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Influence of Risk Management Strategies in Building Projects in Kenya: A Case of Kisii County

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Abstract

The construction industry is a major driver of Kenya's economic growth, yet it continues to face challenges of cost overruns, delays, and quality deficiencies. The problem addressed in this study was the lack of clarity on how contractual arrangements influence risk management in building projects. Using a descriptive cross-sectional survey of 42 respondents across clients, contractors, and consultants in Kisii County, the study employed both descriptive and inferential statistics. Principal component analysis (PCA) and regression modeling were applied to examine relationships between contractual arrangements and risk management outcomes. The findings established that 27 risk factors significantly affect project delivery, of which 23 were consistent across ranking approaches. The most critical risks identified included information unavailability, adverse weather conditions, defective specifications, delayed payments, and design variations. PCA results revealed that risks cluster into two categories: cost-time-quality and environment-health-safety, underscoring their interdependencies. The study concludes that contractual arrangements directly influence risk allocation and mitigation effectiveness. It recommends that policymakers and practitioners prioritize robust documentation, improved site investigations, streamlined payment systems, and stronger risk allocation frameworks. Future research should explore contract-specific risk governance models and the integration of sustainability drivers into contractual clauses to strengthen resilience in project delivery.

Keywords

Construction Industry, Contractual Arrangements, Principal Component Analysis, Project Delivery, Risk Management

1. Introduction

1.1. Background Information

The construction industry is a critical driver of economic growth [1] [2], contributing significantly to infrastructure development [3], employment creation [4], and national output [4]. Abedi [5] emphasizes that physical infrastructure supports both social and economic development through job creation and stimulation of local markets. Similarly, Lopes [6] and Saka [7] underscore that construction enhances national GDP by delivering essential infrastructure such as roads, railways, hospitals, schools, and industrial parks. In Kenya, the construction sector has consistently been among the fastest-growing in Africa [8], accounting for 6% of GDP in 2013 and rising to 8.5% in 2014 [7]. This growth has been reinforced by mega projects such as the Thika Superhighway, Standard Gauge Railway, Naivasha Dry Port, Two Rivers Mall, Tatu City, and the Konza Technopolis [9]-[11], which are reshaping the urban and regional landscape. These trends, coupled with the government's Big Four Agenda, particularly affordable housing, manufacturing, and universal health care, demonstrate the sector's strategic importance and its attractiveness to both local and international investors.

Despite this progress, the Kenyan construction industry faces persistent challenges of cost overruns, delays, and quality deficiencies [12]. High-profile cases such as the Huruma building collapse in Nairobi have raised public concerns over project safety and regulatory enforcement [13]. Government-funded projects are particularly prone to inefficiencies, where delays and inflated costs undermine their intended socio-economic impact. Reports by the National Construction Authority (2012) attribute these failures to poor regulatory frameworks, inadequate risk management practices, and weak contractual oversight [14] [15]. As construction projects become increasingly complex and capital-intensive, the ability to identify, allocate, and manage risks across all phases, from planning and design to tendering and implementation, becomes indispensable to project success.

Contractual arrangements play a central role in determining how risks are distributed among project stakeholders [12] [14]. Globally, research shows a growing preference for Design-Build (DB) contracts due to their single-point responsibility advantage, compared to the traditional Design-Bid-Build (DBB) contracts [16] [17]. In the UK and USA, DBB remains dominant because it allows greater division of responsibilities through specific and general contracts [18]. Studies further suggest that collaborative contracting fosters stability, reduces risks, and improves cost efficiency [19] [20]. In Kenya, however, most research has focused on general risk factors such as delays [5], cost overruns [12], and project management challenges [21], with limited attention to the direct relationship between contractual agreements and risk management outcomes. Although studies such as Annamalaisami [22], Lapidus [23] and Gwaya [24] have examined aspects of cost risk, time risk, and contingency allowances, they fall short of exploring how contractual structures themselves influence risk allocation and mitigation.

This gap is particularly critical in Kenya, where the construction sector continues to expand against a backdrop of rising project failures and escalating costs. By investigating the influence of contractual agreements on risk management in building projects, the proposed study seeks to fill this void. Specifically, it will examine how different contractual arrangements shape the allocation of risks, determine accountability, and affect project efficiency. In doing so, the study will provide timely insights to policymakers, practitioners, and investors on how contractual frameworks can be optimized to minimize risks, prevent cost and time overruns, and enhance the overall performance of Kenya's construction industry.

1.2. Contribution

This study makes a technical contribution by empirically linking contractual arrangements to risk management outcomes in Kenyan building projects, an area that existing literature has largely overlooked. While prior research has discussed cost overruns, sustainability drivers, or procurement methods in isolation, this study provides new knowledge by quantitatively demonstrating how risks cluster into primary (cost-time-quality) and secondary (environment-health-safety) components through PCA. The use of composite risk scoring offers a novel framework for ranking risks, capturing not only their direct significance but also their underlying relationships. This approach enables a deeper understanding of systemic risks such as information unavailability, defective specifications, and delayed payments, showing how these cut across multiple project objectives. By providing empirical evidence that procurement choices and contract forms directly shape risk exposure and mitigation effectiveness, the study fills a critical gap in both academic and policy discourse on construction risk governance.

2. Literature Review

2.1. Theoretical Formulation

Risk management in construction projects is best understood within the wider framework of project decision-making [16] [22] [23]. The proposed conceptual model positions risk management at the intersection of behavioral responses, organizational structures, and technological systems, all of which shape the quality and effectiveness of project decisions. Within this framework, the objectives of project and construction risk management must be explicitly articulated and embedded in the decision-making process. These objectives are largely governed by the risk attitudes of project proponents, reflecting the centrality of human judgment in evaluating alternatives and selecting courses of action. As Dziadosz [25] and Fox [26] argue, a sociological and organizational context for risk analysis is therefore essential to account for the non-technical dimensions of project risk.

The model provides a systematic and structured framework for the quantitative identification, analysis, and management of risks in construction projects. A key strength of this approach is its emphasis on proactive rather than reactive risk management. By prioritizing the recognition, allocation, and mitigation of risks before they escalate into disputes, losses, or claims, the model enhances project resilience and reduces the likelihood of time and cost overruns. This proactive orientation not only improves project efficiency but also promotes sustainable practices in construction management.

The relevance of the model is further reinforced by agency theory, which highlights the principal-agent relationship inherent in construction projects [27] [28]. Typically, the client assumes the role of the principal, delegating responsibility to the contractor, who acts as the agent. Agency theory identifies two persistent problems in this relationship [28]: first, the conflict of interest that arises when the objectives of the principal and agent diverge; and second, the difficulty or cost for the principal in verifying whether the agent's actions align with agreed objectives. In the context of construction risk management, these challenges underscore the importance of well-structured contractual agreements, robust monitoring mechanisms, and transparent accountability frameworks. By integrating insights from agency theory, the conceptual model captures both the technical and relational dimensions of risk, offering a holistic approach to managing uncertainties in construction projects.

2.1.1. Risk Identification

Risk identification constitutes the initial stage of the risk management process and involves systematically capturing all potential risks that may emerge during the life cycle of a project. It is widely recognized as the most critical stage, as the accuracy and comprehensiveness of risk identification largely determine the reliability of subsequent risk assessment and analysis. As Chapman [29] observes, the effectiveness of the overall risk management process is directly influenced by the robustness of the identification phase, given that unidentified risks cannot be adequately assessed or mitigated, as presented in **Figure 1**.

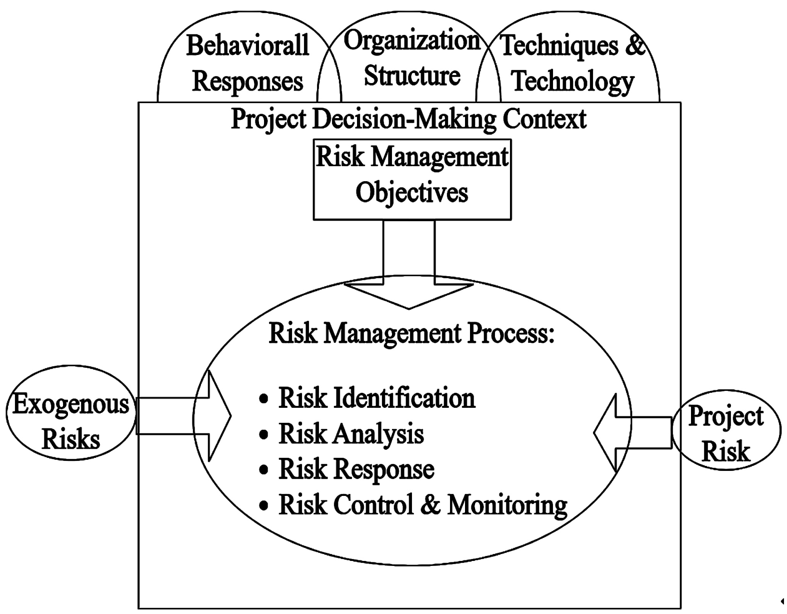

Figure 1. Conceptual model of construction risk management.

Figure 1 indicates that risk identification is the first and most critical stage of the risk management process, as it provides the foundation upon which subsequent stages, analysis, response, and monitoring, are built. Within the construction context, risks can be broadly categorized into controllable and uncontrollable types. Controllable risks are those that decision-makers voluntarily undertake and whose outcomes can be influenced through managerial action, while uncontrollable risks lie outside the project team's sphere of influence [12]. The identification process involves systematically determining which risks are most likely to affect project objectives and documenting their characteristics. This process is iterative rather than one-off, as risks evolve and new ones emerge throughout the project life cycle.

Figure 1 further illustrates how risk identification fits into the broader construction risk management framework, which is embedded within the project decision-making context. Exogenous risks [30], arising from external factors such as economic shifts, regulatory changes, or natural events, interact with internal project risks. They feed into the risk management process, where objectives are set and risks are addressed through four core stages: identification, analysis, response, and control/monitoring. At this stage, identification serves as the gateway, enabling decision-makers to recognize potential threats early enough to influence project outcomes positively.

Practical approaches to risk identification include document review, which often reveals risk factors hidden in contractual provisions [30]. For instance, ambiguities in tender documents may generate disputes if not addressed in advance. Careful attention must therefore be paid to identifying risky clauses, assessing methods for handling quantity variations, and checking for computational errors in unit pricing. Furthermore, reviewing whether contracts conform to international practice, such as the inclusion of reasonable material price escalation clauses, helps mitigate cost-related risks. Beyond contractual scrutiny, project schedules and budgets must be assessed for realism, as overly optimistic targets often translate into delays and overruns. Similarly, resource demand plans should be evaluated to ensure that labor, equipment, and machinery availability do not become constraints to project execution.

By systematically addressing these dimensions, risk identification not only reduces the likelihood of unforeseen contingencies but also enhances the accuracy of risk analysis and strengthens the effectiveness of response measures [23]. As depicted in the model, the ability to capture risks comprehensively at this stage directly influences the extent to which project risks are managed proactively, rather than reactively, thereby safeguarding project objectives and overall performance.

2.1.2. Risk Analysis

Risk analysis forms a critical component of the broader risk management process, as it focuses on understanding the causes and consequences of events that may adversely affect project performance [25]. The central aim of risk analysis is to provide a precise and objective basis for evaluating risks, thereby reducing uncertainty in project decision-making [29]. By systematically capturing all feasible alternatives and analyzing potential outcomes, risk analysis improves the reliability of judgments beyond intuition alone. In the context of building projects, this is particularly important since clients are often concerned with the most likely project cost, yet many projects continue to experience cost overruns due to insufficient consideration of the "what if" scenarios [30].

The process of risk analysis begins with the quantification of identified risks in terms of their likely impact on cost, time, and revenue [22]. These risks can then be evaluated against the economic parameters of the project to assess the extent of potential disruptions. As part of risk response planning, three general strategies are typically employed [31]: risk avoidance or reduction, risk transfer, and risk retention. The choice among these responses depends on the magnitude of the identified risks and the project's tolerance for uncertainty.

Ultimately, the value of risk analysis lies in its ability to offer project participants a clearer vision of potential outcomes, ensuring that decision-making is informed by structured evaluation of risks rather than intuition alone. Gilbert [32] notes, when systematic methods are combined with the best available data, project teams are better positioned to anticipate challenges, allocate responsibilities appropriately, and safeguard project objectives.

2.2. Empirical Review

Fei's [4] study highlighted the issue of how the construction industry can contribute to achieving the UN Sustainable Development Goals (SDGs). Using an explanatory sequential design, the authors administered questionnaires to 130 respondents and conducted validation interviews with 16 experts. Findings showed that the construction sector is critical in delivering SDGs, particularly in sustainable cities, clean energy, and climate action. The study concluded that construction plays a central role in global sustainability. However, it offered little insight into project-level contractual risks and cost control. The research gap lies in linking SDG-driven construction with effective risk management and contractual practices.

Alaloul [3] research addressed the problem of quantifying the construction sector's contribution to Malaysia's GDP and overall economic stability. Using national statistics from 1970-2019 and econometric tools such as VECM, cointegration, and causality tests, the study established strong linkages between construction and other economic sectors. Findings indicated that construction accounts for 5% - 7% of global GDP and sustains employment and industrialization. The authors concluded that construction is vital for sustainable economic development. Yet, the study was country-specific and did not address project risks or governance issues. The gap lies in exploring cost overruns and risk-sharing mechanisms in developing contexts.

Kepher [12] examined persistent cost overruns in real estate projects in Nairobi and Kisumu. It investigated the effects of financial practices, contract management, project environment, and organizational capacity. Employing descriptive and inferential statistics, the findings revealed that weak contract management and environmental uncertainties significantly drive cost overruns. The study concluded that effective financial and contractual strategies reduce project inefficiencies. However, it did not deeply assess how specific contractual arrangements influence risk allocation. The gap is the absence of empirical models connecting contract forms to cost and risk mitigation in Kenya's real estate construction.

Oke [2] research tackled the issue of limited adoption of energy economics principles (EEPs) in Nigeria's construction industry. Through a quantitative survey of construction professionals, the authors ranked drivers such as government regulation, job creation, and sustainability using RII and factor analysis. Results identified six clusters of drivers, financial, environmental, social, governmental, technological, and behavioral. The study concluded that policies and stakeholder awareness are vital for deploying EEPs. Nonetheless, it focused on energy practices rather than contractual or cost risks. The gap remains in aligning sustainability drivers with risk management and contractual frameworks in construction projects.

Gilbert [32] addressed the problem of project failures in industrial chemical plant projects caused by poor risk and complexity management. Using a qualitative single-case study, the researcher interviewed project managers and reviewed company procedures. The findings identified four themes: proactive risk management, expertise utilization, planning, and stakeholder engagement. The study concluded that early identification and collaborative decision-making improve success rates. While useful, the study was sector-specific and not focused on construction contracts. The gap lies in translating these strategies into building projects where contractual risks dominate.

Rwakarehe [16] investigated design error risks under Design-Bid-Build (DBB) and Design-Build (DB) delivery methods in Tanzania. By reviewing multiple projects, it was found that DB often experienced cost and time variations due to client-driven changes, while DBB faced design specification errors and slow decisions. The conclusion emphasized that design errors impact cost, schedule, and quality differently across procurement methods. However, the study did not integrate broader contractual risk-sharing mechanisms. The gap is a lack of analysis on how the procurement method influences overall risk management strategies in construction projects.

Table 1 shows that across these studies, several cross-cutting gaps emerge. First, while the macroeconomic and sustainability importance of construction is well established, the micro-level mechanisms by which contractual arrangements shape risk management remain underexplored. Second, sustainability and energy-economics drivers have been identified but are rarely translated into enforceable contract clauses. Third, proactive risk management practices are known in principle but lack empirical validation in East African building projects. Finally, procurement method comparisons often isolate design risks without integrating them into broader risk-sharing and contract governance frameworks. This proposed study will therefore fill a timely gap by empirically modeling how contractual arrangements influence risk management outcomes in Kenyan building projects, while integrating sustainability and risk drivers into practical contract-based tools.

Table 1. Summary of the emprical review.

Author/Year	Problem Studied	Findings	Critique	Gap Identified
Fei [4]	Construction's role in SDGs	Sector critical to 10 SDGs	Lacks project-level cost/risk analysis	Link SDGs with contractual risk management
Alaloul [3]	GDP contribution of construction (Malaysia)	Strong linkages, 5% - 7% GDP impact	Country-specific, no project risk focus	Explore risk & cost overruns in developing economies
Kepher [12]	Cost overruns in Kenyan real estate projects	Weak contract & financial practices raise costs	No analysis of contract forms on risk	Empirical link between contracts & risk in Kenya
Oke [2]	Adoption of energy economics principles	Six drivers of EEPs identified	Focuses on energy, not contractual risk	Align sustainability drivers with risk management
Gilbert [32]	Project failures in chemical plants	Four themes: proactive risk & engagement	Industry-specific, not construction	Apply strategies to construction contracts
Rwakarehe [16]	Design error risks in DB vs DBB	DB prone to changes, DBB prone to errors	Limited to design errors, ignores contracts	Study procurement effects on risk allocation

3. Proposed Method

This study employed a descriptive research design using a cross-sectional survey approach. A descriptive survey is suitable for obtaining data on people's attitudes, opinions, habits, and practices, particularly where the aim is to understand perceptions on social, organizational, or industry-related issues [33]. In this case, questionnaires and interview schedules were used to gather primary data from three key stakeholder groups in the construction industry: clients, contractors, and professional consultants (including project managers, engineers, quantity surveyors, and architects).

A mixed-methods strategy was adopted, combining qualitative and quantitative techniques. This approach was appropriate since the study sought both subjective insights from respondents and empirical data amenable to statistical analysis. The questionnaire was first subjected to a pilot test involving 11 respondents. Feedback from the pilot exercise was used to refine the research instrument, ensuring clarity and reliability before large-scale administration.

The target population comprised 70 active participants in the building construction industry in Kisii County, specifically clients, contractors, and professional consultants engaged in ongoing projects. To ensure representativeness, the study used stratified random sampling. Stratification allowed the population to be divided into homogeneous subgroups (strata) according to their roles in construction projects, thus improving the precision of estimates and accounting for gender and role balance (Owen, 2002). Sample size determination was guided by Kish [34] formula, widely applied in social science surveys for a 95% confidence level:

$$n = n' / \left(1 + \left(n'/N\right)\right) \tag{1}$$

Substituting $n' = 100$ and $N = 70$ yielded a sample size of 42 respondents. The distribution across strata is presented in **Table 2**.

Table 2. Sample size.

Population Stratum	Population	Sample Size	Percentage Sample (%)
Clients	20	10	50%
Contractors	35	22	63%
Consultants	15	10	67%
Total	**70**	**42**	**60%**

Table 2 illustrates that contractors formed the largest share of the population (35 out of 70), with a corresponding sample size of 22 respondents (63%). Consultants represented the smallest group (15), but due to their critical role in risk management, they were proportionately sampled at 67%, yielding 10 respondents. Clients accounted for 20 participants in the population and were sampled at 50% (10 respondents). Overall, the sample represented 60% of the total population, ensuring robust coverage across stakeholder groups while remaining feasible for fieldwork.

Primary data were obtained directly from respondents through self-administered questionnaires and semi-structured interviews. These provided first-hand insights into contractual agreements and their influence on risk management practices. Secondary data were sourced from academic journals, theses, textbooks, and policy documents to support interpretation and provide a broader conceptual framework.

Data analysis involved both descriptive and inferential statistical techniques. Raw data were cleaned, coded, and analyzed using SPSS and Microsoft Excel. Descriptive analysis employed measures of distribution, central tendency, and dispersion to summarize stakeholder perceptions. Inferential analysis was conducted through principal component analysis (PCA), which was used to identify and rank key risk factors. Regression analysis was further applied to develop a project delivery model, quantifying the relationship between contractual arrangements and risk management outcomes. Findings were presented using pie charts, graphs, tables, radar diagrams, and statistical models, enabling clear interpretation of both patterns and causal linkages.

Reliability of the research instrument was assessed using Cronbach's α coefficients for each multi-item construct. The α values ranged between 0.81 and 0.89, surpassing the conventional 0.70 threshold recommended for internal consistency. Content validity was ensured during the pilot test with 11 respondents drawn from clients, contractors, and consultants. Experts reviewed the questionnaire for clarity, relevance, and representativeness of items to ensure adequate domain coverage before full deployment. These steps collectively enhanced the reliability and validity of the measurement instrument.

4. Data Analysis and Findings

4.1. Descriptive Analysis Findings

The study further examined the types of contractual arrangements adopted across the sampled projects. The distribution of results is presented in **Figure 2**, which highlights the prevalence of different contract forms among clients, contractors, and consultants.

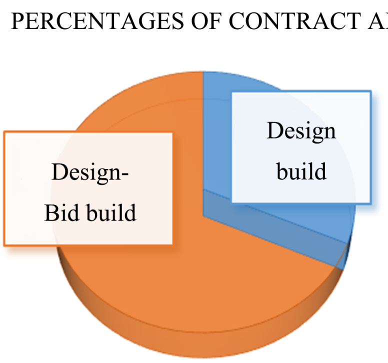

Figure 2. Percentages of contract adopted.

Regarding the nature of contracts adopted in building projects, the results, presented in **Figure 2** indicate that Design-Build (DB) accounted for 32% (n = 11) of the contracts, while Design-Bid-Build (DBB) represented the majority at 68% (n = 24). This distribution demonstrates that DBB remains the dominant procurement method in Kisii County. The preference for DBB may be attributed to its perceived ability to reduce exposure to risk by clearly separating design responsibilities from construction execution. However, while DBB minimizes certain risks for clients, it is also associated with fragmented accountability and increased potential for disputes when design errors or variations arise. The relatively lower adoption of DB suggests that integrated procurement approaches are yet to gain widespread acceptance locally, despite their advantages of single-point responsibility and improved coordination.

4.2. How Risk Management Strategies Influence Management of Risks in Building Projects in Kisii County

4.2.1. Risks Associated with Owners

The study further examined the risk management strategies employed in building projects by evaluating a range of risk factors considered critical to project performance. The analysis focused on identifying how these risks were perceived and managed across different stakeholder groups. The summarized results are presented in Table 3, which highlights the relative importance and frequency of the risk factors encountered in practice.

Table 3. Risks associated with owners.

Factor	Item	Response			χ^2 value
		Very Common	Fairly Common	Not common	
Delayed payment of contractors	Design Build	67% (8)	33% (4)	0.0% (0)	0.401
	Design-bid-build	57% (13)	43% (10)	0% (0)	
	Total	**60% (21)**	**41% (14)**	**0% (0)**	
Unreasonably imposed deadlines	Design Build	0% (0)	33% (4)	67% (8)	0.136
	Design-Bid-build	9% (2)	52% (12)	39% (9)	
	Total	**6% (2)**	**46% (16)**	**48% (17)**	
Delayed payments to workers	Design build	58% (7)	42% (5)	0% (0)	0.321
	Design-Bid-Build	43% (10)	57% (13)	0% (0)	
	Total	**49% (17)**	**51% (18)**	**0% (0)**	
Breach of contract	Design build	46% (5)	27% (3)	25% (3)	0.413
	Design-Bid-Build	25% (6)	42% (10)	33% (8)	
	Total	**31% (11)**	**37% (13)**	**32% (11)**	

The survey examined the types of risks commonly associated with project owners. The results indicate that delayed payment to contractors is the most prominent issue, with 60% ($n = 21$) of respondents describing it as common and 41% ($n = 14$) considering it fairly common. In contrast, only a small proportion of respondents, 6% ($n = 2$), identified unreasonably imposed deadlines as common, while 46% ($n = 16$) regarded such deadlines as fairly common and 48% ($n = 17$) as not common.

When specifically asked about delayed payments, 49% ($n = 17$) of the respondents rated the phenomenon as very common, while 51% ($n = 18$) indicated it was fairly common. Similarly, with regard to breach of contract, 31% ($n = 11$) perceived it as very common, 37% ($n = 13$) as fairly common, and 32% ($n = 11$) as not common.

Disaggregation of the results by contract type showed minimal variation across all evaluated variables. The chi-square test confirmed that these differences were not statistically significant ($\chi^2 = 4.5$, df = 1, $p > 0.005$). This suggests that owner-related risks, such as delayed payments, unreasonably imposed deadlines, and breach of contract, are perceived consistently across both Design-Bid-Build (DBB) and Design-Build (DB) arrangements.

The findings indicate that although payment delays and contract breaches are recognized as recurring challenges, they are not strongly associated with owner-specific risks in the study context. Instead, these risks appear to be systemic issues affecting projects regardless of contractual form, pointing to broader institutional or procedural weaknesses within the construction industry.

4.2.2. Risks Associated with Designers

The study also evaluated respondents' perceptions of risks attributed to designers. The findings, which capture the frequency and severity of these risks as reported by stakeholders, are summarized in Table 4. The table highlights the extent to which design-related issues such as errors, omissions, or inadequate documentation contribute to project risk within the local construction context.

Table 4. Risks associated with designers.

Factor	Item	Response			χ^2 value
		Very Common	Fairly Common	Not common	
Defective design	Design Build	9% (1)	18% (2)	73% (8)	0
	Design-bid-build	29% (7)	67% (16)	4% (1)	
	Total	**23% (8)**	**51% (18)**	**26% (9)**	
Deficiency in drawing	Design Build	9% (1)	27% (3)	64% (7)	0
	Design-Bid-build	38% (9)	58% (14)	4% (1)	
	Total	**29% (10)**	**49% (17)**	**22% (8)**	
Inaccurate material budgets or engineering estimates	Design Build	9% (1)	42% (5)	50% (6)	
	Design-Bid-build	60% (14)	36% (8)	4% (1)	0
	Total	**43% (15)**	**37% (13)**	**20% (7)**	

Table 4 shows survey summary for the examination of risks attributed to designers, focusing on design quality, documentation, and cost estimation. With respect to defective designs, 23% ($n = 8$) of respondents reported the issue as very common, 51% ($n = 18$) described it as fairly common, while 26% ($n = 9$) considered it not common. Similarly, for defective drawings, 29% ($n = 10$) of respondents perceived them as common, 49% ($n = 17$) as fairly common, and 22% ($n = 9$) as not common.

In relation to inaccurate material budgets or engineering estimates, 43% ($n = 15$) of respondents indicated that such errors were common, 37% ($n = 13$) regarded them as fairly common, and the remainder considered them uncommon.

When the data were disaggregated by contract type, the results showed significant variation across the evaluated variables ($\chi^2 < 0.00$). This finding indicates that design-related risks, unlike owner-related risks, are strongly associated with the type of contract adopted. Projects procured under Design-Bid-Build (DBB) appear more vulnerable to design defects and inaccurate cost estimates due to the separation of design and construction responsibilities. In contrast, Design-Build (DB) arrangements, which integrate design and construction under a single entity, may reduce such risks by streamlining accountability and enhancing coordination.

These results underscore the critical role of designers in shaping project outcomes. Defective designs, flawed drawings, and inaccurate estimates not only compromise quality but also increase the likelihood of cost overruns and disputes. The significant contract-type variation highlights the need to reconsider procurement choices as a means of mitigating design-related risks in building projects.

4.2.3. Risks Associated with Contractors

The study additionally sought to capture respondents' views on risks commonly attributed to contractors. These risks, which relate to construction practices, resource management, and adherence to contractual obligations, were evaluated to determine their prevalence and significance in influencing project outcomes. The summarized results are presented in **Table 5**, providing insights into the extent to which contractor-related issues contribute to overall project risk within the construction industry.

Table 5. Risks associated with contractors.

Factor	Item	Response			χ^2 value
		Very Common	Fairly Common	Not common	
Construction accidents	Design Build	33.3% (4)	33.3% (4)	33.3% (4)	0.83
	Design-bid-build	22% (5)	39% (9)	39% (9)	
	Total	**26% (9)**	**37% (13)**	**37% (13)**	
Poor quality workmanship	Design Build	33% (4)	42% (5)	25% (3)	0.304
	Design-Bid-build	22% (5)	65% (15)	13% (3)	
	Total	**26% (9)**	**57% (20)**	**17% (6)**	
Technical quality	Design build	33% (4)	42% (5)	25% (3)	0.304
	Design-Bid-Build	22% (5)	70% (16)	8% (2)	
	Total	**26% (9)**	**60% (21)**	**14% (5)**	
Lack of or departure of qualified staff	Design build	33% (4)	42% (5)	25% (3)	0.171
	Design-Bid-Build	17% (4)	74% (17)	9% (2)	
	Total	**23% (8)**	**63% (22)**	**14% (5)**	
Change in design	Design build	0% (0)	30% (3)	70% (7)	0
	Design-bid-build	28% (7)	68% (17)	4% (1)	
	Total	**20% (7)**	**57% (20)**	**23% (8)**	

The survey also assessed risks attributed to contractors, with emphasis on safety, workmanship, technical quality, staffing, and design alterations and the results are presented in **Table 5**. Regarding construction accidents, responses were evenly distributed, with 37% (n = 13) of participants indicating that accidents are fairly common, while another 37% (n = 13) reported that they are not common. This suggests that safety performance is inconsistent across projects, reflecting variability in the enforcement of occupational health and safety measures.

In terms of poor workmanship, 26% (n = 9) of respondents considered it very common, 57% (n = 20) fairly common, and 17% (n = 6) not common. Similarly, for technical quality risks, 26% (n = 9) rated them very common, 60% (n = 21) fairly common, and only 17% (n = 5) perceived them as uncommon. These findings point to persistent concerns regarding the consistency of construction quality, underscoring the role of contractor capacity and supervision in risk management.

The issue of qualified staff availability also emerged as a critical factor. A combined 70% (n = 26) of respondents reported that lack or departure of skilled personnel is either very common (35%, n = 13) or fairly common (35%, n = 13), while 14% (n = 5) noted it as not common. This highlights human resource constraints as a major risk, with potential implications for project continuity and quality control.

The need for design alterations during construction was considered very common by 20% (n = 7) of respondents, fairly common by 54% (n = 20), and not common by 23% (n = 8). Unlike other contractor-related risks, this factor showed significant variation across contract types, reflecting how procurement choices influence the frequency of mid-project design changes.

When analyzed using chi-square tests, the results showed that for all variables except design alterations, the variation across contract types was not statistically significant ($\chi^2 > 0.05$). This indicates that risks such as poor workmanship, staffing challenges, and technical quality deficiencies are systemic in nature and not strongly dependent on the type of contract adopted. Conversely, design alterations appear to be more sensitive to contract structure, reinforcing the importance of procurement strategies in shaping contractor risk exposure.

The findings emphasize that contractor-related risks remain a critical determinant of project outcomes, particularly in terms of workmanship, technical quality, and skilled labor availability. These risks, while common across contract types, highlight the need for stricter contractor vetting, enhanced supervision, and capacity-building initiatives to mitigate quality-related failures in construction projects.

4.2.4. Key Risk Affecting Project Delivery among Contractors in Kenya: A Case of Kisii County

Risks that significantly influence the delivery of construction projects were identified and ranked to establish those requiring the most urgent management attention. These risks, if not adequately addressed, jeopardize the ability of contractors in Kenya to deliver projects within the stipulated budget, schedule, quality, environmental, and health and safety requirements. To determine their relative importance, risks were evaluated using the Risk Significance Index Score (RSIS) and further subjected to comprehensive score analysis, which enabled ranking based not only on magnitude but also on underlying interrelationships and overall impact on project objectives.

In total, 27 risks were identified as influencing contractual agreements and project delivery. Of these, 23 risks consistently appeared across both ranking approaches, thereby qualifying as the most critical risks for contractors in Kenya. These risks were then ranked using composite scores, which provide a more robust assessment by incorporating both direct significance and relational effects.

Prior to conducting principal component analysis, sampling adequacy and factorability of the correlation matrix were examined. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.721, exceeding the minimum acceptable threshold of 0.6, indicating that the data were suitable for PCA. The Bartlett's Test of Sphericity yielded $\chi^2 = 318.45$, df = 276, $p < 0.001$, confirming that the correlation matrix was not an identity matrix. Two principal components were extracted with a cumulative explained variance of 72.6%, which justified dimensional reduction for interpretation. Component 1 represented cost-time-quality factors, whereas Component 2 captured environment-health-safety dimensions.

The results, summarized in **Table 6**, show that "*Information unavailability* (*details*, *drawings*, *sketches*)" emerged as the single most influential risk, with the highest comprehensive score of 1.05888, underscoring the central role of adequate and timely project documentation in successful delivery. The second-ranked risk was "*Adverse weather conditions*" (comprehensive score 1.05628), reflecting the vulnerability of construction projects to environmental disruptions. The third-ranked risk was "*Inadequate or defective specifications*" (comprehensive score 0.83085), pointing to deficiencies in technical design and documentation as major contributors to project delays, cost overruns, and disputes.

Table 6. Key risks among contractors in Kenya. A case of Kisii County.

ID	Risk Factor	Rsis	Risk Comp.	Rank
R6	Information unavailability-details, drawings, sketches	0.5527	1.05888	1
R39	Adverse weather conditions	0.5347	1.05628	2
R5	Inadequate/defective specification	0.4957	0.83085	3
R23	High performance or quality standards to meet	0.4983	0.81239	4
R4	Inadequate or insufficient site information (site investigation report)	0.4342	0.72726	5
R15	Delayed payment by the employer	0.5849	0.69221	6
R1	Design variations required by clients	0.5474	0.62954	7
R21	Defective work	0.4657	0.60795	8

Continued

R8	Lack of consistency between the BQs, drawings and specifications	0.5265	0.53098	9
R22	Technical complexity and design innovations requiring new construction methods and materials	0.4532	0.46534	10
R41	Unhealthy working condition for workers	0.4499	0.42907	11
R19	Cost under estimation	0.5356	0.42738	12
R43	Lack of compliance with safety and health requirements on site	0.4746	0.42736	13
R28	Wastage of materials on site by workers	0.3255	0.37562	14
R33	Inadequate supervision and supervision team	0.4631	0.29761	15
R36	Excessive approval procedures in administrative government departments	0.5641	0.28793	16
R35	Lack of coordination between project participants	0.4474	0.2785	17
R11	Tight project schedule	0.309	0.26892	18
R29	Actual quantities different from contract quantities	0.5245	0.24672	19
R42	Lack of compliance with environmental requirements	0.4208	0.24326	20
R16	Financial failure of the contractor	0.4878	0.18366	21
R17	Financial failure of the sub-contractor	0.4833	0.11498	22
R14	Delays in supply of utilities *i.e.* electricity and water	0.4898	0.02073	23

These findings highlight that the most critical risks are not only external, such as weather conditions, but also internal and procedural, particularly the adequacy of information, specifications, and documentation. This reinforces the need for proactive risk management strategies focusing on improved design documentation, accurate specifications, and contingency planning for environmental factors. Addressing these key risks is crucial for enhancing the resilience of contractual agreements and ensuring timely, cost-effective, and quality project delivery in the Kenyan construction sector.

To quantify the relative importance of each risk, an RSIS was computed using (1):

$$\text{RSIS}=\left(\sum_{i=1}^{n} w_i r_i\right)\Big/N \tag{2}$$

where w_i denotes the weight assigned to each frequency category, r_i is the corresponding severity rating, and N is the total number of respondents. The RSIS therefore captures both the perceived frequency and impact of a given risk. A comprehensive risk score was further computed by normalizing RSIS values with PCA-derived component loadings, enabling the integration of both direct risk significance and inter-correlation among factors. This dual-scoring approach enhances the robustness of ranking by accounting for overlapping effects across risk domains.

Table 5 indicates that in addition to the top three risks, several other factors emerged as highly influential in shaping project delivery outcomes. Ranked fourth was "*High performance or quality standards to meet*", with a comprehensive score of 0.8123, reflecting the challenge contractors face in aligning project execution with increasingly stringent quality expectations. Closely following in fifth place was "*Inadequate or insufficient site information* (*site investigation reports*)", with a score of 0.72726, highlighting the persistent problem of incomplete preliminary assessments that compromise planning and execution.

"*Delayed payment by the employer*" and "*Design variations required by clients*" were also found to be critical, particularly in their impact on time, cost, and quality performance. These risks were ranked sixth and seventh, with comprehensive scores of 0.69221 and 0.62954, respectively. While their effect on environmental and health and safety performance was minimal, their influence on financial and schedule-related outcomes underscores their centrality to project risk management.

Other significant risks included "*Defective works*" (ranked eighth, comprehensive score 0.60795) and "*Lack of consistency between Bills of Quantities* (*BQs*), *drawings*, *and specifications*" (ranked ninth, score 0.53098). These risks emphasize the technical and documentation-related challenges that frequently undermine project delivery. Finally, "*Technical complexity and design innovations requiring new construction methods and materials*" emerged as the tenth-ranked risk, with a score of 0.46534, reflecting the uncertainties contractors face when adopting unfamiliar technologies or innovative designs.

To evaluate the predictive influence of contractual form on overall project risk outcomes, a linear regression model was estimated with the composite risk score as the dependent variable and contract type (Design-Build = 1, Design-Bid-Build = 0) as the independent variable. Results revealed a statistically significant relationship ($F(1, 40) = 7.82$, $p = 0.008$, $R^2 = 0.163$), indicating that the contractual form accounted for approximately 16% of the variance in risk outcomes. The Design-Build approach exhibited a 0.27-unit lower composite risk score than Design-Bid-Build, suggesting enhanced mitigation effectiveness through integrated responsibility. The model coefficients and significance levels are summarized in Table 7.

Table 7. Regression results linking contractual form and risk outcomes.

Predictor	β Coefficient	Std. Error	t-value	p-value	R^2	F (p)
Constant	3.842	0.217	17.72	<0.001		
Contractual Form (DB = 1)	−0.270	0.096	−2.80	0.008	0.163	7.82 (0.008)

These findings demonstrate that while external risks such as weather remain critical, the majority of the most influential risks are internal, procedural, and contractual in nature. Documentation inconsistencies, design variations, site information gaps, and defective works directly undermine project efficiency and reliability. This underlines the importance of strengthening pre-contract investigations, design coordination, and payment mechanisms, alongside capacity building for managing technical complexity and innovation in the Kenyan construction sector.

4.3. Discussion

The results of this study, particularly the identification of information unavailability, defective specifications, design variations, and delayed payments as key risks, resonate with and extend findings from prior empirical research. Fei [4] emphasized the strategic role of the construction sector in achieving the United Nations Sustainable Development Goals (SDGs), particularly in areas such as sustainable cities and climate action. However, while their study underscored construction's macro-level importance, it did not examine project-level risks. The current study addresses this gap by showing that without proactive management of documentation-related risks and contractual inconsistencies, the sector's potential contribution to sustainability will be undermined. By empirically demonstrating how such risks cluster into cost-time-quality on one hand, and environment-health-safety on the other, this study provides a project-level complement to Fei's macro-sustainability perspective.

Alaloul [3] quantified the construction sector's contribution to Malaysia's GDP and confirmed its linkages with broader economic stability, reporting that construction contributes 5% - 7% of global GDP. However, their macroeconomic approach did not address the micro-level challenges of cost overruns and contractual risks. The current analysis fills this gap by showing that in Kenya, risks such as delayed employer payments and design variations directly compromise budgetary and scheduling objectives. These findings bridge macro-level contributions with project-level inefficiencies, demonstrating that sustaining construction's economic role requires improved contractual risk allocation.

Kepher [12] identified weak contract management and environmental uncertainties as major drivers of cost overruns in Kenyan real estate projects. While the study emphasized the importance of robust contractual and financial practices, it did not examine how different procurement arrangements influence the distribution of risk. The PCA results presented here extend this understanding by showing that certain risks, such as information unavailability and defective works—are not merely managerial failures but are also structurally linked to contractual choices. This underscores the need for empirical models that explicitly connect contract forms to risk mitigation, a gap this study begins to address.

Oke [2] highlighted the underutilization of energy economics principles (EEPs) in Nigeria and clustered financial, environmental, and behavioral drivers of sustainability. Yet, this research did not link sustainability with contractual practices. The current study demonstrates that risks tied to environment and health and safety cluster together in PCA, suggesting that integrating sustainability drivers with contractually mandated risk management measures could reinforce both project delivery and broader SDG alignment.

Gilbert [32] showed that poor risk and complexity management drive failures in chemical plant projects, emphasizing proactive identification and collaborative decision-making. While insightful, the study was industry-specific. The present research adapts such principles to the building sector, showing that risks such as defective specifications and unhealthy working conditions require systematic contractual controls to ensure early mitigation. This translation highlights how strategies validated in other sectors can inform construction risk governance.

Rwakarehe [16] demonstrated that procurement methods (DB vs. DBB) expose projects to distinct types of design risks. This aligns closely with the current findings, where design variations and defective specifications emerged as top-ranked risks. However, unlike Rwakarehe [16] focuses on design errors, the present study integrates broader categories, including cost, quality, environment, and safety—into a unified framework. The PCA thus advances the literature by empirically confirming that procurement choices not only shape design-related risks but also affect systemic risk patterns across multiple dimensions of project delivery.

While prior studies have established the economic, sustainability, and managerial importance of construction, few have quantitatively linked contractual arrangements, risk categories, and project outcomes. This study contributes by demonstrating, through PCA, how risks cluster and interact across dimensions, and by empirically ranking the most influential risks affecting Kenyan building projects. These results provide the missing project-level evidence necessary to inform contractual risk-sharing strategies, bridging macro-level sustainability and economic goals with micro-level project delivery practices.

5. Conclusions

The study set out to examine the influence of contractual arrangements on risk management strategies in building projects within Kisii County, Kenya. The problem addressed was the persistent occurrence of cost overruns, delays, and quality deficiencies in construction projects, despite the sector's central role in economic growth and infrastructure development.

The findings revealed that risk factors such as information unavailability, defective specifications, design variations, and delayed payments are among the most critical threats to project delivery. Through principal component analysis, the study demonstrated that risks are not isolated but cluster into two major categories: cost-time-quality risks on one side and environment-health-safety risks on the other. This interrelationship implies that mitigating one set of risks, such as cost-related risks, also yields benefits for time and quality performance, while addressing environmental risks simultaneously improves health and safety outcomes.

The results confirm that contractual arrangements significantly shape the way risks are allocated, perceived, and managed. For example, design-related risks were found to be more prevalent under Design-Bid-Build arrangements due to fragmented accountability, while Design-Build contracts exhibited reduced vulnerability in this regard. However, risks such as delayed payments and defective works were systemic and cut across contract types, indicating broader institutional weaknesses.

The study concludes that improving contractual frameworks is essential for strengthening project delivery. Contractors, consultants, and clients must adopt proactive risk management strategies that emphasize comprehensive documentation, realistic site investigations, and effective contract administration. In addition, integrating sustainability considerations into contracts can enhance resilience against environmental and health-related risks.

This study was limited by its regional scope (Kisii County) and sample size ($n = 42$), which, while statistically sufficient for PCA and regression analyses, restricts the generalization of results to other Kenyan regions. The reliance on self-reported survey data introduces potential response bias, as perceptions of risk significance may differ from actual project performance records. Future research should therefore employ multi-county or national samples, integrate objective project performance data, and explore longitudinal or comparative designs to validate the observed relationships between contractual arrangements and risk outcomes. Additionally, expanding the analytical framework to include mediating variables such as stakeholder collaboration and sustainability clauses could provide deeper insight into contract-specific risk governance.

Recommendations for policy and future research include the need for policymakers to develop standardized contract provisions that explicitly address common risks such as payment delays and documentation gaps. Training and capacity-building for contractors and consultants should also be prioritized to ensure consistent quality standards and risk mitigation practices. Future research should extend this work by developing contract-specific risk governance models, validating the PCA-based clustering approach in other countries, and exploring the integration of sustainability drivers into contractual clauses to align construction practices with global development goals.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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