COMPARATIVE ANALYSIS OF QUALITY MANAGEMENT PERCEPTIONS IN PUBLIC AND PRIVATE BUILDING CONSTRUCTION PROJECTS IN KATHMANDU VALLEY: AN EXPLORATORY FACTOR ANALYSIS AND RELATIVE IMPORTANCE INDEX APPROACH

ABSTRACT

This study investigates the perceptions of quality management among public and private sector stakeholders in building construction projects within Nepal's Kathmandu Valley, utilizing Exploratory Factor Analysis (EFA) and Relative Importance Index (RII). Based on 73 valid responses from architects, engineers, clients, consultants, and contractors, the study identifies three key quality dimensions: Quality Standards and Assurance, Project Efficiency and Delivery, and Schedule/Budget Adherence, explaining 66.6% of variance. Both sectors prioritize regulatory compliance, material quality, and workmanship (Spearman's $\rho = 0.766$, $p < 0.001$), yet diverge in emphasis, with the private sector valuing verification and aesthetics, and the public sector focusing on productivity. Challenges such as substandard materials and regulatory gaps persist. Recommendations include adopting digital tools like BIM, enhancing compliance, and fostering public-private collaboration. The findings address Nepal-specific gaps in quality management research, offering actionable insights for improving construction quality, safety, and sustainability.

Keywords: Quality Management, Construction Projects, Kathmandu Valley, Exploratory Factor Analysis, Relative Importance Index

Introduction

The construction industry is a cornerstone of Nepal's economic development, driving job creation, revenue generation, and infrastructure development. However, its complex nature presents challenges, particularly in quality management, which is critical for ensuring the safety, functionality, and durability of buildings. Effective quality management ensures construction meets required standards, minimizes defects, and satisfies stakeholder expectations. In Nepal's rapidly urbanizing Kathmandu Valley, quality issues such as poor workmanship, substandard materials, and regulatory gaps persist, leading to safety risks, delays, and cost overruns. This study compares quality management perceptions between public and private sector stakeholders in building projects, using Exploratory Factor Analysis (EFA) to identify key dimensions and the Relative Importance Index (RII) to prioritize factors. By addressing sector-specific differences, the research aims to provide actionable insights for improving construction quality and fostering collaboration.

Statement of the Problem

Quality management is essential for ensuring structural integrity and safety in construction, particularly in public-sector projects serving community needs. Despite efforts, challenges like substandard materials, inconsistent workmanship, and weak regulatory enforcement persist, often causing delays and cost overruns. Perceptions of high costs associated with quality management may lead stakeholders to prioritize short-term savings over long-term durability. Differences in organizational frameworks and priorities between public and private sectors further complicate quality outcomes. This study explores these perceptions in Kathmandu Valley's building projects, using EFA to identify critical dimensions and RII to rank influencing factors, aiming to enhance quality assurance and mitigate risks.

Objectives of the Study

The primary objective is to assess and compare quality management perceptions among public and private sector stakeholders in building construction projects in Kathmandu Valley, using EFA and RII approaches.

Rationale/Significance of the Study

Nepal's construction sector, particularly in Kathmandu Valley, faces unique socio-political and economic challenges, yet quality management remains understudied. Existing literature focuses on developed or other developing countries, with limited research addressing Nepal's context or comparing public and private sector perceptions. Issues like poor workmanship, design inconsistencies, and inadequate supervision persist, necessitating a deeper understanding of stakeholder perspectives. This study fills these gaps by employing a mixed-methods approach, using EFA to extract core quality dimensions and RII to rank priorities, offering context-specific insights to inform policy, enhance contract practices, and improve quality management in Nepal's construction industry.

Scope and Limitations

Scope: The study focuses on building construction projects in Kathmandu Valley, covering public and private sector initiatives. It examines stakeholder perceptions (engineers, consultants, project managers, supervisors, and clients) through structured questionnaires, analyzed using EFA and RII to identify and prioritize quality management factors. The findings aim to improve construction standards and stakeholder collaboration.

Limitations: The study is geographically limited to Kathmandu Valley, potentially restricting generalizability to other regions or project types. Data rely on Likert-scale questionnaires, which may introduce subjective bias. EFA and RII, while robust, do not capture causal relationships or project-specific variables like cost or complexity. Despite these limitations, the research provides a strong foundation for understanding quality management practices and offers a framework for future studies.

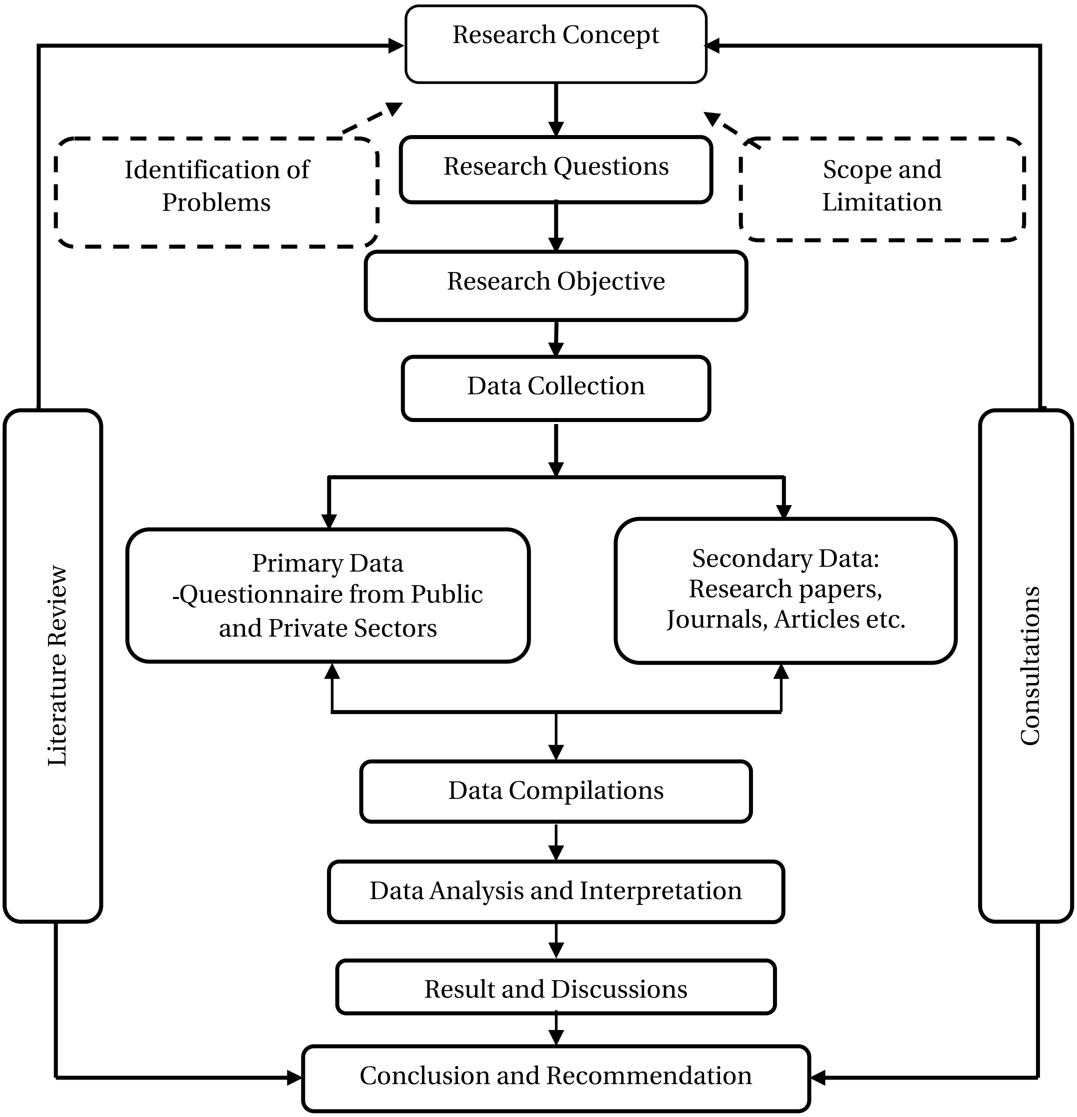
Literature Review and Study Gap

The literature review reveals several critical gaps in the study of quality control perceptions in construction projects. First, there is a lack of context-specific research on quality control perceptions in Nepal, with most studies focusing on countries like Korea, Nigeria, India, and Hong Kong, which do not fully account for Nepal's unique socio-political and regulatory environment. For instance, (Rijal & Bhattarai, 2022) analyzed key performance indicators in health building construction in Nepal, emphasizing quality as a top KPI, but without a focus on perceptual differences between sectors. Second, while stakeholder perceptions and barriers to quality control are discussed, there is limited comparative analysis of public and private sector priorities, leaving a gap in understanding sector-specific approaches. (Joshi, et al., 2023) conducted a comparative study of material management in public and private building projects in Kathmandu Valley, highlighting differences in procurement and inventory practices that influence quality, yet perceptions were not the core focus. Third, the literature lacks stakeholder-specific quality control perceptions and qualitative insights from key informants, such as government engineers and private project managers, which are essential for practical implementation. Additionally, socio-cultural and ethical factors, such as fraudulent practices, are underexplored, particularly in developing countries. Finally, the adoption of modern quality control tools, such as digital apps, and strategies for improving compliance enforcement are insufficiently addressed. (Joshi, et al., 2023) explored supply chain management in Kathmandu Valley building projects, noting perceptual differences in efficiency and quality assurance between sectors, which aligns with this study's perceptual focus. This study aims to fill these gaps by examining quality management perceptions in Kathmandu Valley's construction projects, comparing public and private sector views, and proposing innovative, stakeholder-responsive measures through a mixed-methods approach.

Methodological Framework: The methodological framework adopted during the study is shown in Figure 1.

Figure 1

Research Methodology Flow Process



Study Area:

The study was carried out from the responses of architects, civil engineers, clients, consultants, and contractors engaged in selected private and public building construction projects in the Kathmandu Valley. The study area were two metropolitan cities, Kathmandu and Lalitpur and one sub-metropolitan city, Bhaktapur.

Study Population and Sample Selection and Sample Size

The population for this study comprised architects, civil engineers, clients, consultants, and contractors engaged in private and public building construction projects within Kathmandu Valley, including the metropolitan cities of Kathmandu and Lalitpur and the Bhaktapur Municipality. The exact population size of engineers and related personnel working in these sectors is unknown. To determine the sample size, Daniel's formula for infinite populations (Danial, 1999) was applied, using a 90% confidence level ($z = 1.645$), a 10% margin of error ($e = 0.1$), and a population proportion of 50% ($p = 0.5$, $q = 1 - p = 0.5$). Thus, a minimum sample size of 67 respondents was calculated. Purposive sampling was employed to select respondents, targeting personnel directly involved in selected building construction projects to ensure relevant expertise in quality control and management practices. This non-probability sampling technique was chosen to focus on stakeholders with specific knowledge and experience in the study area. A total of 100+ questionnaires were distributed to personnel across private and public sector projects, with 73 valid responses received (35 from the private sector and 38 from the public sector), yielding an approximate response rate of 73%

Methods of Data Collection

This study employed a mixed-methods approach to collect both primary and secondary data from relevant stakeholders involved in selected private and public building construction projects in Kathmandu Valley. The data collection methods were designed to address the study's objectives, which included assessing perceptions of quality management, identifying factors affecting construction quality, and evaluating probable quality control measures. Primary data were gathered through structured questionnaire surveys.

Primary Data

Primary data were collected through two main methods: a structured questionnaire survey and key informant interviews, targeting stakeholders such as architects, civil engineers, clients, consultants, and contractors from both private and public sector building construction projects in Kathmandu Valley.

Questionnaire Survey: The questionnaire was developed based on an extensive literature review on quality control and management in construction projects. It was structured to address the study's three objective. The questionnaire comprised of 16 perception factors which were rated on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). The questionnaire was distributed to over 100 purposively selected respondents, with 73 valid responses received (35 from the private sector and 38 from the public sector). The survey was conducted in-person and via email to ensure accessibility, and responses were collected over a two-month period in 2025.

Secondary Data

Secondary data were collected to complement primary data and provide contextual insights into quality control and management in construction projects. These data were sourced from a comprehensive review of relevant literature, including project specifications, the Nepal National Building Code (NBC), Standard Bidding Documents (SBD) from the Public Procurement Monitoring Office (PPMO), academic theses from national and international universities, peer-reviewed journal articles, and newspaper reports on construction quality in Nepal. The secondary data informed the development of the questionnaire, particularly in identifying the 16 perception factors. Additionally, secondary sources provided benchmarks for comparing public and private sector practices, such as compliance with regulatory standards and common challenges in quality assurance

Data Analysis

After the process of collection of data from primary and secondary sources, they were analyzed by the descriptive method .For the easier interpretation of data, they are expressed in percentages .Those percentages are implemented for expressing the findings as a proportion of the whole .For easy understanding, these findings are expressed in the form of charts and tables .

This study employed two primary analytical methods Principal Component Analysis (PCA) and Relative Importance Index (RII) to analyze the data collected on quality management practices in building projects.

Principal Component Analysis (PCA)

PCA, a multivariate statistical technique, was used to reduce the dimensionality of the dataset and identify underlying components of quality management practices. The method transforms a large set of correlated variables into a smaller set of uncorrelated components while retaining most of the variance in the data (Jolliffe, 2002).

Relative Importance Index (RII)

RII was employed to rank the importance of quality management factors based on Likert-scale responses from public and private sector stakeholders. RII converts responses into a normalized index (0 to 1), facilitating the prioritization of factors (Holt, 2014).

Alignment with Research Objectives

The combination of PCA and RII directly supported the study's objectives. PCA facilitated the exploration and identification of key quality management factors, while RII enabled their prioritization based on stakeholder input. Together, these methods provided a robust framework for analyzing and interpreting the data, ensuring both statistical rigor and practical relevance.

Reliability of Data

It refers to the consistency of the data .Reliability is an important condition for validity .It is possible to have reliable measures that are not valid .In this study, Cronbach's alpha wa calculated by using SPSS and found to be 0 784.which is more than acceptable.

Results and Discussion

Perception of Private sector and Public Sector Stakholders in Managing Quality in Building Construction Projects

The Principal Component Analysis (PCA) within Exploratory Factor Analysis (EFA) has been carried out for the analysis of the data. Factor analysis is a data reduction technique that summarizes many variables into smaller factors based on inter-correlations, where initial variables are observed, extracted factors are latent, and it is commonly used to develop scales or questionnaires for measuring constructs that are not directly observable in real life (Fabrigar, 1999). The steps used for the factor analysis for this study is presented here below.

- Step 1: Problem Formulation
- Step 2: EFA Requirements
- Step 3: Appropriate Factoring Technique
- Step 4: Decision regarding No. of Factors
- Step 5: Factor Rotation
- Step 6: Model Fit
- Step 7: Running Exploratory Factor Analysis
- Step 8: Interpretation and Reporting

The study followed three major steps for factor analysis: (a) assessing the suitability of the data, (b) extracting factors, and (c) rotating and interpreting the factors.

The category of the factors including their coding considered for the study are presented in table as follows:

Table 1

The category of the factors and their coding

Factor numbers (Perceptions)	Factors	Factor Code
1	Achieving the scope of projects	P1
2	Qualifying the required tests both for materials and work done	P2
3	Keeping the defects minimum (Minimum rework)	P3
4	Profitability of tasks completed (keeping the wastage minimum and productivity high)	P4
5	Minimum variation (Time, Cost, Schedule)	P5
6	Aesthetics (Good looks)	P6
7	Excessive cost	P7
8	Customer satisfaction and fulfillment of their requirements within budget allocated	P8
9	Ensuring specification of materials - Quality materials	P9
10	Ensuring workmanship of specified work - Quality workmanship	P10
11	Conformance to Quality control plan and Quality Assurance Plan	P11
12	Completion of the construction project within budget allocated and time specified	P12
13	Meeting the requirements of the designer, constructor and owner	P13
14	Meeting the requirements of regulatory agencies (Bye-laws, Design codes)	P14
15	Accomplishment of expectations of all the stakeholders involved	P15
16	Fulfillment of the functional requirement	P16

Step a: KMO test to measure suitability of data for factor analysis

For assessment of the suitability of data for factors analysis, Kaiser-Meyer-Olkin (KMO) is used to measure the suitability of data for factor analysis. Similarly, Bartlett's test of Sphericity, correlation matrix, and determinant score are computed to detect the appropriateness of the data set for functioning factor analysis (Tabachnick, et al., 2013). The details are tabulated in table 2 below.

Table 2

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.828
Bartlett's Test of Sphericity	Approx. Chi-Square	825.062
	Df	120
	Sig.	.000

To assess the suitability of the dataset for Principal Component Analysis (PCA), the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity were conducted, as is standard practice in factor analysis (Tabachnick et al., 2013). The KMO test measures the proportion of variance among the 16 quality management factors that may be attributed to common underlying factors, with values ≥ 0.6 indicating adequate suitability, ≥ 0.7 good, and ≥ 0.8 excellent (Kaiser, 1974). Bartlett's Test of Sphericity evaluates whether the correlation matrix of these factors is significantly different from an identity matrix, with a significant p-value ($p < 0.05$) confirming enough correlations for PCA (Bartlett, 1954). Additionally, the correlation matrix and determinant score were computed to verify the absence of multicollinearity or singularity, ensuring the dataset's appropriateness for factor analysis.

The dataset, comprising 73 responses across 16 quality management factors, was subjected to KMO and Bartlett's tests to confirm its suitability for PCA. These tests are not restricted to large datasets but are essential for any dataset undergoing factor analysis to validate the correlation structure (Hair, et al., 2019). The KMO value of 0.828, reported in Table 4.2, exceeds the threshold of 0.8, indicating excellent sampling adequacy. Bartlett's Test of Sphericity was highly significant ($\chi^2 = 825.062$, $df = 120$, $p < 0.001$), confirming significant correlations among variables, making PCA appropriate for this dataset (Loehlin, 2004, Kaiser, 1974, Shrestha, 2021).

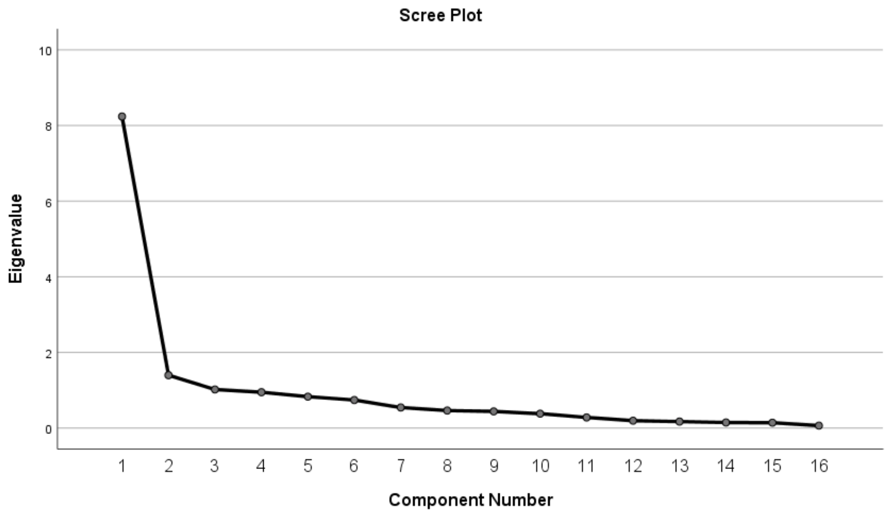
Step b: Factor Extraction

In this study two techniques are used to assist in the decision concerning the number of factors to retain: Kaiser's Criterion (Eigen Value) and Scree Test. In this section, a result on the answer to the second question, which is "Perception of Stakeholders in Managing Quality in Building Construction Proejcts" is discussed. For this purpose, the 16 factors were included in the PCA analysis. The eigenvalue technique was used to determine the number of factors to extract. In this case, only factors with eigenvalues of 1.0 or more were retained. Varimax was used for normalization to reduce the complexity of the factors to maximize the variance in the model.

In multivariate statistics, a scree plot is a line plot of the eigenvalues of factors or principal components in an analysis. The scree plot is used to determine the number of factors to retain in an exploratory factor analysis (EFA) or principal components to keep in a principal component analysis (PCA). As shown in figure 2, scree plot describes that three latent variables have Eigen value >1.

Figure 2

Scree Plot



In Figure 2, for a Scree test, a graph is plotted with eigenvalues on the y-axis against the sixteen (16) component numbers in their order of extraction on the x-axis. The initial factors extracted are large factors with higher eigenvalues followed by smaller factors. The scree plot is used to determine the number of factors to retain. Here, the scree plot shows that there are three factors for which the eigenvalue is greater than one and accounts for most of the total variability in data. The other factors account for a very small proportion of the variability and are considered not so much important (Tabachnick, et al., 2013). The details are tabulated in table 3 below.

Table 3

Eigenvalues (EV) and Total Variance Explained Extraction Method: Principal Component Analysis

Total Variance Explained						
Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.237	51.483	51.483	5.181	32.379	32.379
2	1.397	8.734	60.218	3.211	20.067	52.446
3	1.020	6.377	66.595	2.264	14.149	66.595
4	.948	5.924	72.518			
5	.831	5.194	77.712			
6	.741	4.629	82.342			
7	.543	3.396	85.738			
8	.463	2.892	88.629			
9	.439	2.747	91.376			
10	.380	2.373	93.749			
11	.281	1.757	95.506			
12	.195	1.217	96.723			
13	.171	1.070	97.793			
14	.147	.918	98.711			
15	.142	.887	99.599			
16	.064	.401	100.000			

Table 3 demonstrates the eigenvalues and total variance explained. The extraction method of factor analysis used in this study is principal component analysis. Before extraction, sixteen (16) linear components are identified within the data set. After extraction and rotation, there are three distinct linear components within the data set for the eigenvalue > 1. The three factors are extracted accounting for a combined 66.595% of the total variance. It is suggested that the proportion of the total variance explained by the retained factors should be greater than 50%. The result shows that 66.595% of common variance shared by 16 variables can be accounted for by three factors. This is the reflection of the KMO value, 0.828, which can be considered good and indicates that factor analysis is useful for the variables. This initial solution suggests that the final solution has extract not more than three factors. In the scope of the study, it was determined that there are three factors with an eigenvalue greater than 1. The variance explained by the first factor is 51.483% with Eigenvalue of 8.237; the variance explained by the second factor is 8.734% with Eigenvalue 1.397; and the variance explained by the third factor is 6.377% with Eigenvalue 1.020.

C. Factor Rotation and Interpretation

Table 4

Rotated Component Matrix

	Component		
	1	2	3
P1		.570	
P2	.458		
P3	.626		
P4		.774	
P5		.602	
P6	.530		
P7		.057	
P8	.559		
P9	.824		
P10	.764		
P11	.808		
P12			.708
P13	.714		
P14	.837		
P15		.487	
P16		.764	

A Principal Component Analysis (PCA) with Varimax rotation was conducted on 16 perception variables related to quality in building construction projects. The analysis resulted in the extraction of three distinct components, each clustering items that are conceptually related. The rotated component matrix helped identify underlying themes based on factor loadings. The extracted components are depicted in the table 4. The Extracted component themes are listed below.

Component 1: Quality Standards and Assurance

- P2: Qualifying the required tests both for materials and work done (0.458)
- P3: Keeping the defects minimum (Minimum rework) (0.626)
- P6: Aesthetics (Good looks) (0.530)
- P8: Customer satisfaction and fulfillment of their requirements within budget allocated (0.559)
- P9: Ensuring specification of materials - Quality materials (0.824)
- P10: Ensuring workmanship of specified work - Quality workmanship (0.764)
- P11: Conformance to Quality control plan and Quality Assurance Plan (0.808)
- P13: Meeting the requirements of designer, constructor, and owner (0.714)
- P14: Meeting the requirements of regulatory agencies (Bye-laws, Design codes) (0.837)
- P15: Accomplishment of expectations of all the stakeholders involved (0.537)

This component emphasizes technical quality aspects (materials, workmanship, testing, defect minimization), regulatory compliance, aesthetic elements, and meeting stakeholder expectations (designers, constructors, owners, customers). It reflects procedural and conformance-focused perceptions of quality management.

Component 2: Project Efficiency and Delivery

- P1: Achieving the scope of projects (0.570)
- P4: Profitability of tasks completed (keeping wastage minimum and productivity high) (0.774)
- P5: Minimum variation (Time, Cost, Schedule) (0.602)
- P16: Fulfillment of the functional requirement (0.764)

This component focuses on efficient project execution, including scope achievement, waste minimization for profitability, controlling variations in time/cost/schedule, and meeting functional requirements. It captures resource efficiency and timely delivery aspects of quality.

Component 3: Schedule and Budget Adherence

- P12: Completion of the construction project within budget allocated and time specified (0.708)

This component highlights on-time and on-budget project completion, emphasizing adherence to financial and temporal constraints as a core quality indicator.

Alignment with Objective

These names align with perceptions of quality management in building construction projects for private and public sector stakeholders:

- Quality Standards and Assurance: Addresses technical compliance and stakeholder conformance, key for regulatory-heavy public projects and quality-focused private ones.
- Project Efficiency and Delivery: Reflects efficiency in resource use and functional outcomes, balancing cost and productivity across sectors.
- Schedule and Budget Adherence: Focuses on completion metrics, critical for accountability in both sectors.

P7 is excluded due to no positive loading ≥ 0.4. Component 3 has only one variable, which may indicate a weak factor; consider reviewing eigenvalues or communalities if this is unexpected.

Comparative Study on Perceptions of Public Sectors and Private Sectors in Managing Quality in Building Construction Projects.

Comparative study among public and private sector regarding perception in managing quality in building construction projects has been depicted in the table 5

Table 5

Comparative Table of Rank on Perception

Perception	Factors	Rank	Rank
P1	Achieving the scope of projects	5	7
P2	Qualifying the required tests both for materials and work done	8	2
P3	Keeping the defects minimum (Minimum rework)	6	6
P4	Profitability of tasks completed (keeping the wastage minimum and productivity high)	4	12
P5	Minimum variation (Time, Cost, Schedule)	15	13
P6	Aesthetics (Good looks)	9	5
P7	Excessive cost	16	16
P8	Customer satisfaction and fulfillment of their requirements within budget allocated	12	9
P9	Ensuring specification of materials - Quality materials	2	1
P10	Ensuring workmanship of specified work – Quality workmanship	3	4
P11	Conformance to Quality control plan and Quality Assurance Plan	10	10
P12	Completion of the construction project within budget allocated and time specified	14	15
P13	Meeting the requirements of the designer, constructor and owner	11	8
P14	Meeting the requirements of regulatory agencies (Bye-laws, Design codes)	1	3
P15	Accomplishment of expectations of all the stakeholders involved	13	14
P16	Fulfillment of the functional requirement	7	10

Discussion and Comparison: Public vs. Private Sector Mean Ratings and Ranks (P1–P16) for top most, middle and lower ranks

Top Priorities (High Agreement with Nuance)

- Public Sector Top 3: P14 (Regulatory), P9 (Materials), P10 (Workmanship).
- Private Sector Top 3: P9 (Materials), P2 (Qualifying Tests), P14 (Regulatory).
- Key Insight: While both prioritize P14 (Regulatory) and P9 (Materials), the private sector's #2 rank for P2 (Qualifying Tests) is a major differentiator, highlighting a stronger focus on verification. The public sector's #3 rank for P10 (Workmanship) is also notable.

Middle Priorities (Where Divergence is Clearest)

This is where the core difference in orientation appears.

- The public sector ranks P4 (Profitability/Productivity) at #4, a very high priority.

- The private sector, in contrast, ranks it at #12, but gives higher ranks to client-focused items like P6 (Aesthetics, #5) and P13 (Stakeholder Requirements, #8).

Lower Priorities (Strong Agreement)

Both sectors consistently rank the same factors low:

- P7 (Excessive Cost) is last for both.
- P12 (On Budget/Time) and P5 (Minimize Variation) are in the bottom three, indicating these are secondary concerns to technical quality.

Both value technical compliance, but the private sector emphasizes testing and client-facing results, while the public sector focuses more on productivity and workmanship.

Analysis of Rank Differences Given by The Public and Private Sector

The difference in ranking for each factor (calculated as Public Rank – Private Rank) was visualized in a bar chart as depicted in figure 3 to highlight alignment and divergence across sectors. The tabulated value of rank differences is presented in Table 6 below.

Table 6

Table Rank Differences

Perception	Factor	Rank Difference (d)	Square of difference (d^2)
P1	Achieving the scope of projects	-2	4
P2	Qualifying the required tests	6	36
P3	Keeping defects minimum	0	0
P4	Profitability of tasks	-8	64
P5	Minimum variation	2	4
P6	Aesthetics	4	16
P7	Excessive cost	0	0
P8	Customer satisfaction	3	9
P9	Specification of materials	1	1
P10	Workmanship	-1	1
P11	Quality control plan	0	0
P12	Completion on time/budget	-1	1
P13	Requirements of designer/owner	3	9
P14	Regulatory requirements	-2	4
P15	Stakeholder expectations	-1	1
P16	Functional fulfilment	-3	9

Key Observations from the Rank Difference Chart:

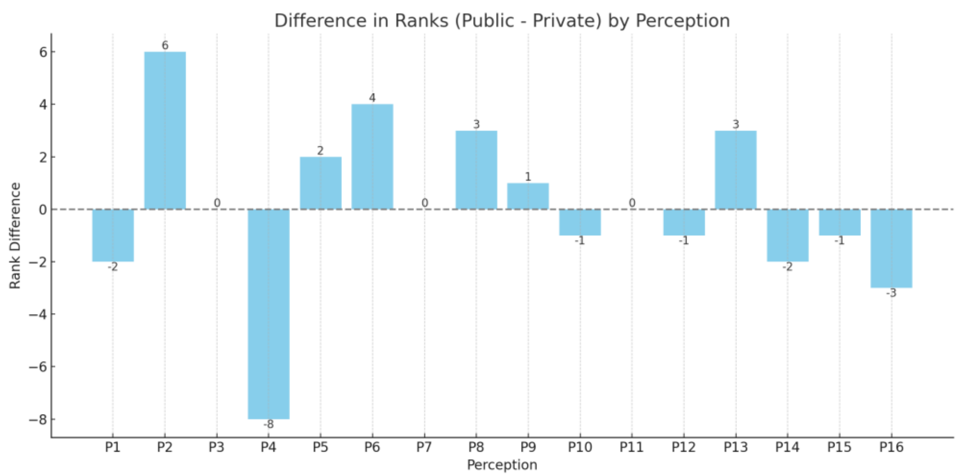
- Positive values (bars above zero) indicate that the public sector ranked a factor higher in importance than the private sector.
- Negative values indicate that the private sector prioritized the factor more than the public sector.

Factors with Notable Rank Differences:

- P4 (Profitability): Ranked much higher by the public sector (Rank 4) than private (Rank 12). This suggests public institutions may associate profitability with project success more strongly than the private sector.
- P2 (Material & Work Testing): The private sector ranked this second, while public placed it at eighth, showing private emphasis on verification and quality control.
- P13 (Meeting stakeholder requirements) and P6 (Aesthetics) also show higher importance in the private sector, possibly reflecting client satisfaction and presentation focus.

Figure 3

Differences in Rank



Spearman's Rank Correlation

To evaluate the similarity in perception rankings between public and private sector stakeholders, Spearman's rank correlation coefficient (ρ) was computed based on their ranks of 16 quality-related perception factors (P1–P16).

Spearman's Rank Correlation (ρ): 0.766

n: 16 perception factors

Σd^2 (Sum of squared rank differences): 159

ρ: 0.766

t-statistic: ~4.452

$$p = 1 - \frac{6\sum d^2}{n(n^2-1)} = 1 - \frac{6 \times 159}{16 \times (256-1)} \approx 0.766$$

$$t = \frac{p \cdot \sqrt{n-2}}{\sqrt{1-p^2}}$$

Substituting values,

$$t = \frac{0.766 \cdot \sqrt{16-2}}{\sqrt{1-0.766^2}} = \frac{0.766 \cdot \sqrt{14}}{\sqrt{1-0.586}} = \frac{0.766 \cdot 3.7417}{\sqrt{0.414}} = \frac{2.866}{0.6436} \approx 4.452$$

degree of freedom = 16 -2 = 16 -2 = 14

For P value, we use the t-value = 4.452 with df = 14 in a two-tailed test. p ≈ 0.00062

$$p - value = 2 \cdot P(T > 4.452)\, under\, T_{14}$$

A ρ value of 0.766 indicates a strong positive correlation between the two ranking patterns. This suggests that public and private sectors tend to prioritize the same quality factors, with only moderate differences. Since $p < 0.05$, we reject the null hypothesis and conclude that: The high correlation demonstrates that both public and private stakeholders share a common understanding of quality priorities in construction projects, especially regarding regulatory compliance, material specification, and workmanship. However, differences on profitability and testing emphasize the need for sector-specific strategies when implementing quality improvement policies.

These sectoral alignments and divergences resonate with broader literature on construction quality in developing countries, where methodological approaches like EFA and RII are commonly employed to identify and prioritize factors. For instance, our identification of three perception components Quality Standards and Assurance (emphasizing materials, workmanship, and compliance), Project Efficiency and Delivery (focusing on scope and variation), and Schedule and Budget Adherence correlates with (Rijal & Bhattarai, 2022), who used RII to rank KPIs in health building construction in Nepal, finding quality as the top indicator, aligning with our emphasis on standards and assurance. Similarly, (Bhattarai, et al., 2024) evaluated interlock blocks as alternatives to traditional bricks in private housing, noting perceptions of enhanced durability and material quality, which supports our high ranking of P9 (material specification) across sectors. However, our findings differ by highlighting strong public-private perceptual alignment (ρ=0.766), a gap in prior studies like (Shahi, et al., 2022), who compared material management in Kathmandu Valley without explicit focus on quality perceptions. (Joshi, et al., 2023) explored supply chain management perceptions, revealing sector differences in efficiency that influence quality, correlating with our private emphasis on testing (P2). (Bhattarai, et al., 2024) analyzed delays in retrofitting projects, linking them to workmanship and compliance issues, diverging from our positive stakeholder alignment but supporting calls for better training. This comparison underscores how our Nepal-specific insights fill literature gaps in these studies, which often lack qualitative KIIs or public-private comparisons. Overall, while correlations exist in core factors (e.g., compliance in developing economies), our findings diverge by demonstrating high sector alignment and proposing tailored strategies, filling Nepal-centric voids in the literature.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

This study examined quality management practices in building construction projects in Nepal's Kathmandu Valley, comparing public and private sector stakeholder perceptions using Exploratory Factor Analysis (EFA) and Relative Importance Index (RII). Key findings include:

- Shared Priorities: Both sectors strongly prioritize regulatory compliance, material quality, and workmanship (Spearman's $\rho = 0.766$, $p < 0.001$), emphasizing safety and durability.
- Sectoral Differences: The private sector focuses on verification (material/work testing) and client satisfaction (aesthetics, stakeholder requirements), while the public sector emphasizes productivity and workmanship.
- Key Components: EFA identified three quality dimensions: Quality Standards and Assurance (66.6% variance), Project Efficiency and Delivery, and Schedule/Budget Adherence.
- Challenges: Substandard materials, inconsistent workmanship, and regulatory gaps persist, exacerbated by urbanization and resource constraints. Cost, schedule, and variation are secondary to technical quality.
- Contextual Relevance: The study addresses Nepal's unique socio-economic challenges, filling a research gap on local quality management practices.

Recommendations

- Strengthen Compliance: Enhance regulatory enforcement using digital tools like BIM, with regular audits and training to align with the Nepal National Building Code.
- Improve Quality Standards: Implement stricter material and workmanship controls through standardized testing and worker training to reduce defects.
- Adopt Digital Tools: Leverage AI-driven monitoring and BIM to improve quality assurance, particularly in resource-constrained public projects.
- Foster Collaboration: Promote public-private partnerships to share best practices, aligning client-centric private approaches with public sector efficiency goals.

- Sector-Specific Strategies: Streamline public sector processes to boost productivity; emphasize verification and aesthetics in private projects.
- Future Research: Expand to other regions, explore causal relationships, and investigate socio-cultural barriers to quality management.

These insights and recommendations aim to enhance quality, safety, and sustainability in Nepal's construction sector, supporting infrastructure development.

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