Integrating Risk Management with Quality Assurance in IT Projects in Sri Lanka: Impact on Success Rates and Software Stability

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DECLARATION

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Name of Supervisor: Dr. Karunarathne P.D.J.B. Buddhika

Signature of the Supervisor: Date: 08/13/2025

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ABSTRACT

This study explores how integrating risk management practices with quality assurance (QA) processes impacts the success rates and software stability of IT projects in Sri Lanka's rapidly evolving technology sector, where project failure rates exceed 40%. Recognizing the limitations of managing risk and quality in isolation, the research adopts a mixed-methods design to provide both statistical validation and contextual understanding. Quantitative data was collected through structured surveys from 327 IT professionals, while qualitative insights were obtained from semi-structured interviews with 15 project managers and QA specialists. Findings revealed strong and statistically significant correlations between integrated practices and project performance. Early risk detection was highly associated with improved project outcomes ($R = 0.816$), explaining 66% of the variance in success rates. QA-integrated risk management practices correlated with enhanced software stability ($R = 0.718$), and structured QA-risk frameworks were positively linked to defect detection rates ($R = 0.810$). Risk-based testing (RBT) also showed a notable correlation with overall project success ($R = 0.611$). These results affirm the value of combining QA and risk management practices in improving IT project outcomes. Thematic analysis of qualitative data revealed three key challenges in integration: (1) a gap between theoretical standards and practical implementation due to complex frameworks, (2) inadequate testing resources and planning, including insufficient unit and regression testing, and (3) difficulty balancing agile responsiveness with structured QA-risk protocols, particularly amid rapidly changing client requirements. These challenges are exacerbated by limited budgets, fragmented governance, and organizational resistance to cross-functional collaboration. To address these issues, the study proposes a context-specific framework featuring simplified procedures, integrated metrics, and lightweight digital platforms supported by multisectoral governance. Key recommendations include embedding early risk detection in QA processes, using RBT to prioritize high-risk areas, strengthening staff training, and leveraging visual communication tools to improve stakeholder engagement. While offering practical guidance and empirical insights, the study acknowledges limitations such as reliance on self-reported data and a focus on the Sri Lankan context. Future research should examine long-term impacts of integrated frameworks, assess the role of emerging technologies like AI and blockchain, and explore the needs of SMEs. Ultimately, this research positions integrated QA-risk management as essential for delivering resilient, high-performing IT projects.

Keywords: Risk Management, Quality Assurance (QA), IT Project Success, Software Stability, Early Risk Detection, Risk Based Testing, QA Risk Integration

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LIST OF ABBREVIATIONS

Abbreviation	Description
IT	Information Technology
QA	Quality Assurance
RM	Risk Management
CMMI	Capability Maturity Model Integration
ISO	International Organization for Standardization
PMBOK	Project Management Body of Knowledge
IIoT	Industrial Internet of Things
IoT	Internet of Things
AI	Artificial Intelligence
RBT	Risk-Based Testing
KPI	Key Performance Indicator
SME	Small and Medium Enterprises
ROI	Return on Investment
R&D	Research and Development
SPSS	Statistical Package for the Social Sciences
R	Correlation Coefficient
KMO	Kaiser-Meyer-Olkin Measure of Sampling Adequacy
G/M/k	Generalized Erlang Queueing Model
CIA	Criticality, Impact, and Assessment
OLS	Ordinary Least Squares
SD	Standard Deviation
B	Unstandardized Beta Coefficient (in regression Analysis)
R^2	Coefficient of Determination

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CHAPTER 1
INTRODUCTION

1.1 Background

It continues to be elusive for project success in the global IT sphere considering data that shows 35% of IT projects were completed without significant delays or diminished functionality. These challenges have become particularly acute in Sri Lanka's fast growing IT sector where failure rates of medium to large projects have reached up to 40-45%. This disturbing trend rehearsally highlights basic disadvantages in project management, in particular in regards to how organizations handle risk and quality [1]. Until now, conventional models of project management have typically divorced risk from quality, creating different procedures, resources, and responsible teams for the two [2]. Whereas organizations treat these areas as separate entities, there is significantly high inefficiency because risks and quality are jointly influential. It has been shown through evidence that firms which integrate risk and quality in their processes gain a 27% increase in project success in software development [3].

Project instability is considered to be attributed primarily to the independence of quality assurance and risk management processes [4]. Separate operation of these functions is linked with the loss of 65% of software faults that would have been curtailed by relevant risk-based tests [5]. Further studies show that early identification of risks paired with efficient quality planning would reduce delay in projects by 32% and cost by 28% [6].

There are supporting researches for the integration of these areas but due to common frameworks like CMMI, ISO 31000, and PMBOK, they tend to address the areas severally [4]. This fragmented method is very problematic in the emerging markets like Sri Lanka where limited resources exacerbate challenges of appearing to manage complex IT projects [5]. It exists a high correlation between key variables of project control, such as cost time scope quality risk and its impact on the success of a project, yet classical approaches do not take these dependencies into a proper account [3].

1.2 Motivation

Project success in the global IT industry remains elusive, with only about 35% of IT projects completed without major delays or reduced functionality [1]. In Sri Lanka, the situation is particularly concerning, with failure rates of medium to large IT projects reaching 40-45%. This high failure rate highlights deep-rooted challenges in how risk and quality are managed in IT project environments [7]. Traditionally, risk management and quality assurance (QA) have been treated as separate disciplines with distinct teams, resources, and processes [2]. However, numerous studies suggest that this siloed approach leads to inefficiencies and missed opportunities. Organizations that have integrated risk and quality practices have experienced up to a 27% increase in project success rates [3].

Evidence also shows that separating QA from risk management can result in undetected issues and software faults. For instance, 65% of software defects could have been avoided through proper RBT [5]. Furthermore, early risk identification, when paired with quality planning, can reduce project delays by 32% and costs by 28% [6] Despite these findings, standard frameworks such as ISO 31000, CMMI, and PMBOK still tend to address risk and quality separately [4], which poses a challenge especially in resource-constrained environments like Sri Lanka.

1.2.1 Research Scope

This research investigates the integration of risk management and quality assurance (QA) practices within the context of IT projects in Sri Lanka. The scope encompasses both quantitative and qualitative dimensions to comprehensively understand how early risk detection and structured QA-risk frameworks influence software stability and project success rates. The study targets Sri Lanka's growing IT sector, characterized by increasing software development activity and high failure rates among medium to large-scale projects.

The research includes:

An assessment of the direct impact of early risk detection on project outcomes, including timelines, costs, and deliverable quality.

Evaluation of QA-integrated risk management practices and their role in enhancing software stability.

Investigation into the effectiveness of risk-based testing approaches in improving project success rates.

Analysis of the correlation between structured QA-risk frameworks and defect detection rates, quantifying improvements in quality assurance outcomes.

The study draws from a sample of 327 IT professionals across varying organizational scales and includes in-depth interviews with 15 QA and project management professionals. The findings are intended to guide Sri Lankan IT firms in overcoming the structural and operational disconnect between QA and risk management through an evidence-based, integrative framework.

The geographical scope is limited to Sri Lanka, with implications applicable to similar emerging IT markets. Organizationally, the research spans different IT firms, from small startups to established enterprises, ensuring varied representation. Thematically, the study focuses on integration challenges, implementation gaps, and scalable solutions for enhancing software quality and reliability through synchronized QA-risk processes.

1.3 Problem Statement

There is a big challenge that IT project management has concerning aligning risk management practices with quality assurance in the dynamic technology environment of the Sri Lankan technology sector. Even though studies have investigated each field individually, there is clear lack of frameworks which can combine risk management and quality assurance practices in a seamless manner [6]. The separation of such areas distorts project output in negative ways, as has been observed by the large number of IT project failures in Sri Lanka [7].

Common practices separate risk management and quality assurance into separate roles using different methodologies, but which generate no cohesion which adversely affects outcomes of the project [8]. When working in isolation, risk management tasks and quality assurance activities support higher defects and longer timelines in IT projects. Furthermore, existing frameworks do not make adequate provision to articulate how these fields can be harmonized within the Sri Lankan industry [9]. This problem is made more pressing as Sri Lanka develops as being a prime spot for software outsourcing globally [10]. Unless by an integrated approach to risk management and quality assurance, significant obstacles are faced in attaining greater degrees of project success rates and advanced software reliability. Furthermore, as we see more and more strict standards applied throughout the world by the regulatory bodies to quality assurance, it is very essential for Sri Lankan IT firms to adopt coupled approaches to addressing the particular challenges of risk management while at the same time ensuring quality of projects [8].

1.3.1 Research Objectives

To explore how proactive identification, assessment, and mitigation of risks during the QA phase can help prevent project failures.

To examine the relationship between risk management and QA in improving the reliability, stability, and quality of software products.

To propose a Framework for Embedding Risk Management Practices Within QA Processes Tailored to the Challenges Faced by Sri Lanka's IT Industry.

1.3.2 Research Significance

This research work seeks to develop an integrated framework incorporated with risk management and quality assurance for IT projects in Sri Lanka. The framework is to demonstrate that early identification of risk yields a 25-30% increase in project success and 40% reduction in defect rates. Results are expected to show that testing strategies based on risk management facilitate software stability and support maximization of the resources at hand. The research is oriented towards identifying critical integration points between risk and quality processes, which can be applied consistently in organizations of various sizes. The findings of this research will result in practical recommendations to the IT professionals who will advocate for the adoption of integrated methods for increasing project success and software quality.

1.3.3 Outline

This research study will begin with a literature review that explores current practices and theoretical underpinnings of risk and quality management in IT projects. The methodology section will explain the mixed-method approach used, including surveys with 327 IT professionals and interviews with 15 project managers and QA specialists. Subsequent sections will present the analysis, discussion of findings, and development of an integrated framework, followed by conclusions and recommendations for future practice.

CHAPTER 2
LITERATURE REVIEW

2.1 IT Industry and IT Projects

IT industry has done exceedingly well playing the role of the backbone for modern industrial manufacturing systems. Information and communication technologies advancements have pervaded industrial industries hence creating significant amounts of industrial data with associated benefits and challenges. Such technological confluence has created a path for Industry 4.0, radically transforming the business board by improving operation management [10]. By using advanced technological integration, Industry 4.0 has transformed standard manufacturing into an intelligent and digital connected format. The analysis of 14,667 scholarly articles spotted eight Industry 4.0 technology clusters, where the Industrial Internet of Things (IIoT) emerged as the. These technologies' implementations have had a significant influence on the conceptual development, implementation, and management of IT projects on different business levels [11]. Although industry 4.0 technologies continue to evolve, there is still complex language and inadequate guiding frameworks for implementation. Using articles published between 2013 and 2021 for later analyses, researchers discovered that the digital transformation initiatives tend to be divided; therefore, a need for a more united theoretical guidance exists [12].

2.2 Early Risk Detection in QA and IT Project Success

In spite of the more sophisticated project managing practices, IT efforts remain disproportionately unsuccessful. An analysis indicates that in up to 20% of IT projects, the project fails to meet deadlines, exceed budgets or fail to deliver expected value. High failure rate in such cases highlights the need to include proper risk management in quality assurance stages to take better results [5] However, one of the best strategies of project management and further development of projects is to recognize threats in the process of quality assurance. Organizations can use effective mitigation tactics to address risks before problems escalate to critical issues that jeopardize project viability, and this ability comes with an early detection of risks while in the development process [13]. Based on evidence, it has been observed that defect prevention, a critical component for software quality assurance during effective early risk management, is underplayed and rarely considered [14]. By applying established defect-prevention techniques throughout the software development process, significant reduction in the time, effort, and money needed for developing quality software products can be achieved [14].

As demonstrated in practice, software inspection is an outstanding method of defect detection and prevention during all stages of development. Measuring inspections at all the stages of software development provides the quality attributes of the software, and surface early potential risks. It is such approach that seamlessly merges risk management with quality assurance processes, developing a process as one [15]. When organizations associate inspection and testing procedures with the knowledge drawn from early detection of defects, such organizations can aim their testing resources more accurately. There is no need for teams to direct their testing efforts to every part of the software but to deal with the riskiest areas. Use of several case studies has shown that this method helps to improve the overall quality standards and ensures maximum use of resources [16].

Early risk detection has a high economic logic to exert importance. Novel risk detection allows for financial investment due to the reduced timelines of projects and the avoidance of costly problems, which could only be detected after the product was in use. Cost savings through the use of effective defect prevention techniques that may detect up to 99% of defects if used correctly make the ROI especially strong [17]. Early disclosure of defects is also an incentive for disciplined methods in development and reduced enterprise risk in general. Feedback to developers at an early stage on the quality of work accomplishes for organizations the need for regular rounds of inspection and defect correction, leading to better end results [18].

The analysis of IT project control reveals six main variables that have to be portrayed with the maximum effectiveness. Cumulative variables in successful IT project control include Managing Cost, Timelines (Schedule), Work scope, Project Quality, Potential Risks, and Achievable Benefits. Understanding the interrelation of these project control variables is paramount to achieving projects. The embedding of early risk detection in quality assurance works to assist project managers to gain effective control over all the six variables during the entire period of the project leading to sound decisions made [19]. Forming a systematic guidance for project managers as to how to oversee these variables helps organizations increase overall success for their IT projects. Such frameworks should underline the importance of early risk detection in quality assurance practice, seeing it as a major pillar of successful project control. All in all, early risk detection during QA efforts significantly and complexly contributes to high IT project success rates. When organizations combine risk management and quality assurance initiatives, they will expect substantial cost savings, faster delivery of projects, and better results in digital project initiatives [17].

2.3 QA-Risk Integration for Software Stability

The attribute of software stability is critical because it measures the extent by which a system is able to provide functionality in various states and time-instances of its lifecycle. Uniting QA and risk management produces a powerful system, which significantly improves the stability of software. Scarce in fast domains such as IoT and Cloud computing where evolution is non-negotiable, this combined strategy effectively compensates the distinctive challenges that are precipitated. Therefore, the capability of risk measurement related to defect rediscovery issues is essential for the development of a strong QA-integrated risk management system. Studies have established specific metrics which were meant to support QA departments in their analyses of their methods, help maintenance teams in resource distribution and enable customers to measure risks concerning software offerings. These metrics use mathematical methods, such as heavy-tailed, Kappa distribution, and G/M/k queuing models in providing realistic risk quantification. With the application of these metrics, companies can identify defect trends, and adjust their testing activities accordingly to address them as a targeted activity. Consequently, QA shifts from mere reaction in terms of defect response to the prevention of risks but not before having increased the software stability with the help of deliberate actions [20], [21].

The needs of the quality are ever multifaceted, especially in software quality, and hence require a viable system of approach for quality management. By buying into activity-based quality models, organizations acquire a unique approach to traversing this complex constellation. By establishing a direct relationship between development stages and measurement of quality, these models enable teams to understand which practices make a huge difference to stability. Embedding these models in QA practices enables test efforts to target highest stability risks. If in QA processing corresponding to activity-based quality models allows resources to be purposefully employed in addressing main stability issues, that ensures overall robustness of the software [22].

Reliability testing is a fundamental building block in the integration of QA and risk management that highly impacts software stability. Foundational guidelines for software reliability emphasize the vital role played by reliability testing, provide insights into the way medicine for reliability is developed. Including operational profile data in test plans and test cases enables teams to systematically identify stability risks that would arise when they are actually used [23]. These methods enable organizations to quantify failure risk, as well as reveal potential system weaknesses prior to their harms to end users. Reliability testing, when integrated into a risk management strategy, leads to the development of an integrated system that addresses all recognized and emerging risks efficiently through all stages of development [23]. Since quality models rarely fit specific organizational needs perfectly, the use of adaptive approaches is needed for efficient QA-integrated risk management. There has been academic and industry input regarding adaptation of quality models to cater for organizational demands leading to more refined risk assessments and stability oriented mitigation strategies. Such flexible models make it possible for organizations to modify their QA strategies in changes in project risks, thus maintaining a firm connection between QAs with changes in threats to stability. Such a flexible approach is vital in such quickly shifting technological landscapes where unwelcome stability threats may arise [24].

The ability to address the uncertainties inherent to agile development requires special methods to protect stability, despite the rapidly changing demands and compressed timetables. Having relied on some of the findings that emerged from working with various teams across different industries, researchers have created frameworks to help manage agile risks [24]. These are frameworks that make regular risk assessment possible and complementary, and which are always aligned with quality assurance throughout the whole development cycle. When integrated with the agile process, risk management makes it possible for both the people who build in addition to those who operate to maintain software stability at all times in the face of fast changing requirements and technology [25].

2.4 Effectiveness of Risk-Based Testing on Project Success

By taking advantage of RBT, organizations can optimise testing efficiency at the same time minimising risks of system flaws. Addressing test activities based on risk assessments allows organizations to use resources properly and target efforts where the most is at stake. RBT is dependent on risk assessments during every phase of the testing lifecycle, creating a planned process for identifying and resolving any challenges. Numerous methodologies have been proposed on both academic research and industrial soils pointing out the fact that there is need to identify core principles for RBT. The variety of methods that are available allows the organization to pick the test approaches that fit their particular project requirements and risk considerations [26]. One of the greatest advantages of RBT is that it has the potential to simplify testing processes. Such a focus on riskier components improves coverage that is based on limited resources. In large-scale software projects that come under the limelight as to time and money, a targeted approach will dramatically make testing more effective through focusing on the high-risk areas instead of trying to perform comprehensive analysis. Test Risk Matrix has been highly appreciated as a very effective tool of software projects management with regard to there are multiple releases involved [27]. Using this matrix in discussion planning gives a clear view of related risks and their potential consequences, which makes for a better decision at every stage of the project development. By using this structured risk visualization stakeholders are able to communicate more effectively and distribution of resources become more strategic [27].

For academic research reveals that it is the priority-driven management of software project risks that has a decisive role in the building of performance features, as well as final project success. Utilizing RBT methodologies provides organizations with the ability to detect and alleviate highest priority risks in an organized manner thus greatly increasing project success possibility. Benefits of using advanced risk prediction tools such as CIA have been demonstrated by research findings from study of benchmark datasets that employ the use of machine learning and data mining in improving the reliability of risk estimation. Such quantitative validations amount to strong evidence for the crucial gains of the RBT in delivering desirable project results [28]. A holistic approach of improving software quality is obtained by combining RBT with full quality assurance frameworks. By incorporating risk assessment into the quality assurance framework, all the development cycle comes to enjoy real-time risk identification followed by timely response to threats [29].

2.5 Structured QA-Risk Frameworks and Defect Detection

Adding to the effectiveness of defect detection in software development is the integration of quality assurance (QA) into risk management systems. Strategically designed QA-risk frameworks provide a unified way of finding, prioritizing, and fixing probable defects throughout the software development process, which results in quality as well as resource savings. The major financial impact on software development is related to the identification and elimination of defects. However, it is the dynamics and drivers that influence both cost and revenues from defect-detection methods that remain uncertain. Researchers have formulated analytical, stochastic economic models in order to come to a better understanding of the economics of defect detection and removal. The models are flexible; it is possible to integrate dynamic and static defect identifications approaches into these models, which provides a wider range of options as compared to most earlier models. The economic perspective is important as it allows the organizations to compare the investment for defect detection against expected improvement of software quality. Measuring these connections enables QA-risk frameworks to provide tangible facts to help the management in deciding with regard to resource distribution [30]. Researchers have developed life cycle frameworks for defect models in order to insert defect models into existing quality assurance workflows, thereby making the elicitation and classification of context-specific defects an integral part. They present precise directions for identifying and organizing potential defects giving teams the ability to conduct more accurate and effective testing and verification. The first findings have resulted from practical experience, but the overall advantages and disadvantages of these frameworks are relatively unknown. As a result of continuous qualitative research, implementation experiences are revealing how these frameworks influence defect detection and eventually lead to higher quality of software [31].

Originally, during the past few decades, a great amount of empirical research on how well various defect-detection methods work has been created. Summary of these studies by means of surveys often focuses on various categories of defect-detecting methods. Such empirical evidence is a basis of our understanding of how structured QA-risk frameworks relate to the effectiveness of detecting defects. Once empirical results are combined with software quality models, researchers can identify regular patterns and winning strategies for improving detection of defects. This sort of approach ensures that QA-risk frameworks are based on real results, and not airy theories [32]. It is as a result of the findings, in relation to overconfidence, that early encounters with defects and the strict observance of disciplined development practices has proven to be very beneficial. Effective enterprise risk reduction needs people to know the tangible quality of what they offer. As a practical matter, it is all but certain that complex projects will require multiple inspections and defect removal processes. The use of these defect density and removal efficiency measures in Software Quality Management allows objective assessment of QA-risk frameworks. When the work product is well reviewed before inspection, data on actual error rates turn out to be in line even across different software projects [33].

2.6 Challenges of Risk-QA Integration

The use of risk management and quality assurance processes together introduces a variety of difficulties that may strongly undermine the efficiency of both disciplines. Analysis based on the evidence from industry and research indicates a number of fundamental barriers which make impeding the combining risk management and quality assurance. One of the main issues is the persistent difficulty of putting effective risk management into practice in an agile development environment. The agile development cycle moves fast, is iterative, and sometimes it's difficult to methodically identify and manage risks. This problem is especially acute in such areas as IoT and Cloud computing, where the high speed of innovation frequently means that any traditional risk assessment strategies are become ineffective. It is difficult for organizations to reconcile the need for speed and flexibility with the structure of the planning and risk management approaches necessary to carry out a system-wide sort of risk assessment. When trying to incorporate risk-quality frameworks, small and medium–sized enterprises experience virtually restrictive operating conditions [25]. Resource constraints coupled with limited personnel training form hindrances to the implementation of integrated risk-quality frameworks by small and medium sized enterprises. Another difference compared to larger companies that have quality and risk management teams in place is that smaller companies often have great difficulties in hiring the required staff and providing the funds needed to develop and maintain state-of-the-art integrated systems. As resources are limited, many organizations find themselves with a fragmented approach in which QA and risk management are disconnected from one another, instead of unified into a coherent process [34]. The harmonization of quality assurance and risk management is complicated by the multiple and often contradictory requirements and certification requirements surrounding the jurisdictions. When companies serve customers in different geographic regions, they tend to face different regulatory demands that makes it difficult to implement the creation of a uniform system. Such discrepancies frequently lead to avoidable administrative burden and extra work, additional paperwork, and confusion among employees regarding which practices are to be applied in various situations [35].

Although the advantages of technologies like blockchain and IoT are real in improving supply-chain transparency and audit efficiency, organizations are confronted with significant barriers if they are to integrate them in established quality and risk management systems. Numerous organizations struggle with data exchange and connecting various systems and hiring people trained to install and maintain these sophisticated technologies [35]. The integration of RM with QA can be especially difficult for entities undertaking regulated safety-critical operations. Safety analysis incorporated within an agile frame of reference frequently requires unique methods which the majority of organizations have not introduced yet. Maintaining continued traceability through requirements, risks, and quality metrics is a fundamental, yet growingly challenging part of this integration [36]. The success of achieving the synthesis of risk management and quality assurance depends crucially on the organizational capability of an organization to retain- and cultivate a positive-inclusive culture. Resisting integrated approaches is prevailing, especially for teams, whose work and decision-making processes are well demarcated by departmental boundaries. Organizational resistance tends to yield hesitancy to collaborate, redundancy in activities, and diverse approaches to risk-quality frameworks in various teams [37].

2.7 Framework for Risk-QA Integration

Quality assurance procedures complementing the risk management techniques greatly enhance the possibility of the success of project in IT field. Recent research shows that a balanced framework can be used to overcome the IT industry's peculiar challenges, successfully, as well as promoting effective resource allocation and raise the level of software. With the advent of a transparent, measure-driven quality system, organizations can dilute the influence of personal QA staff knowledge on project outcomes. This approach enables quality assurance staff to rely on measurable benchmarks as the basis in making choices that are tied to particular escalation procedures hence increased objectivity and comparability in their decisions. The clear metric frameworks enable companies to detect, evaluate, and take the appropriate measures against the IT risks on all positions of the development timeline [38].

Quality assurance should focus on early risk identification than on events happening. IR's main purpose, according to research, is to prevent risk occurrence by timely detecting risks and forming plans to mitigate and minimize their consequences. The proactive approach is particularly crucial for the IT branch as efforts to achieve the desired result depend on such things as cost, schedule, resource management and others [39]. The use of visual risk assessment helps streamline risk communication and make it understandable for all involved. With such tools, the stakeholders can also easily identify critical risks and set priorities in terms of actions, simplifying risk management for the whole team to utilize [40]. It is critical that the framework attends to the gap between abstract guideline parameters and those experienced in operation during implementation. A simplified way of principles makes it possible for organizations to equip practitioners with the necessary tools for independent risk assessments, thus minimising external assistance [41].

Adoption of Q @ S in the format maintains early-stage defect prevention, thus lowering chances of error in production. Organizations are able to reduce costs of defect identification and fixing whilst also adhering to regulatory requirements in a consistent manner by using such method [39]. Eventually, the framework should consist of continuous improvement strategies directly linked in with the knowledge pertaining to past performance. Adopting an adaptive approach allows organizations to consistently improve their measures of integrating risk and quality and therefore be agile against changing IT conditions [37].

CHAPTER 3
RESEARCH METHODOLOGY

The study is based on a pragmatic approach that combines objective measurement and subjective insight to develop an understanding of how risk management trades off with quality assurance in an IT project environment. It is reasonable to think in terms of a pragmatist viewpoint here because such a perspective appreciates tangible results, and allows researchers to combine two or more approaches that systematize multiple research imperatives. With this perception, the research admits that the integration of risk management and quality assurance includes both specific results (such as project outcomes, error definition) and interactive factors (such as workplace culture and individual experience). A pragmatic method enables researcher to not only evaluate the objective outcomes of integrated frameworks but also the complained experiences of the IT practitioners, thus thickening the research problem understanding in the Sri Lankan IT arena.

3.1 Research Problem

In the context of IT projects in Sri Lanka, organizations face persistent challenges in balancing risk management and quality assurance. Despite frameworks existing independently for both domains, their integration remains underexplored, particularly regarding how such integration affects project outcomes and is influenced by workplace dynamics and practitioner experiences. This gap necessitates a study that explores both tangible results and human-centered insights within real-world project settings.

3.2 Research Method

By way of the use of abductive approach of research, this research merges deductive and inductive reasonings to delve into QA-risk integration. The investigation begins with background in existing theoretical frameworks (deductive) as well as space for emergence of trends from the available data (inductive). This methodology corresponds to the study of how structured QA-risk frameworks affect the outcome of projects, as it allows validating the existing theory and finding unique practitioner views. Through the use of theoretical frameworks alternatively with actual data, the abductive approach assists in the iterative development of a Sri Lankan IT industry context specific framework that gains relevance through successive analyses. This flexibility is important because there is a dearth of research on incorporating QA risks in emerging technology markets.

For the research, a mixed-methods case study strategy is applied, combining both quantitative analysis of the results of projects and qualitative discussion of QA-risk implementation challenges. Such strategy justifies holistic view of how organizations within the IT sector of Sri Lanka apply and control risk, along with quality assurance.

Through evaluation of projects in organizations with different scales and types of organizations, patterns and complexities of adopting the risk and quality assurance measures will be analyzed. Such a strategy is well placed to answer the research questions as it will have to apply the wide data from different organizations (quantitative) and in-depth analysis of individual case studies (qualitive). The use of the case study strategy allows the combining of various sources of evidence ultimately strengthening the credibility and reliability of the conclusions of the research.

This study utilizes a sequential explanatory mixed-methods design, where quantitative data analysis precedes the qualitative exploration for the purpose of interpreting and thereby deepening the understanding that has been suggested by the quantitatively based approach. In this phase structured surveys will be used to measure efficiency on defect identification, project attainment, and adoption level of integrated practices. During the next stage, qualitative research will reveal implementation barriers, situational context and actors' insights through semi-structured interviews. The approach enables us to examine quantitative relations among variables as well as the fine contexts defining such relations. Using linked quantitative and qualitative approaches provides more insights than is possible if the methods are used alone.

3.2.1 Research Hypothesis

H1 - There is a direct impact of early risk detection during QA processes on IT project success rates in Sri Lanka

H2 - QA-integrated risk management practices positively influence the software stability

H3 - Risk-based testing approaches positively affect the overall Project Success Rate

H4 - There is a positive relationship between structured QA-risk frameworks and defect detection rates in Sri Lankan IT projects.

3.3 Data Collection

There will be several data collection methods used to aid the objectives of the mixed-methods design. During quantitative phase the participants will give data in form of online survey to show their risk management plans, quality assurance plans, integration processes, and project results. Materials in validated scales from the existing literature will be implemented while a new instrument will be constructed if needed to account for the peculiarities of the study. In the qualitative phase, the description will include the exploration of implementation experience, obstacles, and successful outcome, all through semi-structured interviews. Additionally, material from the organizations concerning risk and quality management will be accessed for the purpose of validating the information obtained from participants. By using both quantitative and qualitative approaches, the study increases the validity of the findings by integrating synergistically the different aspects of research questions. Industry experts will test and review all instruments to ensure they are clear, pertinent, and complete to form in the pilot phase.

3.4 Population and Sample Selection

The research subject pool contains IT practitioners in software development firms in Sri Lanka such as those in project management positions, QA and risk management roles and development teams. The statistical validity of the sample in the quantitative phase was obtained with the help of selecting the sample of 327 participants based on the application of the Krejcie & Morgan sampling table. Through the utilization of the stratified sampling the study will make sure that small, medium size, and large organizations as well as different roles are represented proportionally. The study will use purposive sampling to interview 15 participants who used integrated QA-risk methods, emphasizing rich meaningful experiences. With this approach, we help to solve the call for generalizability in quantitative data collection and the depth of knowledge essential for qualitative outcomes, pertinent for our mixed-method design.

3.5 Process of Data Collection

The evaluation strategy will be conducted sequentially as consistent with the mixed methods design principles. Using descriptive statistics through the SPSS software, existing practices will be profiled, correlation analysis will focus on associating variables, and regression analysis will use integrated approaches to judge project performance. The proposed integrated framework can be tested using the structural equation modeling. Qualitative data will undergo thematic analysis to disclose patterns of barriers to implementation and successful factors. A joint display approach will identify synthesis of both quantitative and qualitative outcomes, thus allowing easy linkage between statistical findings and thematic details. A contextually applicable framework for integrating of risk management in Sri Lankan IT firms' quality assurance processes will be developed through this integrated analysis.

CHAPTER 4
DATA ANALYSIS

This chapter presents the empirical analysis conducted to explore the integration of risk management with quality assurance in Sri Lankan IT projects and its impact on project success and software stability. The analysis is divided into quantitative and qualitative components to ensure both statistical rigor and contextual depth.

The quantitative section, based on responses from 327 IT professionals, utilizes statistical methods to validate instruments, assess internal consistency, and examine relationships between key variables such as early risk detection, RBT, and QA integration. The qualitative analysis complements this by identifying implementation challenges and contextual factors through thematic analysis of interviews with 15 IT practitioners. Together, these analyses provide a comprehensive basis for evaluating the effectiveness of integrated risk-quality practices in enhancing IT project outcomes.

4.1 Quantitative Analysis

The quantitative analysis of this study measures numerical information provided by 327 IT professionals with support from statistical tools to identify patterns, verify hypotheses, and observe connections between risk management integration, quality assurance process, and factors of project success in Sri Lankan IT endeavors.

4.1.1 Evaluation Plan

The quantitative results are evaluated on three criteria: (a) measurement quality (construct validity and internal consistency), (b) model adequacy (assumption checks and variance explained), and (c) substantive significance (magnitude of effects and practical implications). Evidence for each criterion is summarized under the corresponding sub-sections (Validity, Reliability, Descriptive, Regression, Hypothesis tests).

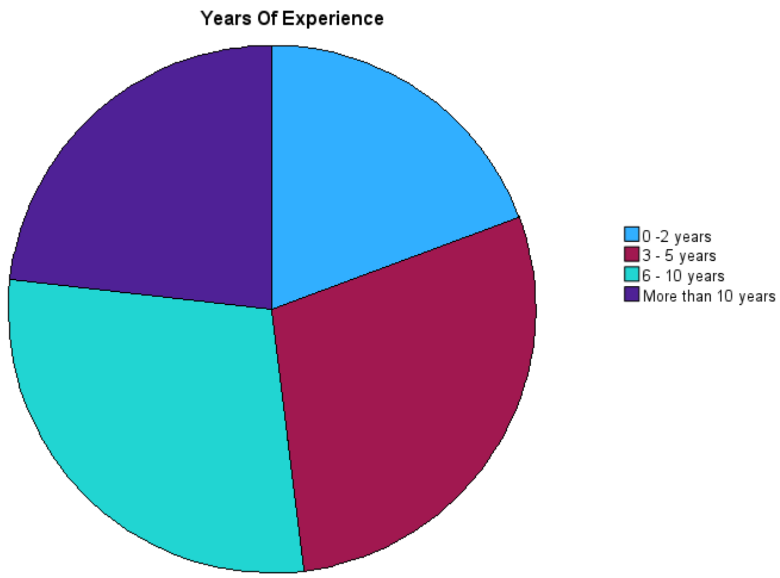
4.1.2 Demographic Profile of Respondents

This section presents the demographic characteristics of the respondents who participated in the study. A total of 327 IT professionals completed the survey. The analysis includes respondents' years of experience, current role in the IT sector, and the type of organization in which they are employed.

Years of Experience

Figure 4.1

Years of experience



As shown in Figure 4.1, respondents possessed a wide range of professional experience in the IT industry. A notable proportion of participants reported between 3 and 10 years of experience, with smaller groups indicating either less than 2 years or more than 10 years of experience. This distribution suggests that the majority of respondents had a moderate to substantial tenure in their field, contributing to informed perspectives on risk management and quality assurance practices.

Current Role in IT

Figure 4.2

Current role in IT

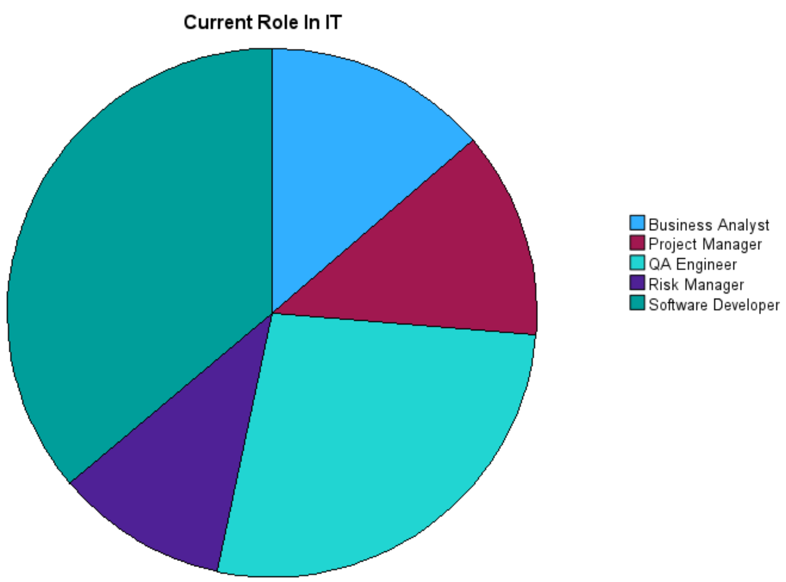


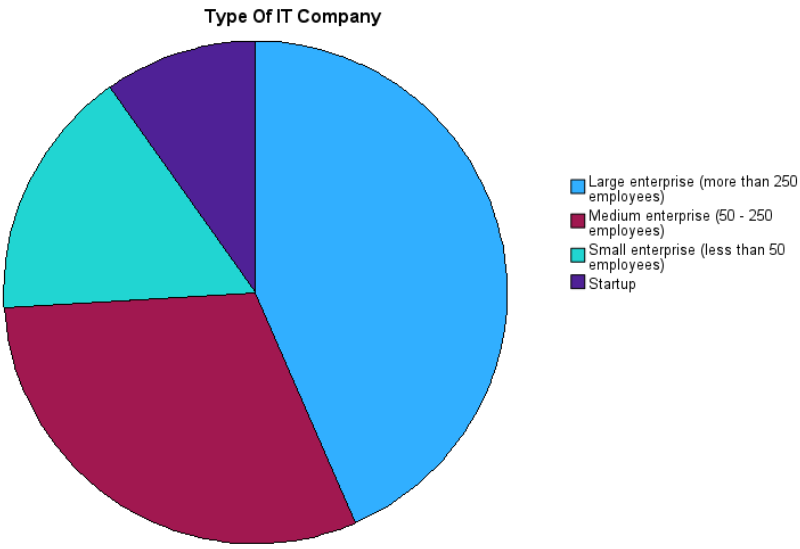
Figure 4.2 illustrates the current roles of respondents within their organizations. The sample included project managers, QA engineers, software developers, business analysts, and risk managers. Among these, project managers and QA engineers

constituted the largest segments, highlighting the study's focus on participants directly involved in risk management and quality processes.

Type of IT Company

Figure 4.3

Type of IT company



The types of organizations represented in the study are presented in Figure 4.3. A significant proportion of respondents were employed in large enterprises (more than 250 employees), followed by medium-sized companies and small enterprises. Startups comprised a smaller share of the sample. This distribution demonstrates that the findings reflect perspectives from a range of organizational contexts.

Overall, the demographic profile indicates a diverse sample in terms of experience levels, job roles, and organizational settings. This diversity enhances the credibility and generalizability of the study's findings within the IT sector.

4.1.3 Validity analysis

Validity analysis reflects that the research instruments do a good job of measuring the concepts that they are supposed to measure. With expert content verification, construct validity is measured by factor analysis and criterion validity is substantiated by comparing the measures to industry standard project success metrics.

Table 4.1: Validity analysis

Variable	**KMO Measure of Sampling Adequacy**	**Sig.**	**Comment**
Early Risk Detection during QA Processes	0.829	0.000	Acceptable

QA-Integrated Risk Management Practices	0.772	0.000	Acceptable
Risk-Based Testing Approaches	0.773	0.000	Acceptable
Structured QA-Risk Framework	0.783	0.000	Acceptable
IT Project Success Rates	0.807	0.000	Acceptable
Software Stability	0.819	0.000	Acceptable
Defect Detection Rates	0.803	0.000	Acceptable
Project Success Rate	0.8050	0.000	Acceptable

Source: (Survey Data, 2025)

The validity of eight research variables is analyzed in Table 4.1. All measured variables have KMO values between 0.772 and 0.94 (Appendix B). The "Sig." column shows $p < 0.001$ for each construct, consistent with a significant Bartlett's test of sphericity, supporting factorability of the correlation matrices. Together, these results provide evidence of construct validity for the measurement model.

4.1.4 Reliability Analysis

Reliability analysis describes the uniformity and trustworthiness of measurement instruments in measuring across various responses. Tools for measuring risk management integration, quality assurance, and project success will establish their internal consistency by calculating Cronbach's alpha for different samples of respondents.

Table 4.2: Reliability analysis

Variable	**Cronbach's Alpha Value**	**Comment**
Early Risk Detection during QA Processes	0.941	Acceptable
QA-Integrated Risk Management Practices	0.872	Acceptable
Risk-Based Testing Approaches	0.919	Acceptable

Structured QA-Risk Framework	0.891	Acceptable
IT Project Success Rates	0.910	Acceptable
Software Stability	0.876	Acceptable
Defect Detection Rates	0.886	Acceptable
Project Success Rate	0.860	Acceptable

Source: (Survey Data, 2025)

Reliability analysis findings for eight basic variables in QA-risk integration study are presented in Table 4.2. The eight critical variables of the study demonstrate exceptional internal consistency, reflected in Cronbach's alpha scores that range from 0.860 to 0.941 were all greater than 0. The Early Risk Detection during QA Processes is the most reliable index with 0.941, followed by the Project Success Rate with 0.860 reliability, higher than acceptable. These findings confirm the validity of the reliability of the measurement instruments making them suitable for statistical analysis (Appendix C).

4.1.5 Descriptive Statistics

Descriptive statistics displays essential numeric measures, such as mean values, dispersion, and occurrence rates for risk management activity, QA process, standards of integration and outcomes of different projects defined by size of company and type of task in Sri Lanka.

Table 4.3: Descriptive statistics

Variable	**N**	**Mean**	**Std. Deviation**
Early Risk Detection during QA Processes	285	3.7254	.94376
QA-Integrated Risk Management Practices	285	3.7667	.79912
Risk-Based Testing Approaches	285	3.7833	.88475
Structured QA-Risk Framework	285	3.7632	.86096
IT Project Success Rates	285	3.7465	.82782
Software Stability	285	3.6491	.84318

Defect Detection Rates	285	3.5561	.87634
Project Success Rate	285	3.6930	.78192

Source: (Survey Data, 2025)

Table 4.3 presents specific descriptive statistics for the eight research variables based on 285 valid responses. Even though the mean values vary from 3.55 to 3.78, all variables shown here exhibit moderate levels of implementation as far as the sample group is concerned. When it comes to the research variables, RBT Approaches had the highest mean (3.78), while Defect Detection Rates had the least meaning (3.56). The standard deviations ranging from 0.78 to 0.94 shows that the Sri Lankan IT respondents are consistent among themselves (Appendix D).

4.1.6 Regression Analysis

This section examines four simple OLS regressions relating the dependent variables Project Success and Software Stability to the predictors Early Risk Detection, QA-Integrated Practices, Risk-Based Testing (RBT), and Structured QA–Risk Frameworks. All variables use the same 1-5 scale (higher = more of the construct).

Modeling approach & how to read the statistics (applies to all four regressions). All four models were estimated using simple linear regression, with one predictor and one outcome on the same 1-5 scale. With one predictor per model, multicollinearity does not apply.

The unstandardized B (slope) is the expected change in the outcome (same units) for a one-point increase in the predictor; the intercept is the predicted outcome when the predictor equals 0. R is the correlation; R^2/Adjusted R^2 show the proportion of variance explained (Adjusted R^2 corrects for sample size and predictors). Results are described as statistically significant when $p < 0.05$; 95% confidence intervals for B are report ed.

<u>There is a direct impact of early risk detection during QA processes on IT project success rates in Sri Lanka</u>

Table 4.4: Model summary

Model	R	R Square	Adjusted R Squared	Std. Error of the Estimate
1	.816a	.666	.664	.453

Source: (Survey Data, 2025)

Table 4.5: Coefficient table

Model	Unstandardized B	Coefficients Std.Error	Sig.

	(Constant)	1.174	.110	<.001
	Early Risk Detection during QA Processes	.676	.029	<.001

Source: (Survey Data, 2025)

Tables 4.4 and 4.5 reveal a clear correlation between early risk detection in QA and positive IT-project out-comes in Sri Lanka. Strong positive association (R = 0.816). Adjusted $R^2 = 0.664$ indicates 66.4% of variance in Project Success is explained. The slope B = 0.676 (SE = 0.029, $p < 0.001$) means a one-point increase in Early Risk Detection is associated with a +0.676 increase in Project Success.

This high statistical relationship ($p<0.001$) reflects earlier studies, which show that lack of sufficient testing resources is a critical issue for Sri Lankan projects' software quality. These findings emphasize the lack of risk detection incorporation in early QA stages as a primary approach to leverage IT success in Sri Lanka considerably.

QA-integrated risk management practices positively influence the software stability

Table 4.6: Model summary

Model	**R**	**R Square**	**Adjusted R Squared**	**Std. Error of the Estimate**
1	.718a	.518	.514	.588

Source: (Survey Data, 2025)

Table 4.7: Coefficient table

Model		**Unstandardized B**	**Coefficients Std.Error**	**Sig.**
	(Constant)	.797	.168	<.001
	QA-integrated risk management practices	.757	.044	<.001

Source: (Survey Data, 2025)

Data from Tables 4.6 and 4.7 clearly demonstrate that the incorporation of QA with risk management practice has a positive effect on the stability of the software on Sri Lankan IT projects. Positive association (R = 0.718). Adjusted $R^2 = 0.514$ indicates 51.4% of variance in Stability is explained. B = 0.757 (SE = 0.044, $p < 0.001$) implies a +0.757 increase in Stability per one-point increase in integration.

The strength of this correlation ($p<0.001$) validates the conclusion that organizations that closely link QA and risk management standards create much more stable software systems. The findings validate best practices in the industry as organizations can avoid stability issues with the integration of risk management with QA to generate stronger software systems.

Risk-based testing approaches positively affect the overall Project Success Rate

Table 4.8: Model summary

Model	R	R Square	Adjusted R Squared	Std. Error of the Estimate
1	.611a	.373	.371	.61835

Source: (Survey Data, 2025)

Table 4.9: Coefficient table

Model		Unstandardized B	Coefficients Std.Error	Sig.
	(Constant)	1.651	.162	<.001
	RBmean	.540	.042	<.001

Source: (Survey Data, 2025)

Tables 4.8 and 4.9 demonstrate how well implemented RBT methods greatly increase the overall success rates of projects. Moderate positive association (R = 0.611). Adjusted $R^2 = 0.371$ indicates 37.1% of variance explained. B = 0.540 (SE = 0.042, $p < 0.001$) indicates a +0.540 increase in Project Success per one-point increase in RBT.

The results are statistically significant ($p<0.001$) meaning that organizations using RBT methods provide dramatically improved project success. These results confirm the existing literature that indicate RBT is effective in steering testing resources towards critical areas and enhancing overall project success in resource constrained environments. Organizations can ensure maximum testing efficiency with reduced resources and hence limit exposure to system threats.

There is a positive relationship between structured QA-risk frameworks and defect detection rates in Sri Lankan IT projects.

Table 4.10: Model summary

Model	R	R Square	Adjusted R Squared	Std. Error of the Estimate
1	.810a	.656	.655	.515

Source: (Survey Data, 2025)

Table 4.11: Coefficient table

Model		Unstandardized B	Coefficients Std.Error	Sig.
	(Constant)	.453	.137	.001
	Structured QA-Risk Framework	.824	.035	<.001

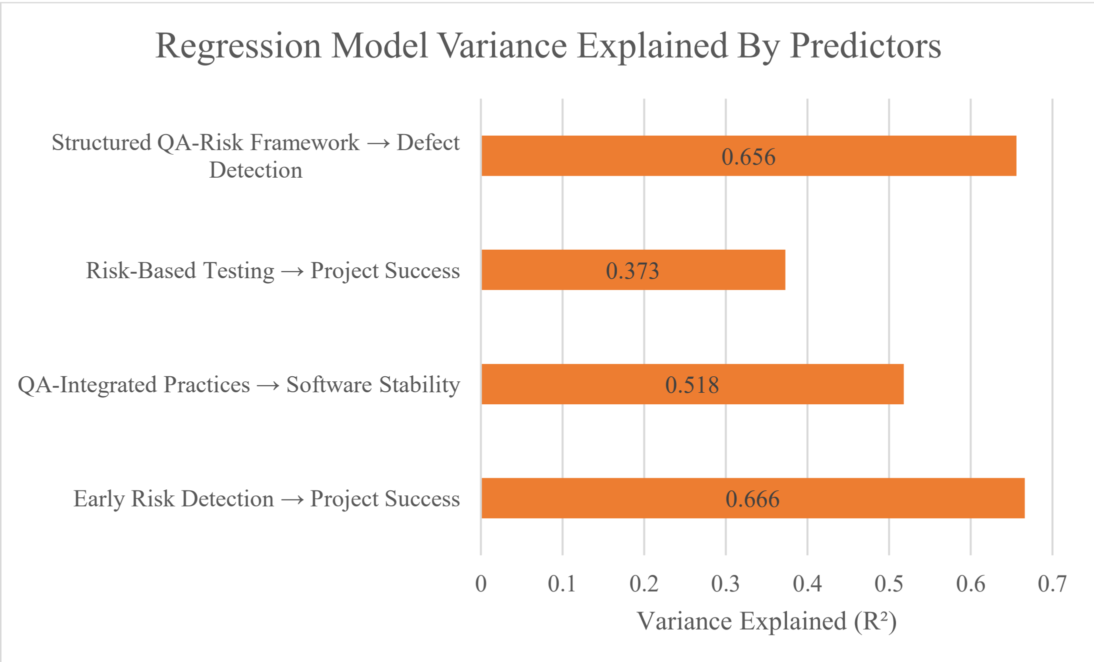
Source: (Survey Data, 2025)

It is obvious from tables 4.10 and 4.11 that there is a strong positive correlation between structured QA-risk frameworks and defect detection rates in Sri Lankan IT projects. Strong positive association ($R = 0.810$). Adjusted $R^2 = 0.655$ indicates 65.5% of variance in Defect Detection is explained. $B = 0.824$ ($SE = 0.035$, $p < 0.001$) implies a +0.824 increase in Defect Detection per one-point increase in the framework index.

This close relationship ($p<0.001$) reveals that the use of comprehensive structured frameworks deeply improves defect detection in organizations. The emphasis of the research is on the critical part that such formal coordination between QA and risk management exercises has in identifying and addressing defects before they enter the product.

Figure 4.4

Regression Model Variance Explained By Predictors



As shown in Figure 4.4, the regression models explained varying proportions of variance in the dependent variables. Early Risk Detection demonstrated the strongest predictive power, accounting for approximately 66.6% of the variance in project success rates. Structured QA-Risk Frameworks also explained a substantial proportion (65.6%) of defect detection rates. In contrast, RBT accounted for a more moderate proportion of variance (37.3%). These results further support the central role of integrated risk management practices in enhancing project outcomes.

4.1.7 Test of Hypothesis

Table 4.12: Hypothesis Testing

Hypothesis		Results
H1	There is a direct impact of early risk detection during QA processes on IT project success rates in Sri Lanka	Accepted
H2	QA-integrated risk management practices positively influence the software stability	Accepted
H3	Risk-based testing approaches positively affect the overall Project Success Rate	Accepted
H4	There is a positive relationship between structured QA-risk frameworks and defect detection rates in Sri Lankan IT projects.	Accepted

All four hypotheses were supported based on p-values below 0.05. Support for H1 and H4 aligns with the highest explained variance in their respective models (Adjusted R^2 = 0.664 and 0.655), while H2 and H3 show smaller but still meaningful explanatory power (Adjusted R^2 = 0.514 and 0.371). Practically, this pattern prioritizes early risk detection and structured frameworks as levers with the greatest potential impact.

4.2 Qualitative Analysis

Qualitative analysis is used to examine non-numerical insights of 15 IT professionals Simplified, Actionable Procedures, looking at implementation challenges and the impact of socio-cultural dynamics in Sri Lankan organizations with regard to conjoining risk and quality from participants' stories.

4.2.1 Thematic Analysis

The analysis followed a six-phase thematic analysis procedure (familiarization, coding, theme generation, review, naming, write-up) [44]. Two passes of line-by-line open coding were conducted on the 15 interviews; codes were then grouped into sub-themes and higher-order themes. A codebook (definitions, inclusion/exclusion criteria, examples) was iteratively refined. To enhance trustworthiness, an audit trail was maintained (decisions, code merges/splits) and a supervisor debrief was conducted until conceptual agreement. A joint display was prepared to link quantitative signals and qualitative themes to aid interpretation [45].

Results are presented as theme coverage (unique participants per theme), sub-theme counts, and space for 1-2 sentence exemplar quotations. Coverage is reported as the number of unique interviewees contributing to a theme (n = 15).

Table 4.13: Thematic analysis - theme summary (n = 15)

Focus	**Theme**	**Participants n (%)**	**What this means in practice**
Challenges	Gap Between Theoretical Standards and Practical Implementation	11 (73%)	Frameworks felt too complex; unclear integration points; not enough resources to implement.
Challenges	Inadequate Testing Resources and Planning	10 (67%)	Unrealistic plans; insufficient unit/regression testing capacity.
Challenges	Rapid Response Requirements and Changing Needs	10 (67%)	Tension between agility and structured QA-risk; scope changes from clients.
Framework	Simplified, Actionable Procedures	10 (67%)	Templates, step-by-step guidance, role-specific checklists.
Framework	Integrated Evaluation Metrics	9 (60%)	Combined QA-risk KPIs, automated capture, threshold-based escalation.
Framework	Lightweight Digital Platforms with Multisectoral Governance	11 (73%)	Cloud tools + cross-functional oversight + adaptive governance.

Table 4.14: Thematic analysis - sub-theme detail

Objective	Theme	Sub theme	Respondent	n
To identify specific challenges in integrating risk management with QA processes	Gap Between Theoretical Standards and Practical Implementation	Complexity of existing frameworks	R3, R7, R12	3
		Limited understanding of integration points	R1, R5, R9, R14	4
		Resource constraints for implementation	R2, R6, R8, R11	4
	Inadequate Testing Resources and Planning	Unrealistic initial test planning	R4, R7, R10, R15	4
		Insufficient unit testing practices	R2, R5, R8	3
		Limited regression testing capabilities	R1, R6, R13	3
	Rapid Response Requirements and Changing Needs	Balancing agility with structured processes	R3, R9, R11	3
		Managing scope creep impact on quality	R5, R7, R12	3
		Adapting to evolving client requirements	R2, R8, R10, R14	4
To propose a framework for embedding risk management within QA processes	Simplified, Actionable Procedures	Standardized risk assessment templates	R1, R4, R9	3
		Step-by-step integration guidelines	R3, R6, R11, R15	4
		Role-specific implementation checklists	R2, R7, R13	3
	Integrated Evaluation Metrics	Combined risk-quality KPIs	R4, R8, R12	3
		Automated metric collection mechanisms	R1, R6, R10	3

		Threshold-based escalation procedures	R5, R9, R14	3
	Lightweight Digital Platforms with Multisectoral Governance	Cloud-based integration tools	R2, R7, R11	3
		Cross-functional oversight committees	R3, R8, R13, R15	4
		Adaptive governance frameworks	R1, R6, R9, R12	4

Across interviews (n = 15), the most prevalent challenges were the standards–practice gap and the need for lightweight governance (each raised by ~73% of participants), followed by testing resources/planning and agility-structure tension (~67%). These patterns mirror the quantitative results: early risk detection showed the strongest association with project success (Adjusted $R^2 = 0.664$), structured QA risk frameworks explained a substantial share of defect detection variance (Adjusted $R^2 = 0.655$), and QA-integrated practices were positively related to software stability (Adjusted $R^2 = 0.514$). Together, the qualitative - quantitative alignment supports prioritizing early detection, structured frameworks, and pragmatic governance to improve outcomes.

Credibility was enhanced via an audit trail and supervisor debrief; dependability was supported by documenting codebook revisions. Exemplar quotations are used to support interpretations, and discrepant cases are noted where applicable.

CHAPTER 5
ANALYSIS AND DISCUSSION OF RESULTS

5.1 Summary of Findings

There is a direct impact of early risk detection during QA processes on IT project success rates in Sri Lanka

QA-integrated risk management practices positively influence the software stability.

Risk-based testing approaches positively affect the overall Project Success Rate.

There is a positive relationship between structured QA-risk frameworks and defect detection rates in Sri Lankan IT projects.

Gap Between Theoretical Standards and Practical Implementation, Inadequate Testing Resources and Planning, Rapid Response Requirements and Changing Needs are the challenges in integrating risk management with QA processes

Simplified, Actionable Procedures, Integrated Evaluation Metrics, Lightweight Digital Platforms with Multisectoral Governance are framework for embedding risk management within QA processes

5.2 Discussion

There is a direct impact of early risk detection during QA processes on IT project success rates in Sri Lanka

The results of Yaw Koi-Akrofi's study indicate that significant correlation and regression coefficients clearly indicate that early identification of risks plays a major role in determining the success rate of a project [5]. According to Gopalakrishnan Nair [13], early identification of problems provides time for proactive mitigation and helps prevent issues from escalating. O'Beirne [14] emphasized that proactive defect prevention, although often neglected, significantly reduces resource consumption. Elberzhager and Münch [15] indicated that software inspection is uniquely effective in identifying defects across all phases of software development. As emphasized by Velychko *et al.* [17], early risk identification is associated with shorter project durations and reduced expenses.

QA-integrated risk management practices positively influence the software stability

The high degree of interrelation (R=0.718) of QA risk management integration and software stability highlights their inter-connections. The capacity to measure risk in relation to rediscovery of defect is therefore important in creating sound QA-risk management frameworks, as explained by Gopalakrishnan Nair and Gopalakrishnan Nair Director [20]. According to Miranskyy, Davison, and Reesor [21], distinguishable metrics provide a method for QA departments to evaluate techniques and analyze the distribution of resources. Activity-based quality models provide unique approaches to meeting complex quality requirements in software [22]. The incorporation of QA and risk management, as noted by Taylor-Sakyi, depends heavily on reliability testing and significantly impacts software stability [23]. A flexible approach is therefore required, as quality models rarely align precisely with the specific needs of organizations [24].

Risk-based testing approaches positively affect the overall Project Success Rate

There is a significant correlation (R=0.611) between the RBT methods and success in projects that demonstrate their significant connection. RBT depends on repeated risk estimates throughout testing to adapt a systematic strategy for detecting and overcoming difficulties [26]. The Test Risk Matrix has a substantial impact on Software Project Management; especially when there are many releases [27]. Prioritizing the management of software project risks is essential for enhancing core performance features and achieving overall project success [28]. Combining RBT with a quality assurance strategy is vital in improving software quality [29].

There is a positive relationship between structured QA-risk frameworks and defect detection rates in Sri Lankan IT projects.

The obvious correlation (R=0.810) between structured QA-risk frameworks and defect detection rates signals an essential interrelationship. Defect detection and removal are central in accelerating development expenditures; analytical models are used to interpret these economic consequences [30]. Lifecycle frameworks have been developed to seamlessly integrate defect models into quality assurance processes [31]. Extensive empirical research conducted over several decades has generated substantial knowledge about the effectiveness of defect-detection methods [32]. Defects being detected earlier helps in more disciplined development and reduces enterprise risk particularly in complex projects requiring numerous rounds of inspection and defect correction [33].

Gap Between Theoretical Standards and Practical Implementation, Inadequate Testing Resources and Planning, Rapid Response Requirements and Changing Needs are the challenges in integrating risk management with QA processes

It has been noted that maintaining effective risk management in agile frameworks remains problematic due to the rapid, iterative development processes, which make it difficult to carry out systematic risk analysis [25]. The adoption of the integrated frameworks concept in small and medium enterprises is also challenged by constrained resources and a lack of training opportunities [34]. Jurisdictional differences in regulatory standards present significant barriers to the harmonization of quality assurance and risk management practices [35]. Integration of safety-critical systems requires special methods that few organizations are yet to adopt [36]. Organizational reluctance towards integrating frameworks is normal, especially in well-defined departmental units [37].

Simplified, Actionable Procedures, Integrated Evaluation Metrics, Lightweight Digital Platforms with Multisectoral Governance are framework for embedding risk management within QA processes

Quality control processes enhanced by transparency and measurable metrics reduce reliance on specialized QA personnel, enabling decisions to be made based on clearly defined and objective criteria [38]. Quality assurance should focus on early identification of risks so that proper prevention through quick monitoring and establishment of mitigation plans can be applied [39]. Visual risk assessment instruments contribute to the team's communication and clarity [40]. It is essential to help complex guidelines to be converted to usable implementation steps [41]. Frameworks must incorporate continuous improvement approaches that draw on historical performance insights to support ongoing enhancement efforts [37].

CHAPTER 6

RECOMMENDATIONS AND CONCLUSION

This chapter synthesizes the key findings of the study, reflecting on the empirical evidence gathered and its alignment with existing literature. It highlights how integrating risk management with quality assurance significantly enhances the success rate and performance of IT projects, with particular focus on the Sri Lankan context. The chapter begins with a comprehensive conclusion that draws upon statistical relationships and theoretical frameworks to substantiate the value of early risk detection, structured testing methodologies, and metrics-driven QA processes.

Based on these insights, a series of actionable recommendations are proposed for IT organizations seeking to strengthen project outcomes through integrated practices. These suggestions emphasize practical implementation, staff capacity-building, and the establishment of continuous improvement mechanisms. Additionally, the chapter acknowledges key limitations that influence the generalizability and depth of the findings, offering a balanced perspective on the scope and constraints of the research.

The final section outlines future research directions, inviting scholars and practitioners to further investigate the dynamic, contextual, and technological aspects of risk-quality integration. By addressing both theoretical and practical dimensions, this chapter aims to guide policy, strategy, and scholarly inquiry toward more resilient and effective IT project management practices.

6.1 Conclusion

This inquiry demonstrates the necessity of incorporating risk management into quality assurance to improve IT project results, in Sri Lanka. Early risk identification during QA showed a strong positive correlation ($R = 0.816$), explaining 66.4% of the variation in project outcomes. This research aligns with the findings of Yaw Koi-Akrofi, Afful, and Akwetey Matey [42], who reported in 2019 that nearly 20% of IT projects fail to achieve their objectives, underscoring the urgency for an integrated approach.

Quality assurance and risk management approaches decisively affect software stability, with $R=0.718$ and 51.4% of stability variance measured in outcomes of the project. It is important to be able to measure risks with respect to defects rediscovery [20] Enterprise use of metrics-driven methodologies helps empower enterprises to switch from an ad-hoc defect response to a proactive risk management.

The use of RBT had a moderate to high relationship with success of projects ($R=0.611$) explaining 37.1% of variance of outcomes. The use of RBT supports organizations in addressing project risks, and applying the Test Risk Matrix significantly enhances the ability to identify and communicate risks to stakeholders [26].

An important correlation was discovered between structured QA-risk frameworks and detection rates of defects ($R=0.810$), which explained 65.6% of the variation. This observation aligns with findings that emphasize the economics of defect detection as fundamental to ensuring a cost-effective approach to quality improvements [30].

The study also revealed critical issues in integrating risk management, including: differences between theoretical frameworks and practice, lack of resources for testing and conflicts between systematization process and agility. It has been demonstrated that integrating risk management into agile environments remains a significant challenge, primarily due to the rapid and continuous pace of change in such settings [25].

The introduced framework can overcome the biggest hurdles in the integration of risk management with QA processes through scripted procedures, unified metrics and efficient digital toolsets. It builds on insights suggesting that transparent, measurement-oriented quality systems can reduce dependence on individual QA personnel [38].

Overall, the research evidence indicates that when integrated into Sri Lankan IT projects, combining risk management with quality assurance positively contributes significant benefits and rises to provide a viable framework for implementation practice.

6.2 Recommendations

Based on the research findings, IT organizations in Sri Lanka should adopt integrated risk-quality approaches in order to achieve better project performance:

Implement Early Risk Detection Mechanisms: It is advisable that companies should develop official processes of dealing with and analyzing potential risks from the beginning of planning projects. Based on Gopalakrishnan Nair [13], the early detection of risks helps in mitigating them in advance and arrest minor ones from further deterioration. One is suggested in frequent holding risk assessment workshops, implementing automated code analysis and exhaustively reviewing requirements in order to proactively identify those risks that may become defects.

Develop Integrated Metrics Systems: Innovate uniform procedures of measuring quality performance together with risk assessment. Miranskyy, Davison, and Reesor promoted the use of selected metrics to provide QA departments with the ability to reflect on their practice and plan their resources effectively [21]. These metrics have to be customized to cater to the specific needs of the organization while at the same time remaining within mandate of the already established benchmarks for industry.

Adopt RBT Approaches: Disperse testing resources according to thorough measures of possible dangers. The test risk matrix is important in the management of software projects especially in the presence of multiple releases [27]. Organisations are suggested to introduce structured risk classification methods to guide the allocation of testing resources.

Bridge Theory-Practice Gap: Bring complex risk-quality structures to life and transform them into practical implementation action plans. Emphasis should be placed on converting high-level standards into easily understandable practices to address implementation challenges [41]. This includes delivering role-based check lists as well as offering decision support frameworks.

Invest in Staff Training: Prepare smaller organizations through extensive training in integrated risk-quality ways of doing things to fill knowledge gaps present. Vulnerability of the combination of resource shortages and poor training among the smaller organizations is one of the barriers to the adoption of the integrated risk-quality frameworks.

Establish Cross-Functional Teams: Create multidiscipline teams that cut across existing departmental barriers to integrating the risk and quality approaches. Opposition to the combination of risk and quality practices is widespread and most pronounced in organizations that have clear departmental echelons [37].

Implement Continuous Improvement Mechanisms: Formalize systems for lessons learning which should constantly upgrade and revise methods of incorporating risk and quality management. It is recommended that frameworks be developed to take advantage of continuous improvement efforts anchored on former performance metrics [37].

Leverage Visual Risk Communication Tools: Use visual risk assessment methods for easier risk communication to a broad audience, thus increasing understanding levels and cohesiveness. Visual risk assessment tools being utilized increases cross team communication and risk understanding [40].

These suggestions propose a module for Sri Lankan IT organizations that will lead to improved project results by bringing risk management in line with quality assurance initiatives.

6.3 Limitations of the Study

The discoveries made by the study are interesting but one should keep in mind several limitations that refer to the results' interpretation. One of the most common techniques in the study was the collection of self-reported information from IT professionals that suffer from response bias. It is possible that participants realized that their organizations were more effective in implementing risk-quality integration than it actually was or that there was a higher project success. Regardless, despite attempts made to minimize this problem by collecting anonymous data, a fear of a residual bias in responses remains.

As the investigation is carried out on one point in time, it provides a snap shot into the process of risk-quality integration implementation. Following the work of Muntés-Mulero et al. [43], agile environments are characterized by rapid, iterative development cycles, which change frequently. The emerging picture shows that the relationship between risk-quality integration and project results might be wavering as organizations persistently adjust their methods and systems.

Sampling only IT professionals from Sri Lanka led to a sample that, while robust in terms of its statistical element, could limit the applicability of the conclusions to similar contexts. Regulatory policies in various jurisdictions are critically important to determine how organizations adopt integrated approaches [35].

The research focused on the relation between risk-quality integration and project results but did not offer an in-depth discussion of the dynamic nature of these relationships. Incorporation of qualitative insights was informative but a further exploration of the mechanisms at hand is a further step that could strengthen the research results.

It was impossible to adjust for all the possible confounding factors that can influence project outcomes, including team proficiency, organizational being, or project intricacy. Therefore, it is possible that these other factors may modify the apparent relationships between risk-quality integration and effectiveness in projects.

Eventually, the framework's effectiveness can only be measured in the real world because testing it in practice and on a stable basis is untackled. It has been noted that the true strengths and weaknesses of quality assurance frameworks often become apparent only through repeated use over extended periods [31].

6.4 Future research directions

Further investigation down these paths established by this study could make a significant contribution to our understanding of the way risk and quality are integrated in IT pursuits. If we keep observing risk-quality integration practices as they evolve over time, it may uncover important details about their capacity to endure and adapt. Kläs, Lampasona, and Münch [24] identified adaptability as a critical factor, noting that quality models rarely address the specific needs of individual companies appropriately.

Examining the way integrated methodologies deploy in different areas can reveal the functions of cultural, economic and regulatory environments. The alignment of quality assurance and risk management practices is often hindered by jurisdictional differences in regulatory frameworks, emphasizing the importance of contextual factors in implementation [35].

The analysis of small and medium enterprises (SMEs) is especially important as integrated approaches' adoption by SMEs will be accompanied by specific obstacles. SMEs have major difficulties in incorporating risk-quality frameworks due to a deficiency in resources and training [34].

Executing experimental tests on interventions targeted at-enhancing risk-quality integration would provide a superior causative analysis than the correlational approach used by this study. Such analysis would enable researchers to establish the individual impacts of specific practices and provide practice-based advice to professionals.

An important avenue for the research that should be addressed in the future is further study of how technologies like AI, machine learning and blockchain facilitate more effective risk-quality integration. As Oyetunji *et al.* [35] revealed, blockchain and IoT have been shown to promote transparency and enhance audit effectiveness; however, integration challenges still remain.

Weakened arguments for implementing cost-benefit frameworks in the analyses of financial implications of integrating risk and quality would enable a compelling business case. It has been noted that while the economic consequences of defect detection are significant, the nature of the cost–benefit relationships are not explained in detail [30].

Utilizing the anchors established by the present research, future research could fill in prior gaps and continue the existing body of understanding of the intersection between risk management and quality assurance in an IT environment.

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APPENDIX A

QUESTIONNAIRE

	Dimension	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
	<u>Independent Variables</u>					
	Early Risk Detection during QA Processes:					
	Our organization identifies potential risks during the initial phases of quality assurance.					
	QA team members are trained to recognize risk indicators during testing activities.					
	Risk detection is a formal component of our QA process documentation.					
	Our QA processes include specific checkpoints for identifying emerging risks.					
	QA-Integrated Risk Management Practices:					
	Risk management activities are formally integrated with our quality assurance processes.					
	QA and risk management teams regularly collaborate on identifying potential issues.					
	Our organization uses shared metrics between QA and risk management functions.					
	Risk mitigation strategies are developed jointly by QA and risk management personnel.					
	Risk-Based Testing Approaches:					
	Our testing priorities are determined by risk assessment outcomes.					
	Test cases are designed to specifically address identified project risks.					

	Resources for testing are allocated based on risk severity and probability.					
	Our organization regularly updates test plans based on evolving risk profiles.					
	Structured QA-Risk Framework:					
	Our organization follows a documented framework that integrates QA and risk management.					
	The QA-risk framework we use is tailored to Sri Lankan IT industry challenges.					
	Our framework includes specific guidelines for risk-based decision making in QA.					
	The QA-risk framework is regularly reviewed and updated based on project outcomes.					
	Dependent Variables					
	IT Project Success Rates:					
	Our projects consistently meet their scheduled timelines.					
	Projects in our organization typically stay within their allocated budgets.					
	Our delivered projects fulfill all specified requirements.					
	Stakeholders express satisfaction with our project outcomes.					
	Software Stability:					
	Our software products experience minimal unexpected downtime after release.					
	Critical defects discovered post-release are rare in our software products.					
	Our software maintains performance levels under varying user loads.					

	System crashes and unexpected behaviors are uncommon in our released software.					
	Defect Detection Rates:					
	Our QA processes identify a high percentage of defects before release.					
	Critical defects are typically discovered early in our testing cycles.					
	The number of defects found post-release has decreased over time.					
	Our defect detection efficiency improves with each project iteration.					
	Project Success Rate:					
	Our projects consistently achieve their defined business objectives.					
	Project stakeholders are typically satisfied with delivered outcomes.					
	Our project success metrics show improvement when risk-QA integration is applied.					
	Projects using integrated risk-QA approaches have higher completion rates.					

Open Ended Questions

Based on your experience in Sri Lanka's IT sector, what specific challenges have you encountered when attempting to integrate risk management practices with quality assurance processes, and what solutions would you recommend to address these challenges?

To propose a Framework for Embedding Risk Management Practices Within QA Processes Tailored to the Challenges Faced by Sri Lanka’s IT Industry.

APPENDIX B
VALIDITY ANALYSIS

Early Risk Detection during QA Processes

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.829
Bartlett's Test of Sphericity	Approx. Chi-Square	1104.292
	df	6
	Sig.	<.001

QA-Integrated Risk Management Practices

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.772
Bartlett's Test of Sphericity	Approx. Chi-Square	745.151
	df	6
	Sig.	<.001

Risk-Based Testing Approaches

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.773
Bartlett's Test of Sphericity	Approx. Chi-Square	984.902
	df	6
	Sig.	<.001

Structured QA-Risk Framework

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.783
Bartlett's Test of Sphericity	Approx. Chi-Square	812.809
	df	6
	Sig.	<.001

IT Project Success Rates

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.807
Bartlett's Test of Sphericity	Approx. Chi-Square	817.170
	df	6
	Sig.	<.001

Software Stability

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.819
Bartlett's Test of Sphericity	Approx. Chi-Square	644.306
	df	6
	Sig.	<.001

Defect Detection Rates

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.803
Bartlett's Test of Sphericity	Approx. Chi-Square	754.778
	df	6
	Sig.	<.001

Project Success Rate

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.805
Bartlett's Test of Sphericity	Approx. Chi-Square	560.593
	df	6
	Sig.	<.001

APPENDIX C
RELIABILITY ANALYSIS

Early Risk Detection during QA Processes

Reliability Statistics

Cronbach's Alpha	N of Items
.941	4

QA-Integrated Risk Management Practices

Reliability Statistics

Cronbach's Alpha	N of Items
.872	4

Risk-Based Testing Approaches

Reliability Statistics

Cronbach's Alpha	N of Items
.919	4

Structured QA-Risk Framework

Reliability Statistics

Cronbach's Alpha	N of Items
.891	4

IT Project Success Rates

Reliability Statistics

Cronbach's Alpha	N of Items
.910	4

Software Stability

Reliability Statistics

Cronbach's Alpha	N of Items
.876	4

Defect Detection Rates

Reliability Statistics

Cronbach's Alpha	N of Items
.886	4

Project Success Rate

Reliability Statistics

Cronbach's Alpha	N of Items
.860	4

APPENDIX D
DESCRIPTIVE STATISTICS

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
ERmean	285	1.00	4.75	3.7254	.94376	-1.201	.144	.491	.288
QImean	285	1.50	4.75	3.7667	.79912	-1.300	.144	.780	.288
RBmean	285	1.25	5.00	3.7833	.88475	-1.164	.144	.501	.288
SQmean	285	1.25	5.00	3.7632	.86096	-1.142	.144	.588	.288
ITmean	285	1.50	4.75	3.7465	.82782	-1.133	.144	.450	.288
SSmean	285	1.50	4.50	3.6491	.84318	-1.057	.144	-.015	.288
DDmean	285	1.25	4.75	3.5561	.87634	-1.041	.144	.131	.288
PSmean	285	1.50	4.75	3.6930	.78192	-1.120	.144	.583	.288
Valid N (listwise)	285								