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Ranking of Factors Affecting Construction Project Quality Using the Hierarchical Method (Case Study: Kabul)

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Abstract

In this study, attempts will be made to prioritize factors that affect the quality of construction projects in Kabul using the Analytical Hierarchy Process (AHP). The reason for the need to consider the quality in construction projects is extremely important because of the large financial, social, and environmental expenses. So, determining factors influencing quality in construction projects could increase management effectiveness. In this study, initially, the factors affecting the quality of construction projects were identified by reviewing literature and interviewing experts in the construction sector. Then, the prioritization of factors affecting the quality of construction projects was made by using the AHP. In the AHP method, an analytical hierarchy of influential factors was formed, which includes different levels of main factors and subfactors, such as communication, managerial, legal, social and cultural, project-related, occupational, environmental, and safety factors. According to the results, communication factor having relative weight of 0.299, takes first place; the managerial factor with a relative weight of 0.256, second; the legal, social, and cultural factor with a weight of 0.139, third; and the safety factor with a weight of 0.048 lastly. Conclusions from this study will be helpful for project managers and policy makers in improving construction project quality in terms of construction industry in Kabul. It can provide a foundation for further research into this field in other parts of the world. In general, this study indicates that there are several factors that affect construction project quality in Kabul and a multidimensional approach should be taken.

Keywords: Construction project quality, Analytical hierarchy process, Project management, Materials and equipment.

1 | Introduction

The construction industry is considered to be highly critical for any country in terms of economic growth and expansion of infrastructure projects. Nevertheless, owing to its complexity, involvement of many players,

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dynamic environment, and presence of various risks, the management of quality of the constructions becomes extremely difficult. The improper management of the quality of construction leads to budget overflows, delays, dissatisfied stakeholders, safety accidents, and harmful environmental impact. Consequently, the recognition and prioritization of the construction project quality influencing factors has gained particular importance.

As far as the construction projects in Kabul, Afghanistan are concerned, there are more difficulties that make the quality management rather complicated. These include financial limitations, shortage of professional personnel, political instability, and lack of necessary infrastructure. Furthermore, unfavorable environmental factors and unexpected delays add to the existing problems of the construction quality. Hence, the proper quality improvement of construction projects in Kabul presupposes the identification of influential factors.

Construction quality is interrelated with good management, effective communication, safety of workers, regulation, and sustainable project execution. Earlier researches have pointed out that safety and sustainability cannot be treated as two separate entities, but rather as two interdependent qualities that need to be evaluated together in order to estimate the quality of a construction project [1], [2]. Moreover, human and organizational factors are also considered important for assessing the result of construction project as well as construction site safety [3], [4].

Many foreign researchers have explored construction performance, safety, and project success, identifying critical determinants for these processes. For instance, Gunduz and Almuajebh [5] used the method of Analytical Hierarchy Process (AHP) to identify and prioritize the Critical Success Factors (CSFs) for sustainable construction project management, singling out finance, experienced construction managers, and skilled labor as critical determinants. Negash et al. [6] used fuzzy Delphi, ISM, and Best-Worst Method to develop a hierarchical model of sustainable waste management effectiveness [7].

Elraaid et al. [8] used AHP method in their study on the barriers to implementation of PMO and concluded that one of the main barriers to success is the absence of commitment from senior management and resistance to change. Soltanzadeh et al. [9] developed a risk management strategy based on a fuzzy AHP approach and proved the efficiency of MCDA models in construction risk assessment.

From a safety aspect, Chan et al. [10] and Ayoobi et al. [11] reported that construction accidents are caused by interaction of different organizational, management-related, and technical reasons rather than isolated cases. Mohandes et al. [12] argued that safety of the personnel can be increased only if there is commitment at the managerial level, safety training programs, and organizational assistance. Moreover, Choi et al. [13] showed that safety culture and legislative measures affect occupational accidents in construction significantly, and Zhou et al. [14] determined poor supervision and low safety awareness as important causes of construction accidents.

From a sociotechnical systems approach, the authors of Zarei et al. [3] highlighted the importance of the involvement of people and organizations in creating safety and formulated dynamic risk models to account for these aspects [15].

Although a considerable amount of work has been carried out to date in order to analyze the concepts of construction safety, sustainability, and success factors in construction projects, very little empirical research has investigated the factors influencing the quality of construction projects from a hierarchical point of view within the context of developing nations. Specifically, not much information exists in relation to the prioritization of quality factors in Kabul's construction sector.

This paper thus intends to use the AHP model in an attempt to determine the factors that impact on the quality of construction projects in Kabul.

2 | Literature Review

Various aspects of quality associated with construction projects have been studied intensively during the last few years, and there was substantial research performed in several related areas, namely CSFs, safety management, sustainability, organizational performance, and Multi-Criteria Decision-Making (MCDM) methods used in construction. In general, based on the available literature, it is possible to state that construction project quality can be viewed as a multidimensional phenomenon affected by various aspects, such as technical, managerial, organizational, and environmental factors, which means that quality should not be assessed individually.

In particular, an important trend in recent researches relates to the identification of CSFs in construction projects. For example, Gunduz and Almuajebh [5] determined 40 CSFs and divided them into seven categories, highlighting that financial strength, managerial capabilities, as well as good approval and decision-making processes were some of the most critical factors for project success. Another interesting study was conducted by Kiani Mavi and Standing [16] who extended the concept of CSF through sustainability factors, and using a fuzzy DEMATEL-ANP method showed that organizational capability and the environment had a key influence on project performance.

Another important line of research revolves around the contribution of safety management to construction quality. It was established by Chan et al. [10] that construction accidents seldom occur because of isolated cases of risky behavior but arise through intricate interactions within the system caused by various organizational, management, and technological errors. Furthermore, the role of the systemic approach was highlighted by Choi et al. [13], who concluded that national safety culture, enforcement, and institutions have a significant impact on the number of construction accidents in different countries. Moreover, according to Mohandes et al. [12], factors such as safety training, commitment to safety, organizational readiness, and workers' awareness of the importance of safety measures contribute considerably to improving safety performance.

Methodologically speaking, MCDM methods have been applied extensively to the evaluation and prioritization of risks and other issues in relation to constructions. For instance, Soltanzadeh et al. [9] proposed a fuzzy AHP model to prioritize safety risks and showed its performance and success in dealing with uncertainties and enhancing the accuracy of decisions regarding construction safety. It is worth noting the increasing appropriateness of MCDM in solving problems and making decisions in situations that are complex and involve a degree of uncertainty. Additionally, Zarei et al. [3] constructed more sophisticated systems-based models for analyzing safety issues considering human and organizational aspects. In doing so, they showed that safety risks originate from dynamic sociotechnical systems [15].

Another aspect of sustainability has become one of the most crucial determinants of construction project performance. According to Nawaz et al. [1], safety and sustainability are not two separate areas and they should be regarded as interrelated ones since the incorporation of both into the project process contributes to enhanced overall project results. Similarly, Negash et al. [6] found that effective waste management strategies and cross-functional coordination are among the main factors driving the sustainable performance of construction projects. This evidence suggests that sustainable measures are not only environmentally friendly but also contribute to project efficiency.

Apart from technical and sustainability-related factors, project management and organizational governance processes were also found to play a pivotal role in project performance. As pointed out by Elraaid et al. [8], the obstacles associated with resistance to change, absence of top management support and commitment to PMOs result in poor realization of the latter ones. Moreover, according to the Project Management Institute (PMI) [17], the project management structure is vital for the effective achievement of the project goals.

However, while there is a vast amount of literature that discusses safety, sustainability, project management, and successful factors in general, not many researchers have concentrated on prioritizing quality factors of construction projects, especially in a developing country scenario. Similarly, very few authors have employed hierarchical decision techniques like the AHP for evaluating quality factors in such an environment. This paper is an attempt to contribute to literature through identifying, analyzing, and prioritizing the quality factors in Kabul's construction industry utilizing AHP.

3 | Research Methodology

The research adopted both qualitative and quantitative methodology. It is an applied study which is descriptive in methodology. First, the theoretical background was established using literature review and scientific sources, and factors affecting the study were determined.

Later, through questionnaire and fuzzy Delphi technique, indicators were finalized according to expert opinions. Then, paired comparison questionnaire technique was applied to gather information that was analyzed using the fuzzy AHP technique for evaluating and ranking the indicators and determining their weightages. Finally, the conclusions were drawn by applying the Importance–Performance Analysis (IPA) technique.

3.1 | Identification of Factors Affecting Construction Project Quality

This is the stage whereby the variables that can affect the quality of the construction projects have been collected from the literature and from scientific and industrial researches. At the next stage, the opinion of the experts was sought using the Delphi technique.

At the same time, it was requested from the experts that they score each of the influencing factors within the scale of 1 to 5 (where 1= least influence; 5= most influential).

Table 1. Findings of the Delphi survey for the comparison of identified indicators.

No.	Main Criteria	Identified Sub-Criteria	Very Low	Low	Moderate	High	Very High	Geometric Mean Score
1	Project-related Factors	Constructability of designs	2	5	7	1	0	2.31
2		Number of ongoing projects	2	2	7	4	0	2.65
3		Design changes	1	8	4	2	0	2.33
4		End-user involvement	0	3	8	3	1	3.03
5		Financial resources	1	2	6	5	1	3.01
6	Managerial Factors	Performance of the project manager	2	6	4	3	0	2.33
7		Quality of project planning	0	0	6	5	4	3.78
8		Poor planning and scheduling	0	2	6	5	2	3.35
9		Lack of project manager awareness and knowledge	0	5	4	4	2	3.03
10		Poor material management	0	6	6	3	0	2.70
11		Delays in decision-making	2	5	6	2	0	2.35
12		Risk allocation	3	4	5	3	0	2.29
13		Inaccessibility of managers when needed	1	8	3	3	0	2.38
14	Communication Factors	Contractor selection and supervision	0	1	7	5	2	3.44
15		Communication and cooperation among project participants	0	6	6	3	0	2.70
16		Selection of the best contractor	2	3	9	1	0	2.44

Table 1. Continued.

No.	Main Criteria	Identified Sub-Criteria	Very Low	Low	Moderate	High	Very High	Geometric Mean Score
17		Contractor's financial capability	1	6	5	3	0	2.51
18		Contractor's management team	0	4	7	3	1	2.95
19	Environmental Factors	Adverse weather conditions	2	5	5	3	0	2.40
20		Resource shortages	2	5	7	1	0	2.31
21		Infrastructure availability	1	2	10	2	0	2.74
22		Availability of technical personnel	0	5	7	3	0	2.78
23	Legal, Social, and Cultural Factors	Increase in material prices	2	3	9	1	0	2.44
24		Law and order	0	7	7	1	0	2.53
25		Bureaucracy and political influence	0	4	7	4	0	2.91
26		Terrorism	3	4	7	1	0	2.20
27		Regulatory authorities	0	3	4	8	0	3.23
28		Inflation	3	3	7	2	0	2.31
29	Safety Factors	Supervision of on-site project activities	0	4	4	6	1	3.13
30		Weak on-site supervision	0	6	6	2	1	2.74
31	Occupational Factors	Construction work skills	1	2	9	2	1	2.84
32		Incentive mechanisms	2	6	6	1	0	2.25
33		Performance measurement	5	1	8	1	0	2.06
34		Teamwork	0	5	5	4	1	2.93
35		Shared benefits	2	6	5	2	0	2.29

Note: Indicators with a geometric mean score greater than 2.50 were retained for subsequent analyses based on the Delphi consensus procedure.

Based on expert scoring and using the average rating given by the experts, those indicators that received a mean score greater than 2.5 were chosen. As such, the following factors have been found to be the efficient indicators of the research:

3.1.1 | On-site project activity monitoring

It represents an active process of controlling activities and processes conducted at the construction site or project premises. On-site project activity monitoring is characterized by a continuous presence of supervisors and strict supervision of the work performance.

3.1.2 | Weak on-site project monitoring

It stands for the lack of active presence of supervisors at the construction site or project premises. Weak project supervision includes indirect monitoring methods like work performance reports provided by employees and inspections of supervisors.

3.2 | Comparison of All Criteria among Themselves

As all criteria belong to different groups and classes, the weight coefficients obtained by the AHP method will be determined inside the categories separately. Nevertheless, the Expert Choice program allows comparing all criteria without any separation, calculating their weights and inconsistency ratio simultaneously.

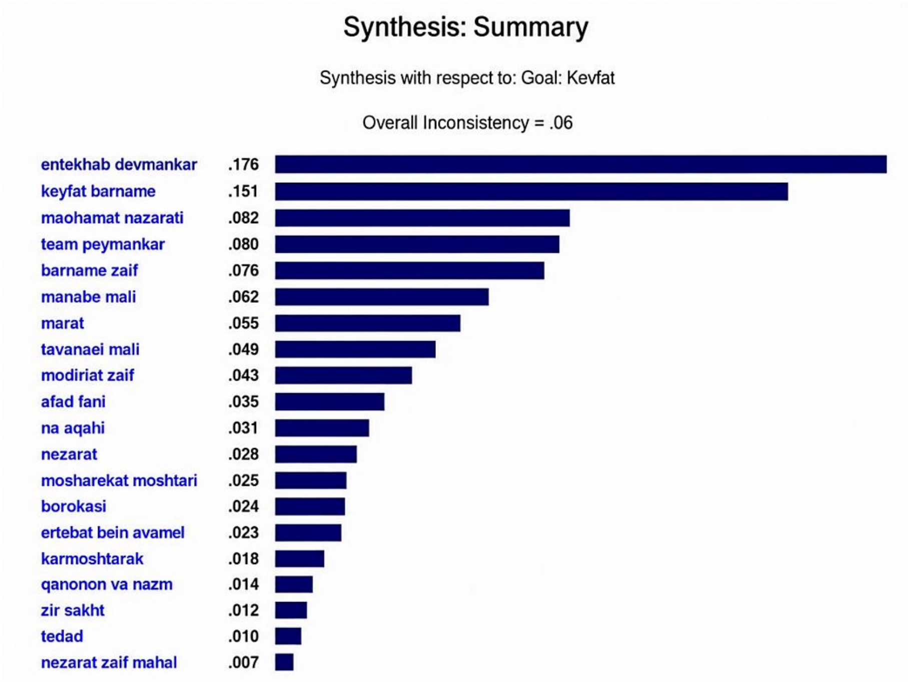

Fig. 1. Synthesis: Summary.

It was established that among the major criteria, the communication criterion (0.299) and managerial criterion (0.256) were rated as having the highest importance level while safety criteria were rated with the least importance (0.048). In terms of the minor criteria, contractor selection and supervision (0.176), quality of project planning (0.151), and regulatory authority (0.082) were identified as having the greatest significance.

Table 2. Description of the main criteria and sub-criteria.

Main Criteria	Sub-Criteria	Code
Communication Factors	Contractor selection and supervision	E1
	Contractor's management team	E2
	Contractor's financial capability	E3
	Communication and cooperation among project participants	E4
Managerial Factors	Quality of project planning	T1
	Poor planning and scheduling	T2
	Poor material management	T3
	Lack of project manager awareness and knowledge	T4
Legal, Social, and Cultural Factors	Regulatory authorities	O1
	Bureaucracy and political influence	O2
	Law and order	O3
Project-related Factors	Financial resources	C1
	End-user involvement	C2
	Number of ongoing projects	C3
Occupational Factors	Construction work skills	V1
	Teamwork	V2
Environmental Factors	Availability of technical personnel	M1
	Infrastructure	M2
Safety Factors	Supervision of on-site project activities	P1
	Weak on-site supervision	P2

Table 3. Ranking of main criteria based on relative importance.

Main Criteria	Relative Weight	Rank
Communication factors	0.299	1
Managerial factors	0.256	2
Legal, social, and cultural factors	0.139	3
Project-related factors	0.106	4
Occupational factors	0.093	5
Environmental factors	0.060	6
Safety factors	0.048	7

Table 4. Global ranking of sub-criteria.

No.	Sub-Criteria	Code	Relative Weight	Global Rank
1	Contractor selection and supervision	E1	0.176	1
2	Quality of project planning	T1	0.151	2
3	Regulatory authorities	O1	0.082	3
4	Contractor's management team	E2	0.080	4
5	Poor planning and scheduling	T2	0.076	5
6	Financial resources	C1	0.062	6
7	Construction work skills	V1	0.055	7
8	Contractor's financial capability	E3	0.049	8
9	Poor material management	T3	0.043	9
10	Availability of technical personnel	M1	0.035	10
11	Lack of project manager awareness and knowledge	T4	0.031	11
12	Supervision of on-site project activities	P1	0.028	12
13	End-user involvement	C2	0.025	13
14	Bureaucracy and political influence	O2	0.024	14
15	Communication and cooperation among project participants	E4	0.023	15
16	Teamwork	V2	0.018	16
17	Law and order	O3	0.014	17
18	Infrastructure	M2	0.012	18
19	Number of ongoing projects	C3	0.010	19
20	Weak on-site supervision	P2	0.007	20

Table 5. Local and global ranking of main criteria and sub-criteria.

Main Criteria	Relative Weight	Sub-Criteria	Local Weight	Local Rank	Global Weight	Global Rank
Communication factors	0.299	E1 – Contractor selection and supervision	0.538	1	0.176	1
		E2 – Contractor's management team	0.243	2	0.080	4
		E3 – Contractor's financial capability	0.149	3	0.049	8
		E4 – Communication and cooperation among project participants	0.070	4	0.023	15
Managerial factors	0.256	T1 – Quality of project planning	0.502	1	0.151	2
		T2 – Poor planning and scheduling	0.252	2	0.076	5
		T3 – Poor material management	0.143	3	0.043	9
		T4 – Lack of project manager awareness and knowledge	0.102	4	0.031	11
Legal, social, and cultural factors	0.139	O1 – Regulatory authorities	0.683	1	0.082	3

Table 5. Continued.

Main Criteria	Relative Weight	Sub-Criteria	Local Weight	Local Rank	Global Weight	Global Rank
		O2 – Bureaucracy and political influence	0.200	2	0.024	14
		O3 – Law and order	0.112	3	0.014	17
Project-related factors	0.106	C1 – Financial resources	0.637	1	0.062	6
		C2 – End-user involvement	0.258	2	0.025	13
		C3 – Number of ongoing projects	0.105	3	0.010	19
Occupational factors	0.093	V1 – Construction work skills	0.750	1	0.055	7
		V2 – Teamwork	0.250	2	0.018	16
Environmental factors	0.060	M1 – Availability of technical personnel	0.750	1	0.035	10
		M2 – Infrastructure	0.250	2	0.012	18
Safety factors	0.048	P1 – Supervision of on-site project activities	0.800	1	0.028	12
		P2 – Weak on-site supervision	0.200	2	0.007	20

Remark 1. The local weights denote the degree to which each sub-criteria contributes to its corresponding main criteria, while global weights show how much influence each sub-criteria has on construction project quality within the hierarchy of criteria.

The *Table 5* presents all the relative weights of various factors based on the pairwise comparison in Expert Choice. Based on the local and global ranking of main criteria and sub-criteria, the choice of a suitable construction company turned out to be the most important factor influencing construction project quality, with a relative weight of 0.176. Project planning quality (0.151) and effectiveness of supervisory body (0.082) were the next most important factors. Poor on-site supervision, on the other hand, turned out to be the least important factor, having a relative weight of 0.007.

4 | Importance–Performance Matrix Based on Importance–Performance Analysis Technique

In this stage, based on the opinions of the expert team, the importance, probability of occurrence, and impact on performance of each of the seven factors affecting construction project quality were identified.

In the next step, the threshold value is calculated. For this purpose, the arithmetic mean of the indicators in both the importance and performance dimensions is computed. The results are as follows:

I. Arithmetic mean of importance and probability of occurrence: 6

II. Arithmetic mean of performance impact: 5.1

In the next stage, the IPA matrix is constructed based on four quadrants, and the status of each indicator along with subsequent strategies is determined.

Based on the expert team's average evaluations, the importance and performance impact values of the seven indicators were calculated as shown in *Table 6*.

Table 6. Status of performance and importance in the IPA matrix.

No.	Indicator	Code	Mean Importance and Probability	Mean Performance Impact
1	Project-related factors	A	7.68	5.18
2	Managerial factors	B	7.15	6.17
3	Communication factors	C	7.13	6.74
4	Environmental factors	D	5.87	4.45
5	Legal, social, and cultural factors	E	6.06	6.76
6	Safety factors	F	5.89	4.63
7	Occupational factors	G	5.04	4.82

Accordingly, based on the above table, the IPA matrix is illustrated in *Fig. 2*.

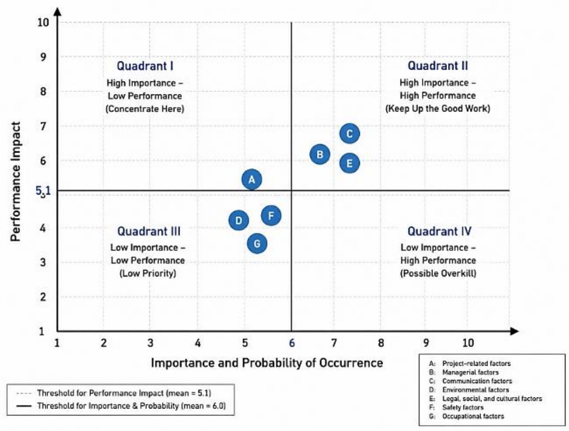

Fig. 2. IPA matrix and four quadrants.

As seen from the IPA matrix above, based on the weight of importance and probability of occurrence, indicator C was ranked the highest among the indicators, while indicator G was ranked the lowest.

Based on performance weight, indicator E was ranked the highest, while indicator D was ranked the lowest.

Strategic implication from the positioning of the indicators in the four quadrants of the IPA matrix include:

I. Quadrant I (high importance – low performance):

II. This quadrant requires the highest attention and investment. Indicator: A

III. Quadrant II (high importance – high performance):

IV. hese indicators are well-performing and strategically important: B, C, E

V. Quadrant III (low importance – low performance):

VI. These factors are not critical threats to system performance and do not require immediate corrective actions (low priority): D, F, G

VII. Quadrant IV (low importance – high performance):

VIII. These represent non-critical strengths, where resources may be better allocated to more important areas.

5 | Conclusion

The present study identified an initial set of 35 indicators potentially affecting the quality of construction projects in Kabul. Through the application of the Delphi technique and the aggregation of expert judgments, these indicators were refined and localized to reflect the contextual characteristics of the Kabul construction industry. Ultimately, 20 key factors were selected as the most significant determinants of construction project quality.

These 20 factors were classified into seven overarching categories, namely:

I. Project-related factors

II. Managerial factors

III. Communication factors

IV. Environmental factors

V. Legal, social, and cultural factors

VI. Safety factors

VII. Occupational factors

The identified factors were subsequently evaluated and prioritized using the AHP. The findings revealed that communication factors and managerial factors received the highest priority rankings, highlighting the importance of effective stakeholder interaction, coordination, and managerial competence in achieving higher levels of project quality. In contrast, safety and environmental factors were assigned comparatively lower priorities within the study context.

Furthermore, the results of the IPA suggest that greater attention and resource allocation should be directed toward communication, managerial, and legal/social factors, as improvements in these areas are likely to yield the greatest enhancement in construction project quality. In addition, project-related factors, owing to their high level of importance and probability of occurrence, warrant strategic investment and continuous improvement initiatives.

By contrast, safety, environmental, and occupational factors were positioned within the lower-priority quadrant of the IPA matrix. Therefore, excessive concentration of resources on these dimensions may not result in proportional improvements in overall project quality. Decision-makers are consequently advised to adopt a balanced and evidence-based approach to resource allocation, prioritizing those factors that offer the greatest potential to improve the quality and performance of construction projects in Kabul.

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