bootstrapping was performed using PLS-SEM at the 95% confidence level. According to the results in Table 4.10, stakeholder collaboration has a significant impact on knowledge sharing, as the p-value falls below 0.05, with a beta value of 0.535.

4.7.2 Mediation Path Analysis

This section of the study addresses the assessment of mediation results, which are shown in Table 4.11.

Table 4.11

Mediation Results

Hypo-theses	Path	Beta Value	Std. Error	T-Value	P-Value	Confidence Intervals		
						Lower Limit (5%)	**Upper Limit (95%)**	**Decision**
H6	TA→ KS→ RME	0.060	0.023	2.616	0.004***	0.026	0.101	Supported
H7	SC→ KS→ RME	0.093	0.030	3.151	0.001***	0.046	0.143	Supported

Note: ****Significant at 0.01 (1-tailed), **significant at 0.05 (1-tailed)*

Hypothesis 6: (TA→KS→RME) Knowledge sharing significantly mediates the relationship between technology adoption and the risk management effectiveness.

Bootstrapping was performed using PLS-SEM at the 95% confidence level. According to the results in Table 4.11, knowledge sharing significantly mediates the relationship between technology adoption and risk management effectiveness, as the p-value falls below 0.05, with a beta value of 0.060.

Hypothesis 7: (SC→KS→RME) Knowledge sharing significantly mediates the relationship between stakeholder collaboration and the risk management effectiveness.

Bootstrapping was performed using PLS-SEM at the 95% confidence level. According to the results shown in Table 4.11, knowledge sharing significantly mediates the relationship between stakeholder collaboration and risk management effectiveness, as the p-value falls below 0.05, with a beta value of 0.093.

4.8 Predictability of Model

4.8.1 Coefficient of Determination (R^2)

Table 4.12

Predictive Relevance Adjusted R^2

Constructs	R^2	Adjusted R^2	Results
KS	0.694	0.692	Substantial
RME	0.731	0.729	Substantial

After testing the hypotheses, it is necessary to test the predictive relevance of the model used in the study. One of the most crucial steps in performing structural model analysis is knowing the predictive power of the dependent variables taken in the model. Table 4.12 is showing the values of R-Square and Adjusted R-Square. The value of the Adjusted R-Square is taken for interpretation. Henseler et al. (2015) propose that R-Square values can be categorised into three main categories. If the value of R^2 is between 0 and 0.02, the result is weak. If the value lies between 0.03 and 0.13, it can be said to have a moderate level of effect, and if the value exceeds 0.13, it can be said to have a substantial level of effect. In Table 4.12, it becomes clear that the values of both endogenous constructs are more than 0.13 or 13%. The adjusted R-squared value for KS was 0.692 (69.2%) and that for RME was 0.729 (72.9%). This implies that technology adoption and stakeholder collaboration explain 69.2% and 72.9% of the variance in defining knowledge sharing and risk management effectiveness, respectively.

4.8.2 Predictive Relevance (Q^2)

Table 4.13

Predictive Relevance Q^2

Constructs	**SSO**	**SSE**	**Q^2(=1-SSE/SSO)**
TA	2070.000	2070.000	0.000
SC	5175.000	5175.000	0.000
KS	2070.000	1228.320	0.407
RME	6900.000	4449.712	0.355

Note: *Omission distance 7*

Hair et al. (2014) suggest that another parameter for knowing the predictive relevance is the Q-Squared, which deals with predicting the accuracy of the model. In this study, cross-validated redundancy was used to show the values obtained for endogenous constructs. Hair et al. (2016) suggested that Q^2 values for endogenous variables should be greater than 0 to show acceptability in predictive relevance. Table 4.13 shows that the Q-Squared for endogenous variables appears to be greater than 0, which means that the model under study possesses a sufficient level of predictive relevance.

4.9 Summary of Findings

This section summarizes the findings regarding the hypotheses of this study. Table 4.14 is summarizing the results obtained from the data analysis.

Table 4.14

Summary of Findings

Hypotheses	Statement	Finding
H1	There is a significant impact of technology adoption on the risk management effectiveness.	Supported
H2	There is a significant impact of stakeholder collaboration on the risk management effectiveness.	Supported
H3	There is a significant impact of technology adoption on the knowledge sharing.	Supported
H4	There is a significant impact of stakeholder collaboration on the knowledge sharing.	Supported
H5	There is a significant impact of knowledge sharing on the risk management effectiveness.	Supported
H6	Knowledge sharing significantly mediates the relationship between technology adoption and the risk management effectiveness.	Supported
H7	Knowledge sharing significantly mediates the relationship between stakeholder collaboration and the risk management effectiveness.	Supported

4.10 Chapter Summary

This study investigated the mediating effect of knowledge sharing on the link between technology adoption, stakeholder collaboration, and risk management effectiveness. SPSS was used to assess the missing values, outliers, normality, and descriptive analysis to explain the demographic information of respondents, which was also performed at the initial stages of data analysis. PLS-SEM has also been used to measure validity and reliability. All five hypotheses regarding direct relationships were tested using the bootstrapping technique in PLS-SEM. Besides this, mediating paths were also tested to assess the significance of mediating effects, which showed that knowledge management appeared to be significantly mediating the relationship between independent and dependent variables.

CHAPTER FIVE

DISCUSSION AND CONCLUSION

5.1 Introduction

This chapter examines the results obtained from the analysis of quantitative data. The discussion in this chapter is based on the comparison of results with the existing literature regarding the link between knowledge sharing and technology adoption, stakeholder collaboration, and risk management effectiveness. Moreover, this discussion is based on the research objectives developed in Chapter One.

5.2 Overview of Findings

This study examined the mediating role of knowledge sharing between two independent variables, namely technology adoption and stakeholder collaboration, and one dependent variable, namely risk management effectiveness. Moreover, this study has assessed the interplay of these aforementioned variables by taking quantitative data from employees working in different departments of the Al Jaber Building (AJB) located in Fujairah in the UAE. This chapter of the study has based its discussion on the hypotheses developed in chapter one. In light of the outcomes yielded from the results chapter, it can be said that knowledge sharing significantly mediates the relationship between technology adoption, stakeholder collaboration, and risk management effectiveness. Moreover, technology adoption, stakeholder collaboration, and knowledge sharing were found to be strong determinants of the risk management effectiveness, especially in the context of employees working in a construction firm.

5.3 Discussion

The purpose of this study is to assess the mediating role of knowledge sharing in the link between technology adoption, stakeholder collaboration, and risk management effectiveness, and to assess the direct link between technology adoption and risk management effectiveness and stakeholder collaboration and risk management effectiveness. In addition, this study assesses the direct links between technological adoption and knowledge sharing, stakeholder collaboration and knowledge sharing, and the direct link between knowledge sharing and risk management effectiveness. To achieve the research objectives, this section discusses the findings in view of previous findings in the literature. The discussion is as follows.

5.3.1 Knowledge Sharing as a Mediator between Technology Adoption And The Risk Management Effectiveness.

This research is contributing in the literature regarding the knowledge sharing in the sense that it is acting as a mediating variable between technology adoption and the risk management effectiveness. The results in Chapter Four indicate that knowledge sharing significantly mediates the relationship between technology adoption and employees' risk management effectiveness, which aligns with the study performed by Shayan et al. (2022). Moreover, the outcomes of this study are consistent with those of other studies. For example, a study conducted by Deng et al. (2023) explain that technology adoption significantly increases the ability to share knowledge among employees, which affects organizational performance. In addition, the results of the study are also consistent with the study performed by Hubbard (2020), which strongly supports the idea of an important role played by knowledge sharing in determining the risk management effectiveness of organizational employees. Furthermore, Manesh et al. (2020) mention that knowledge sharing significantly mediates between technology adoption and risk management effectiveness. The introduction and adoption of the technology in the firm's operations encourages employees' knowledge-sharing behavior because they feel it is easy to share and disseminate organizational knowledge with each other. Consequently, knowledge sharing increases employees' capability to manage risks effectively. Therefore, it becomes clear that risk management effectiveness within the organizational context is significantly determined by the role played by employees, particularly by demonstrating the behavior of knowledge sharing facilitated by the adoption of technology. Moreover, the sharing of knowledge among organizational employees enhances capability at the individual and organizational levels, which tends to contribute to the collective organizational intelligence that is highly crucial for risk identification and mitigation.

5.3.2 Knowledge Sharing as A Mediator Between Stakeholder Collaboration And The Risk Management Effectiveness.

The results obtained in Chapter Four show that knowledge sharing significantly mediates the relationship between stakeholder collaboration and risk management effectiveness. This mediating relationship is supported by the existing literature in that Mathrani and Edwards (2020) and MacDonald et al. (2022) strongly support the role of stakeholder collaboration in determining the degree to which knowledge is shared. In addition, Majid and Yasir (2017) maintain that the interplay existing between the stakeholder collaboration and the concept of risk management is highly influenced by the mechanisms regarding the knowledge sharing. This means that it is necessary for management to take all its stakeholders into account and collaborate with them, which will facilitate employees to share the knowledge that leads to increased levels of awareness among employees to mitigate potential risks.

5.3.3 Effects of Technology Adoption, Stakeholder Collaboration, and Knowledge Sharing on Risk Management Effectiveness

According to the results, implementing digital technology helps expedite building projects by improving risk management. During project execution, the use of technologies like artificial intelligence and Building Information Modelling (BIM) facilitates quicker information flow, enhances decision-making, and lowers uncertainty. Alaloul et al. (2020) observed similar findings and contended that digital transformation improves control and efficiency in the construction industry. This is in line with national programs like Vision 2025 in the United Arab Emirates, which promote the use of smart technology to enhance project delivery.

The investigation also demonstrates that successful risk management is positively impacted by stakeholder participation, particularly that of contractors, consultants, and government officials. Improved cooperation lowers conflict, fosters trust, and guarantees that dangers are promptly recognized and reduced. This is consistent with the findings of El-Sayegh et al. (2021) and Freeman (2010), who emphasized the connection between cooperative methods and better project results. These results are especially pertinent in the United Arab Emirates, where a significant percentage of megaprojects encounter disagreements and setbacks as a result of inadequate cooperation frameworks.

The data also demonstrates how crucial information exchange is to enhance the effects of stakeholder cooperation and technology adoption on risk management. If individuals and companies consistently exchange experiences, lessons gained, and technical expertise, projects have a higher chance of success. This bolsters the findings of Shehzad et al. (2022), who discovered that efficient information sharing amplifies the advantages of digital tools and teamwork in building projects. The argument presented by Baron and Kenny (1986), which contends that a mediator explains the mechanism by which independent factors influence outcomes, is also supported by the mediation results.

5.4 Implications of Study

This section explains the implications of this research for employees working in the construction sector of the UAE, particularly those working in the Al Jaber Building located in Fujairah, a city in the UAE. The theoretical and practical implications of this study are as follows:

5.4.1 Theoretical Implications

Theoretically, this study examines variables that act as vital determinants of the risk management effectiveness of employees working in the construction sector of the UAE based on the Diffusion of Innovation Theory. Theoretically, it can be said that a very limited amount of literature has dealt with the mediating role of knowledge sharing in the interplay between technology adoption, stakeholder collaboration, and risk management effectiveness in UAE based construction companies, namely Al Jaber Building. Mohiuddin et al. (2022) maintains that for predicting the development and the enhancement of knowledge sharing, there is a need to understand its sources of motivation. It means that researchers need to inquire more about the attitudinal, collaborative, technological, cultural, managerial, and organizational aspects of the knowledge sharing behavior of employees. Moreover, this research contributes from a theoretical perspective in the sense that it focuses on the collaborative and technological aspects of knowledge sharing. This study provides a quantitative understanding of the collaborative and technological aspects of knowledge sharing and how people tend to develop risk-mitigation capabilities in an organizational setting. In addition, this study also develops a theoretical understanding of how people protect themselves from exposure to potential risks existing at construction sites by adopting new technology changes in their indoor and outdoor (on-site) operational affairs. Moreover, this study also quantitatively shows how collaboration among all stakeholders affects employees' ability to mitigate risks in both indoor and outdoor settings.

5.4.2 Practical Implications

Based on the outcomes of this study, the results show that the concept of knowledge sharing significantly mediates the relationship between the concept of technology adoption, stakeholder collaboration, and risk management effectiveness, which clearly indicates that for employees to mitigate potential risks effectively, management needs to encourage the adoption of new technology and the practice of collaborating with employees and all other direct or indirect stakeholders, and also take steps to encourage the practice of knowledge sharing among employees. Moreover, technology adoption and stakeholder collaboration need to be seriously focused on by management. Practically, this study provides useful insights for construction firm managers to recognize the importance of knowledge sharing in the sense that if managers implement the practice of knowledge sharing among employees, they will tend to implement more informed and effective decisions. Moreover, Nunes and Abreu (2020) argued that effective knowledge sharing can also lead to a significant improvement in the performance of the project taken by the firm. Hence, along with adopting and implementing new technological advancements in their operational affairs and encouraging stakeholder collaboration, an effective mechanism of knowledge sharing is necessary for employees to ensure workplace safety and protection from other risks that may affect project or organizational performance.

5.5 Limitations of Study

This study had certain limitations. For example, the first limitation is that it only focuses on employees working in a single firm, whereas, due to limited time, this study cannot be extended to other firms covering the overall construction firms of the UAE. Moreover, this study included a limited number of respondents, due to which the limited perspective is investigated regarding the phenomenon under study. In addition, this quantitative study is concerned with explaining the phenomenon to managers and practitioners on how risk management effectiveness works, but it does not explain how stakeholder collaboration and technology adoption are determined.

5.6 Recommendations for Future Research

Future research may consider other mediating variables in the relationship between technology adoption, stakeholder collaboration, and risk management effectiveness. In addition, it can be said that knowledge sharing serves as a dimension of knowledge management, whereas other dimensions of knowledge management include knowledge acquisition and sorting, which can also be taken as a mediator between independent and dependent variables.

Future research can involve developing a comprehensive understanding of risk management effectiveness by incorporating further variables explaining technology adoption and stakeholder collaboration, as well as examining additional moderating effects. Moreover, future researchers can possibly extend and test this model in other industries or even in other UAE based construction firms to validate the results of this study.

5.7 Conclusion

The primary purpose of this study is to assess the mediating role of knowledge sharing in the relationship between technology adoption, stakeholder collaboration, and the risk management effectiveness of Al Jaber Building employees. This study also assessed the direct impact of technology adoption and stakeholder collaboration on risk management effectiveness. Overall, this study concludes that knowledge sharing as a mediator has a positive relationship with the dependent and independent variables. Knowledge sharing is an essential element required to effectively manage construction projects undertaken by construction firms. Additionally, this research also shows that the presence and adoption of new technology significantly increase safety and allows employees to mitigate the potential risks existing in the workplace, which leads to enhanced levels of project performance. Further research is needed to assess the contribution of other mediating and moderating effects in defining the risk management effectiveness of employees working in an organization.

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APPENDIX 1

Dear Participant,

I am a master's student at Universiti Utara Malaysia. I am seeking your cooperation to respond to the attached survey on "Impact of Technology Adoption and Stakeholder Collaboration on Risk Management Effectiveness in Fast-Track Construction Projects: Knowledge Sharing as a Mediator". This survey is part of the university requirement for the completion of my thesis. The questionnaire will take about 15 minutes to complete. Instructions for filling it can be found on the questionnaire. The questionnaire consists of six sections. Respondents have to choose one option from the given five-point Likert scale where 1 represents Strongly disagree, 2 represents Disagree, 3 is Neutral, 4 represents Agree, and 5 represents Strongly agree.

I would really appreciate if you could complete and return the questionnaire. Please be assured that all information provided will be treated with utmost confidentiality and strictly used for academic purpose. Thank you for your time, cooperation, and participation. For further enquiries, please you may contact:

Mohamed Salim Marzouq Almas Alloghani

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Survey Questionnaire

Section A: Demographic Profile

1. Gender

Male ☐ Female ☐

2. Age

20 – 24	☐	25– 30	☐
31 – 35	☐	36 – 40	☐
41 – 45	☐	46 – 50	☐
51 – 55	☐	56 and above	☐

3. Marital Status

Single	☐	Married	☐
Widowed	☐	Divorced	☐

4. Education Level

High School	☐	Diploma	☐
Bachelor	☐	Masters	☐
PhD/Doctorate	☐	Others (please specify)	☐

5. Work Experience with the organization

1-2 years	☐
3-5 years	☐
6-10 years	☐
11-15 years	☐
16-20 years	☐
More than 20 years	☐

6. Current Position

: ____

Section B: Risk Management Effectiveness

Please indicate your level of agreement with each statement with (1) strongly disagree (2) disagree (3) to some extent (4) agree and (5) strongly agree.

		1	2	3	4	5
1)	I define the risk measurement criteria to be used, e.g., high/medium/low					
2)	I define risk materiality, i.e., when risk is important					
3)	I define risk time frame applicable to risk impact and risk probability, i.e., when risk is expected to occur.					
4)	I clarify risk terminology, i.e., use of terms such as impact, consequence, probability/likelihood					
5)	I determine the level of acceptable risk, i.e., the risk tolerance level of the firm.					
6)	I develop risk information database, e.g., information gathering, risk history database.					
7)	I identify how and why risk arises.					
8)	I conduct present and future risk identification, e.g., develop risk register information quality, management techniques.					
9)	I use physical inspection to identify the risk.					
10)	I determine the risk cause, risk duration, risk volatility.					

11)	I determine the probability of the risk occurring, the impact, classification consistency, i.e., high/medium/low.					
12)	I establish the risk profile, e.g., high probability/high impact, high probability/low impact.					
13)	I assess risks by quantitative analysis methods, e.g., probability, sensitivity, scenario, simulation analysis					
14)	I assess risks by qualitative analysis methods, e.g., direct judgement, comparing option, descriptive analysis.					
15)	I identify risk treatment options by avoiding risk.					
16)	I identify risk treatment options by mitigating risk.					
17)	I identify risk treatment options by retaining risk.					
18)	I identify risk treatment options by transferring risk.					
19)	I predefine actions to counter the identified project risks.					
20)	I prepare and implement risk action plan.					

Section C: Technology Adoption

Please indicate your level of agreement with each statement with (1) strongly disagree (2) disagree (3) to some extent (4) agree and (5) strongly agree.

		1	**2**	**3**	**4**	**5**
1)	My company is engaging in digital transformation					
2)	My company has relevant sensors / technology to collect and sense information from multiple sources in real time					
3)	My company employs technology solutions to transform data into a usable format, to help understand the collected information.					

4)	My company employs technology solutions to use the data for making forecasts that will help prepare for the future.					
5)	My company employs technology solutions to automate the processes relevant to data-driven decision making					
6)	My company has strategies in place for workforce skills development, to effectively manage and use the technology solutions.					

Section D: Stakeholder Collaboration

Please indicate your level of agreement with each statement with (1) strongly disagree (2) disagree (3) to some extent (4) agree and (5) strongly agree.

		1	2	3	4	5
1)	My organization manage stakeholders with social responsibilities(economic, legal, environmental and ethical).					
2)	Mu organization formulate a clear statement of project missions.					
3)	My organization identify stakeholders properly.					
4)	My organization understand area of stakeholders’ interests.					
5)	My organization explore stakeholders’ needs and constraints to projects.					
6)	My organization assess stakeholders’ behaviour.					
7)	My organization predict the influence of stakeholders accurately.					
8)	My organization assess attributes (power, urgency, and proximity) of stakeholders.					
9)	My organization analyse conflicts and coalitions among stakeholders.					
10)	My organization compromise conflicts among stakeholders effectively.					
11)	My organization keep and promote good relationships with stakeholders.					

12)	My organization formulate appropriate strategies to manage stakeholders.					
13)	My organization predict stakeholders' reactions for implementing the strategies.					
14)	My organization analyse the change of stakeholders' influence and relationships during the project process.					
15)	My organization communicate with and engage stakeholders properly and frequently.					

Section E: Knowledge Sharing

Please indicate your level of agreement with each statement with (1) strongly disagree (2) disagree (3) to some extent (4) agree and (5) strongly agree.

		1	**2**	**3**	**4**	**5**
1)	I shared the minutes of meetings or discussion records in an effective way.					
2)	I always provided technical documents, including manuals, books, training materials to each other.					
3)	I shared project plans and the project status in an effective way					
4)	I always provided know-where or know-whom information to each other in an effective way					
5)	I tried to share expertise from education or training in an effective way.					
6)	I always shared experience or know-how from work in a responsive and effective way					