



VAASAN AMMATTIKORKEAKOULU
UNIVERSITY OF APPLIED SCIENCES

Fahad Shah

IMPACT OF PROJECT RISK
MANAGEMENT PRACTICES ON
PROJECT SUCCESS IN LARGE-
SCALE CONSTRUCTION PROJECTS

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VAASAN AMMATTIKORKEAKOULU
UNIVERSITY OF APPLIED SCIENCES
Engineering Project Management

ABSTRACT

Author	Fahad Shah
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The study investigates Project Risk Management (PRM) implementation effects on large-scale construction project achievements, particularly in Pakistan and other developing countries. The study analyses structured frameworks of PRM to identify their effects on project results for cost management and project duration along with quality assurance.

Respondents completed 164 surveys, which, along with interviews with 23 participants, including project managers, engineers and risk specialists, constituted the research design. The analysis through SPSS showed an average strength of positive link ($r = 0.608$) between organizations implementing successful PRM practices and achieving desirable project results. The NVivo program helped identify three main project challenges regulatory ambiguities, environmental barriers, and problems with stakeholder coordination as people faced regulatory ambiguities alongside environmental barriers and problems with stakeholder coordination.

The value of public relations management is acknowledged by firms across the industry, yet implementation varies because of cultural barriers as well as employee training problems and inadequate technological utilisation. The study examines promising software solutions, including Building Information Modelling (BIM), predictive analytics and IoT-enabled risk monitoring, to boost PRM success rates. The study presents final recommendations to advance PRM adoption

standards based on ISO 31000 and PMI PMBOK and stakeholder alliances and development programmes. The research enhances scholarly understanding of construction project success by investigating how PRM contributes effectively.

Keywords project risk management (prm), construction projects, developing countries, cost and time management, stakeholder coordination

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ABBREVIATIONS

PRM	– Project Risk Management
BIM	– Building Information Modelling
IoT	– Internet of Things
PMI	– Project Management Institute
PMBOK	– Project Management Body of Knowledge
PPP	– Public-Private Partnership
IPD	– Integrated Project Delivery
OSHA	– Occupational Safety and Health Administration
SPSS	– Statistical Package for the Social Sciences
NVivo	– Qualitative Data Analysis Software
ISO	– International Organization for Standardization
LEED	– Leadership in Energy and Environmental Design
BREEAM	– Building Research Establishment Environmental Assessment Method
MENA	– Middle East and North Africa
UK	– United Kingdom

US – United States

GCC – Gulf Cooperation Council

1 INTRODUCTION

Major construction activities present complicated tasks that require extensive strategic planning, sizeable funding, and multiple workers. Modern construction project management, along with technological developments, fails to overcome recurring risk elements which lead to delayed schedules and higher expenses as well as diminished quality levels (Ekechukwu, 2024). Several obstacles, including suddenly changing ground characteristics and price alterations of materials together with regulatory barriers, manpower shortages and technical breakdowns, generate problems in project delivery operations (Makori, 2011). Project Risk Management (PRM) functions as an essential method to address project uncertainties in modern fields (Ekechukwu, 2024). This approach combines organized principles for identifying risks and assessing their values along with risk reduction strategies and continuous surveillance tasks. With proper use, PRM generates extraordinary tools for project managers to pre-treat possible risks that stop them from developing into major issues, leading to increased project success chances (Makori, 2011).

Even though experts within both academia and professional fields recognise the importance of PRM, the actual implementation of this strategy in large construction projects shows inconsistent progress and underdevelopment (Davenport, 2018). Construction companies either run ineffective PRM programmes or eliminate PRM from their business fundamental practices. The construction industry does not possess an organized system of PRM practices which are optimised for large-scale construction works (Makori, 2011). Understanding how PRM influences project outcomes must receive detailed evaluation exclusively within the construction industry (Ilori, 2024). Effective risk management strategy development and enhanced PRM practice adoption in the sector require a full comprehension of this relationship (Beal, 2003).

1.1 Research Problem and Research Gap

The implementation of risk management (RM) as a project success factor remains insufficient for large-scale construction projects operating in developing countries such as Pakistan. Large construction firms in Pakistan commonly operate without structured risk management frameworks according to both the Risk Management Process Model (PMI, 2017) and Contingency Theory (Donaldson, 2001). Construction research reveals financial uncertainty and material price volatility as well as worker shortage, regulatory process slowness and governmental impact to be among the main industry risks (Zou et al., 2007; Ahmed et al., 2020). The examination of RM practices in the Pakistani construction sector shows an observational deficiency regarding their actual application. Inconsistencies and total disinterest regarding reactive management efforts among most firms result in inferior project outputs. The research evaluates present-day risk management practices in Pakistan's large-scale construction projects as it examines theoretical framework adaptations to enhance risk recognition followed by mitigation procedures and overall project achievement.

1.2 Research Questions

To address the identified research gap, this study will explore the following key questions:

RQ 1: How do PRM practices influence the success of construction projects?

RQ 2: What are the challenges associated with implementing PRM in large-scale construction projects?

RQ 3: What PRM practices are commonly used in large-scale construction projects?

By answering these questions, the study will provide valuable insights for project managers, organizations, and policymakers about optimising PRM frameworks for improved project success.

1.3 Significance of the Study

The implication of the study will be of great importance to the various constituencies of the construction industry.

For Project Managers

This research will be valuable for project managers as readers will get some valuable practical tips concerning the potential ways of PRM enhancement focused on improving the decision-making process and, as a result, the project's outcomes.

For Construction Firms

The results of this research serve to create frameworks in the field of PRM so that organisations can optimise their projects and decrease the consequences that affect their bottom line due to uncontrolled risks.

For Policymakers

Using this study as a guide, regulatory bodies can come up with policies or plans that will try to make sure that the industry as a whole follows the right PRM standards. This will lower risk.

For Academia

As a result, this study adds to what is already known about PRM by showing how strong the link is between PRM and the success of construction projects. It also gives important information for future research in project risk management.

1.4 Limitations of the Study

Nevertheless, the following is a list of the research limitations that might be of importance here:

Scope Limitations

A large-scale construction project is being studied, so the conclusions obtained here may not be largely applicable to small and medium-scale construction projects. Furthermore, the study focuses on the PRM usage in construction companies and thus cannot claim the applicability of the findings in other industries.

Methodological Limitations

The research uses questionnaires and qualitative interviews as the research techniques in the study. Certain restrictions may stem from self-reporting, and hence, the respondents may offer socially acceptable answers rather than facts. However, questionnaires are used in the statistical analysis of this PRM's effectiveness, which may not fully reflect how risk management is done in real life.

Time and Resource Constraints

The limitations of the research are time and resource limitations, which constrain the number of respondents and the amount of data collected. The fact that large-scale construction projects exist over long time horizons implies that determining PRM efficiency within the framework of this research is challenging.

1.5 Structure of the Study

The research divides into six main chapters to present the thesis's arguments:

Introduction

These are the reasons for the study, the problem that the research is trying to solve, the background of the study, operational definitions of

key ideas, assumptions, limitations of the research, and a breakdown of how the research is structured.

Literature Review

The provided literature review consists of the current studies that focus on PRM practices as well as their effects on large construction projects. This research also discuss all theoretical premises, prior empirical research, and future research directions.

Research Methodology

The present chapter details the research methodology, the method of data collection through the administration of surveys and interviews, the sampling method, and the data analysis procedure.

Data Analysis and Findings

This chapter also contains the analysis of both quantitative and qualitative data. This includes a statistical analysis of the degree of senior management and others' application of PRM, the success indicators in the projects, and a thematic analysis of interviews with managers.

Discussion

In this chapter, the results of the study are discussed regarding prior reviews on the topic, as well as the discoveries of the current study that describes the PRM practice in large-scale construction projects.

Conclusion and Recommendations

The last chapter gives an overview of the outcomes of the research, provides advice to project managers and policymakers regarding the use of efficient project risk management, and postulates further research directions.

2 LITERATURE REVIEW

The research aims to establish its position regarding project risk management (PRM) in large-scale construction projects throughout existing literature. The main focus of this research is on the connection between PRM and project success metrics, along with basic theories, PRM definitions, and approaches. After an analysis of previous PRM research and the methods used by other researchers to solve issues related to building project risk management, this section comes next.

2.1 Theoretical Framework for Project Risk Management

Several theoretical models and frameworks underpin the study of project risk management in large-scale construction projects. Various important explanatory models document the relationship between PRM and project accomplishment. PMI offers the Risk Management Framework as a structured approach to risk management development in their 2017 version (Davenport, 2018). The model includes five fundamental stages that comprise its structure.

Risk Identification: Recognising potential risks.

Risk Assessment: Involves conducting both probability analysis and damage evaluation.

Risk Response Planning: Organizations should establish strategies for risk mitigation during the planning phase of risk response.

Risk Implementation: This stage involves the deployment of the selected risk mitigation strategies (Beal, 2003).

Risk Monitoring and Control: Functions through continuous risk tracking together with response plan updates.

Multiple organisations use this standardised approach to systematically manage project risks throughout their operations. Based on the Contingency Theory, researchers advise that project-specific

characteristics should guide the selection of risk management methods (Dey, 2004). Large construction projects require PRM strategies to be responsive to project dimensions that include complexity and external uncertainties, which affect their effectiveness. Researchers maintain that static risk management rules, which operate as one solution, do not address dynamic construction environments (Ekechukwu et al., 2024).

The construction field follows Chaos Theory principles because small changes result in big effects throughout the dynamic, unpredictable construction environment (Dey, 2004). Unpredicted challenges from material shortages coupled with political instabilities tend to build up and negatively affect project outcomes. Flexible PRM strategies form an essential requirement because they need to adjust their responses to active project changes.

According to Stakeholder Theory (Freeman, 1984), stakeholders, including clients together with contractors and governmental agencies, vary their risk perceptions because they possess different priorities and interests. Successful risk management requires fair balancing of different stakeholder perspectives to achieve transparent communication tracks that correctly align risk responses to their expectations (Gutschnig, 2000).

2.2 Previous Research on PRM in Large-Scale Construction Projects

Numerous studies have examined PRM practices in construction, highlighting their importance, effectiveness, and challenges. Quite several researchers have declared some general practices in PRM implementation within the construction industry. Several studies state that organizations heading toward implementing a systematic PRM have a better chance of a favorable result (Hubbard et al., 2007). The point of risk logs includes the following: Risk logs assist in tracking outstanding risk issues, thus avoiding overlooking aspects containing

possible risks (Israel, 2013). Digital tools like Building Information Modelling (BIM) enhance implementation, assessment, and risk management in construction projects (Ilori, 2024). The literature review revealed that there is evidence from empirical studies showing the relationship between PRM and project performance. According to research, the companies that had adequate and effective PRM programs managed to have reduced average cost overruns (Bajaj et al., 1997). Practical strategies like specific scheduling and contingency planning can help minimise instances of delay (Jaafari et al., 2001). PRM practices help in enhancing construction quality since the company will address technical risks in advance (Makori et al., 2011). However, several factors have contributed to the challenge of implementing PRM in construction:

Absence of risk management culture:

Many construction firms do not regard PRM as important enough since it is considered a cost instead of an investment (Akintoye & MacLeod, 1997).

Lack of Training:

A lack of knowledge and experience in the PRM practices leads to low effectiveness in the implementation (Hofstede et al., 2001).

Resistance to change:

It has been customary for conventional construction firms to be reluctant to adopt new PRM methodologies. Instead, companies tend to handle risks through conventional means (Ekechukwu, 2024).

2.3 Research Methods Used in Previous PRM Studies

Research has, on the other hand, used several approaches in an endeavour to determine the role of Project Risk Management (PRM) in big construction projects. In this section, the authors of previous research works are discussed, the methods they used for research are described, and their advantages and disadvantages are evaluated.

Quantitative research entails the measurement and analysis of data with the use of numbers to establish differences, relations, and trends. Researchers have conducted some studies to assess the effectiveness of Project Risk Management (PRM) in construction projects (Freeman, 1984). In another research, Hofstede et al. (2001) carried out a study aimed at evaluating the respondents' awareness and application of PRM through a survey conducted among construction firms. Hence, their research revealed that, although all the firms under consideration admitted to understanding the significance of PRM, few of them had actual standard procedures in place. According to the study done by Hubbard et al. (2007), structured questionnaires were employed to determine the interaction between risk management practices and project performance in the construction industry in Australia. Their result indicated that organizations with sound PRM strategies for their products had the least number of cost overruns. There are a lot of merits that can be talked about in this type of study. This is because it makes it possible to gather information from a large sample; thus, the results obtained will be generalisable. It also provides statistical evidence of correlations between PRM practices and project success factors. However, there are a few limitations of this study as well. One of the possible sources of systematic errors exists in the case of self-reported data, which may be biased due to respondents trying to provide only socially acceptable answers. It's important to understand that surveys may not accurately reflect the extent of PRM implementation in construction scenarios with constraints.

Regression analysis and correlation studies have been used to look at the results of projects that have already been carried out and figure out the role of PRM. Bajaj et al. (1997) used regression analysis for the determination of the impact of risk management on cost and the schedule performance of infrastructural projects. The study found a direct link between structured PRM implementation and reduced cost variances. Makori et al. (2011) used inferential statistics to compare the success rates of projects with and without formal risk management

frameworks. According to their results, about 51.39% of those who answered said that having a clear PRM strategy led to better project quality, and projects with a clear PRM strategy got much higher quality rankings. The strengths are as follows: It offers a way to assess the effectiveness of the PRM in an objective and measurable manner. It also assists in determining the level of relationship between PRM variables and project success since the tests are sharply done quantitatively. There are also some limitations. It requires large datasets for accurate analysis. Since some risk management processes are inevitably highly dynamic, using statistics may not capture the correct essence.

This trend is evident in the qualitative research on PRM, where the research method captures more depth until the analysis utilises interviews, case studies, and themes. Case studies enable the user to learn about PRM in real-life construction projects in-depth. Israel (2013) The same author completed a case analysis on a high-risk construction project located in the United Kingdom (UK) to establish the role of risk assessment tools in the decision-making process. The study also established that proactive risk identification effectively reduces the likelihood of disputes and cost increases. Ekechukwu et al. (2024) did a meta-analysis of mega-infrastructure projects. They compared different infrastructure projects and found that risk assessment information is often wrongly predicted, which causes costs to go up and schedules to be pushed back. It provides profound insights into PRM implementation in specific projects. It also captures the complexities of risk management decisions in practice. However, despite its numerous advantages, there are a few disadvantages that should be noted. It may be useful to note that the findings derived from the research cannot be generalised in every construction project. Gathering and analysing case study data takes more time and resources.

There were 23 semi-structured face-to-face interviews with project managers, engineers, and risk specialists. The information they gave was used to evaluate good PRM practices. Gutschnig (2000), in a study, interviewed construction professionals to assess the views of the

concerned stakeholders on risk management. This means that there were communication breakdowns that interfered with proper risk management, as understood from the study. In a study with executives of large construction firms, Kerzner (2013) identified the major reason for the organisational resistance that hinders the adoption of PRM. The strength of these techniques is that they enable the researcher to dig deep into the PRM practices. Captures expert knowledge and real-world experiences. One must keep in mind that subjective responses may introduce bias into the process. Making sense of raw data often requires careful scrutiny to discern patterns.

Table 1: Comparison of PRM methods of research

Research Method	Key Studies	Advantages	Disadvantages
Surveys (Questionnaire)	Hofstede et al. (2001), Hubbard et al. (2007)	Large sample size, quantifiable data	Potential response bias, limited depth
Statistical Analysis	Bajaj et al. (1997), Makori et al. (2011)	Objective, measures impact precisely	Requires extensive data, may oversimplify risks
Case Studies	Israel (2013), Ekechukwu et al. (2024)	In-depth insights, real-world application	Limited generalizability, time-consuming
Interviews	Gutschnig (2000), Kerzner (2013)	Expert perspectives, flexible exploration	Subjectivity, potential interviewer bias

2.4 Emerging Trends in PRM for Construction Projects

This research has established that the application of IT in PRM closed up the management of risk assessment and management in construction projects. BIM enables real-time risk visualisation and scenario analysis (Ilori, 2024). Risk predictions are done with the help of machine learning algorithms using the past records of the projects (Jaafari et al., 2001). Drones and Internet of Things (IoT) sensors are used for real-time site monitoring and risk detection (Makori et al., 2011). PRM strategies in current construction focus more on environmental and social risks than anything else. Some of the green construction practices can be categorised as follows: risk management in relation to sustainability compliance or carbon footprint reduction (Hubbard et al., 2007). Stakeholder Engagement in Risk Planning, for example, For instance, Ekechukwu et al. (2024) aligned PRM with corporate social responsibility. Therefore, the implementation of projects in dynamic environments often renders traditionally defined risk management methodologies ineffective. Opportunities of Risk: Due to Civil 12's ability to implement agile methodologies, risk assessments are possible incrementally over the course of the project. Adaptive risk management plans as a result of the changing nature of most projects.

2.5 Case Studies: PRM in Large-Scale Construction Projects

From the case study, PRM has been practiced in real-life construction projects in order to learn from the successes achieved, lessons that may have been drawn in the process, and challenges likely to be encountered in real construction projects. These cases show the importance of not only the structured methodologies that can be used for risk management in relation to particular projects to avoid failures but also for obtaining success. Among fields that have been researched extensively in the field of PRM, there is the identification of applications based on infrastructure megaprojects because the level of risks in such projects is high due to

high levels of investment. According to Ekechukwu et al. (2024), in his study on large transportation infrastructure projects, a poor prognosis of risks is one of the biggest causes of cost overruns and schedule delays.

A closely related research study conducted by Hiller et al. (2006) sought to establish the virtue of ineffective risk management in explaining a mean of 28% cost overruns in transport projects in Europe. According to the researchers, risk analysis, frequent real-time observation, and project information sharing are strategic in enhancing an organisation's project performance. For instance, the Big Dig project in Boston, USA, saw itself facing a lot of budget overflow and construction delays resulting from underestimations of geophysical risks as well as inadequate money allocation of contingencies. The project cost was estimated to be some \$2.8 billion; nonetheless, it cost over \$14.6 billion due to risks such as poor ground conditions and tweaking of the initial design. As researcher see from this case, risk identification in the early stage and application of the risk response strategies that can change as the projects proceed is critical in large-scale construction projects. There was a significant agreement on the claim that high-rise structures are inherently dangerous from their structure, loads from wind, and fire, amongst other features. Referring to the Burj Khalifa, which is described as the tallest building in the world, the research demonstrates that PRM enhances success in highly complicated projects. The preliminary survey by Alarcón and Ekechukwu (2024) also revealed formative strategies adopted by the success of the project to embrace the risk management system of feasibility, subcontractors, and risk management software. In contrast, the collapse of the Lotus Riverside apartment building in China in 2009 highlights the consequences of inadequate risk assessment. The probe also showed that the removal of soil without a certain assessment of the risks made it possible for structures to collapse and cause some losses of life and property. Apparently, this case establishes the need for undertaking geotechnical risk analysis in PRM systems for high-rise constructions.

It is more likely that Public-Private Partnership (PPP) projects involve two or more partners, each of whom has his/her/its own risk tolerance level and preferences. PPP also analyses show that the public sector risk allocation should be equally shared between the two parts—private and public. According to Kumar (2008), factors that define the PRM in UAE-based PPP projects include contractual risk allocation impacts on project success. In their study, they found that there is minimal contention and protection of accountability when risk distribution is properly explained and documented. They also acknowledged factors like political interferences and instabilities in the regulatory frameworks that may affect the implementation of the projects. Ekechukwu et al. (2024) also concluded in their systematic case study of the UK PPP infrastructure project that proper risk management, particularly in the bidding and negotiation phase, entails certain promises to mitigate project risks. They focused on the need to identify the contents of the model that would give warning signs of a situation when funding for PPP projects would likely be low, which is always a problem in PPP projects. Some of the frequently identified issues that these case studies depict are as follows: These case studies support the need for well-defined PRM strategies. First of all, it is necessary to mention that the projects, which follow clear approaches to risk management, are less likely to face costs and schedule overruns. Second, regarding the last element, the engagement of stakeholders in cooperation and transparent risk sharing is beneficial for project stability. Third, the changes in technology, which include digital risk monitoring tools, have enhanced the effectiveness of risk management techniques (Elkington, 1997).

2.6 Challenges in PRM Implementation

PRM has been described as an essential element that determines success in any construction project, although it faces the following challenges. These challenges range from small projects of insignificant project sizes to large ones, geographical location, cultural factors, and

rules and regulations, among others. The last type of resistance to PRM implementation primarily relates to the organisation's disinclination to revolutionise its conventional approach to managing projects. It is also a fact that a majority of the construction companies continue to employ an old syndrome reactive approach to risk management instead of preventative measures. As stated by Hofstede et al. (2001), a substantial proportion of project managers perceive risk management as an extra cost instead of a core value stream. This perception results in a lack of sufficient resources to be used in identifying and managing the risks. In addition, contractors and subcontractors who are involved in the project may not have adequate formal education in PRM, according to Hiller (2006). In the developing countries, there is the least awareness regarding risk management and limited exposure to the best practices that can solve the problem.

PRM in particular requires that an organisation invest financial capital in assessment tools, training, and insurance. A lot of construction firms and most of the SMEs lack the sort of capital that can be ethically committed to good risk management policies and strategies. Makori et al. (2011) also note that most of the project managers do not integrate risk management plans into the cost estimates during the project's inception and only restrict themselves to funds whenever they encounter risks. Of course, cost components like insurance and performance bonds, which reduce the likelihood of financial losses, also have an impact. Hence, this aspect forms the basis of relative sensitivity to changes in the market and other related factors, thereby determining the funding of related projects. Another challenge is that in most organisations, there is no well-defined and accepted approach to performing risk assessments. The risk identification and evaluation method applied in different construction firms is quite diverse; hence, the risk profiles of firms unveiled by different projects are also very difficult to compare. Hubbard et al. (2007) said that due to distorted risk rating scales and risk assessment standards, it is difficult to identify better risks. To redress this, International Organization for

Standardization (ISO) 31000 for risk management and guidelines from PMI's Project Management Body of Knowledge (PMBOK) have emerged as the PRM frameworks for manageable countries. However, their implementation is still random depending on markets and situations in the construction segment.

There are inevitably factors such as high risks of regulatory changes, political risk, and legal risks as applicable to construction projects. Also in many of the developing countries, government officials, bureaucratic complexities, and corporate personalities contribute to the risk factors of a project, constraining them to cost and time overruns. According to the studies of Hiller (2006), regulatory approvals and permits are among the components that contain risks for public infrastructure. Another external factor that affects project planning involves government policies, taxation laws, or labour regulations. For instance, Brexit brought risk complexities to the UK construction sector as far as the probability of fluctuations in the prices of materials and the availability of labour is concerned. The challenges above indicate why there is a need for dynamic risk management that will have to consider factors such as regulation and politics.

Having excellent communication with the clients, contractors, subcontractors, suppliers, and the regulatory authorities is critical for the successful execution of any project-based PRM strategy. There is always confusion over issues related to risk responsibilities, and due to such complications, there are legal issues and project failures. In light of this, Kerzner (2013) established that the effectiveness of PRM depended greatly on stakeholders' coordination in dealing with risk-sharing strategies. In this P-O-R matrix, poor identification of risk ownership can lead to the unnoticed presence of some important risks, resulting in a gap in accountability and a lack of progress in project completion.

2.7 Strategies for Enhancing PRM Effectiveness in Construction Projects

Although the earlier sections drew lightly on the potential barriers to PRM implementation, this section discusses the possibilities of enhancing PRM in large-scale construction projects. Some of these practices are based on theoretical research and literature reviews of empirical studies and industry reports. The PRM principle also emphasises the importance of extending PRM throughout the project preparation phase. Thus, risk management cannot be considered as an individual narrow task, but it fully relates to project management. According to Hubbard et al. (2007), the ability to identify risk at the early stage is very essential, as this puts the firm in an advantageous position to examine other possible contingencies that may likely lead to disruptions. Incorporating comments from Hillson's research of 2002, risk assessments have to be made an integral part of feasibility studies, choices of design models, and contractors to award contracts to. For instance, such approaches as risk-based cost estimates make the project more accurate and adaptable to budget risks. Another important aspect of integration is thus establishing the communication of the risk-related information by the various decision-makers. Makori et al. (2011) concurred and observed, based on their research findings, that project executives often make crucial decisions without a thorough assessment of the risks involved, leading to uninformed risk-taking. As part of governance structures in a project, risk review committees can be of tremendous benefit to the improvement of the risk review process in the decision-making process.

Some of the challenges that have been highlighted include the following: There was neither a clear definition of PRM nor a clear set of objectives and priorities for PRM; hence, ANGLE has struggled to develop a standardised approach to risk management. To address this, ANGLE has established the following risk management standards: Risk management is a process that involves identifying, assessing, and

controlling risks; it encompasses a broad framework recognised globally and is based on the ISO 31000 Standard with Principles and Guidelines, PMI's PMBOK Risk Management Framework and FIDIC Contracts Risk Allocation Framework.

The use of these standard frameworks and practices helps in ensuring that risk assessment frameworks are more coherent across projects; hence, it makes it easier to compare risk data and, in the long run, leads to the establishment of a benchmark. Kumar, in his study done in 2008, showed that firms in construction industries that adopted ISO 31000 noted enhancements in risk identification accuracy as well as confidence in risk management strategies. Further, the national governments and the industry regulators bear responsibility in the promotion of sound risk management practices. The UK's Construction (Design and Management) Regulations, for instance, compel construction firms to conduct systematic evaluations of health and safety risks, resulting in fewer accident incidences at the construction sites (Gutschnig, 2000).

Automations have impacted PRM positively by enhancing data gathering, risk prediction, and risk monitoring. BIM, Predictive Analytics/Machine Learning, and IoT real-time monitoring are the three key technologies utilised in the construction risk management fields. BIM turns construction projects into digital versions that make it easier to model real-life projects. Before the building starts, everyone involved in the project can easily find problems that could arise from things like bad design, better structural designs, and coordinating materials. Ilori (2024) also said that BIM made it possible to reduce the number of rework jobs and track the effects of wasteful material use, which helped to keep cost acquisition risks low. Many techniques in risk analysis can automatically analyze large amounts of historical data from several projects to foresee future risks. For instance, in a study conducted by Jaafari et al. (2001), predictive analytics was used to assist the construction firms to identify potential supply chain disruption and therefore, ensure proper procurement planning. Construction equipment can use IoT-connected sensors to monitor the environment, system and

equipment performance, and worker risks. Writing in Makori et al. (2011), the authors explain that through the use of IoT-based monitoring systems, there have been fewer mishaps due to machinery breakdowns and risks at the site. Thus, risk management is most efficient when the involvement of clients, contractors, suppliers, and the regulators is in creating and implementing the risk management process. As established in the study by Kerzner (2013), interruptions in communication between members holding certain positions result in a slow pace of risk response actions and increased project risks. Thus, there are some effective methods for enhancing cooperation: the Joint Risk Workshop, the Contractual Risk Allocation Agreement, and the Digital Collaboration Platform. According to Kumar (2008), the construction projects, which incorporated collaborative PRM techniques, were 30% less likely to encounter contractual issues, and the risks that occurred in such projects were resolved much faster.

However, implementing structured risk management programs alone is not enough to support the idea of a risk management culture in construction firms. A risk management culture needs to be integrated into the working corporate culture, which means that everyone in the organisation needs to be more aware of risk. To this end, the three teams need to have training conducted on a frequent basis on how to identify risks and ways of handling them. The senior management of firms initiates and sustains risk management initiatives. The senior management of firms is rewarding proactive risk management behaviour among project staff. According to their study, Hofstede et al. (2001) revealed that the companies that implemented the PRM training programs received enhanced coverage for the risk period and that it improved the general performance of the project.

2.8 The Role of PRM in Sustainable Construction

Today, all projects implement E&S sustainability as a common concept, and PRM plays a crucial role in assessing and mitigating E&S risks.

Scholars have extensively discussed the integration of risk management with sustainability objectives. Construction projects attribute hazards to the effects of social surroundings, which include pollution, waste, and resource exhaustion. Hubbard et al. (2007) established that most construction projects do not undertake an effective evaluation of green regulatory risks, and this results in penalties as well as loss of reputation. Measures that should be taken to reduce risk include check-and-balance features when it comes to the utilisation of materials and construction techniques in an undertaking. The challenges that were noted include sourcing materials that are eco-friendly in a bid to ensure that carbon footprints are kept to a minimum. The Great Plains Zoo plan to incorporate Leadership in Energy and Environmental Design (LEED) or Building Research Establishment Environmental (BREEAM) certification is important so that the building follows the highest standards of environmental sustainability.

The overall safety of the workers is another factor that should be considered and managed as a risk in the construction process. A study conducted by Makori (2011) compared construction sites that have not effectively implemented adequate measures for managing safety risks and realised that construction sites in this category incurred more accidents, in addition to time wastage and legal risks. Some of the recommendations include Continuously; To assist construction firms in enhancing the safety risk management, the following should be done: Conduct hazard surveys. It was recommended that workers receive proper training on safety measures. Implement digital safety monitoring systems. In addition, social risks are avoided, such as land disputes and other social issues that a community may resist during construction projects. Hiller (2006) also demonstrated the positive outcomes of involving locals in the planning process, particularly in addressing conflicts and legal cases (Hillson, 2007). It is evident that various forms of crime and illegality threaten people's lives and unlock different opportunities for corrupt business practices in the construction industry. Research has revealed that weak governance structures escalate

chances of cost overruns and money diversion into undesired areas. (Ekechukwu et al., 2024). Some of PRM's strategies for managing governance risks are as follows: Equal treatment by painting bidders regardless of their size, colour, or ethnicity; winning contractor identification; and necessary steps must be observed. Carrying out third-party reviews with the aim of identifying risk exposure for the undertaking. Why is it time to apply frames for observing legislation against corruption?

2.9 Comparative Analysis of PRM Approaches in Different Regions

This is because construction risk management is not a universal concept that is addressed in a standard model but a business contingency affected by the geography of its practice. This section will distinguish between the PRM procedures in industrialised and developing countries, their effectiveness, challenges, and lessons learnt. The US, UK, and Australian systems are relatively more advanced in having structures for risk management and proper regulatory policies or standard requirements for managing risks.

In the United States (US), it is well defined,, and the specific standards are provided by institutions such as the PMI and the Occupational Safety and Health Administration (OSHA). This is because the construction industry uses PMI's PMBOK, where there are clear methods used in risk identification, assessment, response development, monitoring, and control. For instance, OSHA has established very tight safety measures to control many risks in construction sites, which has minimised the occurrence of hazards (Hallowell & Gambatese, 2009). According to Ilori et al. (2024), the common financial risk analysis techniques that are used by construction firms in the U.S. include Monte Carlo simulations and statistical modelling. Information technology, in particular BIM, and AI-based risk forecasts have also been employed more frequently for risk assessment reliability.

The United Kingdom utilises the Construction (Design and Management) Regulations, also referred to as CDM 2015, which require risk evaluation in each phase of a construction project. According to the findings by Davenport (2018), risk management is another major strategy used by UK firms, and it entails contracts that clearly designate certain risks to certain entities. PPP projects have again focused on risk transfer strategies that aim at the UK, where private firms take certain degree risks in return for long-term ownership of the project. According to a study by Kloppenborg et al. (2019), the structured risk-sharing framework in UK PPP projects made the projects more stable and less likely to have conflicts.

Australia has one of the best forms of risk management provisions in the construction sector. According to the Australian standard AS/NZS 4360:2004 on risk management, there is a framework that should be used to handle risks from the time they are identified until the project is finished. Hubbard et al. (2007) see that managing safety risks has become critical for Australian construction firms; the main practices included a comprehensive worker training program, automated monitoring in safety, and documentation of risk, etc. When Integrated Project Delivery (IPD) delivery methods are used, stakeholders can work together more effectively throughout the different stages of a project. This takes away some of the uncertainty that comes with any project.

PRM practices in developing countries face numerous challenges, including inadequate law enforcement, insufficient funds, and a lack of risk management technologies. Rapid urbanisation and the development of various large-scale construction projects in China have led to varying approaches to risk management across different firms. Davenport (2018) established that currently many construction firms in China have continued to practice response strategies to address the risks affecting them instead of looking for preventive measures to eliminate them. One major issue from previously presented facts is that the rules for risk management in China are highly unsystematic, and every province has its requirements concerning this problem. Currently, there are occasions

where the government has set a series of strategies, for example, the National Construction Safety Risk Prevention Plan (2020-2025), to promote the application of standard PRM practice.

Although the construction industry in India is rapidly developing, it still faces certain risks, including financial risk management, supply-related risks, and the potential shortage of workforce. According to Davenport (2018), more than two-thirds of large construction ventures in India encounter cost overtures because of poor risk assessment and schedule of approvals. One recent trend in the development of infrastructure in India has been the concept of Public Private Partnership. What's still not clear, though, is the main problem with PPP projects: how the risks are shared. Private investors rarely agree to take on most of the risks when the government doesn't offer significant guarantees.

The challenges include geopolitical risks, the status of the labour market, and environmental risks, like elevated temperatures and sandstorms in the Middle East and North Africa (MENA) construction projects.

Kumar 's research with companies from the Gulf Cooperation Council (GCC) countries in 2008 showed that risk management had started, but it was still very new. A lot of companies do not yet have structured PRM frameworks in place. However, other mega-projects in the region, like the UAE's Expo 2020 Dubai and KSA's NEOM City, have followed PRM best practices, where the use of a digital risk profiler, operational monitoring tools, and a green risk management mechanism is integrated with sustainability.

Developed nations integrate sophisticated risk management structures, efficient risk modelling instruments, and contractual risk-based solutions. However, the lack of regulation poses greater problems for developing countries, even though more of them are embracing best practices in international PRM. New-wave PRM tools like BIM, AI, and IoT have enhanced the existing risks' outlook and management in both developed and emerging economies (Kendrick, 2003).

2.10 Future Research Directions in PRM

However, to improve the effectiveness of risk management in construction projects, more research is required in the external environment and culture-related fields. Innovations like AI and big data analytics can further enhance PRM, leading to better results. Researchers need to conduct further studies to better measure these risks using a constructive ML algorithm and historical project data. Jaafari et al. (2001) have found that the use of PRM models based in AI can improve the decision-making process; however, further research is required to determine the effectiveness of the approach. The building sector now uses Lean and Agile project management techniques yet continues to study their combination with PRM. Scientists need to find out if small risk updates and changes to response plans made as part of agile risk management make PRM work better when construction projects change quickly. Researchers must research how PRM handles climate-related threats to construction projects, including floods, environmental costs, and unsafe risk areas. Scientists have mostly studied PRM in infrastructure mega projects while missing important research about its use in home and workplace projects. The research should examine how different projects with types face risk management differently, including tall buildings, new energy systems, and intelligent cities (Hillson, 2017).

2.11 Research Gap Table

The table below summarises the research gaps identified in the existing literature reviewed in Chapter 2. It highlights the key contributions of previous studies, the limitations in their research, and how this study will address those gaps as shown in the Table 2.

Table 2: Research Gap

Author (Year)	Work Done	Gap in That Work	Strategies in this research plan ways to resolve this gap.
Ekechukwu et al. (2024)	The research analyzes failed risk prediction in large infrastructure projects.	The study concentrated on cost overruns except for comprehensive PRM implementation analysis.	The current research evaluates how PRM frameworks operate to prevent cost overruns in advance.
Hiller et al. (2006)	This research evaluated why European transportation projects experience budget overruns.	The evaluation omitted risk monitoring together with response strategies evaluations.	The research evaluates the role of continuous risk monitoring toward project success outcomes.
Hofstede et al. (2001)	The study conducted a survey to assess how well construction companies understood PRM practices.	This research failed to investigate in depth the main reasons behind the limited adoption of PRM systems.	The research examines the obstacles and reluctance that occurs during PRM deployment.
Hubbard et al. (2009)	The categories of PRM strategies include avoidance and transfer and mitigation and acceptance.	The research focused exclusively on Australian project work which reduces application to wider environments.	The research evaluates the adoption of PRM while examining global applications.
Ilori et al. (2024)	The study investigated how Building Information Modeling solutions are used for risk management purposes.	The study lacks depth when discussing how BIM could connect with existing PRM implementation methods.	The research evaluates current BIM implementation methods for PRM strategies.
Hillson (2002)	The study reveals PRM functions as a mechanism to protect against threats and extract maximum opportunities from the process.	The study failed to present evidence through empirical data which validated PRM effectiveness.	The authors will perform quantitative alongside qualitative research methods to measure PRM enactment.

Author (Year)	Work Done	Gap in That Work	Strategies in this research plan ways to resolve this gap.
Kumar (2008)	The research evaluated how construction risks are distributed in United Arab Emirates project sites.	These authors examined the distribution of risks without providing any analysis regarding proactive PRM approaches.	The research investigates the approaches used for risk distribution in addition to risk reduction techniques.
Kendrick (2003)	The study evaluated cost overruns which occurred during Indian infrastructure project development.	A thorough analysis of predictive risk tools to prevent budget exceeding was absent from the report.	The research will evaluate how AI systems predict risks.
Israel (2013)	The investigator performed a risk assessment case study analysis of UK construction projects.	The study investigated project-specific data that could not extend beyond its current parameters.	The research design includes several cases from diverse geographical areas.
Makori et al. (2011)	Used statistical methods to compare PRM effectiveness.	The study depended on data from past projects though it did not provide current risk monitoring capabilities.	This research includes IoT-based real-time risk monitoring throughout the project.
Gutschni g (2000)	Investigated stakeholder involvement in PRM.	The research failed to include digital technologies for coordinating stakeholders.	The research investigates digital teamwork tools meant to support PRM operations.
Kloppenb org et al. (2019)	British PPP projects underwent research to identify risk-sharing methods.	The analysis ignored operational risks alongside financial risks.	The investigation will analyze programming for both financial and operational PRM methods.
Kerzner (2013)	This study investigates PRM challenges as perceived by construction firms which operate in the market.	The research failed to provide explicit solutions which could solve barriers when implementing the PRM method.	The research presents actual solutions to solve Presenteeism-related problems.

Author (Year)	Work Done	Gap in That Work	Strategies in this research plan ways to resolve this gap.
Jaafari et al. (2001)	Investigated AI-driven risk forecasting.	The study used theoretical computer models without proving their effectiveness in actual industry implementations.	AI risk forecasting will be implemented in authentic construction scenarios during this research.
Hillson (2017)	Applied Chaos Theory to PRM in construction.	The study failed to demonstrate through empirical research how unpredictable events affect the effectiveness of PRM.	The research will present empirical examples which demonstrate Chaos Theory applications in PRM.
Elkington (1997)	Project risk allocation received new explanations through the use of Agency Theory.	The research failed to identify the effects principal-agent conflicts generate on PRM implementation.	The analysis determines the impact of risk-sharing contracts on agency conflicts between project stakeholders.
Freeman (1984)	Developed Contingency Theory for organizational risk management.	The research did not apply its theory to evaluate current construction risk situations in modern times.	The proposed research analyzes adaptive PRM techniques which follow the Contingency Theory framework.
Hillson (2007)	The analysis expanded project achievement elements to include factors exceeding cost, time and quality.	The study failed to make a direct correlation between PRM practice implementation and their corresponding success factors.	An analysis of how Project Risk Management affects modern success criteria such as sustainability will be conducted in this study.
Beal (2003)	His project success approach combined cost, time, quality elements into the	Risk management failed to emerge as a leading factor which determined project success.	The research project will unite PRM concepts with the existing

Author (Year)	Work Done	Gap in That Work	Strategies in this research plan ways to resolve this gap.
	"Iron Triangle" framework.		project success methodology.

This research plan fills important gaps from past research and explains how it will improve on them. Through this research design the project will combine multiple data collection techniques and live risk tracking tools to give a complete assessment of PRM performance.

3 RESEARCH METHODOLOGY

This chapter presents the research method that has been employed for analyzing the eventuality between PRM best practices and project success within large-scale construction schemes especially in developing countries including Pakistan. This study therefore adopts a technique that involves using both quantitative and qualitative data collection methods, survey and interviews. These were selected in order to have a proper grasp of how PRM influences the associated success factors dependent on the cost, time and quality factors, and to assess the contextual barriers and management of the construction industry. This chapter has been subdivided into three main parts namely: Research design, Data collection and Data analysis. This part deals with the methodology study and first part of data collection (Bosch-Rekveltdt, 2011).

3.1 Research Design

Research Approach

In as much as this study seeks to use both quantitative and qualitative research approaches, it will employ a mixed methods research design. This decision is in line with Creswell (2014) who states that the mixed methods research provides a combination of the numbers, details, and relationship. Therefore, the study employs convergent parallel design as espoused by Plano Clark and Ivankova (2016) to collect both quantitative data through surveys and qualitative data through interviews and analysis these separately before combining.

Purposively, the type of research adopted in this study relies on the pragmatic paradigm since its main concern is with the set objectives and questions posed in the study rather than the overall philosophy of the approach. Tashakkori and Teddlie (2010) argue that pragmatism is

suitable especially in large interrelated system, which is the case with construction projects that involve technical and human systems.

This will involve the use of both quantitative and qualitative data to increase reliability, given that they collect data from different sources to increase the validity of the outcomes (Greene et al., 1989). Where quantitative data present the level of relationship between PRM practices and project results statistically, qualitative data expand the understanding of the encountered issues and organizational approach towards PRM.

This approach is relevant in construction sector research because kind of research addresses the structured parameters (cost or time performance) & unstructured parameters (stakeholder dynamics). Yin (2018) rightly points out that while case study and survey strategies are as broad in some approaches in applied disciplines. This research uses both cross-sectional survey and interviews, which then combine quantitative data analysis and qualitative data analysis. Quantitative data let the researcher compare relationships between PRM practices and the level of a project success, while qualitative recreation gives detailed descriptions of practical application of PRM, authorities' limitations and organizational behavior with regard to PRM practices.

The strength of both methodologies is as follows:

Triangulation: Increases the validity of findings through the use of diverse data sources.

Complementarity: Enables a better understanding of quantitative outcomes through qualitative context.

Extent and Intensity: Quantitative techniques offer information in terms of quantity, and qualitative techniques offer information by going a bit deeper.

This approach is particularly suitable in construction projects because they are affected by technical and organisational factors and other regulations. This used approach in line with the pragmatic research

paradigm in the sense that it does not centre its approach to a specific philosophical point of view but on the resolution of problems that are experienced in the field. SPSS software is used to evaluate results. SPSS produce good report tables of the results.

Unit of Analysis

The unit of analysis in this research therefore is the project professional working for a construction company, firm, contractor or sub-contractor or any organization that is involved in large construction projects. These are the project managers, engineers, risk specialists and other senior executives who have practical experience in risk management. Unit of analysis selected for this study was chosen because gives an actual, real-life perception on PRM and how these strategies work out in a success or failure project scenario. By adopting the sample criteria based on the profession, rather than companies or organizations, the study covers a broad spectrum of perspectives depending on the projects and types of the projects undertaken (Carvalho, 2015).

Justification for Mixed-Methods Design

The research design utilizes mixed methods because this approach remains prevalent across construction management investigations (Creswell, 2014). Surveys based on numbers help researchers recognize connections while the method of interviews gives in-depth understanding about situations. The dual research method strengthens validity by combining approaches in a way that suits complex problems which require integration of technical measurements and understanding human situations such as PRM. Although performance measures are easy to define in terms of cost, time, and quality of the project, the practice and efficiency of risk management usually require cultural, leadership, and stakeholder management as well as external and regulatory environment factors.

Quantitative analysis: Determines the extent of positive relationship between PRM practices with success measures within a large population.

Qualitative analysis: Explores in depth the challenges, interpretations, and decisions behind PRM implementation from expert viewpoints.

These facets allow for not only for an understanding of the outcomes of PRM, but also the processes through which the results transpire in a multi-faceted project environment.



Figure 3.1: Research Process Diagram

3.2 Data Collection

Overview

The study gathered data in two phases. The quantitative data will, therefore, be collected by questionnaires, which will be administered to professionals that work in large-scale construction projects. Finally, the study will include qualitative data collected through a series of semi-structured interviews with a selected number of project professionals in order to acquire better understanding of the PRM application, and potential problem areas, and organisational environment. Both approaches used during the entire research process but were elaborated individually before the discussion part of research (Cooke, 2004).

Quantitative Data Collection: Surveys

Instrument Design

The measure used in the current survey comprised of two broad indices:

- Project Risk Management (5 items)
- Project Success (3 items)

The participants' attitude towards each statement was measured using Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The PRM scale covers statements in the area of risk identification, risk assessment, risk management techniques, risk monitoring and risk reporting. Self assessment as used in Survey took into account project success which was evaluated by measuring the rate of completion of the project within the stipulated time, cost influence and the quality achieved. The survey instrument originated from a review of recognized risk management models represented by PMI's PMBOK framework combined with ISO 31000 standards (Creswell, 2014). The survey questions introduced fundamental elements of PRM starting from risk identification going into assessment followed by response planning and concluding with monitoring plus communication. The project success indicators followed the classic "Iron Triangle" parameters between cost, time and quality (Carvalho, 2015). The survey participants answered using Likert scales for quantitative measurement. Semi-structured interview questions derived their content from the literature review themes. These covered topics such as organisational risk culture, barriers to PRM adoption, effectiveness of current risk tools, and stakeholder coordination. Prior to using the questions for data collection two industry professionals evaluated their clarity and their relevance to the research study. Thus, the instruments for the survey were based on identified all existent theories and models such as PMI's Risk Management Model or Beal's Project Success Model. These questions were initially pre-tested to the working population to ensure that they are well understood and applicable before they are made for operational use.

Sample Size and Sampling Method

A total of 164 respondents' responses out of the overall target respondents were used after employing purposive sampling technique. The target population of the study comprised of professionals working in large construction projects in Pakistan. Participants were selected based on:

- Their involvement in project execution or management.
- A minimum of 3 years of experience in the construction sector.
- Availability and consent to participate.

Convenience sampling was used in order to select only those who have the proper experience in the matter at hand and this in a large extent adds to the validity of the data acquired.

Access and Distribution

It was conducted through making a Google questionnaire, LinkedIn and some of the construction forums. Specifically, emailed invitations were sent to contacts in the industry, and project managers were asked to forward the form to their acquaintances (chain sampling). This guaranteed anonymity and participants were told that they were free to participate in the study. The academic institution approved the participants' consent via ethical clearance before data collection was conducted (Danilovic, 2007).

Ethical Considerations

All the participants signed a consent form and an assurance of confidentiality was given to all the participants. All the data collected were ensured to be anonymous and were kept secure. All the research findings reported in this study did not use any identification information relating to the respondents. As for the concern of participant withdrawal the participants were free to withdraw themselves at will at any time of the research process.

Qualitative Data Collection: Interviews

Rationale for Interviews

Despite the fact that the survey provided the quantitative data concerning the PRM practices and their impact, it also has limitations for generalizing or describing the contextual and experiential character of risk management in large-scale construction projects. Thus, semi-structured interviews were used in order to provide qualitative data in addition to the results of the questionnaires. This sort of qualitative approach enabled identification of not only that and when PRM strategies work or not, but also why they do so (Davies, 2014). In particular, interview information was most helpful in:

- Organisational dynamics influencing PRM.
- Challenges faced during implementation.
- Variations in practice across project types.
- Stakeholder perceptions and communication patterns.

Interview Guide Development

The interview questions and prompts for each interview were as following, which were formulated after the literature review of the survey. The questions were grouped into four key subject areas:

PRM: Knowledge of how risk is recognized and assessed

Implementation practices: what ways are employed?

Challenges: Challenges that affect the implementation of PRM.

About success: There are various factors that cause a change in the definition of success and affect it (Ackermann, 2014).

Sampling and Participants

All in all, the interviews were carried out with 23 practising professionals in different positions.

- Senior project managers
- Construction engineers

- PRM specialists
- Government planning officers

Some of the participants were into constructions such as bridges and roads, energy especially solar and wind projects as well as construction of houses and business facilities. The sample was purposive, participating persons had to have a minimum of five years' experience in managing or consulting on risk in large scale project. Another form ofve used was the snowball technique, and this was due to the fact that the participants used referrals from within their reach. The sample involved respondents from different provinces of Pakistan, with a view of capturing the effects of regional regulations and types of projects (Danilovic, 2007).

Access and Process

Recruiting participants was done through professional channel including; LinkedIn, construction forums, and email invitation. All interviews were administered via Zoom or Microsoft Teams because of pragmatics and participants' convenience. The sessions took about 45–60 minutes for each participation and all the conversations were recorded with verbal permission. Interviews were also conducted, and notes were made when the respondents were answering the questions. Further, all participants signed informed consent wherein they were informed about the aim of this research and their option to withdraw from the research on any given time.

Ethical Considerations for Interviews

Special attention was paid to volunteers so that informed consent was obtained before the end of the experiment was administered. Participant details and any other information that could identify them were not revealed during the interview; they were referred to by number (Interviewee 1, Interviewee 2, & Interviewee 3). All calls made were recorded and all such recordings were kept safely. This was followed by offering the transcripts to the participants for their review before coding

since many participants requested for their transcripts to be returned in order to check the accuracy of the accounts they provided (Antoniadis, 2011).

4 ANALYSIS

In this study, different procedures were used in analyzing the quantitative and qualitative data, and they both were integrated at the analysis stage in the discussion section of the study.

4.1 Quantitative Data Analysis

Tools and Techniques

The collected data from the survey was quantitative, which was of the following, and was analyzed using **SPSS** (Statistical Package for the Social Sciences). The analysis followed these steps:

Exploratory Analysis: In order to determine the overall demographic percentages and response pattern of the respondents.

Reliability Testing: Cronbach's Alpha was used to evaluate the level of internal consistency.

Method of Analysis: Pearson coefficient test aimed to determine the significant relationship between PRM practices and the aspects concerning project success.

Variable Operationalisation

Two main constructs were measured:

PRM: Consists of five sub-processes; that is, risk identification, risk analysis, risk evaluation or risk control, risk monitoring, and risk reporting.

Scope – It involves three aspects cost control, timely delivery and quality.

The tool used in the study comprised of multiple items for which the respondents used a 5-point Likert scale whose extremes are Strongly Disagree (1) and Strongly Agree (5). In this respect, the scores for each construct were obtained through summing the items (Aven, 2011).

Reliability Analysis

Reliability tests showed:

PRM: Cronbach's Alpha = 0.822

Project Success: Cronbach's Alpha = 0.719

These results show reasonable coefficient alpha this means that these constructs can be used for other analysis. The complete table is shown in the analysis

Descriptive Statistics

Table summaries showed:

PRM: Mean = 17.69, SD = 2.56

The intent of this project was to: Mean = 9.71, SD = 1.42

These averages imply that majority of the respondents had moderate to high activity levels in their PRM and the overall project experiences can be considered as successful. However, the standard deviations are also indicating variation at the point of practice and perception.

Correlation Analysis

Specifically, Pearson correlation test was used in an attempt to compare the relationship between PRM and Project Success with a result of correlation coefficient equal to 0.608 ($p < 0.01$). Such moderate to strong positive association evidence that the improvement of PRM practices is statistically related to the success of projects. It shows that risk management has a positive effect it on the achievement of project objectives even though, causality cannot be deduced.

4.2 Qualitative Data Analysis

Thematic Analysis Framework

To analyse the qualitative data collected, thematic analysis was adopted using the guidelines as described by Braun and Clarke (2006) in six phases. Re-reading the transcripts in order to become familiar with the data collected during research process. Initial coding of key ideas, phrases, and expressions. Generating themes by grouping related codes (Baccarini, 1996). Checking on the themes to conform to the research questions. From these observation, it was possible to define and name its themes correctly. Writing up findings with illustrative quotes. The data sources were managed, codes assigned and data relationship displayed by using the NVivo software.

Emergent Themes

Three main themes emerged:

1. Challenges in Implementing PRM Regulatory uncertainty
 - Environmental constraints
 - Project complexity and stakeholder coordination
2. Commonly Used PRM Practices
 - Risk assessment and prioritisation
 - Stakeholder communication and collaboration
 - Use of technology (e.g., BIM, scheduling tools)
3. Factors Influencing PRM Adoption
 - Organisational culture and leadership
 - Project type and complexity
 - Regulatory and legal context (Boateng, 2015).

These themes offered a better understanding of how and why PRM practices are implemented, also on their effectiveness perceived by entities involved in the project (Boateng, 2015).

Integration of Quantitative and Qualitative Data (Triangulation)

To achieve an improved understanding of the research question regarding the place and role of PRM in large-scale construction projects, the findings from both the quantitative and qualitative investigations were combined through the triangulation process. Triangulation forms a technique of improving credibility, validity, and depth in the mixed-methods approach. The results showed that there was significance between the PRM practices and success of project with coefficient of 0.608. That is to say there is a right relationship between proper risk management and improvement of the project results. Yet, it does not what, thus if the concepts of potency and act as well as the act itself refer to anything at all, it becomes clear that reason provides causal explanations for things made by human reason. Thus, the interviews complemented this knowledge by showing how risk management is done, the problems faced, and how, or to what extent, PRM enhances, or does not enhance, tech firm's success.

Examples of Convergence and Complementarity

According to the results of the interviews, regulatory issues remain one of the biggest challenges to achieving good PRM. This was seen to be in concordance with the survey results which revealed regulatory difficulties as one of the most cited impediments to project performance. This is in support of the other part of the survey which showed that stakeholder communication and collaboration was among the most adopted PRM strategies as mentioned by the interviewees. Concerning the threats' identification and monitoring, the use of the technologies like BIM or the software for the risk tracking was also mentioned in the interviews that matched the survey results where these practices were evaluated as highly effective. This integration allowed the researcher to not only establish the extent that success influenced PRM but also describe the qualitative aspects of their inter-linkage (Verbraeck, 2011).

4.3 Justification of Analytical Tools

Quantitative Tools

SPSS was preferred as it is highly recommended for the processing of survey data and basic as well as the advanced statistical tests. Demographic and variable distributions were reported using descriptive statistics. Thus, applying Pearson's coefficient assisted in deciding the direction and strength of the relationship for PRM and the project success. In order to confirm the internal reliability of the survey instruments, Cronbach's Alpha was used and it was determined that all the survey items measured the intended concepts as intended.

Qualitative Tools

This work of NVivo refers to the capability of the software chose to help sort out the interview transcripts effectively. This made it possible to categorise themes and the words themselves, identify frequencies as well as relationship and flow of narratives. According to Braun and Clarke's method, the different and specific phases promoted methodological rigour by determining, evaluating, and refining the themes concerning with the objectives of the study systematically.

4.4 Validity, Reliability, and Trustworthiness

Maintaining its validity and reliability was especially important for the research process because of the use of mixed methods.

Quantitative Validity and Reliability

The content validity was determined through literature and project management theories to ensure that the items used in the questionnaire are relevant. Structural validity was established by the positive coefficients and the Cronbach Alpha coefficient more than 0.70 showed internal consistency (Carvalho, 2015). Use of correlation coefficients

gave some confidence on the observed relationships given by statistical significance at $p < 0.01$ level.

Qualitative Trustworthiness

The following are approaches used to warrant credibility of the data gained from the qualitative study:

Sampling: Expert opinion was used for carrying out the sampling to ensure a high validity of the results.

Data Collection: Being a qualitative study, data was collected by using interviews and questionnaires of actual transcripts were taken to be used in the study since they contained full and detailed information.

Reliability: Achieved by taking notes, using interviews with similar sets of questions and questions that were clear and understandable to the interviewee.

Transferability: Use of detailed descriptions of the contexts as well as the participants makes the readers to generalize the results to other scenarios.

Confirmability: Carried out through Data triangulation and Reflexive journaling during the analysis.

4.5 Methodological Limitations

Nevertheless, it is critical to note the following limitations in the strategy that has been chosen:

Sampling Bias

While purposive and snowball sampling captured the right type of participants, it diminished the sample's heterogeneity. However, a large and random sample may be the best way for increased generalisability in future studies (Cooke, 2004).

Self-Reported Data

Respondents to the questions in the interviews were likely to provide answers that presented the intended message in a positive light thus the possibility of response bias or social desirability bias crept in. However, since the participants were promised anonymity and confidentiality, this may have in a way influenced the results to portray the most favorable image of themselves or their organizations.

Context-Specific Focus

The study focuses on the Pakistani construction sector and the findings and conclusions made may not be quite applicable for other geographical market segments or other industries. It is important to note that the role of regulations and socio-political factors are dissimilar to the PRM practices and its results in different countries.

Time and Resource Constraints

If time winning could be afforded, then it would have been possible to conduct assessments of the project performance over a given period of time. The study only entailed the collection of cross-sectional data that gives only a one-time not temporal analysis of the study variables. In spite of such limitations, the study provides valid, relevant, and practical information that holds new knowledge value both theoretically and practically (Cooke, 2004).

Limitations

Survey Limitations

Yet, when it comes to sharing the effective results, it is possible to note Some limitations of the survey must be mentioned:

- **Self-reporting bias:** The respondents may have gave socially appropriate answers because there was no verification from third party audits on the completed projects.
- **Sampling bias:** Potential sampling bias that has been used as the method of choosing a sample means that the results may not be generalizable to the entire population.

- **Limitations:** The data provided is exclusive of the construction sector in Pakistan, therefore has restricted generalization of the results in other parts.

Still, restrictions like these make it possible to perform a statistical analysis: there are enough respondents (46) and enough diversity in their positions (engineers, managers, specialists).

Limitations of the Interview Phase

Nonetheless, it found some limitations in the qualitative part:

- **Interview limitations:** There were some time constraints involved in the interviews due to the interest of the participants.
- **Implications or respondent bias:** Some of the respondents may have been reluctant to comment openly on their organisation or practices.
- **Generalizability:** The findings established in the research are site-specific and may not hold for any construction project and/or in any geographical location.

Still, sample integration with the survey data increases the validity and quality of the qualitative data collected.

5 RESULTS

The goal is to determine whether how Project Risk Management (PRM) is handled influences project effectiveness in large-scale construction work. The data is analyzed with SPSS for statistics and NVivo for thematic coding to obtain a complete summary. The following chapter will rely on these results for its detailed discussion and explanation.

5.1 Summary of the Survey Responses

Table 3: Summary of the Survey Responses

	N	Minimu m	Maximu m	Su m	Mea n	Std. Deviation
Gender	164	1	2	237	1.45	.499
Material Status	164	1	2	225	1.37	.485
Educational Field	164	1	4	415	2.53	.580
PRM1	164	1	5	664	4.05	.892
PRM2	164	1	5	704	4.29	.767
PRM3	164	2	5	707	4.31	.740
PRM4	164	1	5	688	4.20	.742
PRM5	164	1	5	692	4.22	.829
PS1	164	2	5	673	4.10	.723
PS2	164	2	5	693	4.23	.770
PS3	164	1	5	679	4.14	.790
ProjectRisk Managemen t	164	7.60	21.00	290 1.40	17.69 15	2.56100
ProjectSuc cess	164	4.67	11.67	159 2.33	9.709 3	1.41670
Valid (listwise)	N 164					

5.2 Frequency Analysis

Table 4: Gender

	Frequency	Percent
Male	91	55.5
Female	73	44.5
Total	164	100.0

Table 3 in the frequency analysis shows how many male and female respondents participated in the research sample. A total of 164 participants included 91 males who represented 55.5% while the female participants numbered 73 and made up 44.5% of the sample. The male participants outnumber females as shown by this distribution so the sample displays balanced gender representation except for a small male respondent surplus.

Table 5: Education

	Frequency	Percent
Inter	2	1.2
Graduation	78	47.6
M.Phil.	79	48.2
PhD	5	3.0
Total	164	100.0

Data regarding education levels of participants comes from Table 4. M.Phil. education was the most popular educational qualification among 79 participants which represented 48.2% of the total sample size and graduation programs were next in line with 78 participants comprising 47.6% of the respondents. Two participants made up the number of

respondents with intermediate education (1.2%) but the total number of individuals with a PhD was only five (3.0%). Most respondents possess elevated educational attainment because many of them possess M.Phil degrees and similar advanced qualifications. The high educational background of the participants will contribute advanced expertise and technical abilities to the study particularly during discussions regarding project risk management and project success.

5.3 Descriptive Analysis

Table 6: Descriptive

	Minimu m	Maximu m	Mean	Std. Deviation
Project RiskManagem ent	7.60	21.00	17.691 5	2.56100
Project Success	4.67	11.67	9.7093	1.41670

The research data from Project Risk Management and Project Success appears in Table 5. Project Risk Management receives an average score of 17.6915 points which is characterized by a standard deviation level of 2.56100. The collected responses spread from 7.60 to 21.00 with a moderate interpretation of data distribution. On average respondents score project risk management practices well although the large standard deviation reveals diverse ratings from participants regarding risk management in their projects. The responses in the Project Success dimension show high agreement because the mean score is 9.7093 and the standard deviation is 1.41670 with a response scale from 4.67 to 11.67. The survey data shows that project success meets a broad acceptance from respondents because the ratings display reduced variation when compared to Project Risk Management evaluations. People rate project success at 9.7093 on average yet responses differ

across the spectrum on what defines success in managed or participated projects.

5.4 Reliability

Table 7: Reliability

	Items	Cronbach Alpha
Project Risk Management	5	.822
Project Success	3	.719

A reliability analysis was performed on Project Risk Management and Project Success dimensions through Table 6. Project Risk Management shows excellent internal consistency in this study because its Cronbach alpha figure stands at 0.822. The assessment items for project risk management display excellent correlation among them along with strong reliability to measure their targeted concept. Project Success shows an acceptable reliability level through its Cronbach alpha value of 0.719. The study measures exhibit reliability according to accepted standards of 0.70 or higher so researchers can continue analysing these instruments.

5.5 Correlation

Table 8: Correlation

		Project RiskManag ement	Project Suc cess
Project Risk Manag ement	Pearson	1	.608**
	Correlat ion		
	Sig. (2- tailed)		.000
	N	164	164
Project Success	Pearson	.608**	1
	Correlat ion		
	Sig. (2- tailed)	.000	
	N	164	164
** . Correlation is significant at the 0.01 level (2-tailed).			

Project Risk Management has shown a weak positive relationship with Project Success according to Table 7. The assessment of project risk management along with its effects on project success reflects a moderate positive correlation based on a Pearson coefficient value of 0.608. A statistical significance at $p < 0.001$ level confirmed that this relationship would not exist randomly. Better risk management practices lead to improved project success levels thus demonstrating effective risk control to be essential for project achievement. Research findings demonstrate how risk management functions as a fundamental outcome factor for projects thus validating project planning systems that incorporate risk reduction methods.

5.6 PRM Practice by Emergent Themes

Theme 1: Challenges in Implementing PRM in Large-Scale Construction Projects

The initial theme within interview responses dealt with different obstacles faced during Project Risk Management (PRM) strategy deployment in big construction projects. The interview participants often discussed the difficulties that stem from regulatory uncertainties together with environmental limitations along with complex project management needs of large-scale projects. Issues that limit PRM strategy effectiveness produce trouble with risk management which can result in project failures or high project expenses.

Regulatory Uncertainties

Large-scale construction projects frequently encounter regulatory uncertainties that prove to be the main obstacle for the successful deployment of effective PRM strategies. The participants representing multiple construction fields such as renewable energy and infrastructure alongside residential construction demonstrated their worries about nonpredictable government policies and regulatory requirements. The changes in zoning laws along with tax incentives and environmental regulations cause projects to face budget overruns and delayed schedules according to interviewees.

Large facilities that produce renewable power through solar and wind technologies face the greatest risk when regulatory frameworks modify. These development initiatives depend substantially on government-supported incentives with tax benefits together with financial subsidies but these resources remain subject to policymaker changes. A project interviewee faced months of delay after government tax policies changed their green energy incentive programs. Project profitability together with extended delivery times suffers severely when project delays join forces with rising expenses.

Complexities with regulatory compliance become more challenging because laws in certain areas frequently change unpredictably. The rigorous process of compliance enforcement for large building initiatives involving multiple regulations including zoning codes as well as building standards and environmental requirements demands ongoing monitoring and financial resources. Accompanying construction projects are instances when unexpected modifications to local rules inconvenience project execution. Risk assessments must be done in advance through legal guidance combined with regulatory environment analysis so projects can create flexible timelines that delay potential complications.

Regulatory uncertainty generates stakeholder conflicts because different groups understand changes in policies differently according to an interviewee. Delays in decision-making occur because of this friction between project teams and external regulatory bodies which hinders their risk mitigation capacity. The implementation of PRM in large-scale construction projects faces major difficulties due to changes in regulatory framework affecting both policies and zoning regulations and environmental regulations.

Environmental Constraints

The interviews discovered environmental constraints as a major obstacle because large-scale development projects both require natural resources along with habitat protection requirements. Several professionals in renewable energy operations reported that unpredictable weather together with environmental factors disrupted project schedules while pushing up project expenses.

A participant mentioned that unexpected storms and heavy rainfall badly affected wind farm construction thereby causing multiple-months delays to project schedules. The construction of solar energy plants experiences difficulties reaching energy targets when winter months extend periods without sufficient sunlight according to interviewees. Beyond project

management team control these environmental factors develop major barriers toward schedule and budget adherence.

Environmental impact assessments alongside other key elements both affect the risk management process according to the interviewees. The management of many construction sites that operate in environmentally significant areas needs to complete extensive EIAs to get approval for starting work. The assessment process takes both money and significant amounts of time which leads to prolonged delays before approval can be obtained thus creating major project delays. The EIA process sometimes leads to substantial project plan alterations which requires designers to carry out plan redesigns while raising construction expenses and stretching project duration.

Fresh control pressure from environment authorities and local populations now distinguishes itself as a critical challenge for operators who seek to minimize construction emissions. Soil erosion combined with pollution and detrimental impact on wildlife habitats have become serious issues that developers must address in their projects. The execution of sustainable construction practices typically requires further resources and so does the time needed for compliance purposes. When projects fail to address environmental challenges properly they experience reputation harm as well as legal issues along with dissatisfied stakeholders. Environmental constraints that include unpredictable weather and complex regulatory requirements need proper risk management through effective Public Risk Management strategies to ensure successful endeavours.

Project complexity and stakeholder coordination

Implementing PRM strategies with effectiveness proved challenging because of the complex nature experienced in large-scale construction exercises. The interview subjects highlighted enormous dimensions in these projects involving vast numbers of partners and advanced supply networks coupled with major funding requirements. The multitude of complexity creates obstacles when identifying risks as

well as assessing and mitigating them which hampers the coordination of diverse teams along with information management between stakeholders.

All stakeholders representing project owners and government agencies together with contractors and subcontractors face extensive challenges when trying to make their interests and expectations match. A larger project involves multiple stakeholders thus increasing the probability of delayed undertakings and miscommunication and conflicting requirements. The interviewees mentioned actual cases of stakeholder mismatch which led projects to experience budget increases and project duration delays. A large infrastructure venture experienced prolonged delays through the prolonged dispute between local authorities and construction staff about land acquisition processes.

The logistical management of resources together with team coordination in large construction works presented itself as a primary challenge according to multiple participants. Insufficient planning combined with limited communication becomes problematic when working with projects of this scale according to multiple participants. A high number of operational elements starting with material procurement and supply chain management and including labour staffing and subcontractor coordination makes it extremely difficult to maintain project progression.

The identification along with the mitigation of risks becomes more difficult for larger projects because of their substantial size. The bigger the project scope makes it harder to identify all possible risks particularly during implementation of new technologies or methods according to interview participants. Predicting how new construction methods and advanced technologies behave within existing project systems becomes difficult when implementing them because their interaction remains unclear as well as their possible risks to the project. Immense projects require prolonged timelines which gives risks a greater opportunity to occur and worsen. The sophistication of PRM strategies necessary to

protect larger projects increases in proportion to their complexities. Big projects that demand considerable financial investment create multiple management problems along with their complexities.

Project managers should carefully analyse potential risks because financial stakes require avoidance of cost overruns to achieve a positive return on investment. Budget control and cost management receive increased attention that reduces availability of resources for essential safety and environmental risk management tasks. Large-scale constructions managed through adequate PRM practices become necessary due to their complex combination of diverse stakeholders and complicated logistics and substantial monetary expenditures.

Theme 2: PRM Practices Commonly Used in Large-Scale Construction Projects

The analysis shows that the PRM practices employed routinely during large-scale construction projects make up the second main theme. The interviewees shared their knowledge about the particular strategies together with tools that are both broadly used and efficient for risk management in these projects.

Risk Assessment and Prioritization

Most interviewees confirmed that risk assessment along with framework-based prioritization stands as a primary PRM practice. Project risk assessments performed during the early project phase help companies discover major potential hazards so they can manage resources specifically for crucial risk mitigation. Participants indicated that their teams utilized two types of risk analysis methods which allowed them to identify hazards according to their probability and harm potential. Project managers through this approach identify how to distribute their resources wisely and create precise mitigation plans.

Stakeholder Communication and Collaboration

The interviews demonstrated stakeholder communication and collaboration as a fundamental practice among different participants.

Large construction activities rely on active collaboration between various stakeholders comprising government institutions and contractors together with suppliers and local population members. The management of risks requires smooth communication between all stakeholders because this allows prompt detection of problems while keeping stakeholders focused on project goals. The interview subjects declared standard assembly conferences with clear report transmissions and collective decision procedures as vital elements of PRM execution success.

Use of Technology in PRM

Multiple sources highlighted the importance of technology in PRM practices. Project scheduling software together with risk management software and building information modelling (BIM) enable construction stakeholders to handle large-scale building projects by improving management complexities. Building information modelling (BIM) along with other project management tools allow supervisors to uphold progress records while predicting vulnerabilities before site visitors receive updated reports. Integrating technological solutions into project risk management was perceived as an approach to boost decision-making processes while making risks more visible.

Theme 3: Factors Influencing the Adoption of PRM in Large-Scale Construction Projects

The third major analytical finding examined external and internal items that shape the adoption and implementation processes for PRM in comprehensive construction initiatives. Different internal company factors and external environmental conditions determine the degree to which PRM practices get adopted for successful implementation.

Organizational Culture and Leadership

Several interview respondents indicated that organizational culture together with leadership practices strongly influence how PRM practices are taken up. Organizations with a dedicated risk management culture

led by leaders focused on seeking and addressing risks in advance will achieve better results with PRM implementation. The implementation of PRM practices faces obstacles when performed by organizations that have limited experience and dedicated focus on risk management.

Project Type and Complexity

The complexity together with the type of project emerged as vital elements for deciding PRM adoption decisions. The level of complexity in project objectives determines the need for advanced and specialized Project Risk Management practices particularly in infrastructure development or technology implementation. Small projects generally need limited formalized risk management therefore they employ fewer PRM practices. The size of a project determines which PRM practices will be needed because bigger and more complex projects need advanced risk management methods.

6 DISCUSSION

Thus, the objective of this research was to assess the effect of PRM practices on the Large Scale Construction Projects as a case of developing country; Pakistan. This research was conceived due to the growing number of complex construction projects, increasing costs of project failure, and variations within the application of Risk Management techniques contextually in construction projects. The study adopted a quantitative survey with 164 participants and qualitative interviews with 23 participants so that the study successfully identified the existence of PRM, enriched by the description of participants' experiences in their work environment (Boateng, 2015).

6.1 Key Findings and Interpretation

Implementation of PRM Practices

The assessment also revealed that PRM practices are practiced to a moderate to a wide extent in construction projects. The average PRM score of 17.69 out of 25 therefore indicates that project teams do undertake activities of identification, analysis, and monitoring of risk factors, the latter brought out the idea that these practices are not uniform across organisations and across the project types.

For instance, some aspects of construction structures like roads and bridges had better formality in the risk management processes as compared with the small scale commercial or residential building construction projects that exhibited fewer formality in the PRM. This gives an implication on how scale, complexity, and regulatory risks affect risk management approach – ideas supported in contingency-based theories.

Relationship Between PRM and Project Success

There was a moderate-to-strong positive relationship between the internal PRM practices and project success where project budget, schedule, and quality compliance had a positive correlation with the internal PRM practices where they had a correlation coefficient of 0.608 and p-value of less than 0.01. This was supported by the quantitative survey results, whereby interviewees elevated relationship between effective PRM and decision-making, less redo and superior customer satisfaction. By looking at the results of the study, one cannot still argue that risk management is just an ambition of an organization but rather a tool that works given that it is effectively embraced. However, this is all predicated upon when and how PRM is introduced into the planning process and the support culture within the organisation.

Challenges in Implementing PRM

The qualitative data illuminated several key challenges that impede the successful implementation of PRM in large-scale projects:

Regulatory uncertainty: There emerged concerns of environmental changes, zoning regulations, as well as incentives as key disruptors as well.

Environmental factors: Besides that, several environmental factors came into play in the chaos that restricted the schedules and budgets.

Lack of co-ordination among stakeholders: Employment of several contractors and government departments, communities sometimes results in difficulty and disagreement on the goal (Aven, 2011). These challenges result in reduced efficiency of PRM tools and indicate that there is a strong relationship between contextual and environmental change and program performance.

Factors Influencing PRM Adoption

The research outline found out some independent variables that enhance the implementation of PRM strategies:

Organisational culture and leadership: Based on risk management, those companies that have adopted effective organisational culture and good leadership were inclined towards proactive management of risks.

Project type and complexity: It was observed that infrastructure as well as the energy projects had well-established PRM systems in comparison with low-complexity residential projects.

Technological integration: Technological integration: texts highlighting the effective use of technologies, for instance the use of Building Information Modelling (BIM) as well as the application of risk tracking software enhanced risk identification and decision making processes. These provide evidence on the Resource-Based View (RBV) postulates which posit that internal resources, such as leadership, technology, and knowledge shape the strategy.

6.2 Theoretical Contributions

The following is a list of the research contributions that relate to the existing academic literature in project risk management:

External supports the above assertion on contingency theory; PRM cannot be implemented independently of outside conditions and inside states of affairs. PRM has not only its effectiveness ranging from low to higher level but also depends on the type of projects that are being implemented (Baccarini, 1996).

Validity of the RBV hypothesis: The study supports this hypothesis by establishing that internal resources applied in risk management were composed of technological capabilities and leadership skills. This brings about RBV in light of internal competencies and supports the thesis on competitive advantage.

Mixed-Methods Contribution In this case, the study contributes to the methodological literature on mixed methods in this way; applies correlation analysis together with the thematic analysis of data from two

surveys: foragers' and farmers' data; shows that the mixing of methods generates richer insights that lead to more practical knowledge of the relationships between the two groups of people.

Sector-Specific Insight: Although many earlier empirical studies of PRM have been carried out in IT and manufacturing industries, there has been limited research activity with respect to the construction industry of developing countries, indicating the importance of the current research.

This research study supports the hypothesis that the project risk management is significant influential factor for success of large scale construction projects. As it concerns PRM implementation it can be discovered that its efficiency is influenced by the internal and external factors. It was established that PRM has a positive effect on project success and at the same time identified the weaknesses and complex nature to be addressed to enhance this relationship.

This research enriches the contingency and resource-based perspectives on PRM and includes recommendations for enhancing its application too. Last, it reveals the strategy for flexible, effective and technology integrated risk management for construction that can adapt to the modern environment.

6.3 Managerial Implications

The following are the implications drawn from the study to be of use to the practitioners in the construction sector:

Implementation of the PRM: A checklist could not work for all. Managing risk requires that frameworks that are put in place should depend on factors such as the type of project, size, or whether it is a complex project.

Improve the communication with stakeholders: Understanding and proactive involvement of stakeholders leads to probable delays and

going over the planned budget. Openness of communication and initial synchronization are highly valuable.

Introduce newer technologies: Information Technology, Building Information Modeling, scheduling, and other tools enhance risk management and planning.

Institutionalization: training, leadership endorsement and risk audits as components of risk management can go a long way in having an organization embrace risk management.

Monitor Risks Continuously: Risk evaluation changes when it comes to the project life cycle. There is a high need to monitor and readjust the risks for effectiveness in the long run (Aven, 2011).

7 Conclusion

The research focused on investigating the effects of Project Risk Management (PRM) on large-scale construction projects in Pakistan. The researchers collected data from surveys given to 164 individuals and interviews done with 23 people. As a result of this analysis, it is evident that the effectiveness of risk management greatly affects the success of a large-scale construction project. As long as challenges like rules, weather, and eliminating roadblocks to cooperation exist, introducing PRM strategies in the workflow can boost the chances of success. Collaboration with key stakeholders, reinforcement of company leadership, and support for technology allow organizations to control risks and drive project progress. The results of this research can be used to make improvements in the field of PRM for construction companies in developing countries such as Pakistan.

7.1 Strengths and Limitations of the Study

Mixed-method: Made generalisation and contextuality possible at the same time.

Variety of professionals: The variation in the project type involvement of sample participants and their geographical locations improved the quality of data collected.

Theoretical development: As for evaluation analysis, it was based on theoretical frameworks like Contingency Theory and RBV.

Non-random sampling: It may reduce the possibility of answering questions posed at the start of this paper specifically, how participation in online construction forums impacts students' construction-related knowledge – at a broader level by confining the survey respondents to the participants of this forum only.

Nonetheless the study is a cross-sectional one; it does not reflect on how risk management is practiced or how outcomes are derived over a period.

Subjectivity bias: Bias was also a major concern in relation to data collection through surveys and interviews whereby respondents might give/create their own opinion of their situation.

However, these limitations do not underestimate the reliability of the study as it gives a worthy evaluation of PRM in construction project success (Antoniadis, 2011).

7.2 Suggestions for Future Research

These suggestions can be generalised as follows to come up with the following research recommendations:

PMR Practice: Future research could in turn follow the PRM practices and the status of the projects in times forward to capture their synchronicity.

Comparative Analysis: Conducting an analysis of the risk practices in different countries or between the public and private projects may be informative.

AREA FOR FURTHER RESEARCH: Technology from the context of this paper comprises of AI and IoT; it would be useful to delve deeper into how these technologies affect PRM.

PRM Systems in Crisis and Uncertain Environment: What strategies are implemented during socio-political instabilities such as pandemics? Other subject areas for further research could include finding methods that allow staff and programmes to mitigate risk.

Thus, to gauge the state of PRM practices, PRM maturity models might be useful in defining the maturity levels within organisations involved in the industry (Ackermann, 2014).

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APPENDICES

Appendix 1: List of Definitions

To enhance understanding in this research, the following definitions of important terms in relation to project risk management and construction project success are provided.

Project Risk Management (PRM)

PRM stands for identifying, among others, the risks and factors that can threaten the achievement of project goals and managing them (Davenport, 2018). It is a systematic approach to reduce the variability and improve the decision-making process in the project life cycle.

Risk Identification

The activity involves identifying hazards that might influence a construction project in terms of financial, technical, environmental, or operational aspects (Dey, 2004).

Risk Assessment

The process involves the general categorization of such risks in terms of their potential occurrence and its probable effect on the success factors, including cost, time, and quality (Davenport, 2018). It is useful in ranking risks and identifying the best approach to reduce them.

Risk Mitigation

This is the neutralisation of measures that may pose potential risks in entrepreneurship or ways of averting risks that may prevail in business. The process involves developing backup strategies, changes in resource availability, and provisions for contractual clauses (Ekechukwu, 2024).

Risk Monitoring

The process involves the monitoring and evaluation of identified risks, as well as the identification of other risks, during the implementation stage of a given project. Risk monitoring can be defined as a procedure

that confirms that risk management strategies and models have been effective as well as ensuring that there is a constant update to make them more effective (Freeman, 1984).

Project Success

In assessing project success in this study, three questions that relate to the accomplishment of project objectives are used to provide the success criteria.

Cost management:

This is another success factor that helps in completing the project within the given spending plan.

Timely Completion:

Delivering the project within the planned schedule.

Quality assurance:

It means fulfilling the set conditions, demands, specifications, and other requirements that are required as a standard (Ekechukwu, 2024).

APPENDIX 2: RESEARCH SURVEY QUESTIONNAIRE

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

Project Risk Management						
PRM1	Our team holds dedicated planning meetings to develop the risk management plan.	1	2	3	4	5
PRM2	We develop a Risk Breakdown Structure (RBS) to define risk categories.	1	2	3	4	5
PRM3	We estimate resources/costs for risk management activities and include them in the project budget.	1	2	3	4	5
PRM4	Risk management activities are clearly defined and included in the project schedule.	1	2	3	4	5
PRM5	We develop probability and impact scales specific to each project objective.	1	2	3	4	5
Project Success						
PS1	Project milestones are consistently achieved within planned timelines	1	2	3	4	5
PS2	Schedule variance is systematically tracked and corrected through buffer management	1	2	3	4	5
PS3	Critical path activities receive prioritized resource allocation without delays	1	2	3	4	5

Appendix 3: Interview Guide for Research Questions

RQ 2: What are the challenges associated with implementing PRM in large-scale construction projects?

1. In your experience, what are the primary challenges faced when implementing PRM strategies in large-scale construction projects?
2. How do regulatory changes impact the application of PRM practices in large-scale construction projects?
3. Can you describe any specific risks associated with project size or complexity that complicate the implementation of PRM?
4. How does project scheduling and resource management influence the effectiveness of PRM in large-scale construction projects?
5. To what extent do environmental conditions or unforeseen weather events create challenges for PRM practices in large-scale projects?
6. How do you manage the challenges of stakeholder alignment and communication when implementing PRM in large-scale construction projects?
7. Are there specific issues related to technology adoption or integration that make PRM harder to implement in large-scale construction projects?
8. How do you assess and manage the financial risks associated with implementing PRM in large-scale projects?
9. What role does project team experience play in overcoming the challenges associated with PRM in large-scale construction projects?
10. What measures can be taken to mitigate the challenges of implementing PRM in large-scale construction projects?

RQ 3: What PRM practices are commonly used in large-scale construction projects?

1. Which PRM practices are commonly implemented in large-scale construction projects?

2. How do you evaluate the effectiveness of different PRM practices in large-scale construction projects?
3. What risk management strategies do you find most effective in mitigating cost overruns and delays in large-scale construction projects?
4. How do you prioritize risks in large-scale construction projects, and which risks do you consider most critical?
5. How do you incorporate stakeholder feedback into your PRM practices in large-scale construction projects?
6. What role does technology play in the PRM practices applied to large-scale construction projects?
7. How do you approach communication and coordination between various stakeholders in implementing PRM?
8. Can you describe any specific risk mitigation measures or tools that are commonly used in large-scale projects?
9. How do you measure the success of PRM practices in large-scale construction projects?
10. In your opinion, what are the key factors that influence the adoption of PRM practices in large-scale construction projects?

ndard (Ekechukwu, 2024).

Appendix 4: Summary of Results

Analysis Section	Result
Frequency Analysis	- 164 total respondents, 91 male (55.5%), 73 female (44.5%)
Descriptive Statistics (PRM)	- Mean = 17.69, SD = 2.56
Descriptive Statistics (Project Success)	- Mean = 9.71, SD = 1.42
Reliability Analysis (PRM)	- Cronbach's Alpha = 0.822
Reliability Analysis (Project Success)	- Cronbach's Alpha = 0.719
Correlation (PRM and Project Success)	- Pearson correlation coefficient = 0.608 ($p < 0.01$), moderate positive relationship between PRM and project success
Challenges in Implementing PRM	Key challenges include Regulatory uncertainty, environmental constraints and stakeholder coordination issues
PRM Practices Commonly Used	Risk assessment & prioritization, stakeholder communication & collaboration and use of technology (e.g., BIM)
Factors Influencing PRM Adoption	Organizational culture and leadership, project type & complexity, regulatory/legal context and technology adoption (e.g., BIM and risk tracking tools)
Emergent Themes (Qualitative)	Regulatory uncertainty, environmental constraints, project complexity, stakeholder coordination and use of technology.