



The identification and prioritization of critical success factors in healthcare projects through the application of the Analytic Hierarchy Process (AHP)

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Abstract: - The integrity of healthcare infrastructure is a critical determinant in the provision of dependable healthcare services; thus, the successful execution of healthcare construction projects is a significant concern for the Iranian healthcare authority, due to their direct impact on societal well-being. The extant research highlights that beyond cost, time, and quality, which are universally acknowledged as pivotal project success indicators, various elements such as legal considerations, feasibility assessments, and strategic planning play critical roles in determining the outcome of these projects. This paper employs a qualitative methodology to identify 29 success factors specific to healthcare construction projects within the Iranian context. Notable among these are appropriate construction practices, adherence to contemporary healthcare standards, financial viability, and environmental sustainability. Subsequent to this identification, these factors were prioritized using the Analytic Hierarchy Process (AHP). Given the challenge associated with managing all 29 factors, the study emphasizes the importance of focusing on key factors. For the data collection necessary for the AHP analysis, a questionnaire comprising 406 items was developed, and completed by five experts, each with a minimum of 15 years of experience in healthcare construction projects. The findings indicate that factors such as personnel expertise, maintenance efficiency, project management acumen, financial management, and compliance with standards are prioritized over others. The insights generated by this study have enhanced the understanding of project managers regarding the critical success factors in healthcare construction projects, suggesting that by allocating resources and efforts towards these high-priority areas, the likelihood of project success can be significantly improved.

Keywords: *AHP method, Healthcare project, Iran, Prioritizing, Success Factor.*



1. Introduction

Healthcare projects are pivotal in enhancing health and social welfare by meeting the qualitative and quantitative needs of society. The construction of adequate healthcare facilities is closely tied to the improvement of a country's health outcomes through the establishment of suitable medical environments. By the close of 2022, the initiation of 876 healthcare projects underscored the vigorous efforts of various governments to advance this sector. This surge in projects highlights the critical and prominent role of healthcare development projects, thereby necessitating effective management practices within the construction industry.

As the significance of these projects escalates, it becomes essential to explore the factors contributing to their success. Traditionally, the success of projects is measured against the "golden triangle" of project management, encompassing time, cost, and quality. However, research across various sectors of the construction industry suggests that additional factors play crucial roles in determining project success. These include the provision of financial resources, the competence of construction personnel, resource availability, and the integration of cutting-edge construction technologies. Ignorance of these success factors can lead to project failures, resulting in resource wastage and loss of trust among stakeholders, primarily affecting the intended beneficiaries at the top of the hierarchy.

This study seeks to investigate the determinants of successful healthcare construction projects. It also aims to identify key success factors through interviews with managers and civil engineers who possess at least 15 years of experience in the field. The study engages contracting firms, consulting services, and employing companies, applying hierarchical analysis through the Analytic Hierarchy Process (AHP) to prioritize these factors effectively.

2. Literature Review in Iran

Numerous studies have been conducted on the success of construction projects across various regions, notably Europe and Eastern Asia. Rockart [1] pioneered the investigation into the critical success factors of construction projects in 1982, focusing on the elements distinguishing success from failure. The definition of project success hinges on achieving predefined goals, with success traditionally declared when a project meets its scheduled completion, stays within budget, and fulfills stakeholder needs. Project success indicators include proper functionality, profitability for contractors, and the absence of claims. These can be categorized into two groups: tangible, measurable objectives ("hard") and intangible, qualitative outcomes ("soft").

The trio of time, cost, and quality are well-established as the "triangle of project management," but factors such as safety, environmental health, and technical aspects have gained importance. Client satisfaction, effective communication among project participants, and the absence of disputes are also critical for success. In scholarly literature, client satisfaction has emerged as a key variable in project success, with its evaluation often paralleling project completion.



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Several researchers, such as Madhooshi in 1994 [2], have explored success and failure factors in construction, proposing models to predict project outcomes. However, applying a universal model across all construction projects is impractical due to variations in project size, nature, and complexity. For instance, success factors for road construction differ markedly from those for healthcare projects, which are among the most complex and often involve multiple contractors.

Shokouhinia [3] identified success factors in oil, gas, and petrochemical projects through his study at Aria-Petro-Gas Company, while Piran [4] used business environment indices to predict and evaluate project success. Although these studies are informative, the accurate identification of success factors requires thorough analysis, expert opinions, and extensive literature review, as mere categorization into internal and external factors is insufficient.

Furthering this exploration, Abolhasani [5] assessed key success factors in project management at South Pars, Iran's largest gas project, using a group decision-making technique. Dalirpour [6] focused on identifying key success factors in project-based organizations, emphasizing the need for continuous improvement. Minaie [7] tackled the identification and prioritization of success factors in mass building construction, which differs significantly from healthcare projects due to the unique standards required in healthcare settings.

3. Methods

The review of existing literature focused on the identification of project success factors, particularly within the domain of healthcare construction projects and across various international contexts. This comprehensive review enabled the researcher to glean relevant success factors from diverse geographical settings and adapt them for application within the current study, which aims to identify and prioritize success factors in healthcare projects in Iran.

To achieve a nuanced understanding of these factors, a mixed-methods approach was employed, combining both qualitative and quantitative methodologies. This approach facilitated an in-depth exploration of the subject matter, revealing its complex dimensions. The qualitative component was particularly emphasized through the use of interviews, which were selected as the primary data collection method to leverage the extensive expertise of professionals in the field [8].

Twenty-five interviews were conducted with seasoned professionals in the construction industry, each possessing at least fifteen years of experience in healthcare project construction. The participants were selected via snowball sampling, ensuring a rich reservoir of knowledge and expertise. The interviews were unstructured, providing the interviewees the flexibility to express their insights freely and thoroughly, which were subsequently transcribed into text for analysis.



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The data, rich with the seasoned perspectives of these experts, were analyzed using thematic analysis. This method was instrumental in distilling and categorizing the expressed ideas into coherent themes that represent key success factors.

Following the identification of these factors, the Analytic Hierarchy Process (AHP) was employed to prioritize them. AHP is particularly suited for decision-making scenarios involving multiple criteria and alternatives, as it utilizes a systematic framework for evaluating the relative importance of each factor. This framework involves constructing a hierarchy, making pairwise comparisons, and calculating the relative weights of alternatives to derive a final weighted prioritization of the success factors [9].

This rigorous methodology not only identifies but also systematically prioritizes the critical success factors in healthcare construction projects, thus providing actionable insights for stakeholders involved in such ventures.

Table1: The Demographics of the Interviewees

ROW	CODE	ROLE	Education	Field	Experience (year)	Organization Type
1	C1	Project Administrator	Bachelor	Civil Engineer	15	Client
2	C2	Physics	Specialist	Oncology	30	Client
3	C3	Project Manager	Bachelor	Civil Engineer	20	Client
4	C4	Project Manager	Bachelor	Civil Engineer	20	Client
5	C5	CEO	Master	Law	20	Client
6	C6	Project Manager	Master	Civil Engineer	20	Client
7	C7	Project Manager	Bachelor	Civil Engineer	17	Client
8	C8	Project Manager	Bachelor	Civil Engineer	25	Client
9	C9	Project Manager	Master	Civil Engineer	29	Client
10	N1	Project Administrator	Bachelor	Civil Engineer	25	Consultant
11	N2	Project Administrator	Bachelor	Civil Engineer	18	Consultant



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12	N3	Project Administrator	Bachelor	Civil Engineer	16	Consultant
13	N4	Project Manager	PhD	Architecture	20	Consultant
14	N5	Project Manager	Bachelor	Civil Engineer	17	Consultant
15	N6	Project Manager	PhD	Civil Engineer	21	Consultant
16	N7	CEO	Master	Mechanics	30	Consultant
17	O1	Project Manager	Bachelor	Civil Engineer	25	Contractor
18	O2	CEO	Bachelor	Mechanics	35	Contractor
19	O3	CEO	Bachelor	Mechanics	36	Contractor
20	O4	Project Administrator	Bachelor	Civil Engineer	18	Contractor
21	O5	Project Manager	Bachelor	Management	17	Contractor
22	O6	CEO	Bachelor	Civil Engineer	35	Contractor
23	O7	Project Manager	PhD	Civil Engineer	16	Contractor
24	O8	Project Manager	Master	Civil Engineer	35	Contractor
25	O9	Project Manager	Master	Civil Engineer	40	Contractor

4. Results

The data analysis revealed the existence of over 50 distinct factors influencing the success of healthcare construction projects. These factors were initially divided into 29 categories, which were then consolidated into 8 groups based on similarities among conditions. This step was crucial to manage the complexity and ensure the relevance of each category to the specific field of healthcare construction, acknowledging that these findings are context-specific and not necessarily applicable to broader fields.

A comprehensive questionnaire was developed, featuring 432 questions aimed at performing paired comparative analysis. The questionnaire was structured such that the first 28 questions addressed the major categories, while the remaining questions focused on the sub-factors, employing a scaling system from 1 to 9 for evaluation.



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Following the collection of completed questionnaires, the Analytic Hierarchy Process (AHP) was employed for data analysis, utilizing software tools like EXCEL and EXPERT CHOICE. An 8x8 matrix was constructed where the scores from the questionnaire were input into the upper triangle of the matrix, and inverse scores were placed in the lower triangle. This arrangement facilitated the calculation of the weight vector for each row, allowing for the determination of relative weights for each factor within its respective category. Subsequent steps involved recalculating the weights for the 29 sub-factors derived from the initial 8 groups, culminating in the determination of an ultimate weight for each factor by multiplying the sub-factor weight by the corresponding category weight.

The final prioritization revealed that the human resources factor, with a weight of 0.348, was the most critical for the success of healthcare construction projects. Within this category, experience and project management were identified as the most influential sub-factors, weighted at 0.185 and 0.086, respectively, highlighting the pivotal role of skilled personnel in these projects.

The second most significant category was executive affairs, with a weight of 0.195, where maintenance and repair were emphasized, reflecting the operational necessities of healthcare project success. Financial affairs, including budget provision, weighed at 0.078, underscored the importance of fiscal management. Other critical factors identified included standards and legal affairs, illustrating the regulatory and compliance challenges inherent in healthcare construction. Interestingly, the study and planning factors, despite being foundational in interviews, were weighted at 0.057 and 0.045, respectively, suggesting a moderate but essential influence on project success. Further down the list, feasibility study, time estimation, and design were also significant but less so compared to other factors, with weights of 0.032, 0.025, and 0.020 respectively, indicating their role but lesser priority in the hierarchy of project success factors. This structured approach to weighting and prioritizing success factors offers a clear roadmap for project managers and stakeholders in healthcare construction to allocate resources effectively and focus on the most impactful areas to ensure project success.

Table2: weight of main success factor

Rank	Main Success Factors	Weight
1	Human Resource	0.348
2	Executive Affairs	0.195
3	Standard	0.125
4	Macro Affairs	0.105



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5	Financial Affairs	0.098
6	Study	0.057
7	Program	0.045
8	Management	0.027

Table3: weight of sub-success factor

Rank	Sub-Success Factors	Weight
1	Experience	0.185
2	Repair and Maintenance	0.088
3	The role of Project Manager	0.086
4	Budget	0.079
5	Standard	0.078
6	Construction method	0.058
7	cultural and social	0.042
8	Psychological and emotional factors	0.041
9	Policy	0.038
10	Feasibility	0.032
11	Treaty and Regulation	0.030
12	Equipment and Facilities	0.028
13	Estimated Time	0.025
14	Stakeholders	0.022
15	Design	0.020
16	Estimated Cost	0.019
17	Knowledge	0.018



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18	opposed	0.017
19	Human Resource	0.014
20	Economic	0.013
21	Material	0.013
22	Environment	0.012
23	Scope	0.010
24	Machinery	0.007
25	Schedule Program	0.007
26	Risk	0.006
27	Strategy	0.005
28	Control and monitoring	0.003
29	Quality	0.003

5. Discussion

In Iran, four organizations have been instrumental in the development of healthcare infrastructure, culminating in the completion of 876 healthcare centers integrated into the national hygiene network by the end of 2013. The significance of these projects is underscored by the anticipated demographic shift towards a predominantly senior population over the next two decades, heightening the necessity for adequate healthcare facilities.

A comprehensive review of both international and domestic literature on project success factors was undertaken to enhance understanding in this field. Historical research such as Rockart [1], Jugdev and Muller [10], and Chan [11], [12], [13], [14], [15], [16], [17], [18], [19], [20] and [21] provided foundational insights, inspiring Iranian researchers like Madhooshi [2] who focused on civil project success models. Recent studies by Shokuhi Nia [3], Piran [4] and Minayi [7], have explored success factors in oil, gas, and petrochemical sectors, yet research specifically targeting healthcare projects remains sparse.



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To bridge this gap, qualitative research methods, including in-depth interviews with seasoned healthcare research professionals, were employed. Utilizing snowball sampling, these interviews were conducted unstructured, allowing for a rich, unfiltered exchange of ideas. The subsequent thematic analysis of the transcribed interviews revealed over 50 factors influencing project success, initially categorized into 29 sub-factors and later consolidated into eight broad categories.

The Analytic Hierarchy Process (AHP) was employed to prioritize these factors based on input from five healthcare project experts. The prioritization highlighted experience (weight 0.286), repair and maintenance (weight 0.08), and standards (weight 0.067) as top factors. Lesser weight was assigned to feasibility (weight 0.067) and design (weight 0.015), indicating varying levels of influence on project success. Factors such as control and supervision, and quality management, were deemed less critical, reflecting their lower impact.

Human resources emerged as the most critical category with a weight of 0.444, emphasizing the importance of skilled personnel in project execution. Administrative affairs followed, highlighting the necessity of effective project management. These findings underscore the multifaceted nature of project success, which extends beyond financial considerations to encompass expert selection and strategic planning.

The study also identified common pitfalls that lead to project failure, such as uniform project designs applied indiscriminately across diverse regions, leading to cost and time overruns. It suggests that successful healthcare projects require tailored approaches based on thorough regional analysis, considering local disease profiles, cultural contexts, climate conditions, and demographic specifics. Furthermore, financial strategies must be adaptive, considering the economic and political landscape, including potential sanctions. Collaboration with the private sector is recommended to complete healthcare projects effectively. Ultimately, selecting knowledgeable and experienced project managers who can leverage identified success factors is crucial for enhancing the success rates of healthcare projects in Iran.

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