

ADDIS ABABA UNIVERSITY

COLLEGE OF BUSINESS AND ECONOMICS

SCHOOL OF COMMERCE

The Effect of Risk Management Practices on Project Success: The Moderating Role of Environmental Uncertainty in the Ethiopian Software Sector

By

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Thesis In partial fulfillment of the requirements for the Degree of Master of Arts in Project Management

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Addis Ababa, Ethiopia

STATEMENT OF DECLARATION

I declare that the research thesis entitled **"The Effect of Risk Management Practices on Software Project Success: The Moderating Role of Environmental Uncertainty in the Ethiopian Software Sector"** is my original work and hasn't been published or submitted for any kind of qualification elsewhere. All sources of material used in the work have been duly acknowledged.

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STATEMENT OF CERTIFICATION

This is to certify that this project work, **"The Effect of Risk Management Practices on Software Project Success: The Moderating Role of Environmental Uncertainty in the Ethiopian Software Sector,"** undertaken by **Muse Mulatu** in partial fulfillment of the requirement for the Master of Arts in Project Management at Addis Ababa University School of Commerce, is an original work and has not been submitted earlier for any Degree either at this university or any other university.

_____

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Abstract

The overarching objective of this study was to examine the relationship between risk management practices and multidimensional project success within the Ethiopian software sector and to investigate the moderating role of environmental uncertainty in this relationship. This research uses an explanatory, sequential mixed-methods design. It mainly employs a quantitative explanatory survey approach in order to statistically investigate the relationship, from which data was collected from 120 software professionals. Additionally, qualitative evidence was used as a triangulation component, consisting of six in-depth expert interviews. The quantitative data demonstrated a strong, statistically significant positive effect of risk management on Ethiopian software project success. Environmental uncertainty has a direct, statistically significant negative influence on project outcomes. Furthermore, the findings indicated a significant negative moderation effect. As external volatility increases, the positive impact of structured risk management is weakened. This study concludes that risk management is a vital determinant of software project success in Ethiopia; however, its application and effectiveness are heavily constrained by the operating environment. Software teams in this context operate under a state of high systemic volatility, and traditional, highly formalized project management frameworks may become difficult to sustain under conditions of high environmental uncertainty.

Keywords: **Software Project Management, Risk Management Practices, Environmental Uncertainty, Mixed-Methods, Ethiopia**

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List of Acronyms and Abbreviations

AAU	- Addis Ababa University
CBE	- Commercial Bank of Ethiopia
CMMI	- Capability Maturity Model Integration
DV	- Dependent Variable
GoE	- Government of Ethiopia
ICT	- Information and Communication Technology
IV	- Independent Variable
MInT	- Ministry of Innovation and Technology
NBE	- National Bank of Ethiopia
PMBOK	- Project Management Body of Knowledge
PMI	- Project Management Institute
PMO	- Project Management Office
SEM	- Structural Equation Modeling
SPSS	- Statistical Package for the Social Sciences
SWOT	- Strengths, Weaknesses, Opportunities, Threats

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the Study

Worldwide, achieving Project Success in the delivery of complex software projects has become a determinant to organizational performance and national digital transformation efforts. However, software projects are particularly susceptible to failure due to their inherently complex nature and higher levels of volatility. To mitigate these failures and navigate uncertainties, the implementation of strong Risk Management Practices is essential. In developing economies, these challenges of achieving Project Success challenges are coupled by intense infrastructural, economic, and institutional constraints.

In Ethiopia, the nation's developmental trajectory is shifting from historical dependence on agriculture. It is shifting towards a knowledge-based economy. This is driven by initiatives such as the "Digital Ethiopia 2025" strategy of the Government of Ethiopia (GoE). The initiative seeks to leverage digital technologies to promote inclusive economic growth through the modernization of IT-enabled services. It also achieves this goal through the development of enabling systems such as the Digital ID (Fayda) and interoperable digital payment platforms (e.g., Telebirr and EthioSwitch).

The effective delivery of software systems is crucial to the successful operationalization of these national initiatives. Globally, the Project Management Institute (PMI) framework has established that a structured, continuous cycle of Risk Management Practices (RMP) is a critical determinant of project success. This cycle explicitly encompasses planning, identification, analysis, response, and monitoring processes (Project Management Institute, 2017).

In the Ethiopian software and tech sector, actual project outcomes and massive digital infrastructure investments have increasingly experienced a persistent gap. For instance, Teklemariam (2017) observed an 11% success rate among software projects in Addis Ababa, noting that the vast majority were either abandoned or delivered with substantial deficiencies. Thus, empirical evidence from the local sector presents a concerning situation. Risk

management is either ignored or applied in a purely ad-hoc manner in many organizational environments. This has led to an increasing likelihood of delays and cost overruns.

Moreover, operating in a developing economy has exacerbated these challenges. Factors such as foreign currency shortages, infrastructure instability (e.g., unreliable internet and power supply), and evolving regulatory conditions create an uncertain operating environment. This condition aligns with Contingency Theory, which posits that the effectiveness of managerial practices depends on the context in which they are applied (Donaldson, 2001).

Accordingly, the effectiveness of structured risk management practices may vary significantly in environments characterized by higher systemic volatility as compared to more stable contexts. Environmental uncertainty may also weaken the extent to which formal risk management practices contribute to project success, in addition to directly constraining project execution.

As a result, the present study examines both the relationship between risk management practices and project success and whether environmental uncertainty moderates the strength of that relationship within the Ethiopian software sector.

1.2. Statement of the Problem

Resource-constrained environments such as Ethiopia are characterized by high demand for digital transformation alongside limited infrastructural and financial capacity (Ministry of Innovation and Technology [MInT], 2020). However, software project failure remains a persistent challenge globally and within developing economies. Consequently, in places like Ethiopia, unsuccessful software projects represent a significant economic and organizational burden. Failed or underperforming systems not only waste scarce resources but also delay the realization of broader national digital transformation objectives.

Empirical evidence within Ethiopia indicates that formal risk management contributes positively to IT project performance. Existing literature suggests consistently that structured risk management practices are associated with improved project outcomes. For example, Gumataw (2019) reported that risk management practices explained substantial variation in project success at Ethio Telecom. Similarly, Assefa (2023) identified similar relationships across non-governmental projects. Yet, the practical adoption of formal risk management still

remains limited. Teklemariam (2017) found that only 16% of Ethiopian software organizations implemented formal risk management models. Particularly, many organizations rely on reactive and informal approaches to project threats.

Software projects in Ethiopia also operate within highly uncertain external environments on top of the internal managerial limitations. Challenges such as foreign currency shortages, unreliable infrastructure, inflationary pressures, evolving regulatory conditions, and third-party dependency instability frequently plague project execution. These environmental challenges have been acknowledged as important operational risks by prior localized studies (Teklemariam, 2017; Worku et al., 2021). However, most existing studies have largely treated environmental uncertainty as a background condition or an item on a list of external risks. They refrained from examining how such uncertainty may directly constrain project success and alter the effectiveness of structured managerial practices.

Thus, despite evidence that risk management practices are associated with improved project outcomes, software projects in Ethiopia continue to operate within highly uncertain environments characterized by infrastructural, economic, and regulatory challenges. While previous studies have examined the direct relationship between management practices and project outcomes, limited attention has been given to the moderating role of environmental uncertainty in shaping these relationships. Consequently, there remains insufficient empirical understanding of how environmental uncertainty affects the effectiveness of risk management practices and influences project success within the Ethiopian software sector.

1.2.1. The Research Gap

A growing body of literature has examined IT project performance in Ethiopia. However, important gaps remain regarding how risk management practices operate in volatile software development environments.

As such, the primary gap addressed by this study is a contextual and analytical gap that deals with the conditional effectiveness of risk management practices when under environmental uncertainty.

Public institutions, state-owned enterprises, or construction-related contexts have been predominantly focused on by existing Ethiopian studies on project management (Gumataw,

2019; Zeray, 2020; Gebretsadik, 2018). The rapidly evolving private software sector has received comparatively limited empirical attention. Moreover, prior studies have generally only examined direct relationships between project management practices and project outcomes. They failed to also explicitly test whether uncertain environmental conditions alter the effectiveness of those practices.

As a result, limited evidence exists regarding whether environmental uncertainty changes the strength of the relationship between risk management practices and project success in Ethiopian software projects. The current study draws on Contingency Theory to address this gap. It models Environmental Uncertainty as a moderating variable that influences the relationship between Risk Management Practices and multidimensional Project Success.

Additionally, previous Ethiopian studies have frequently solely relied on traditional "Iron Triangle" measures of success. This "triangle" consists of time, cost, and scope metrics. These indicators remain important. However, they may insufficiently capture broader dimensions of software project outcomes such as customer impact, business value, and future organizational capability. This study, therefore, provides a broader assessment of software project performance by adopting Shenhar and Dvir's (2001) multidimensional project success framework.

Finally, many prior local studies have relied heavily on descriptive approaches or single-organization case contexts. This potentially limits broader sectoral generalizability. The present study attempts to remedy this by employing a cross-organizational explanatory design involving software firms, IT departments, and financial-sector IT environments within Addis Ababa.

1.3. Research Objectives

General Objective:

The overarching objective of this study was to examine the relationship between risk management practices and project success within the Ethiopian software sector and to investigate the moderating role of environmental uncertainty in this relationship.

Specific Objectives:

To achieve the general objective, this study pursued the following specific objectives:

- To assess the level of adoption of risk management practices across Ethiopian software firms and IT departments.
- To examine the relationship of risk management practices and project success (measured through Project Efficiency, Customer Impact, Business Success, and Future Readiness.)
- To assess the direct effect of environmental uncertainty on project success.
- To analyze the moderating effect of environmental uncertainty on the relationship between risk management practices and project success.

1.4. Research Questions

This study sought to answer the following research questions, in alignment with the specific objectives:

- To what extent are formal risk management practices adopted and implemented within Ethiopian software development environments?
- How do risk management practices influence multidimensional project success in the Ethiopian software sector?
- How is environmental uncertainty associated with multidimensional project success within Ethiopian software projects?
- How does environmental uncertainty moderate the relationship between risk management practices and project success?

1.5. Research Hypotheses

The following hypotheses were formulated and tested after being primarily grounded in Contingency Theory and prior project management literature:

- **H1**: Risk Management Practices, conceptualized through the dimensions of Risk Planning, Risk Identification, Risk Analysis, Risk Response, and Risk Monitoring, have a significant positive effect on Project Success in the Ethiopian software sector.
- **H2**: Environmental uncertainty significantly moderates the relationship between risk management practices and project success, such that the positive effect of risk management practices on project success weakens under higher levels of environmental uncertainty.
- **H3**: Environmental uncertainty has a significant negative effect on project success.

1.6. Significance of the Study

The findings of this study provide multi-layered significance. They address theoretical gaps, practical industry needs, and national policy priorities.

1.6.1. Theoretical Significance

Academically, this study contributes to the growing body of knowledge on software project management within developing economies. It accomplishes this by extending the application of Contingency Theory to the Ethiopian software sector. Specifically, the study contributes by moving away from empirically examining Environmental Uncertainty only as an external contextual condition. Instead, it treats as also a moderating factor capable of influencing the relationship between Risk Management Practices and multidimensional Project Success.

Furthermore, by adopting Shenhar and Dvir's (2001) multidimensional project success framework, the present study also contributes methodologically. It moves beyond exclusively resulting on the traditional "Iron Triangle" measures of time, cost, and quality. In doing so, the study recognizes that software project success within volatile emerging-market environments may extend beyond operational efficiency. It instead also includes broader dimensions such as customer impact, business value, and future organizational capability.

1.6.2. Practical Significance

The empirical results of this study offer actionable insights, specifically for these key stakeholders in the Ethiopian digital ecosystem:

- **For Project Managers and Practitioners:**
  This study provides empirical evidence on how structured risk management practices contribute to improved project performance outcomes. It demonstrates how systematic risk identification, analysis, and monitoring are associated with better schedule adherence and budget performance. Moreover, it shows that in volatile environments, balancing formal risk planning with adaptive, agile methodologies is important for survival. It guides teams that during external disruptions, it may be more beneficial to focus on continuous risk monitoring and functional value delivery than rigid schedule adherence.
- **For Software Founders and Executives:**
  For leadership within the Ethiopian software sector, this study establishes the

relationship between the adoption of structured risk management practices and broader organizational outcomes. This includes long-term business value and capability development. It provides a practical basis for investing in Project Management Office (PMO) structures and professional capacity-building.

- **For Banking and Financial IT Officials:**
  These officials are custodians of critical digital infrastructure; financial IT leaders can use these findings to strengthen vendor selection, project governance, and procurement processes. Beyond improving vendor governance, it also highlights that continuous risk and vulnerability tracking for in-house core banking development is necessary. The study also supports the development of risk-aware Terms of Reference (ToR), which helps to reduce failure rates in projects.

1.6.3. Policy and National Significance

At a macro level, central to Ethiopia's "Digital Ethiopia 2025" strategy is the successful implementation of Information and Communication Technology (ICT). However, project outcomes continue to be undermined by systemic constraints—such as foreign currency shortages and infrastructure instabilities.

This study provides evidence on how such environmental uncertainties interact with project management practices. It offers policymakers insight into what structural barriers affect digital transformation. The findings highlight that to ensure that national digital investments translate into successful and sustainable project outcomes, strengthening enabling infrastructure and regulatory stability is important.

1.7. Scope of the Study

1.7.1. Geographic Scope

The present study was primarily geographically delimited to Addis Ababa. This is because of the economic structure of Ethiopia's digital ecosystem, where the capital serves as the hub for the nation's technology and financial sectors.

The vast majority of software development firms, IT consulting agencies, and financial institution headquarters are concentrated in Addis Ababa. This, it makes it the most appropriate setting for capturing relevant industry practices.

1.7.2. Sectoral Scope

The research focused on the intersection of the primary drivers of Ethiopia's digital economy. Hence, the target population was delimited to software professionals (e.g., Project Managers, Software Engineers, Tech Leads, Quality Assurance Specialists) operating within:

- **Software Development Companies (Providers)**: Established private firms and startups engaged in custom software development, IT consulting, and system integration.
- **Financial Institutions**: Specifically, the IT departments and Project Management Offices (PMOs) of banks and insurance companies. This sector was selected because it currently manages the highest volume of high-stakes, heavily capitalized software projects in the country.
- **Public Sector and Large NGOs:** Specifically, government IT departments and non-governmental organizations executing large-scale digital initiatives. This sector was included because public institutions are the primary executors of the national "Digital Ethiopia 2025" strategy and frequently operate under unique institutional and bureaucratic constraints.

1.7.3. Methodological Scope

This study methodologically adopted a quantitative, cross-sectional explanatory design. It employed regression-based moderation analysis to examine the relationships among risk management practices, multidimensional project success, and the moderating role of environmental uncertainty. As such, the unit of analysis for this study was a single completed software project, as perceived by the respondent.

1.8. Operational Definitions

- **Risk Management Practices:** This refers to the application of management policies, procedures, and practices for identifying, analyzing, responding to, and monitoring project risks (PMI, 2017). This construct, in the present study, is operationalized through five dimensions. Namely: Risk Planning, Risk Identification, Risk Analysis, Risk Response, and Risk Monitoring.

- **Project Success:** This is a multidimensional construct wherein the present study, it is operationalized through four distinct dimensions: Project Efficiency, Customer Impact, Business Success, and Future Readiness (Shenhar & Dvir, 2001). Each dimension was then l operationalized through multiple survey items reflecting perceived performance

outcomes of a recently completed software project. Additionally, these dimensions were measured using a 5-point Likert scale ranging from 1 = Strongly Disagree to 5 = Strongly Agree.

- **Environmental Uncertainty:** It is a construct that reflects upon the degree of instability and unpredictability in external macroeconomic, infrastructural, and regulatory conditions. These factors affect project planning and execution but remain beyond the control of the project team. To operationalize it as a composite construct, it was measured through these sub-dimensions: infrastructural instability, economic instability, and regulatory unpredictability, using a 5-point Likert scale based on respondent perceptions.

- **Risk Register:** This is a historical and organizational document or database that is used to dynamically record and track identified risks. It serves as the central repository for risk data and details the severity, potential impact, probability of occurrence, and assigned owner for every identified threat (PMI, 2017).

In the current study, a five-point Likert scale format was used to standardize all Likert-scale items used. While maintaining statistical equivalence for analysis purposes, anchors were adapted according to construct wording (frequency-based for practices and agreement-based for perceptual constructs).

CHAPTER TWO
REVIEW OF RELATED LITERATURE

2.1. Theoretical Framework

Project management is a discipline grounded in organizational, behavioural, and contextual theories. It is not just merely a set of procedural tools. These theories explain how under uncertain conditions, decisions are made and how project outcomes are shaped by internal practices, stakeholder interactions, and external environmental conditions.

The central theoretical foundation for the present study is anchored in Contingency Theory. It serves for explaining how environmental conditions influence the effectiveness of project risk management practices for project success. The study also draws upon Project Management and Decision Theory to support this perspective. These theories explain managerial behaviour under uncertainty and multidimensional project success.

2.1.1. Project Management Theory

As shown above, the triple constraint model historically grounded project management theory. It defines project success in terms of time, cost, and scope. A project is considered successful if it is delivered on schedule, within the allocated budget, and according to predefined technical specifications. It is a classical, construction-based view.

However, scholars like Fred Brooks (1987) and later expanded on by Demir (2008) note that the modern assertions assert that "essential difficulties" plague software projects. Software projects operate in highly dynamic environments as opposed to traditional infrastructure projects, which rely on predictable base technologies and visible physical progress. Hence, modern scholars assert that the triple constraint model is fundamentally inadequate for software development. Software projects suffer from inherent intangibility that makes such status tracking not only difficult and elevates the level of uncertainty.

As a result, while efficient software project management could be indicated by achieving the Iron Triangle, it fails to register whether the project has achieved its overall strategic goals. Recognition of this limitation has led to a paradigm shift in project management research. Value-oriented success measurement has enjoyed more focus than efficiency-focused evaluation. This shift, however, does not imply that traditional efficiency metrics are merely

irrelevant. Rather, it just recognizes that schedule and budget performances are just one dimension of overall project success metrics.

In line with this, Shenhar and Dvir (2001) introduced a comprehensive, multidimensional model that aligns project execution directly with long-term business objectives. The limitation of the triple constraint model could be resolved by the value-based perspective that has evolved within modern theory. By operationalizing success across four distinct dimensions, the present study adopts their framework. These dimensions are: Project Efficiency, Customer Impact, Business Success and Future Readiness.

In the Ethiopian context, this expanded view of success is important. For example, consider a project that would be deemed successful under traditional metrics. A mobile banking application that targets rural populations and that was coded flawlessly, launched on schedule, and delivered on budget, can still be considered totally successful even if the user interface fails to account for the digital literacy levels of the target demographic and adoption of the application subsequently became negligible. A value failure would be mislabeled as a "success" if relying solely on the Iron Triangle model. As a result, the present study has adopted a multidimensional view of success that considers both immediate efficiency and long-term organizational value.

2.1.2. Decision Theory and Utility Theory

Decision Theory examines how individuals and organizations make choices under uncertainty conditions and incomplete information. As such, risk management practices are then intrinsically related to Decision Theory. Important trade-offs between risk, cost, and schedule are often made by managers in software projects. For example, a complex decision matrix presents itself to a manager when a system defect is discovered shortly before deployment. Reputational and financial costs would be incurred if delaying the launch is chosen. On the other hand though, proceeding with the launch would created an unquantifiable risk, with potentially catastrophic levels of system failure.

By incorporating behavioral insights regarding risk perception and loss aversion, Utility theory extends Decision Theory. Particularly, the Prospect Theory developed by Kahneman and Tversky (1979) does this job. The psychological impact of financial or reputational loss is significantly more intense than the impact of a comparable gain in resource-constrained environments. This is because in such places as Ethiopia, where resources are constrained,

institutional safety nets are minimal and capital is scarce. The consequence is that stakeholders often exhibit a higher risk aversion level. Decision delays or overly cautious managerial behaviour could manifest themselves. Moreover, decision makers may even refuse to sign off on requirements, delay important vendor procurements in search of perfect conditions, or rely on intuition defensively instead of structured risk analysis.

Furthermore, inconsistent adoption and execution of risk management practices in resource-constrained environments could be behaviouraly explained by the Prospect theory. Practically, behavioural tendencies influence the extent to which formal risk management practices are implemented within software projects.

2.1.3. Contingency Theory: The Role of Environmental Uncertainty

Internal project dynamics and behavioural choices could be explained by Project Management and Decision theories. However, they cannot alone fully account for the influence of external macroeconomic constraints. Thus, the present study adopts Contingency Theory as its central theoretical foundation to bridge this gap.

Contingency Theory posits that the effectiveness of specific management practices is strictly dependent on the context and environment where they are applied at. It claims that there is no single, universal way that is optimal to manage an organization. When applied to project management, this implies that the relationship between project success and standard risk management practices is not static. But rather, they are sensitive to the boundary conditions of the environment.

When translated to the Ethiopian software sector, projects are excuted in an uncertain environment that is characterized, among others, by infrastructure instability, forex availability changes, evolving regulatory frameworks, and bureaucracy. In resource-scarce areas, what works well in a stable and well-funded environment might not work. These external conditions actively alter the efficacy of internal managerial processes, according to Contingency Theory. Thus, environmental uncertainty is not just treated as a contextual background noise. It is taken as a structural condition where the effectiveness of formal managerial practices can be altered by it.

Environmental Uncertainty is formally positioned as a moderating variable in this study by leveraging Contingency Theory. The research is moved beyond assuming a simple and direct relationship by this theoretical anchoring. It provides it a robust framework to test how environmental instability weakens the effectiveness of formal risk management practices. This, in statistical terms, implies that project outcomes are not just merely influenced by environmental uncertainty. It implies that environmental uncertainty also alters the strength and direction of the relationship between risk management practices and project success.

2.1.4. Synthesis of Theoretical Perspectives

This study integrates complementary theories under a structured hierarchy since no single theoretical perspective independently is able to explain the complexity of software project performance in unstable developing-country environments.

As the primary theoretical foundation, the study uses Contingency Theory, which explains that the effectiveness of managerial practices depends upon contextual environmental conditions. This is in alignment to the study's central proposition that the relationship between Risk Management Practices and Project Success is moderated by Environmental Uncertainty.

Next, the operational foundation for the study is provided by Project Management Theory. This is done by establishing that multidimensional project success beyond traditional time-and-budget efficiency measures is contributed to by structured risk management practices. The independent and dependent variables' conceptualization is supported by this.

Finally, Decision Theory complements these perspectives by explaining how managerial behavior when under uncertainty influences the practical implementation of formal risk management practices. It particularly does so in environments that are resource constrained and characterized by high perceived risk and institutional instability.

These theories together provide a united framework for explaining how formal risk management practices influence software project success. Additionally, they explain why risk management effectiveness may vary under conditions of environmental uncertainty within the Ethiopian software sector.

2.2. Empirical Literature Review

This section reviews the existing empirical evidence regarding software project risk management and performance outcomes. It builds upon the established theoretical and conceptual foundations to accomplish this.

To achieve this objective, the review is structured sequentially. First, global empirical evidence is examined, analyzing the moderating role of environmental context. It then sequentially and finally narrows focus down to the specific realities of the Ethiopian software sector.

2.2.1. Global Evidence on Risk Management and Success

Largely due to unmitigated risks, Arafeh and El-Ahmad (2018) reported that a significant proportion of software projects fail to achieve total success. Software project failure is actually a well-documented global phenomenon. Arafeh and El-Ahmad's findings (2018) suggest that active implementation of structured risk management practices is associated with improved project outcomes.

Wallace et al. (2004) examined systematically the foundational nature of software-related risks. They categorized key dimensions of risk, which include environmental uncertainty and organizational complexity. It is highlighted by their work that understanding the nature and structure of risk is just as important as the presence of risks being identified.

It is demonstrated further by empirical studies that statistically as well, structured risk management practices are associated with project performance outcomes. For example, risk management practices were found to explain a considerable proportion of variance in IT project success ($R^2 \approx 0.35$) by Pimchangthong and Boonjing (2017). Specifically, they found that risk identification was a strong predictor. In similar fashion, it was shown that the absence of risk monitoring leads to significant project overruns by Kishk Ukaga. This reinforces the importance of lifecycle-based risk management.

However, the broader literature reveals that despite the above findings, debate still exists regarding the actual effectiveness of formal risk management in dynamic software environments. Many scholars argue that the relationship between risk management practices and project success is not consistent and also depends on context. De Bakker, Boonster, and

Wortmann (2010), for example, found limited empirical evidence that demonstrates traditional risk management knowledge is applied effectively in practice. It was noted by them that in many organizations, risk registers were treated as symbolic or administrative artifacts. They noted that they were not used as active decision-making tools.

Similarly, it was demonstrated by Kutsch and Hall (2005) formal risk management processes were frequently abandoned by project managers when under conditions of high uncertainty and organizational complexity. Instead, in these conditions, project managers rely on reactive behaviour that could be described as "fire-fighting." It was recorded that they relied on intuition, avoidance, or delayed decision-making.

In addition, more studies, such as that by Pimchangthong and Boonjing (2017), suggest operational inefficiencies could be created by procedural formalization itself when it becomes excessive. These findings that seem contradictory suggest that risk management's effectiveness is neither automatic nor is it beneficial universally. Instead, it shows that it is highly contingent on environmental stability, organizational maturity, and implementation practices that are adaptive.

2.2.2. Environmental Uncertainty and Contextual Risk Management

Sicotee and Bourgault (2008) provided a foundational contribution that shows that project management practice effectiveness is contingent on environmental uncertainty profiles. Although structured risk management practices are widely associated with better project outcomes, their effectiveness is, however, not uniform across all project environments. Sicotee and Bourgault's findings (2008) indicate that the relationship of managerial practices and project success is altered significantly by environmental instability.

Moreover, several more studies suggest that operational inefficiencies could be created by excessive procedural formalization in dynamic software environments. Project performance was found by Pimchangthong and Boonjing (2017) to be negatively affected when excessive risk analysis was conducted. This is because it consumed critical project time and resources. Similarly, Arafeh and El-Ahmad (2018) caution against "overdoing" formal risk management on smaller or rapidly changing projects. This is because it may distract development teams from immediate project priorities by creating unnecessary administrative overhead.

At the same time, scholars within the software engineering literature argue that highly uncertain technological environments often require more adaptive management approaches. It is explained by Nerur, Mahapatra, and Mangalaraj (2005) that traditional plan-driven methodologies may struggle to accommodate rapidly evolving technologies and changing customer requirements. They also explain further that because of these factors, many software organizations adopt agile or lightweight approaches to management. Iterative development, informal communication, and adaptive coordination are emphasized by these approaches.

These findings, however, do not suggest that formal risk management becomes irrelevant altogether. Rather, they indicate that the effectiveness of structured risk management practices becomes increasingly dependent upon environmental stability, organizational maturity, and contextual adaptability.

Overall, and taken together, the central premise of Contingency Theory is strongly supported by this body of research. It supports the premise that the effectiveness of management practices is highly context-dependent. The protective value of formal risk management practices may weaken in volatile environments characterized by infrastructure instability, macroeconomic disruption, and institutional uncertainty. This persists unless organizations adapt their implementation approaches to local conditions.

2.2.3. Software Projects in Developing and Emerging Economies

Due to institutional instability, infrastructure limitations, resource constraints, and similar challenges, software project implementation within developing and emerging economies differs considerably from implementation in industrialized environments. According to Heeks (2002), higher rates of total failure, partial failure, and sustainability failure are registered in these places compared to projects implemented in stable industrialized economies. These failures are often associated with inadequate telecommunications infrastructure, an unstable electricity supply, limited ICT capacity, weak institutional coordination, and inconsistent policy environments.

Scholars argue within the Information and Communication Technology for Development (ICT4D) literature that many project management and information systems models are designed implicitly around assumptions of institutional stability, reliable infrastructure, and

predictable administrative systems. Referring to the divergence between formalized technological designs and the practical realities of developing-country environments, Heeks (2002) conceptualized these assumptions as a “design-actuality gap." According to this perspective, imported project management methodologies often depend on stable organizational structures, rational decision-making processes, and continuous resource availability. However, these stable conditions may not exist in volatile, developing economies.
As a result, when formal management systems are transferred into unstable contexts without adaptation, project implementation becomes highly vulnerable.

Moreover, Avgerou (2008) further argues that information systems initiatives in developing countries are deeply influenced by political interests, institutional restructuring, shifting organizational priorities, and conflicting stakeholder objectives. Unstable implementation environments are created by these conditions in which consistently sustaining standardized management practices becomes difficult. Hence, in many developing-country contexts, software projects are not shaped by technical complexity only. But rather, they are also shaped by broader socio-economic and institutional constraints that continually disrupt planning assumptions.

In addition, the literature also suggests that highly formalized, plan-driven project management approaches may become less effective when under conditions of extreme uncertainty and rapidly changing technological requirements. Nerur, Mahapatra, and Mangalaraj (2005) argue that traditional project management approaches often lack crucial flexibility. As a consequence, they may struggle to accommodate dynamic software environments characterized by evolving customer requirements and technological uncertainty. Similarly, Shenhar and Dvir (2007) note that “one size does not fit all” in project management; they contend that highly uncertain projects require adaptive management approaches rather than rigid procedural control.

Consequently, software organizations are increasingly adopting agile or lightweight management approaches. These approaches emphasize iterative development, informal communication, rapid feedback cycles, and adaptive coordination mechanisms. However, this doesn’t imply that formal risk management becomes irrelevant. Rather, the literature points out that the effectiveness of structured risk management practices becomes highly contingent

upon elements such as environmental stability, organizational maturity, and the adaptive capacity of project teams. This perspective aligns strongly with Contingency Theory. As such, it also support the present study's proposition that environmental uncertainty moderates the relationship between formal risk management practices and multidimensional project success.

2.2.4. The Ethiopian Context

When reviewing previous empirical studies, we find that Teklemariam (2016) found that only 16% of organizations used formal risk management models, and that only 27% implemented the full lifecycle of risk management. As a result, project success rates were very low—approximately 11%, meaning only 5 out of 45 projects met schedule, budget, and specifications—which indicates there's a significant gap between theory and practice. Therefore, we can see that in Ethiopia, while risk management practices are generally associated with improved project outcomes, the paradox is that the adoption of the practices is limited.

The Ethiopian local literature also points to several both institutional and behavioural barriers contributing to this low adoption of risk management practices. For instance, Teklemariam (2017) pointed out a widespread "watching" phenomenon where project managers incorrectly assume that merely observing project progress constitutes effect risk management. In doing so, they entirely bypass formal identification, analysis, and response planning processes. Zeray (2020) in his study also found that Risk management is frequently perceived as an additional administrative burden that reduces implementation flexibility and also consumes the already limited project resources.

Furthermore, although they are required to sustain systematic risk management practices, Grebretsadik (2018) and Gumataw (2019) reported that organizations often lack formal training programs, supportive reporting structures, and continuous monitoring mechanisms. As a consequence, risk management implementation in many Ethiopian software environments remains reactive, inconsistent, and fragmented.

Conversely though, studies focusing on environments that are more structured show stronger relationships. For instance, Gumataw (2019) reported that risk management practices explained ($R^2 = 0.570$) of variance in project success, and risk monitoring being the strongest

predictor with β= 0.786. Similarly, although such high values are uncommon in social sciences, Assefa (2023) too reported a high explanatory power ($R^2 = 0.917$). However, the unusually high values may indicate methodological artifacts such as common method bias, construct overlap or sample homogeneity. Hence, the findings should not be assumed to generalize across contexts. This reinforces the need for contextually grounded models that also account for environmental variability rather than assuming stable relationships across the board.

Moreover, Zeray (2020) found that risk management maturity levels remain moderate too, especially in monitoring practices. This is consistent with Gebretsadik's (2018) findings, who identified that risk monitoring and communication processes were weak. These findings further suggested that although risk management practices are associated with improved outcomes in Ethiopia, their effectiveness is constrained by both limited adoption and environmental conditions that are challenging.

2.3. Summary of the Literature and Research Gap

2.3.1. Literature Review Summary

While several studies report high positive relationships between structured risk management and project outcomes (such as Pimchangthong & Boonjing, 2017; Gumataw, 2019), others show that risk management practices are often implemented inconsistently, applied symbolically, or partially abandoned in uncertain environments (Kutsch & Hall, 2005: de Bakker et al., 2010).

Accordingly, the reviewed literature generally supports the premise that structured risk management practices contribute positively to software project success both globally and in local contexts. However, it also reveals inconsistencies regarding the extent to which formal risk management practices remain effective under environmental volatility, institutional instability, and quickly changing software requirements. Furthermore, in developing country contexts, additional constraints such as infrastructure instability, foreign currency shortages, weaker institutional continuity, and limited ICT capacity complicate more the implementation of formal project management frameworks (Heeks, 2002; Avgerou, 2008).

Although existing empirical evidence from developing contexts (Heeks, 2002; Algremazy et al., 2023) list environmental conditions such as inflation, forex constraints, and infrastructure

instability as significant risks, no localized Ethiopian studies have empirically tested the moderating effect of environmental uncertainty on the relationship between risk management practices and multidimensional project success. Additionally, prior Ethiopian studies heavily relied on solely traditional time and budget metrics. As such, by dredging this gap with Contingency Theory and Shenhar and Dvir's (2001) multidimensional success model, this study tests whether standard PMBOK practices still have their predictive power under severe environmental uncertainty.

Table 2.1: *Summary of Related Empirical Studies*

Author (Year)	Context/Industry	Methodology	Key Findings
Teklemariam & Mnkandla (2016)	Ethiopian Software Sector	Mixed Methods (Survey & Interview)	Found an 89% failure rate among studied software projects. Only 16% utilized formal risk models, relying largely on ad-hoc crisis management.
Arafeh & El-Ahmad (2018)	Global Software Sector	Quantitative Survey	Established high global failure rates, proving that proactive risk management implementation directly prevents software project failure.
Wallace et al. (2004)	Global Software Projects	Quantitative Survey	Developed foundational models categorizing software risks; demonstrated how environmental and project

			complexity act as critical risk dimensions.
Sicotte & Bourgault (2008)	Global High-Tech Projects	Quantitative Survey	Foundational study on moderation: Proved that project management practices must be adapted to the specific dimensions of environmental uncertainty to achieve success.
Raz, Shenhar & Dvir (2002)	Israeli high-tech sector	Quantitative survey	Used Process Approach, Showed Risk analysis and monitoring show strong positive relationships with project success
Gumataw (2019)	Ethio Telecom (Public IT)	Quantitative Survey	Proven causal link: Risk management practices explained 57.0% ($R^2 = 0.570$) of IT project success, with Risk Monitoring being the strongest predictor.
Assefa (2023)	Ethiopian NGO/Church Projects	Quantitative Regression	Demonstrated a highly significant correlation between RM practices and

			success ($R^2 = 0.917$), though the extreme homogeneity of the sample suggests limited generalizability.
Zeray (2020)	Ethiopian Airlines Digital PMO	Quantitative Survey	Classified overall risk maturity as merely "moderate," highlighting a systemic inability to transition from risk identification to continuous risk monitoring.

2.3.2. The Research Gap

There's limited evidence that exists regarding whether structured risk management practices are still effective under conditions of macroeconomic instability, infrastructural issues, regulatory unpredictability and similar issues in the Ethiopian software sector. Hence, despite the valuable empirical contributions summarized in Table 2.1, a major contextual and explanatory gap remains in project management literature of the Ethiopian software milieu.

Local studies have typically looked at risk management practices either descriptively or through direct effect models only. As such, they refrained so far from empirically testing how environmental uncertainty alters the relationship between formal risk management practices and project success.

- First, despite the fact that macroeconomic disruption, institutional volatility, and infrastructure instability are identified in both developing country and global ICT4D literature as significant causes of software project failure (Heeks, 2002; Avgerou, 2008), localized Ethiopian studies have largely treated these environmental

conditions as descriptive background factors rather than empirically testable variables. As a result, limited evidence exists regarding whether environmental uncertainty actively moderates the relationship between formal risk management practices and project success within the Ethiopian software sector.

- Second, while some research indicates that risk management and project success are strongly positively correlated, other studies contend with this. They suggest that formal practices are often applied inconsistently, reduced to bureaucratic exercises, or partially abandoned in situations of environmental volatility and organizational complexity (Kutsch & Hall, 2005; de Bakker et al., 2010).
- This shows that there is still theoretical inconsistency in the broader literature on the efficacy of formal risk management techniques in highly uncertain software environments.

- Third, a large portion of the Ethiopian literature now in publication is descriptive in nature. It focuses on the status or maturity level of risk management without statistically analyzing its predictive association with multidimensional project performance. In addition, previous localized studies have paid little attention to customer impact, business value, and long-term organizational capabilities in favor of typical project success metrics focusing on time, cost, and scope.

- Finally, this study adds to the literature by empirically examining the relationship between formal risk management practices and multidimensional project success while testing the moderating role of environmental uncertainty within the Ethiopian software sector. It integrates Contingency Theory with multidimensional success measurement; as such, the study offers a more contextually grounded understanding of software project performance in uncertain developing economy environments. Previous studies have typically focused either on risk management adoption or on traditional project performance measures without integrating contextual instability into a broader explanatory framework. Without incorporating contextual instability into a more comprehensive explanatory framework, previous research has typically concentrated on either the adoption of risk management or on conventional project success metrics.

Therefore, this study contributes to the body of literature by assessing the moderating effect of environmental uncertainty in the Ethiopian software industry and empirically testing the relationship between formal risk management techniques and multidimensional project success. It also offers a more contextually grounded view of software project performance in uncertain developing economy situations. It does so by combining Contingency Theory with multidimensional success assessment.

But, since software project environments are also affected by organizational culture, managerial perceptions, institutional instability, and behavioral responses to uncertainty that cannot be fully captured through numerical indicators alone, qualitative evidence was used to triangulate, contextualize, and explain the findings. The intention behind the qualitative component was not to generate a new theory but rather to enhance interpretation and provide a deeper insight into why formal risk management practices weaken under uncertain environmental conditions.

Thus, the study combines both quantitative explanatory analysis and qualitative contextual interpretation. This allows for a more comprehensive understanding of risk management in software projects within the Ethiopian software ecosystem.

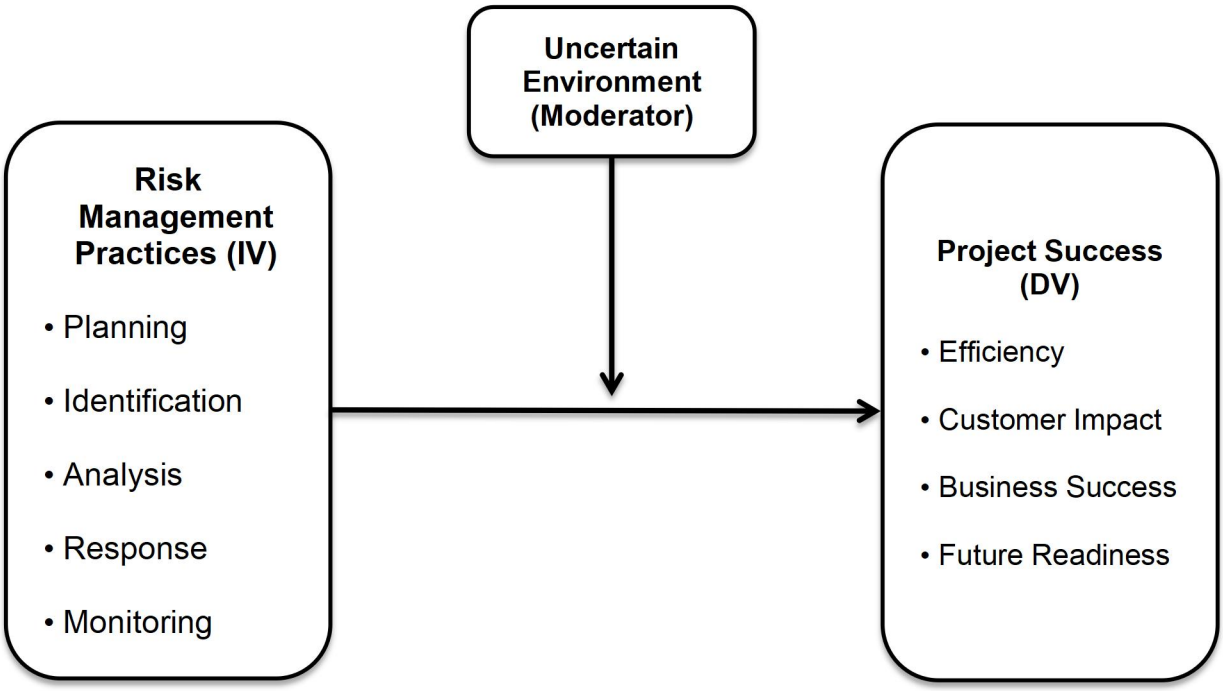
2.4. Conceptual Framework of the Study

The current study proposes a conceptual framework where Risk Management Practices are hypothesized to positively affect multidimensional Project Success and where Environmental Uncertainty moderates their relationship's strength. The framework is primarily grounded in Contingency Theory. It assumes that the effectiveness of formal managerial practices is not universal and it's dependent on environmental conditions where projects are executed in.

As such, Envirnmental Uncertainity is positioned by the framework as a moderating condition that is capable of strengthening or, to the contrary, weakening the effectiveness of Risk Management Practices. Even well-structured risk management systems may experience reduced effectiveness in unstable environments characterized by infrastructure instability, economic constraint, regulatory unpredictability, and related challenges.

The framework thus exsamines the direct relationshipt between Risk Management Practices and Project Success, as well as the conditional influence Environmental Uncertainity between their relationship in the Ethiopian Software sector.

Figure 2.1: *Conceptual Framework*



Source: *Developed by the researcher based on PMI (2017) and Shenhar (2001)*

The framework consists of three primary components:

- **Independent Variable** (IV): Risk Management Practices
- **Dependent Variable** (DV): Multidimensional Project Success
- **Moderating Variable** (MV): Environmental Uncertainty

Environmental Uncertainty in this model is hypothesized to interact with the Independent Variable, and that it influences both the strength and direction of the relationship between risk management and project success.

2.5. Operational Models of the Study

The current study has adopted established and validated operational models from project management literature to transition theoretical concepts into measurable constructs.

2.5.1 Risk Management Practices (Independent Variable)

The Project Management Institute framework (PMBOK Guide, 2017) was used to operationalize Risk management practices. Risk management in this framework is conceptualized as an iterative process consisting of fice distinct and measurable components instead of treating it as a singular event.

2.5.2 Project Success (Dependent Variable)

Project success has been operationalized using the multidimensional model proposed by Shenhar and Dvir (2001) in order to capture the full value of software deliverables. Focus is shifted in this model to strategic value creation across four dimensions instead of focusing on mere technical delivery only.

2.5.3. Environmental Uncertainty (Moderating Variable)

The research operationalized environmental uncertainty as a perceptual construct and it reflected the degree of instability and unpredictability in the external environment in which projects are executed. This variable was specifically measured through three external dimensions after recognizing the macroeconomic constraints in the Ethiopian context:

- Economic Constraints: The perception of how factors like foreign exchange (forex) shortages and inflation directly impede the procurement of necessary software licenses, cloud services, and hardware.
- Infrastructural Instability: The perceived operational disruption caused by unreliable telecommunications networks, internet connectivity drops, and power supply interruptions.
- Regulatory Unpredictability: The impact of sudden policy shifts or shifting compliance frameworks on active project implementation.
- It was hypothesized that when external instability reaches critical thresholds, this variable moderates the primary relationship by testing whether the protective benefits of formal risk management diminish in such conditions.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1. Research Philosophy

Given the multifaceted and context dependent nature of software project management, this study adopts a Pragmatic research philosophy with a post positivist orientation. Pragmatism emphasizes the use of methodological approaches most appropriate for addressing the research problem in lieu of rigidly adhering to a single philosophical tradition. This is particularly appropriate for this study because understanding software project success within the Ethiopian environment requires both statistical examination of measurable relationships and contextual interpretation of practitioner experiences. As a result, this study uses a pragmatic research philosophy with a predominant post-positivist perspective due to the multifaceted and context dependent nature of software project management.

Because it aims to empirically verify derived hypotheses about the relationship between Risk Management Practices (RMP) and Project Success (PS), and the moderating role of Environmental Uncertainty (EU) between them, the study is primarily post-positivist in its perspective. As such, structured measurement, hypothesis testing, and inferential statistical analysis are relied upon to build the Quantitative component.

But, since software project environments are also affected by organizational culture, managerial perceptions, institutional instability, and behavioral responses to uncertainty that cannot be fully captured through numerical indicators alone, qualitative evidence was used to triangulate, contextualize, and explain the findings. The intention behind the qualitative component was not to generate a new theory but rather to enhance interpretation and provide a deeper insight into why formal risk management practices weaken under uncertain environmental conditions.

Thus, the study combines both quantitative explanatory analysis and qualitative contextual interpretation. This allows for a more comprehensive understanding of risk management in software projects within the Ethiopian software ecosystem.

3.2. Research Design

This research uses an explanatory sequential mixed-methods design to conform to its pragmatic philosophical orientation. It mainly employs a quantitative explanatory survey approach in order to statistically investigate the relationship between risk management practices and project success and the moderating effect of environmental uncertainty. Hence, the main analytical part of the study is this quantitative phase.

Additionally, qualitative evidence was used as a triangulation component to support and strengthen the statistical findings. The quantitative relationships were interpreted and contextualized using semi-structured qualitative insights obtained from experienced software professionals. This was especially insightful with regards to understanding institutional and behavioral factors that hinder the adoption of formal risk management in uncertain environments.

As discussed above, because the study first demonstrates statistical patterns through quantitative analysis and then uses qualitative evidence to explain why those patterns exist within the Ethiopian software sector, the explanatory sequential design was selected.

3.2.1. Operationalization of Study Variables

The study's conceptual framework was translated into measurable indicators to facilitate quantitative measurement. Table 3.1 outlines the operationalization of the independent, dependent, and moderating variables.

Table 3.1: Operationalization of Study Variables (Measured on a 5-point Likert Scale)

Variable Type	Dimension	Measurement Indicators (Likert Items)
	Risk Planning	• Allocation of time, budget, and resources for risk activities •Development of a documented, formal risk management plan • Involvement of relevant stakeholders in the planning phase

Independent Variable (Risk Management Practices)	Risk Identification	•Application of structured techniques (e.g., brainstorming, checklists) • Utilization of historical data and past project lessons • Systematic documentation in a formal risk register •Execution of identification at the early project stages • Participation of key stakeholders in identifying risks
	Risk Analysis	• Assessment of risks via probability and impact • Prioritization of risks based on severity or risk scores • Qualitative and/or quantitative analysis is performed.
	Risk Response	• Development of specific mitigation or contingency plans • Assignment of risk management responsibilities to specific individuals • Clear definition of response strategies (avoid, mitigate, transfer, accept) • Preparation of alternative fallback plans for major risks
	Risk Monitoring and Control	• Regular review of risks during project meetings • Continuous updating of the risk register throughout the lifecycle

		• Comparison of actual risk outcomes against planned responses • Tracking and communication of risk status changes to stakeholders
	Project Efficiency	• Completion within the planned schedule • Completion within the planned budget • Completion without major disruption or cancellation • Fulfillment of specified functional requirements
	Customer Impact	• End-user satisfaction with usability and performance • System reliability with minimal failures or downtime
Dependent Variable (Project Success)	Business Success	• Delivery of measurable business value (e.g., ROI, cost savings) • Contribution to achieving organizational strategic objectives
	Future Readiness	• Development of new technical capabilities or infrastructure • Enhancement of the organization's ability to execute future projects
Moderating Variable (Environmental Context)	Environmental Uncertainty	• Infrastructure instability (e.g., power outages, unreliable internet) • Regulatory or policy shifts during project execution

	• Economic conditions (e.g., forex shortages, inflation) affecting procurement • Difficulty in forecasting due to external environmental changes • General unpredictability and instability of the external environment

3.2.2. Qualitative Triangulation

To improve interpretative depth and methodological triangulation, an additional qualitative component was added to the quantitative survey. It involved semi-structured discussions with experienced software professionals from software companies and corporate IT environments. These discussions revolved around real-world experiences regarding:

- the implementation of formal risk management practices,
- organizational attitudes toward risk,
- infrastructure and institutional constraints,
- client–vendor coordination challenges,
- and adaptive project management behaviors under uncertainty.

The qualitative component's goal was to contextualize and explain the statistical results produced by the quantitative phase rather than to independently build grounded theory. Specifically, it helped explain why formal risk management practices often can become fragmented, informal, or inconsistently applied in volatile project environments.

Thus, the addition of qualitative data served the triangulation purpose by:

- validating the plausibility of the quantitative findings,
- explaining unexpected or nuanced statistical relationships,
- and improving contextual understanding of the Ethiopian software ecosystem.

Alongwith the quantitative results, thematic analysis of the qualitative responses was included into the discussion chapter.

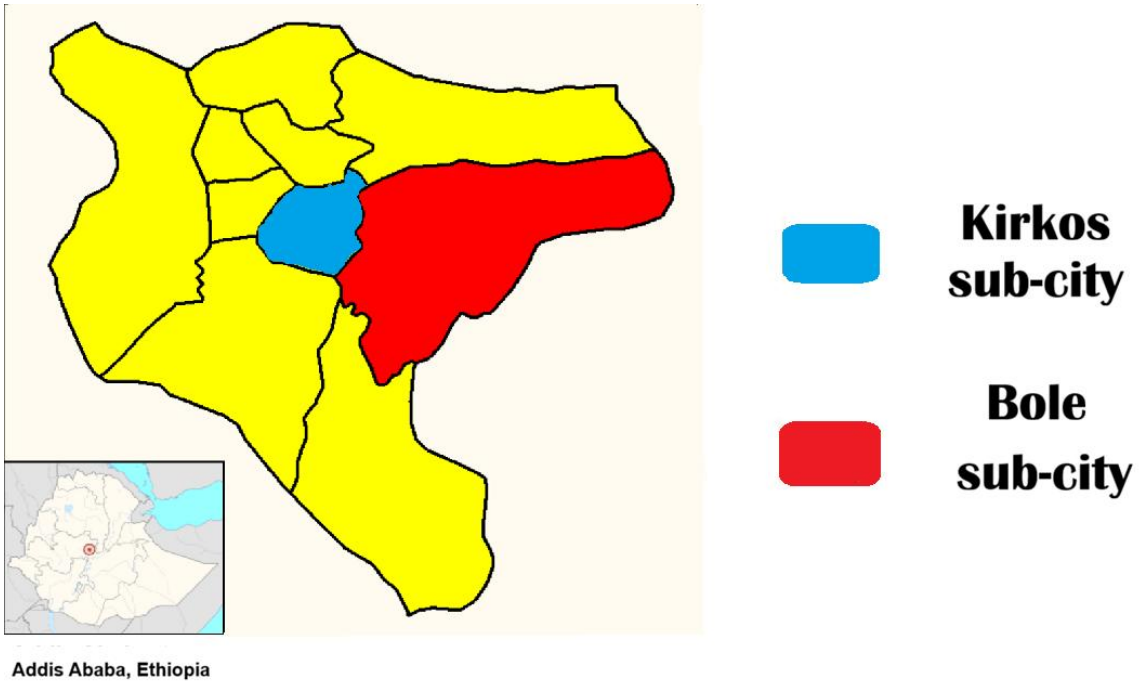


Figure 3.1: Map of Study Area (*Source: Adapted by the researcher from WikiMedia Commons, 2014*)

This study used a cross-sectional survey approach, meaning it collected data from respondents only at a single point in time. The design was chosen because the study's main goal is to investigate how risk management practices, environmental uncertainty, and software project success are related in Ethiopia's software industry. Although longitudinal designs may offer stronger evidence of temporal change and causality, they necessitate prolonged project tracking over several implementation stages, which was impractical given the current study's scope and timeline. Long-term project tracking is also challenging in Ethiopia because software initiatives are often impacted by shifting economic conditions, unstable infrastructure, bureaucracy, regulatory changes, and organizational disruptions.

As a result, the cross-sectional design offered a practical and methodologically appropriate way to capture the perceptions and experiences of professionals working on recently finished software projects. The design also aligns with earlier empirical studies in software project management and information systems research; these studies relied on perceptual survey data to examine relationships between project management practices and project outcomes.

Moreover, qualitative insights obtained through interviews were added to the quantitative findings to strengthen depth and contextual understanding. This triangulation approach enabled the study to complement statistical relationships with contextual explanations. The practical realities of managing risks in software projects within uncertain environments were thus explained better.

3.2.3. Unit of Analysis and Use of Perceptual Measures

The primary unit of analysis for this study was the operationalized, knowledgeable project participants' perceptual evaluation of a software project. This is consistent with established research in information systems and project management. As such, the respondents were to evaluate one recently completed software project in which they had direct professional involvement, as instructed. This helped to ensure responses were based on specific project experiences instead of generalized industry opinions.

For a number of reasons, it is methodologically suitable to use perceptual measures. First, in many Ethiopian software companies, objective organizational project records such as formal risk budget reports and internal performance metrics are often inaccessible, inconsistently documented, or confidential. Secondly, customer satisfaction, organizational value, future readiness, and similar subjective aspects form the metrics of software project success. Hence, since software project success is inherently multidimensional, it cannot be adequately measured by objective financial indicators alone (Shenhar & Dvir, 2001).

Finally, the questionnaire included screening questions that required respondents to confirm their professional role, project involvement level, and level of experience before completing the survey. This step was incorporated to help improve response quality and reduce key informant bias.

3.3. Target Population

Software professionals engaged in the design, development, implementation, management, or supervision of software projects within the Ethiopian software sector made up the study's target demographic. The study targeted software professionals employed in private software development companies, financial institutions, government organizations, and non-governmental organizations involved in software project implementation. However, due to

the absence of a publicly accessible and comprehensive sampling frame for software project professionals in Ethiopia, the exact size of the target population (N) could not be determined.

Additionally, only those who had taken part in at least one finished software project in the recent past were deemed eligible for the study in order to get higher chances of informed responses.

3.3.1. Software Development Companies

These companies usually work in fast-changing, dynamic environments with many ongoing projects, shifting client needs, and differing levels of agile or adaptive project management techniques. They include private software companies, technology startups, software vendors, systems integrators, and IT service providers that operate inside Ethiopia's digital ecosystem. It was important to include respondents from these firms because these organizations are responsible directly for implementing technical risk management tasks throughout the software development lifecycles.

Because the research focuses on organized project environments where formal or semi-formal project management methods are more likely to exist, freelancers and informal gig workers were not the primary focus of the study.

3.3.2. Financial Institutions and Enterprises

A more comprehensive and balanced understanding of risk management practices for software projects was obtained by including respondents from both client organizations and software vendors. IT departments, project management offices (PMOs), and digital transformation divisions found in commercial banks, insurance corporations, government organizations, and big operational enterprises fall under this category. These companies are Ethiopia's largest users of enterprise software solutions, and they often take part in challenging software installation projects involving system integration, cybersecurity needs, regulatory compliance, and extensive digital transformation projects.

3.4. Sampling Strategy and Sample Size

It was not possible to use a purely probability-based sample strategy because there was no complete and publicly available sampling frame of current software project specialists in

Ethiopia. Therefore, to find respondents with pertinent professional experience in software project environments, this study used a purposeful non-probability sampling technique.

3.4.1. Sampling Technique

The study used a purposive and non-probability sampling technique. It was supplemented by network-based distribution methods. Probability sampling using formal organizational or governmental registries was considered initially. However, it was later deemed impractical due to the availability issues of comprehensive registries that consistently list active firms and that identify professionals directly involved in software project management activities.

Under the purposive sampling approach, respondents were selected based on predefined inclusion criteria. This approach was adopted because a publicly accessible sampling frame identifying software project professionals was not available, making probability-based sampling impractical. Furthermore, it helped ensure to target only participants with relevant experience in software project environments were included in the study. Eligible respondents were required to be active IT professionals such as software engineers, project managers, business analysts, QA specialists, or related professionals. They also had to have participated in at least one completed software project.

The researcher utilized network-based survey distribution to reach this specialized population. This includes professional contacts, industry intermediates, LinkedIn outreach, and relevant technology-focused communities. The approach improved access to experienced practitioners while also reducing organizational gatekeeping effects that might have limited participant diversity.

The questionnaire also included demographic screening items and validation checks. This was to enhance data quality and accordingly, responses that were ineligible, incomplete, duplicated, or inconsistent were excluded during data cleaning prior to final analysis commencement.

3.4.2. Sample Size Determination

The study employed an a priori statistical power analysis based on Cohen (1988) to determine the sample size for the multivariate statistical analysis. Statistical power analysis has more rigor in its method to estimate the minimum sample size required to notice significant

relationships in comparison to rule-of-thumb approaches. It also minimizes the chances of Type II error occurrence.

Hence, by using the G*Power software under commonly used parameters in social science and behavioural research, the minimum required sample size (N_{min}) = 92 respondents was calculated.

- Statistical Test: Linear Multiple Regression (Fixed model, R^2 deviation from zero).
- Significance Level (α): 0.05 (Standard academic threshold).
- Power ($1 - \beta$): 0.80 (Minimum standard for robust research).
- Effect Size (f^2): 0.15 (Medium Effect Size).
- Number of Predictors (m): 3 (The aggregated independent variable, the moderating variable, and the interaction term used in the regression model).
- Software Output ($_{Nmin}$): 92 respondents.

Risk Management Practices were aggregated into a single composite construct for the primary hypothesis testing and moderation analysis in order to maximize inferential power and maintain consistency with the conceptual model. As a result, the G*Power analysis and the principal regression model included three predictors: the independent variable, the moderating variable, and their interaction term.

However, because Risk Management Practices were conceptually defined through five dimensions (PMI, 2017), the individual dimensions were also examined separately during the supplementary analysis. This included descriptive analysis, correlation analysis, and additional dimensional moderation regressions conducted to provide a more detailed understanding of how Environmental Uncertainty influences different stages of the risk management process.

Finally, the sample was adjusted to account for an expected invalid or non-response attrition rate of approximately 30%. This helped ensure the final dataset remains valid and still retains adequate statistical power even after the data cleaning phases.

$$N_{target} = N_{minimum} \times (1 + \text{Buffer Rate})$$

$$N_{target} = 92 \times 1.30$$

$$N_{target} = 119.6 \approx 120$$

Hence, as shown above, the study targeted a final usable dataset of 120 respondents.

3.5. Data Collection Instruments

A structured and self-administered questionnaire was the primary instrument for quantitative data collection done through Google Forms. It contained predominantly closed-ended question items that were measured on a five-point Likert scales. This facilitated quantitative coding and statistical analysis.

The instrument was organized into the following four sections:

- **Part I:** Demographic and Contextual Information

  In this section, we collected background information of respondents— including organizational type, professional role, years of experience, and project involvement. Additionally, respondents were asked to briefly describe a recently completed software project. This was to further confirm relevant project participation and improve response validity.

- **Part II:** Risk Management Practices (Independent Variable)

  This section measured the extent of risk management implementation. It did so by using dimensions adapted from the PMI PMBOK framework. The questions here assessed practices related to risk planning, identification, analysis, response, and monitoring using a five-point Likert scale ranging from “Never” to “Always”.

- **Part III:** Project Success (Dependent Variable)

  In this part of the questionnaire, multidimensional project success was measured. To do so, constructs adapted from Shenhar and Dvir’s (2001) project success framework were used. The instrument evaluated project efficiency, customer impact, business success, and future readiness using a five-point Likert scale ranging from “Strongly Disagree” to “Strongly Agree”.

- **Part IV:** Environmental Uncertainty (Moderating Variable). The degree of environmental uncertainty affecting software projects was assessed in this section. It assessed things such as infrastructure disruptions, macroeconomic volatility, regulatory changes, and general unpredictability in the operating environment of the project.

Finally, qualitative follow-up interviews were conducted with selected experienced professionals in addition to the quantitative questionnaire. The interviews provided contextual explanations and triangulated the quantitative findings regarding risk management implementation, and environmental uncerainty within Ethiopian software projects.

3.6. Validity and Reliability

Specific quality control measures were put in place to help ensure the scientific rigor of the study. This included making sure that the instrument measured the correct constructs (Validity) and measured them consistently (Reliability).

3.6.1. Validity and Pilot Study

Generally, validity refers to the extent to which the research instrument correctly measures the intended constructs.

- **Content and Face Validity:** The initial questionnaire was reviewed by the research advisor and experienced industry practitioners familiar with software project management within the Ethiopian context to enhance the content and face validity. Contextual appropriateness, relevance, and clarity of the measurement items were assessed by the help of their feedback.
- **Pilot Study:** A pilot study involving 18 people was conducted prior to the main data collection phase. It was conducted with respondents who were software professionals selected purposively. Question clarity, preliminary reliability performance, terminology consistency, and instrument flow were evaluated during the pilot study. The feedback indicated that some traditional PMBOK terminology did not fully align with agile and project management language commonly used within local software development environments. As such, without altering the theoretical constructs, minor contextual clarifications and operational examples were added into some selected questionnaire items. This improved clarity and construct interpretation.
- **Triangulation and Credibility** Interview data obtained from experienced industry professionals in the Ethiopian software sector were triangulated with the quantitative findings for the purposes of improving interpretive validity. This allowed the study to compare statistical findings with the real-world practitioners' experiences and contextual explanations.

3.6.2. Reliability

This refers to the measurement instrument's consistency and internal stability. As such, to assess the internal consistency of the questionnaire constructs, Cronbach's Alpha coefficient was used. A minimum threshold value of 0.70 was adopted as the acceptable reliability standard to be consistent with Nunnally (1978).

During the pilot study phase, preliminary reliability testing was conducted. Minor adjustments were made to improve internal consistency where necessary. Moreover, during the main statistical analysis phase, final reliability analysis was subsequently performed using the full dataset.

3.7. Data Analysis Methods

The survey responses were exported, cleaned, coded and then analyzed using SPSS statistical software version 32.0 after data collection was complete. Prior to analysis, responses that were incomplete, duplicate, insufficiently engaged or otherwise deemed ineligible were excluded.

Descriptive Statistics

To summarize respondent characteristics and assess the general level of risk management practice implementation within the sector, descriptive statistical techniques such as means, standard deviations, and frequencies were used.

Correlation Analysis

To examine the strength and direction of bivariate relationships among the study's variables, Pearson's Product-Moment Correlation analysis was employed.

Moderated Multiple Regression Analysis

As the primary inferential technique, hierarchical moderated multiple regression analysis was employed. It was used to test the study hypotheses and also examine whether environmental uncerainty moderates the relationship between risk management practices and project success.

The regression model is expressed as:

$$Y = \beta_0 + \beta_1 X + \beta_2 Z + \beta_3 (XZ) + \varepsilon$$

Where:

Y = Project Success (Dependent Variable)

X = Risk Management Practices (Independent Variable, based on five PMBOK dimensions)

Z = Environmental Uncertainty (Moderating Variable)

XZ = The interaction term (Centered IV × Centered MOD)

$\beta_{1\text{-}3}$ = The coefficients of weight

ε = Error term

Predictor variables were mean-centered prior to generating the interaction term to reduce the multicollinearity during the interaction testing.

Qualitative Analysis

In this phase, the qualitative interviews were analyzed thematically following a structured coding process (Braun & Clarke, 2006). The interview data were transcribed, manually coded for recurring patterns, and categorized into central themes. These themes were used primarily to contextualize, explain, and triangulate the quantitative results. Particularly, they were used to understand the barriers to risk management implementation and the influence of environmental uncertainty on Ethiopian software projects. The triangulation of these qualitative insights with the quantitative models is presented in Section 4.9 (Triangulation of Quantitative and Qualitative Findings) of chapter 4.

3.8. Ethical Considerations

The following several ethical safeguards were implemented to protect participants. They were particularly important since the study involved professional experiences related to software project performance and organizational practices.

- **Informed Consent** Prior to completing the questionnaire or interviews, the confidentiality of responses, voluntary nature of their participation, and the purpose of the study was explained with a clear introductory statetemnt to all participants.

- **Confidentiality and Anonymity** The survey participation was anonymous. During the primary dataset collection, no personally identifying information, organizational

names, or confidential project identifiers were collected. Findings were reported only in aggregated form to protect respondents and organizations alike.

- **Voluntary Participation** Participation in both the survey and the interviews were entirely voluntary. Respondents retained the right to discontinue the participation at any stage without consequence.

- **Participant Appreciation** As appreciation, respondents were optionally allowed to enter a separate contact form for a small mobile data package flow without compromising anonymity. This secondary form was entirely independent from the main survey dataset and could not be linked to individual survey responses.

- **Data Security** All digital data were protected and were only accessible to the researcher and academic supervisor.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1. Introduction

Findings derived from the primary data collected through the structured questionnaire are presented in this chapter. The data collected was cleaned, coded, and analyzed using IBM SPSS Statistics, version 32.0. To test the hypothesized relationships, the analysis is divided into descriptive statistics—to profile the respondents and the baseline maturity of the sector—and inferential statistics (correlation and multiple regression) to test the hypothesized relationships.

To reiterate, the main objective of this study was to examine the effect of risk management practices on software project success in Ethiopia and the moderating role of environmental uncertainty.

4.1.1. Response Rate and Data Screening

The quantitative data collection aimed to obtain 120 valid responses based on the planned sample size that was established during the research design phase. Data were then collected through targeted digital distribution until the required number of valid responses was achieved. Screening for completeness and suitability for the study was conducted on completed responses. Responses that did not meet the inclusion criteria, such as those lacking sufficient relevance to the project context or indicating insufficient knowledge of the project, were not retained for analysis. Data collection was concluded once the predetermined target of valid responses was reached, and the dataset was prepared for analysis.

Hence, prior to importing the data into SPSS, only responses considered valid and usable were included in the final dataset.

This process resulted in 120 participants for the final analysis. The screening helped ensure that the subsequent statistical analyses were based on respondents with adequate familiarity with the project context, thereby supporting the reliability of the findings.

4.2. Pilot Study and Instrument Reliability

For this preliminary analysis, a sample of 18 software professionals with direct software project experience was utilized. The pilot study was conducted to test the internal consistency and reliability of the measurement scales within the Ethiopian context before the survey instrument was deployed in a full-scale manner for the main study.

Reliability was measured using Cronbach's Alpha (α); it assesses how closely related a set of items are as a group. An alpha coefficient of 0.70 or higher was considered the baseline for acceptable reliability. This is in accordance with standard thresholds for academia (Nunnally, 1978; Hair et al., 2010).

Table 4.1 summarizes the reliability analysis of the pilot data, which confirmed that all constructs showed higher internal consistency.

Table 4.1: *Reliability Test Results (Pilot Study, N=18)*

Construct / Variable	Number of Items	Cronbach's Alpha (α)
Independent Variables		
Risk Planning	3	0.886
Risk Identification	5	0.835
Risk Analysis	3	0.835
Risk Response	4	0.925
Risk Monitoring and Control	4	0.930
Dependent Variables		
Project Efficiency	3	0.757
Customer Impact	3	0.942
Business Success	2	0.922
Future Readiness	2	0.897

Moderating Variable		
Environmental Uncertainty	5	0.934

Initial assessment of the pilot data revealed a slight contextual ambiguity in traditional PMBOK terminology for the Ethiopian agile development (specifically in the Risk Identification and Project Efficiency areas). After minor clarifications were added, all variables achieved Cronbach's Alpha scores above the 0.70 threshold. The highest observed was Customer Impact ($\alpha = 0.942$) and Environmental Uncertainty ($\alpha = 0.934$).

As a result, for the primary data collection phase, the instrument was deemed reliable, statistically robust, and validated.

4.2.2. Common Method Bias Testing

Since there is an inherent risk of Common Method Bias (CMB) artificially inflating the relationships between variables because the quantitative data was collected using self-reported questionnaires from a single source, Harman's Single-Factor test was conducted to test for this. As such, an unrotated Principal Component Analysis (PCA) was performed on all 35 Likert-scale items. The analysis revealed that the single largest factor accounted for only 22.06% of the total variance. This is below the strict 50% threshold (Podsakoff et al., 2003). Hence, it is concluded that Common Method Bias does not pose a significant threat to the validity of the dataset or the subsequent regression models.

4.3. Test of Normality

The assumption of normality was assessed prior to conducting the parametric inferential statistics (Pearson correlation and Ordinary Least Squares regression). Also, relying solely on the Shapiro-Wilk test can yield misleading results given the sample size of N = 120 since it becomes overly sensitive to minor deviations in larger samples. As such, Skewness and Kurtosis metrics were used to evaluate normality.

Table 4.2: *Skewness and Kurtosis of Core Constructs*

Statistics

		Risk_Mgmt_IV	Success_DV	Uncertainty_MOD
N	Valid	120	120	120
	Missing	0	0	0
Skewness		-.300	.323	-.098
Std. Error of Skewness		.221	.221	.221
Kurtosis		-.545	-.112	-.828
Std. Error of Kurtosis		.438	.438	.438

All skewness and kurtosis values fall well within the acceptable range of -2.0 to +2.0 (Hair et al., 2010), as shown in Table 4.2. This means that we fail to reject the assumption of normality. Furthermore, samples higher than 30 observations approximate a normal distribution in accordance with the Central Limit Theorem (CLT).

As a result, it was deemed appropriate to apply parametric techniques in this study.

4.4. Demographic and Project Profile

To contextualize the findings in the Ethiopian software sector, the demographic characteristics of the 120 respondents were analyzed.

Organization Type:

The research instrument defined organization categories from which data was collected accross. The majority of respondents were from private software development companies (46.7%, n=56). Under the “other” category (29.1%, n=35) startups and independent vendors were reclassified under it during analysis. Additionally, 15.% (n=19) represented Bank and Insurance IT departments, and the remaining 8.4% (n=10) represented Government and NGO software projects.

Role in the Project:

From the project execution roles, the sample included a diverse cross-section of it. It included Software Engineers/Developers, who made up the largest group (42%), followed by Project Managers/Scrum Masters (31%), QA Testers/Analysts (18%), and DevOps/System Administrators (9%).

Table 4.3: *Demographic and Project Profile of Respondents (N=120)*

Category	Frequency (n)	Percentage (%)
Organization Type		
Private Software Development Company	56	46.7%
Startups and Independent Vendors (Other)	35	29.1%
Bank and Insurance (IT Dept)	19	15.0%
Government and NGO	10	8.4%
Total	120	100%
Role in the Project		
Software Engineer / Developer	50	42.0%
Project Manager / Scrum Master	37	31.0%
QA Tester / System Analyst	22	18.0%
DevOps / System Administrator	11	9.0%
Total	120	100%

4.5. Descriptive Statistics

All variables used to make the descriptive statistics were measured on a 5-point Likert scale. The descriptive statistics, which included Mean and Standard Deviation, were calculated for the purpose of assessing the baseline extent of risk management practices. Moreover, the individual Likert-scale items for Risk Management Practices, Environmental Uncertainty, and Project Success were aggregated into composite mean scores for each respondent. This was to help get a higher-level inferential analysis.

Table 4.4: *Descriptive Statistics for Constructs*

Construct	N	Mean	Std. Deviation
Risk Management Practices (Overall IV)	120	3.18	0.732
- Risk Planning	120	2.96	0.97
- Risk Identification	120	3.33	0.89
- Risk Analysis	120	2.99	0.96
- Risk Response	120	3.15	0.82
- Risk Monitoring and Control	120	3.32	0.89
Environmental Uncertainty (Moderator)	120	3.407	0.82
Project Success (Overall DV)	120	3.01	0.73
- Project Efficiency (Time & Budget)	120	2.40	0.91
- Customer Impact	120	3.28	0.9
- Business Success	120	3.30	1.03
- Future Readiness	120	3.22	1.04

The results may indicate a stronger emphasis on ongoing project tracking and team coordination practices in the local sector contrary to formal, upfront Risk Planning (Mean = 2.96), which ranked lowest. This is because the descriptive results show that the most frequently applied practices are Risk Identification (Mean = 3.33) and Risk Monitoring

(Mean = 3.32).

4.6. Correlation Analysis

To assess the relationship between variables, Pearson product-moment correlation coefficient was computed.

Table 4.5: *Pearson Correlation Matrix*

Variables	1	2	3	4	5	6	7
1. Risk Planning	1.000						
2. Risk Identification	0.584***	1.000					
3. Risk Analysis	0.494***	0.634***	1.000				
4. Risk Response	0.614***	0.568***	0.556***	1.000			
5. Risk Monitoring	0.529***	0.620***	0.596***	0.666***	1.000		
6. Env. Uncertainty (MOD)	-0.011	-0.136	-0.090	-0.096	-0.062	1.000	
7. Project Success (DV)	0.492***	0.594***	0.479***	0.574***	0.522***	-0.365***	1.000

Table 4.5 presents the Pearson correlation coefficients among the five dimensions of Risk Management Practices, Environmental Uncertainty, and Project Success. The results indicate that although varying in magnitude, all five risk management dimensions demonstrate moderate positive relationships with the dependent variable. As such, the correlation coefficients ranged from 0.479 to 0.594 ($p < 0.001$). This suggests that higher levels of risk

planning, identification, analysis, response, and monitoring are generally associated with improved project outcomes.

Moreover, Environmental Uncertainty showed a statistically significant negative relationship with Project Success ($r = -0.365$, $p < 0.001$). This indicates that higher levels of environmental uncertainty are associated with lower levels of project success. In contrast, the correlations between Environmental Uncertainty and the five risk management dimensions were weak and statistically insignificant, ranging from -0.011 to -0.136. This suggests that Environmental Uncertainty represents a conceptually distinct construct rather than a direct reflection of risk management practices.

Finally, the intercorrelations among the five risk management dimensions ranged from 0.494 to 0.666. Therefore, the correlation matrix provides preliminary support for proceeding with the subsequent regression analyses.

4.6.1. Assumptions of Multiple Regression Analysis *

* See Appendix C for the Normal P-P plots and scatterplots

1. Multicollinearity Test

When independent variables are highly correlated, multicollinearity occurs, which can distort the regression coefficients and reduce the predictive power of the model. To test for this assumption, Collinearity Diagnostics were evaluated using Tolerance and the Variance Inflation Factor (VIF).

Table 4.6: *Collinearity Test Results*

Variables	Tolerance	VIF
Risk Management (Centered)	0.990	1.010
Environmental Uncertainty (Centered)	0.990	1.010
Interaction Term (RM * EU)	0.984	1.016

According to standard statistical guidelines (Hair et al., 2010), multicollinearity is not a concern if the Tolerance value is greater than 0.20 and the VIF value is below 5.0. As demonstrated in Table 4.6, all Tolerance values in the model exceed 0.98, and all VIF values are well below the threshold, hovering near the ideal baseline of 1.0. Furthermore, the mean-centering of the variables successfully prevented any multicollinearity that typically arises when introducing an interaction term. Therefore, it is concluded that multicollinearity is not a concern in this dataset, and the model is robust for moderation analysis.

2. Linearity and Homoscedasticity

A scatterplot of standardized residuals versus standardized predicted values, alongside residual statistics were used to assess the assumptions of linearity and homoscedasticity. No clear pattern such as funneling or curvature was observed in the plot. It also showed a random dispersion of data points. Furthermore, acceptable limits were largely observed for the standard residuals (Minimum = -3.074, Maximum = 2.024). This shows that the relationships between the predictor variables and project success are linear. It also shows that there are no severe outliers distorting the model and that the variance of the residuals is nearly constant.

3. Independence of Errors

Durbin-Watson statistic was used to assess the independence of residuals. The acceptable range of 1.5 to 2.5, and since the obtained value for our dataset (1.954) falls within it, it indicates that there is no significant autocorrelation in the residuals.

Therefore, the study proceeded to test the hypothesized relationships since all assumptions of multiple regression were confirmed to be satisfied. Hierarchical regression analysis was used for it.

4.7. Multiple Regression and Moderation Analysis

The predictor (IV) and moderator (MOD) were mean-centered to test the hypotheses before creating the interaction term (IV x MOD). This was done to mitigate against multicollinearity. As such, a hierarchical moderated regression analysis was conducted to evaluate the main effects and the interaction term.

The overall model was significant ($F(3, 116) = 55.442$, $p < 0.001$). The main effects of risk management and environmental uncertainty explained 51.8% of the variance in Project

Success. The inclusion of the interaction term increased the explained variance by 7.1% ($\Delta R^2 = 0.071$), resulting in a final R^2 of 0.589, indicating a statistically significant moderating effect of environmental uncertainty.

Note: *The raw statistical outputs generated via IBM SPSS, including the full ANOVA and Model Summary tables, are provided in Appendix C for methodological transparency.*

Table 4.7: *Hierarchical Moderation Regression Analysis for Project Success*

Predictor Variables	Unstandardized B	Standard Error	t-value	p-value
(Constant)	2.992	0.043	68.909	< 0.001
Risk Management (Mean-Centered IV)	0.605	0.060	10.140	< 0.001
Env. Uncertainty (Mean-Centered MOD)	-0.299	0.054	-5.538	< 0.001
Interaction Term (IV x MOD)	-0.300	0.067	-4.471	< 0.001
Model Summary				
R^2	0.589			
ΔR^2 (Change in R2)	0.071			
F-statistic	55.442			
Df	(3, 116)			

Interpretation of Findings (Hypothesis Testing):

- **Main Effect of Risk Management:** Project success increases by 0.605 units for every 1-unit increase in risk management maturity. Hence, Hypothesis 1 is accepted. This is because the effect of risk management on project success is positive and highly significant ($B = 0.605$, $p < 0.001$). (Hypothesis 1 is Accepted).

- **Main Effect of Environmental Uncertainty:** Project outcomes are statistically significantly and negatively impacted by an uncertain environment ($B = -0.299$, $p < 0.001$). This provides strong empirical evidence that macroeconomic instability directly harms project delivery. (Hypothesis 3 is Accepted).

- **The Moderation Effect:** The findings show that as environmental uncertainty (such as infrastructure instability or forex constraints) increases, the positive impact of standard risk management practices on project success is significantly weakened. This is demonstrated by the interaction term (IV x MOD) being negative and highly significant ($B = -0.300$, $p < 0.001$). Hence, Environmental Uncertainty acts as a negative moderator. (Hypothesis 2 is Accepted).



Figure 4.1: *Interaction plot showing the moderating effect of environmental uncertainty on the relationship between risk management practices and project success*

Table 4.8: *Hypothesis Testing Summary*

Hypothesis	Path / Relationship	B Coefficient	p-value	Decision
H1	Risk Management Practices -> Project Success	0.605	< 0.001	Supported
H2	Risk Mgmt * Env. Uncertainty -> Project Success	-0.300	< 0.001	Supported
H3	Environmental Uncertainty -> Project Success	-0.299	< 0.001	Supported

4.7.1 Dimensional Moderation Analysis

An additional dimensional analysis was conducted to provide a more detailed understanding of how Environmental Uncertainty influences individual risk management practices. The aggregated construct was retained for the primary hypothesis testing because the conceptual objective of the study was to examine the overall effect of risk management practices as an integrated managerial capability.

This supplementary analysis is consistent with the conceptualization of Risk Management Practices as comprising five interrelated dimensions: Risk Planning, Risk Identification, Risk Analysis, Risk Response, and Risk Monitoring.

For this purpose, all predictor variables were mean-centered prior to interaction testing in order to reduce multicollinearity. Collinearity diagnostics were evaluated for each of the five models, with all Tolerance values exceeding 0.90 and VIF values remaining near 1.0, confirming that multicollinearity was successfully mitigated. Five separate hierarchical moderated regression models were then conducted. In each model, Project Success was specified as the dependent variable, the respective risk management dimension was entered as the independent variable, Environmental Uncertainty was entered as the moderator, and an interaction term was subsequently introduced.

The results are summarized in Table 4.9.

Table 4.9: *Dimensional Direct and Moderation Effects on Project Success*

Dimension	Direct Effect (β)	Moderation Effect (β)	ΔR^2	Sig. (p-value)
Risk Planning	0.488***	-0.181*	0.033 (3.3%)	0.013
Risk Identification	0.555***	-0.245***	0.057 (5.7%)	< 0.001
Risk Analysis	0.450***	-0.242**	0.058 (5.8%)	0.001
Risk Response	0.544***	-0.233***	0.054 (5.4%)	< 0.001
Risk Monitoring	0.501***	-0.271***	0.073	< 0.001

Dimension	Direct Effect (β)	Moderation Effect (β)	ΔR^2	Sig. (p-value)
			(7.3%)	

*Note: ***p < 0.001, **p < 0.01, p < 0.05. *Direct effects are derived from Model 1, while moderation effects and ΔR^2 values are derived from Model 2.*

Some important observations emerge from the dimensional analysis.
First, all five dimensions demonstrated statistically significant positive direct effects on Project Success. This indicates that each component of the risk management process contributes positively to project outcomes when considered independently. The findings therefore reinforce the broader result that effective risk management practices are associated with higher levels of software project success.

Second, Environmental Uncertainty exhibited a statistically significant negative moderation effect across all five dimensions. Although the strength of the effect varied, the direction remained consistently negative throughout. This finding suggests that environmental uncertainty does not influence only one specific stage of the risk management process. Rather, it exerts pressure across the risk management lifecycle by reducing the effectiveness of planning, identification, analysis, response, and monitoring activities.

However, it is worthy to note that the magnitude of the moderation effect was not identical across the dimensions. Risk Planning experienced the weakest negative moderation effect ($\beta = -0.181$, $\Delta R^2 = 0.033$), while Risk Monitoring experienced the strongest ($\beta = -0.271$, $\Delta R^2 = 0.073$).

One possible explanation is that planning activities are typically concentrated during the earlier phases of a project, before many environmental disruptions fully materialize. As a result, planning processes may be relatively less exposed to ongoing external volatility. In contrast, monitoring activities occur continuously throughout project execution and require constant observation, communication, and adjustment. As such, monitoring mechanisms are more likely to be affected by disruptions in the enviornmnent.

4.8. Qualitative Data Analysis Procedure

An explanatory sequential mixed-methods design was utilized to substantiate statistical findings and to help ensure that they reflect the operational realities of the Ethiopian software sector. This is why a mixed methods approach was used despite all the research hypotheses being statistically evidenced by the quantitative phases. As such, in-depth qualitative data were collected from six highly experienced local practitioners.

These practitioners included: a Bank Software Engineer (Interview A), a Senior PM/Founder (Interview B), a Government IT Lead (Interview C), an Agile Delivery Manager (Interview D), a Full-Stack Developer (Interview E), and a Backend/API Engineer (Interview F). The study used accepted methods to ensure participant availability. Five of the interviews were conducted through voice, while one participant provided detailed written responses asynchronously. Grounding necessary to interpret the quantitative regression results were provided by their contextual insights.

To process this data, the six-step framework established by Braun and Clarke (2006) was used to conduct the thematic analysis. Methodological rigor was ensured for the qualitative data in this manner. Moreover, to achieve deep familiarity with the data transcripts and text responses were reviewed iteratively. From recurring participant statements, initial codes were generated. They were generated from their statements regarding risk management strategies, environmental disruptions, and project evaluation metrics.

Next, similar codes were grouped into broader categories. Overarching themes were then made by refining the broader categories. Across the interviews, recurring patterns suggested reasonable thematic consistency. This provided a reliable foundation for explanatory triangulation.

The following table presents the qualitative coding framework developed from interview data following thematic analysis procedures.

Table 4.10: Qualitative Coding Framework

Raw Statement from Interviews	Initial Code	Category	Overarching Theme
"The PO and Tech Lead prepare BRS and SRS... all tasks are based strictly on these approved requirements."	Requirement baselining	Formal Planning	Adaptive and Formal Risk Mitigation
"Unannounced API changes from Telebirr caused timeouts, making testing harder."	3rd-party integration failure	Vendor/Infrastructure Instability	External Volatility as Project Disruptor
"Instead of formal matrices... to avoid accountability when funds lack, we just push through."	Abandoning procedures	Process Constraint	Uncertainty Weakening Structured Risk Management
"Even if delayed, success is whether the critical features work and the customer is satisfied."	Delivery over timeline	Alternative Success Metrics	Flexible and User-Centered Definitions of Success

From the analysis, it can be see that it ultimately generated four major themes:

1. Adaptive and Formal Risk Mitigation
2. External Volatility as Project Disruptor
3. Environmental Uncertainty Weakening Structured Risk Management
4. Flexible and User-Centered Definitions of Project Success

Subsequently, to support contextual interpretation, these themes were integrated with the quantitative findings.

4.9. Triangulation of Quantitative and Qualitative Findings

4.9.1. Triangulating Hypothesis 1: The Direct Impact of Risk Management

Quantitative Result: Supported ($\beta = 0.605$, $p < 0.001$)

The qualitative findings provide strong contextual support for the quantitative regression results. It was shown earlier that statistically, there is a strong, positive relationship between risk management practices and project success. The qualitative findings as well illustrate that both formal and informal risk mitigation substantially safeguard project outcomes.

For organizations that employ formal methodologies, the impact on success is explicit. Interview 4 (Agile Delivery Manager) explained that strict adherence to Business and Software Requirement Specifications (BRS/SRS) acts as an early risk shield: *"Before development begins, the customer and our company formally sign off on the BRS and SRS... Any requirement not included is handled through formal change management."* Even in teams where risk management is highly agile and informal, it remains a primary driver of success. Interview 5 noted that risks are managed dynamically through daily stand-ups and continuous tracking. Similarly, Interview A (Bank Developer) highlighted that while upfront formal documentation is sometimes bypassed, rigorous post-development vulnerability checks are mandatory before launch. Whether through strict initial baselining or iterative agile reviews, the findings suggest that actively identifying and responding to risks contributes substantially to functional system delivery.

4.9.2. Triangulating Hypothesis 3: The Direct Impact of Environmental Uncertainty

Quantitative Result: Supported ($\beta = -0.299$, $p < 0.001$)

The quantitative data indicated that environmental uncertainty significantly harms project outcomes. The qualitative data vividly illustrates this statistic by identifying specific macroeconomic and infrastructural vulnerabilities unique to the Ethiopian context.

Third-party vendor instability was heavily cited as a primary disruptor. Interview 6 (Backend Engineer) described a severe disruption when a major local payment gateway suffered unexpected API changes, blocking critical transactions during launch. Similarly, Interview A

noted that reliance on external funding bodies often results in delayed disbursements or sudden scope demands that disrupt project timelines.

The impact of institutional uncertainty appears particularly severe in the public sector. Interview C (Government IT Lead) explained how a lack of distinct tech policies, combined with rigid bureaucracy and funding deficits, actively constrains project reach. He cited the "All-in-One Smart Education System" as a prime example of a project that suffered restricted accessibility due to these external constraints. The consensus among the practitioners reinforces the statistical finding: the findings suggest that characteristics of the Ethiopian external environment can significantly threaten software project delivery.

4.9.3. Triangulating Hypothesis 2: The Moderating Role of Environmental Uncertainty

Quantitative Result: Supported ($\beta = -0.300$, $p < 0.001$)

The regression model demonstrated that environmental uncertainty acts as a negative moderator—indicating that as external volatility increases, the effectiveness of risk management practices decreases. The qualitative interviews explain this mechanism, showing how severe external shocks make formal risk management difficult to sustain consistently.

When resources and environments are relatively stable, teams utilize logical impact/effort assessments (as noted by Interview B). However, when massive uncertainties strike, these formal processes become strained. Interview C provided a striking example: under severe funding and bureaucratic pressures, teams often bypass the creation of formal risk matrices. Instead, driven by the pressure of accountability, they resort to fragmented, *"trial and error"* efforts merely to keep the project moving.

Crucially, this does not mean risk management is completely abandoned (as evidenced by the continued positive effect of H1). Rather, its structured application is heavily constrained. Interview 6 noted that an unexpected external API crash meant that *"most of our actions were reactive at first,"* forcing the team into ad-hoc troubleshooting rather than following a predefined mitigation strategy. This provides a clear practical illustration of the moderation effect: high environmental uncertainty fractures the systematic application of risk management, significantly weakening its protective impact on the project.

4.9.4. Contextualizing "Project Success" in the Ethiopian Software Sector

Traditional project management literature has historically emphasized the "Iron Triangle" (delivering strictly on time, on budget, and within scope) as the ultimate measure of success. However, the qualitative data reveals that the Ethiopian tech sector employs a highly flexible, user-centered definition of success.

Across the interviews, timeline delays and budget overruns were frequently accepted as inevitable byproducts of the operating environment. As Interview B (Senior PM) stated: *"No matter how much delay or disruption happens... the MVP reaching the actual end-user and them using it is a huge success."* Interview 4 echoed this sentiment, noting that a heavily delayed government project was still deemed highly successful because *"key modules were launched, users adopted the system, and issues were handled through phased delivery."* This cultural and operational context is vital. It implies that Ethiopian developers do not view risk management merely as an administrative tool to protect budgets and schedules. Instead, developers utilize risk management as an adaptive survival mechanism to ensure that, despite overwhelming environmental uncertainty, a functional product ultimately delivers value to the market.

Overall, the integration of quantitative and qualitative findings suggests that software project success in Ethiopia is shaped not only by the presence of risk management practices, but also by the ability of teams to adapt those practices within highly volatile operational environments.

CHAPTER FIVE: SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.1. Introduction

This final chapter presents a synthesis of the study's empirical and qualitative findings, situating them within the broader context of software project management in Ethiopia. It outlines the overarching conclusions drawn from the research, details the theoretical and practical implications, and provides actionable recommendations for industry professionals. Finally, the limitations of the study are acknowledged, and pathways for future research are suggested.

5.2. Summary of Major Findings

The primary objective of this study was to examine the effect of risk management practices on software project success and to determine how environmental uncertainty moderates this relationship within the Ethiopian software sector. Utilizing an explanatory sequential mixed-methods design, data was collected from 120 software professionals and triangulated with six in-depth expert interviews. The following key findings emerged:

- **Risk Management Drives Success (H1):** The quantitative data demonstrated a strong, statistically significant positive effect of risk management on project success. The qualitative findings revealed that while formal planning is sometimes bypassed, active, agile-based risk mitigation (such as iterative vulnerability checks and requirement baselining) is critical to system delivery.
- **Environmental Uncertainty is a Direct Disruptor (H3):** Environmental uncertainty has a direct, statistically significant negative influence on project outcomes. Practitioners confirmed that third-party vendor instability, ad-hoc scope changes, and infrastructure deficits severely disrupt timelines and accessibility.
- **Environmental Uncertainty Weakens Risk Management (H2):** The findings indicated a significant negative moderation effect. As external volatility increases, the positive impact of structured risk management is weakened. Qualitative insights explained that severe external shocks often force teams to abandon formal risk matrices in favor of reactive, ad-hoc survival tactics. Specifically, the dimensional

analysis revealed that continuous Risk Monitoring is the most severely disrupted by external volatility (β = -0.271), whereas early-stage Risk Planning remains the most insulated (β = -0.181).

- **Redefined Project Success:** Qualitative triangulation revealed that the Ethiopian tech sector evaluates project success more pragmatically than traditional Western models. Due to normalized external constraints, success is measured primarily by final system usability and market delivery (MVP launch), rather than strict adherence to initial budgets and schedules.

5.3. Overall Conclusion

This study concludes that risk management is a vital determinant of software project success in Ethiopia; however, its application and effectiveness are heavily constrained by the operating environment. Software teams in this context operate under a state of high systemic volatility. Consequently, traditional, highly formalized project management frameworks may become difficult to sustain under conditions of severe environmental uncertainty.

Rather than viewing risk management as a rigid administrative checklist, Ethiopian software developers utilize it as an adaptive survival mechanism. While severe external shocks weaken the effectiveness of formal risk planning, teams rely on high adaptive flexibility to ensure that functional products reach the end-user. Ultimately, effective project management in developing economies requires more than internal process discipline; it demands a high degree of flexibility and a deep, systemic integration of external realities into project execution.

Moreover, the explanatory sequential mixed-methods design strengthened the study by enabling qualitative insights to contextualize and explain the statistical relationships observed in the regression analysis.

5.4. Theoretical Implications

This study makes a significant contribution to the project management literature by extending traditional risk management frameworks into the context of developing economies. First, the observed weakening of structured risk management under high uncertainty supports Contingency Theory, confirming that there is no "one-size-fits-all" approach to project management; the effectiveness of internal practices is contingent upon their alignment with external environmental conditions. Second, by identifying the moderating role of environmental uncertainty, this study challenges the assumption that risk management exists in a vacuum.

It aligns with Richard Heeks' (2002) concept of the "design–reality gap," demonstrating the friction between formal PMBOK-style system designs and the volatile operational realities of emerging markets. Finally, the qualitative findings expand upon Shenhar and Dvir's (2001) multidimensional models of project success, providing empirical evidence that in highly uncertain environments, "Project Efficiency" (time and budget) is frequently decoupled from "Customer Impact" and "Business Success."

5.5. Practical Recommendations

Based on the integrated findings of the study, the following actionable recommendations are proposed for project managers, IT organizations, and policymakers:

1. Adopt Adaptive Risk Frameworks Over Rigid Matrices

Organizations should balance structured risk planning with adaptive agile practices, ensuring that formal frameworks remain flexible enough to respond to rapidly changing environmental conditions.

2. Strategic Buffering for Infrastructure and Dependencies

Project managers must proactively incorporate environmental uncertainty factors into their baselines. Teams should design systems with higher tolerance for infrastructure disruptions (e.g., building offline-first capabilities or asynchronous fallbacks for unstable third-party APIs) and allocate explicit buffer time for vendor-related delays.

3. Implement Flexible and Phased Contracting

Given the high likelihood of ad-hoc client changes and funding disruptions, IT firms should move away from rigid, fixed-price waterfall contracts. Transitioning to milestone-based, phased-release contracting (focused on delivering Minimum Viable Products) will better protect development teams from scope creep and budget overruns while ensuring continuous value delivery to the client.

4. Policy-Level Interventions

To improve project success rates at a macro level, government and regulatory bodies must support the stability of the ICT ecosystem. Formulating clear national tech policies, standardizing third-party digital integrations, and improving foundational infrastructure (power and internet reliability) will significantly reduce the systemic uncertainty that currently plagues local software initiatives.

5. Build Resilient Monitoring Mechanisms

Because the data indicates that continuous risk monitoring is the dimension most vulnerable to environmental uncertainty, organizations should utilize decentralized or asynchronous tracking tools. Ensuring that risk logs and communication channels can be updated even during infrastructure outages will protect the monitoring lifecycle.

5.6. Limitations of the Study

While this study was conducted with methodological rigor, several limitations must be acknowledged. First, the cross-sectional design captures data at a single point in time, which restricts the ability to observe how risk management effectiveness evolves over the entire lifecycle of a project. Second, the study relied on self-reported perceptual data. However, to assess potential common method variance, Harman’s Single-Factor Test was conducted, and the primary factor accounted for 22.06% of the variance, suggesting that common method bias was unlikely to be a major concern.

Third, the study's measurement of Environmental Uncertainty relies on perceptual Likert scales rather than objective macroeconomic indicators (e.g., inflation rates or foreign exchange delays). While this captures the lived experience of project managers, it simplifies complex economic conditions. Fourth, there is a potential for survivor bias; practitioners are often more likely to report on completed or partially successful projects than on total project

abandonments, which may slightly skew the distribution of outcomes. Finally, the sample (N = 120) and the qualitative participants were primarily drawn from software professionals based in Addis Ababa; thus, the findings may not fully generalize to decentralized projects in other regional tech hubs across Ethiopia. Future research is encouraged to complement these findings with longitudinal data and objective economic indicators.

5.7. Suggestions for Future Research

To build upon the findings of this study, future research should explore longitudinal designs that track software projects from initiation to closure, observing how environmental uncertainty may influence different phases of the project lifecycle over time. Additionally, researchers could employ multi-respondent study designs—collecting matched data from developers, project managers, and end-clients on the same project—to reduce single-informant bias and improve data triangulation. Finally, future studies should explore additional moderating variables, such as organizational culture or team technical competency, to provide a more granular understanding of project survival dynamics in emerging digital economies.

REFERENCES

Algremazy, N. A., Ideris, Z., Alferjany, M. A., & Akram, A. (2023). The effect of risk management practices on project performance: A case study of the Libyan construction industry. International Journal of Professional Business Review, 8(6), e01420.

Arafeh, H., & El-Ahmad, A. (2018). The influence of software risk management on software project success. Master's thesis, Lund University, School of Economics and Management.

Assefa, T. (2023). The effect of project risk management practices on project success: A case study of Ethiopian orthodox Tewahido church Jimma diocese (Master's thesis). Jimma University.

Avgerou, C. (2008). Information systems in developing countries: a critical research review. Journal of Information Technology, 23(3), 133-146.

Boateng, R. (2014). Mobile phones and development: An analysis of IDRC-supported projects. International Development Research Centre.

Boehm, B. W. (1991). Software risk management: principles and practices. IEEE Software, 8(1), 32-41.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77-101.

Brooks, F. P. (1987). No silver bullet: Essence and accidents of software engineering. Computer, 20(4), 10-19.

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Lawrence Erlbaum Associates.

Creswell, J. W. (2014). Research design: Qualitative, quantitative, and mixed methods approaches (4th ed.). Sage Publications.

Creswell, J. W., & Plano Clark, V. L. (2018). Designing and conducting mixed methods research (3rd ed.). Sage Publications.

Dage, H. (2022). Assessment of Software Project Management Practices: The Case of Bank of Abyssinia. (Master's Thesis). Addis Ababa University.

de Bakker, K., Boonstra, A., & Wortmann, H. (2010). Does risk management contribute to IT project success? A meta-analysis of empirical evidence. International Journal of Project Management, 28(5), 493-503.

Demir, K. A. (2008). Measurement of software project management effectiveness.

Donaldson, L. (2001). The contingency theory of organizations. Sage Publications.

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behavior Research Methods, 39(2), 175-191.

Gebretsadik, T. (2018). Assessment of the practice of project risk management system in Ethio-Telecom (Master's thesis). Addis Ababa University.

Green, S. B. (1991). How many subjects does it take to do a regression analysis? Multivariate Behavioral Research, 26(3), 499-510.

Gumataw, K. (2019). The effect of risk management practice and project organization on IT projects success in Ethiopia: The case of Ethio Telecom (Master's thesis). St. Mary's University.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). Multivariate data analysis (7th ed.). Pearson. (Added to Chapter 4 for the VIF/Tolerance Multicollinearity fix and Normality tests).

Heeks, R. (2002). Information systems and developing countries: Failure, success, and local improvisations. The Information Society, 18(2), 101-112.

ICTworks. (2021). The Paradox of Digital Development in Africa. Retrieved from https://www.ictworks.org

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. Journal of Financial Economics, 3(4), 305-360.

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. Econometrica, 47(2), 263-291.

Kerzner, H. (2017). Project management: A systems approach to planning, scheduling, and controlling (12th ed.). Wiley.

Kifle, M., Mbarika, V. W., & Datta, P. (2016). Interplay of innovation and ICT in development: The Ethiopian case. Information Technology for Development, 22(3), 398-412.

Kishk, M., & Ukaga, C. (2008). The impact of effective risk management on project success. In A. Dainty (Ed.), Proceedings of the 24th Annual ARCOM Conference (pp. 1-10). Association of Researchers in Construction Management.

Kutsch, E., & Hall, M. (2005). Intervening conditions on the management of project risk: Dealing with uncertainty in information technology projects. International Journal of Project Management, 23(8), 591-599.

Kwak, Y. H., & Ibbs, C. W. (2000). Calculating project management's return on investment. Project Management Journal, 31(2), 38-47.

Ministry of Innovation and Technology (MInT). (2020). Digital Ethiopia 2025: A Digital Strategy for Ethiopia Inclusive Prosperity. Addis Ababa.

Ministry of Innovation and Technology (MInT). (2023). Digital Progress and Trends Report 2023. Addis Ababa.

National Bank of Ethiopia (NBE). (2024). Annual Report 2023/2024. Addis Ababa.

Nerur, S. P., Mahapatra, R. K., & Mangalaraj, G. (2005). Challenges of migrating to agile methodologies. Communications of the ACM, 48(5), 72-78.

Nunnally, J. C. (1978). Psychometric theory (2nd ed.). McGraw-Hill.

Nyfjord, J., & Kajko-Mattsson, M. (2008). Outlining a model for risk management in Agile software development. 2008 Euromicro Conference on Software Engineering and Advanced Applications, 476-483.

Pimchangthong, D., & Boonjing, V. (2017). Effects of risk management practices on IT project success. Management and Production Engineering Review, 8(1), 30-37.

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. Journal of Applied Psychology, 88(5), 879-903.

Project Management Institute (PMI). (2017). A Guide to the Project Management Body of Knowledge (PMBOK Guide) (6th ed.). Project Management Institute.

Raz, T., Shenhar, A. J., & Dvir, D. (2002). Risk management, project success, and technological uncertainty. R&D Management, 32(2), 101–109.

Ropponen, J., & Lyytinen, K. (2000). Components of software risk management success: A quantitative analysis. IEEE Transactions on Software Engineering, 26(2), 98-113.

Shenhar, A. J., & Dvir, D. (1997). Mapping the dimensions of project success. Project Management Journal, 28(2), 5-13.

Shenhar, A. J., & Dvir, D. (2007). Reinventing project management: The diamond approach to successful growth and innovation. Harvard Business School Press.

Shenhar, A. J., Dvir, D., Levy, O., & Maltz, A. C. (2001). Project success: A multidimensional strategic concept. Long Range Planning, 34(6), 699-725.

Sicotte, H., & Bourgault, M. (2008). Dimensions of uncertainty and their moderating effect on new product development project performance. R&D Management, 38(5), 468-479.

Standish Group. (2015). CHAOS Report 2015. The Standish Group International, Boston.

Tabachnick, B. G., & Fidell, L. S. (2013). Using multivariate statistics (6th ed.). Pearson.

Teklemariam, M. A. (2016). Software Project Risk Management Practice in Ethiopia. (Doctoral Dissertation). University of South Africa (UNISA), Pretoria.

Teklemariam, M. A., & Mnkandla, E. (2017). Software project risk management practice in Ethiopia. African Journal of Science, Technology, Innovation and Development, 9(2), 1-9.

Wallace, L., Keil, M., & Rai, A. (2004). How software project risk affects project outcomes: An investigation of the dimensions of risk and an exploratory model. Decision Sciences, 35(2), 289-321.

Worku, A. W., Burrow, M., & Ghataora, G. (2021). Risks affecting the performance of Ethiopian domestic road construction contractors. International Journal of Construction Management, 21.

World Bank. (2021). Empowering Ethiopians by Laying the Digital Foundations for Economic Growth. Retrieved from https://www.worldbank.org

Zeray, H. (2020). Assessing practice of risk management in IT projects: The case of Ethiopian Airlines Digital Project Management Office (Master's thesis). Addis Ababa University.

Zewdu, A. (2016). Assessment of IT Project Management Practices in Zemen Bank SC. (Master's Thesis). St. Mary's University.

Appendix A: QUESTIONNAIRE

Addis Ababa University | School of Commerce | Postgraduate Studies Program

Title: The Effect of Risk Management Practices on Project Success: The Moderating Role of Environmental Uncertainty in the Ethiopian Software Sector

Dear Respondent, I am a postgraduate student at Addis Ababa University. This study examines how risk management practices influence software project success in Ethiopia, specifically looking at how external uncertainties affect these outcomes. Your participation is voluntary, and responses are strictly confidential.

Instruction: Please think of **ONE** specific completed Ethiopian software project that you participated in recently. Respond to all items based on that one project only.

- Muse Mulatu | 0934963090

SECTION A: DEMOGRAPHIC & PROJECT PROFILE

1. Have you participated in at least one completed Ethiopian software project within the last 3 years?

[ ] Yes [ ] No

2. Type of Organization:

[ ] Private Software Development Company

[ ] Bank / Insurance (IT Dept)

[ ] Government / NGO

[ ] Other: _____

3. Role in the Project:

[ ] Project Manager / Scrum Master / Product Owner

[ ] Software Engineer / Developer

[ ] Team / Tech Lead

[ ] QA Tester / System Analyst

[ ] DevOps / Infrastructure

[ ] Other: _____

4. Work Experience in Software Projects:

[ ] 1–2 Years [ ] 3–5 Years [ ] 6–10 Years [ ] Above 10 Years

5. Project Team Size:

[ ] Less than 5 [ ] 5–10 [ ] 11–20 [ ] Above 20

6. Professional Certification:

[ ] None [ ] PMP / PRINCE2 [ ] Agile / Scrum [ ] Other: _____

7. Level of Involvement: What was your role regarding this specific project?

[ ] Core Leader (PM / Tech Lead) [ ] Core Team Member (Developer, QA, Analyst)
[ ] Occasional Contributor [ ] External Observer

8. Please rate the following statement: "I had sufficient knowledge of this project's performance (timeline, budget, and outcomes) to evaluate it accurately."

[ ] 1 - Strongly Disagree [ ] 2 - Disagree [ ] 3 - Neutral [ ] 4 - Agree [ ] 5 - Strongly Agree

9. Brief Project Description: _____

SECTION B: RISK MANAGEMENT PRACTICES (Independent Variable)

Please indicate the frequency of these practices during the project.

(1 = Never | 2 = Rarely | 3 = Sometimes | 4 = Often | 5 = Always)

Code	I. RISK PLANNING	1	2	3	4	5
RP1	Risk management activities were formally planned (time, budget, resources).					
RP2	A formal risk management plan was developed and documented.					
RP3	Relevant stakeholders were involved in risk management planning.					
Code	**II. RISK IDENTIFICATION**	**1**	**2**	**3**	**4**	**5**
RI1	Structured techniques (brainstorming, checklists) were used to identify risks.					
RI2	Historical data or lessons learned from previous projects were utilized.					
RI3	Identified risks were documented in a formal risk register or log.					
RI4	Risk identification was conducted at the early stage of the project.					
RI5	Key stakeholders participated in the risk identification process.					
Code	**III. RISK ANALYSIS**	**1**	**2**	**3**	**4**	**5**
RA1	Risks were assessed in terms of probability and impact.					
RA2	Risks were prioritized based on their severity or risk score.					
RA3	Qualitative or quantitative analysis (e.g., P-I Matrix) was applied.					
Code	**IV. RISK RESPONSE**	**1**	**2**	**3**	**4**	**5**
RR1	Specific mitigation or contingency plans were developed for key risks.					
RR2	Responsibility for managing major risks was assigned to specific individuals.					
RR3	Response strategies (avoid, mitigate, transfer, accept) were clearly defined.					
RR4	Alternative fallback plans were prepared for major risks.					

Code	V. RISK MONITORING & CONTROL	1	2	3	4	5
RM1	Risks were regularly reviewed during project meetings.					
RM2	The risk register was continuously updated throughout the lifecycle.					
RM3	Actual risk outcomes were compared against planned responses.					
RM4	Changes in risk status were tracked and communicated to stakeholders.					

SECTION C: PROJECT SUCCESS (Dependent Variable)

Please indicate your level of agreement regarding the project outcome.

(1 = Strongly Disagree | 2 = Disagree | 3 = Neutral | 4 = Agree | 5 = Strongly Agree)

Code	I. PROJECT EFFICIENCY	1	2	3	4	5
PE1	The project was completed within the planned schedule.					
PE2	The project was completed within the planned budget.					
PE3	The project was completed without major disruption or cancellation.					
Code	**II. CUSTOMER IMPACT**	**1**	**2**	**3**	**4**	**5**
CI1	The delivered system met the specified functional requirements.					
CI2	End-users are satisfied with the system’s usability and performance.					
CI3	The system operates reliably with minimal failures or downtime.					
Code	**III. BUSINESS SUCCESS & FUTURE READINESS**	**1**	**2**	**3**	**4**	**5**
BS1	The project delivered measurable business value (e.g., ROI, savings).					
BS2	The project contributed to organizational strategic objectives.					
FR1	The project developed new technical capabilities or infrastructure.					
FR2	The project enhanced the ability to execute future projects.					

SECTION D: ENVIRONMENTAL UNCERTAINTY (Moderator)

(1 = Strongly Disagree | 2 = Disagree | 3 = Neutral | 4 = Agree | 5 = Strongly Agree)

Code	EXTERNAL FACTORS	1	2	3	4	5
EU1	Infrastructure (power, internet) created uncertainty for the project.					
EU2	Regulatory or policy changes created uncertainty during execution.					
EU3	Economic conditions (forex, inflation) affected resource procurement.					
EU4	Environmental changes made it difficult to accurately plan/forecast.					
EU5	Changes in external stakeholders (e.g., government agencies, vendors) created uncertainty.					
EU6	The external environment of the project was unpredictable and unstable.					

APPENDIX B: INTERVIEW GUIDE

Protocol for Semi-Structured Interview with Experts

Target Audience: Senior Project Managers, Technical Leads, and Software Executives with over 4 years of experience in the Ethiopian digital sector. Estimated Duration: 20– 40Minutes

Part 1: Introduction and Consent

- Brief explanation of the study's purpose (exploring the intersection of risk management and environmental uncertainty).
- Confirmation of anonymity and request for permission to record the session for transcription purposes.

Part 2: Core Interview Questions

Section A: Risk Management Practices (Focus on Independent Variable)

1. How are risks typically planned and managed in the software projects you have worked on in Ethiopia?

2. Do teams formally analyze risks (e.g., scoring probability and impact), or is the process mostly informal and reactive?

Section B: Environmental Uncertainty (Focus on Moderator)

3. What external factors (e.g., infrastructure instability, regulatory changes, economic/forex conditions) most frequently affect software projects here?
4. Can you describe a specific situation where an external factor severely disrupted a project you were working on?

Section C: Interaction Dynamics (The Moderation Focus)

5. When severe external disruptions occur, how do they affect your team's ability to manage project risks?
6. Do you believe that structured, formal risk management can fully overcome these external macroeconomic challenges? Why or why not?

Section D: Project Success Metrics (Dependent Variable Focus)

7. How do you define a "successful" software project in your experience?
8. Given the volatile environment, have you seen projects considered successful despite

missing initial budget or schedule targets? How was that success measured?

Appendix C: Raw SPSS Statistical Outputs

Table C.1 *Model Summary table*

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.720[a]	.518	.510	.51060
2	.768[b]	.589	.579	.47361

a. Predictors: (Constant), MOD_Centered, IV_Centered

b. Predictors: (Constant), MOD_Centered, IV_Centered, Interaction

c. Dependent Variable: Success_DV

Table C.2 *ANOVA table*

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	32.825	2	16.412	62.951	<.001[b]
	Residual	30.503	117	.261		
	Total	63.328	119			
2	Regression	37.308	3	12.436	55.442	<.001[c]
	Residual	26.020	116	.224		
	Total	63.328	119			

a. Dependent Variable: Success_DV

b. Predictors: (Constant), MOD_Centered, IV_Centered

c. Predictors: (Constant), MOD_Centered, IV_Centered, Interaction

Table C.3 *Coefficients table*

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	1.957	.301		6.499	<.001		
	Risk_Mgmt_IV	.621	.064	.624	9.670	<.001	.990	1.010
	Uncertainty_MOD	-.270	.058	-.302	-4.683	<.001	.990	1.010

a. Dependent Variable: Success_DV

Table C.4 *Dimensional Moderation Analysis Outputs*

C.4.1 *Risk Planning Moderation*

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	df1
1	.609[a]	.371	.360	.58340	.371	34.534	2
2	.635[b]	.404	.388	.57054	.033	6.333	1

Model Summary

Model	Change Statistics	
	df2	Sig. F Change
1	117	<.001
2	116	.013

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	23.507	2	11.754	34.534	<.001[b]
	Residual	39.821	117	.340		
	Total	63.328	119			
2	Regression	25.569	3	8.523	26.183	<.001[c]
	Residual	37.759	116	.326		
	Total	63.328	119			

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.009	.053		56.492	<.001
	Planning_Centered	.368	.055	.488	6.652	<.001
	Mod_Centered	-.322	.066	-.360	-4.907	<.001
2	(Constant)	3.007	.052		57.733	<.001
	Planning_Centered	.356	.054	.472	6.550	<.001
	Mod_Centered	-.330	.064	-.369	-5.141	<.001
	Int_Planning	-.171	.068	-.181	-2.517	.013

Coefficients[a]

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	Planning_Centered	1.000	1.000
	Mod_Centered	1.000	1.000
2	(Constant)		
	Planning_Centered	.992	1.008
	Mod_Centered	.997	1.003
	Int_Planning	.989	1.011

a. Dependent Variable: Success_DV

C.4.2 *Risk Identification Moderation*

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	df1
1	.660[a]	.436	.426	.55264	.436	45.177	2
2	.702[b]	.493	.480	.52622	.057	13.041	1

Model Summary

Model	Change Statistics	
	df2	Sig. F Change
1	117	<.001
2	116	<.001

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	27.595	2	13.797	45.177	<.001[b]
	Residual	35.733	117	.305		
	Total	63.328	119			
2	Regression	31.206	3	10.402	37.565	<.001[c]
	Residual	32.122	116	.277		
	Total	63.328	119			

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	3.010	.050		59.664	<.001
	Ident_Centered	.472	.060	.555	7.918	<.001
	Mod_Centered	-.259	.063	-.290	-4.135	<.001
2	(Constant)	2.988	.048		61.676	<.001
	Ident_Centered	.455	.057	.535	7.992	<.001
	Mod_Centered	-.307	.061	-.343	-5.022	<.001
	Int_Ident	-.237	.066	-.245	-3.611	<.001

Coefficients[a]

Model		Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)		
	Ident_Centered	.982	1.019
	Mod_Centered	.982	1.019
2	(Constant)		
	Ident_Centered	.975	1.026
	Mod_Centered	.935	1.069
	Int_Ident	.951	1.052

a. Dependent Variable: Success_DV

C.4.3 *Risk Analysis Moderation*

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics R Square Change	Change Statistics F Change	Change Statistics df1
1	.578[a]	.334	.323	.60021	.334	29.393	2
2	.626[b]	.392	.377	.57597	.058	11.055	1

Model Summary

Model	Change Statistics df2	Change Statistics Sig. F Change
1	117	<.001
2	116	.001

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	21.178	2	10.589	29.393	<.001[b]
	Residual	42.150	117	.360		
	Total	63.328	119			
2	Regression	24.846	3	8.282	24.964	<.001[c]
	Residual	38.482	116	.332		
	Total	63.328	119			

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	3.009	.055		54.926	<.001
	Analysis_Centered	.343	.058	.450	5.945	<.001
	Mod_Centered	-.291	.068	-.325	-4.288	<.001
2	(Constant)	2.996	.053		56.799	<.001
	Analysis_Centered	.337	.055	.442	6.077	<.001
	Mod_Centered	-.311	.065	-.347	-4.760	<.001
	Int_Analysis	-.197	.059	-.242	-3.325	.001

Coefficients[a]

Model		Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)		
	Analysis_Centered	.992	1.008
	Mod_Centered	.992	1.008
2	(Constant)		
	Analysis_Centered	.991	1.009
	Mod_Centered	.983	1.017
	Int_Analysis	.991	1.010

a. Dependent Variable: Success_DV

C.4.4 *Risk Response Moderation*

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics R Square Change	Change Statistics F Change	Change Statistics df1
1	.653[a]	.427	.417	.55690	.427	43.598	2
2	.694[b]	.481	.468	.53208	.054	12.171	1

Model Summary

Model	Change Statistics df2	Change Statistics Sig. F Change
1	117	<.001
2	116	<.001

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	27.042	2	13.521	43.598	<.001[b]
	Residual	36.286	117	.310		
	Total	63.328	119			
2	Regression	30.488	3	10.163	35.897	<.001[c]
	Residual	32.840	116	.283		
	Total	63.328	119			

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	3.011	.051		59.230	<.001
	Response_Centered	.482	.062	.544	7.743	<.001
	Mod_Centered	-.280	.063	-.313	-4.453	<.001
2	(Constant)	2.996	.049		61.443	<.001
	Response_Centered	.483	.059	.546	8.126	<.001
	Mod_Centered	-.284	.060	-.318	-4.728	<.001
	Int_Response	-.235	.067	-.233	-3.489	<.001

Coefficients[a]

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	Response_Centered	.991	1.009
	Mod_Centered	.991	1.009
2	(Constant)		
	Response_Centered	.991	1.009
	Mod_Centered	.990	1.010
	Int_Response	1.000	1.000

a. Dependent Variable: Success_DV

C.4.5 *Risk Monitoring Moderation*

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	df1
1	.620[a]	.384	.373	.57748	.384	36.450	2
2	.676[b]	.457	.443	.54459	.073	15.558	1

Model Summary

Model	Change Statistics	
	df2	Sig. F Change
1	117	<.001
2	116	<.001

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	24.311	2	12.155	36.450	<.001[b]
	Residual	39.017	117	.333		
	Total	63.328	119			
2	Regression	28.925	3	9.642	32.510	<.001[c]
	Residual	34.403	116	.297		
	Total	63.328	119			

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.009	.053		57.074	<.001
	Monitor_Centered	.412	.060	.501	6.897	<.001
	Mod_Centered	-.299	.065	-.334	-4.596	<.001
2	(Constant)	2.997	.050		60.179	<.001
	Monitor_Centered	.407	.056	.496	7.229	<.001
	Mod_Centered	-.315	.062	-.352	-5.123	<.001
	Int_Monitor	-.262	.066	-.271	-3.944	<.001

Coefficients[a]

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	Monitor_Centered	.996	1.004
	Mod_Centered	.996	1.004
2	(Constant)		
	Monitor_Centered	.996	1.004
	Mod_Centered	.992	1.008
	Int_Monitor	.995	1.005

a. Dependent Variable: Success_DV

Table C.5 *Correlations table*

Correlations

		Risk_Mgmt_IV	Success_DV	Uncertainty_MOD
Risk_Mgmt_IV	Pearson Correlation	1	.654***	-.101
	Sig. (2-tailed)		<.001	.271
	N	120	120	120
Success_DV	Pearson Correlation	.654***	1	-.365***
	Sig. (2-tailed)	<.001		<.001
	N	120	120	120
Uncertainty_MOD	Pearson Correlation	-.101	-.365***	1
	Sig. (2-tailed)	.271	<.001	
	N	120	120	120

***. Correlation is significant at the 0.001 level (2-tailed).

Pearson Correlations

- **Highly Positive: (None)**
- **Positive: (Risk_Mgmt_IV <---> Success_DV)**
- **No Linear Correlation: (None)**
- **Negative: (Risk_Mgmt_IV <---> Uncertainty_MOD), (Success_DV <---> Uncertainty_MOD)**
- **Highly Negative: (None)**

Table C.6 *RM dimesnional Correlations*

Correlations

		Uncertainty_MOD	Success_DV	Risk_Planning	Risk_Identification	Risk_Analysis	Risk_Response	Risk_Monitoring
Uncertainty_MOD	Pearson Correlation	1	-.365***	-.011	-.136	-.090	-.096	-.062
	Sig. (2-tailed)		<.001	.904	.139	.329	.298	.501
	N	120	120	120	120	120	120	120
Success_DV	Pearson Correlation	-.365***	1	.492***	.594***	.479***	.574***	.522***
	Sig. (2-tailed)	<.001		<.001	<.001	<.001	<.001	<.001
	N	120	120	120	120	120	120	120
Risk_Planning	Pearson Correlation	-.011	.492***	1	.584***	.494***	.556***	.529***
	Sig. (2-tailed)	.904	<.001		<.001	<.001	<.001	<.001
	N	120	120	120	120	120	120	120
Risk_Identification	Pearson Correlation	-.136	.594***	.584***	1	.634***	.614***	.666***
	Sig. (2-tailed)	.139	<.001	<.001		<.001	<.001	<.001
	N	120	120	120	120	120	120	120
Risk_Analysis	Pearson Correlation	-.090	.479***	.494***	.634***	1	.568***	.620***
	Sig. (2-tailed)	.329	<.001	<.001	<.001		<.001	<.001
	N	120	120	120	120	120	120	120
Risk_Response	Pearson Correlation	-.096	.574***	.556***	.614***	.568***	1	.596***
	Sig. (2-tailed)	.298	<.001	<.001	<.001	<.001		<.001
	N	120	120	120	120	120	120	120
Risk_Monitoring	Pearson Correlation	-.062	.522***	.529***	.666***	.620***	.596***	1
	Sig. (2-tailed)	.501	<.001	<.001	<.001	<.001	<.001	
	N	120	120	120	120	120	120	120

***. Correlation is significant at the 0.001 level (2-tailed).

Fig. C.1 Regression: Normal P-P Plot

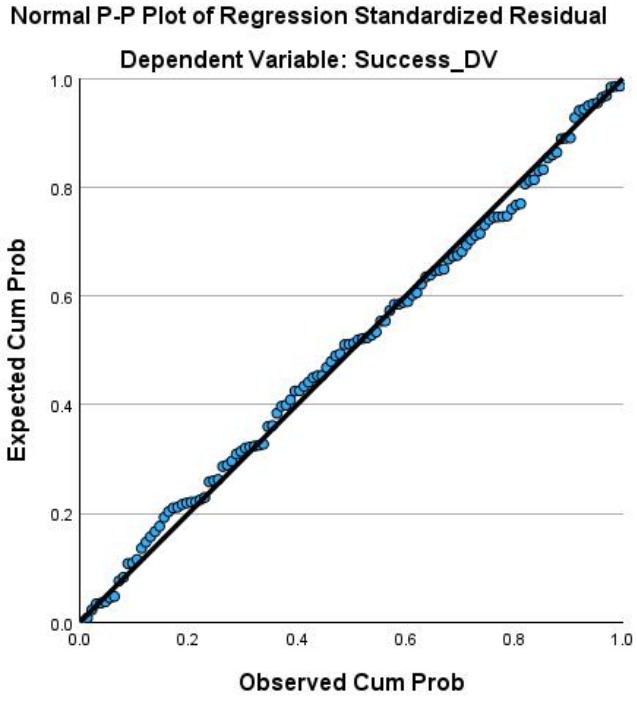


Table C.7 Harman's Single-Factor test

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.722	22.062	22.062	7.722	22.062	22.062
2	2.818	8.052	30.114	2.818	8.052	30.114
3	1.601	4.574	34.688	1.601	4.574	34.688
4	1.436	4.104	38.792	1.436	4.104	38.792
5	1.351	3.860	42.653	1.351	3.860	42.653
6	1.267	3.619	46.272	1.267	3.619	46.272
7	1.245	3.557	49.829	1.245	3.557	49.829
8	1.205	3.444	53.273	1.205	3.444	53.273
9	1.162	3.319	56.592	1.162	3.319	56.592
10	1.079	3.083	59.675	1.079	3.083	59.675
11	1.045	2.986	62.661	1.045	2.986	62.661
12	.952	2.720	65.381			
13	.923	2.636	68.017			
14	.859	2.454	70.471			
15	.830	2.373	72.843			
16	.805	2.300	75.143			
17	.797	2.277	77.420			
18	.714	2.041	79.461			
19	.667	1.904	81.365			
20	.622	1.776	83.141			
21	.599	1.713	84.854			
22	.575	1.643	86.497			
23	.547	1.563	88.060			
24	.535	1.528	89.588			
25	.496	1.417	91.005			
26	.458	1.309	92.315			
27	.394	1.126	93.441			
28	.365	1.044	94.485			
29	.351	1.003	95.488			
30	.343	.981	96.469			
31	.298	.852	97.321			
32	.272	.777	98.097			
33	.249	.710	98.808			
34	.230	.657	99.465			
35	.187	.535	100.000			

Extraction Method: Principal Component Analysis.

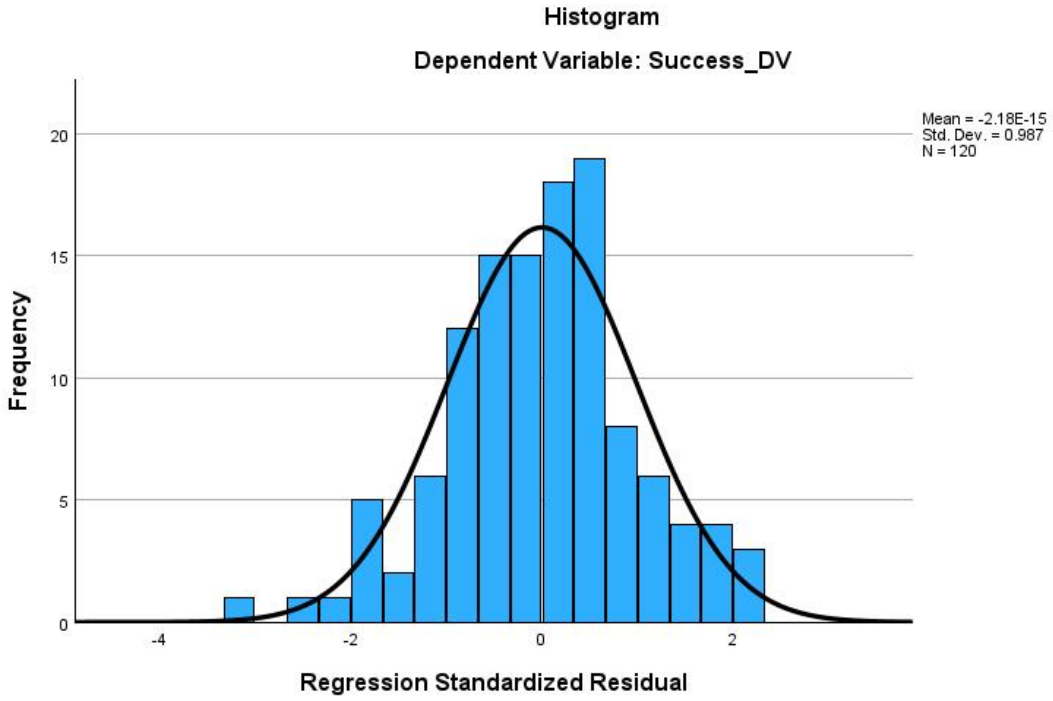


Fig C.2 Histogram of standardized residuals for normality testing

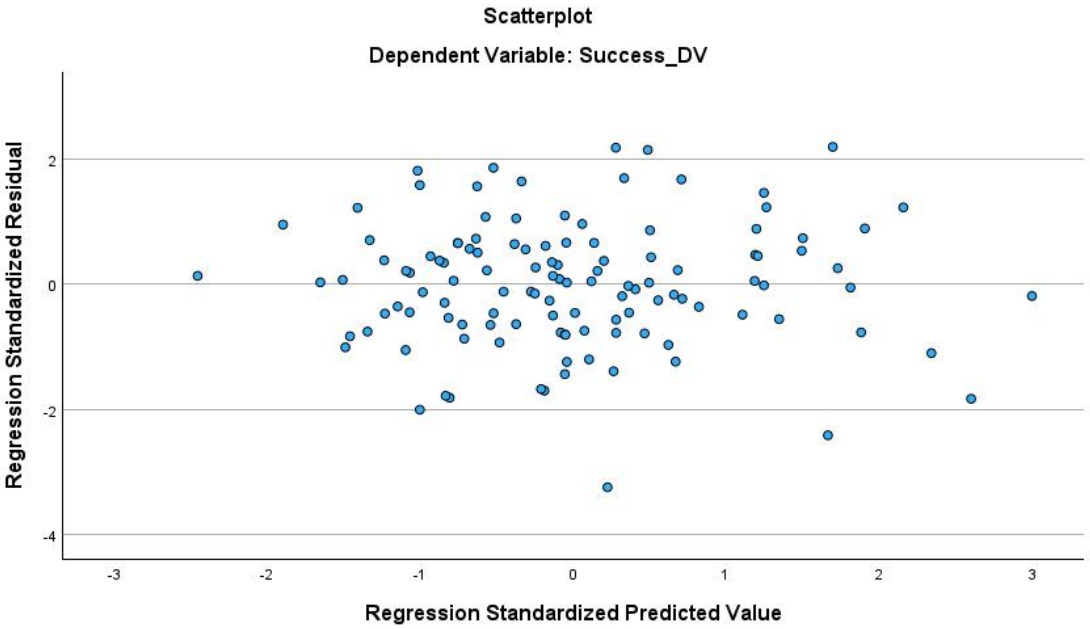


Fig C.3 Scatterplot of standardized residuals versus predicted values for homoscedasticity testing