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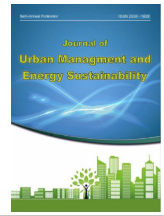

ORGINAL RESEARCH PAPER

Socio-Economic Aspects Influencing the Formation of Low-Cost Housing Architecture after Iran's Islamic Revolution in Kerman City by Using the AHP-ANP Model

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ABSTRACT

low-income groups in developing countries, where residential units constitute a major share of household wealth. In post-revolutionary Iran, rapid population growth, economic instability, and large-scale public housing programs have intensified challenges related to the formation and quality of low-cost housing. Despite extensive governmental interventions, many low-cost housing projects have failed to adequately respond to the socio-economic conditions of their residents. Therefore, this study aims to identify and prioritize the socio-economic factors influencing the formation of low-cost housing architecture after Iran's Islamic Revolution, with a specific focus on the Mehr Housing project in Kerman city. The research adopts a mixed qualitative–quantitative approach and employs integrated fuzzy multi-criteria decision-making models, including the Fuzzy Analytic Hierarchy Process and Fuzzy Analytic Network Process. Data were collected through literature review, expert interviews, and structured questionnaires completed by professionals involved in housing projects. The models were used to determine the relative importance of main criteria and sub-criteria, as well as their internal causal relationships. The findings indicate that contractual indicators play the most critical role in shaping low-cost housing architecture, followed by financial and economic indicators, and technical and technological indicators. Administrative and systematic indicators ranked lowest but were found to have indirect mediating effects. Among sub-criteria, issues such as poor contract management, lack of coordination among contractors, and unfamiliarity of project stakeholders with implementation methods showed the highest influence.The study concludes that low-cost housing should be understood as a complex socio-economic system rather than a purely technical or cost-driven product. Addressing contractual inefficiencies and stabilizing financial mechanisms are essential for improving the quality and sustainability of low-cost housing in Iran.

Running Title: : The Formation of Low-Cost Housing Architecture

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
22	08	24

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INTRODUCTION

The various patterns of contemporary residential architecture reflect deep social, cultural, and economic roots, shaping the way individuals and communities experience built environments (Akinsulire et al., 2024). Housing is a fundamental component for understanding residents' social and economic life, influencing everyday interactions and quality of life (Riazi & Emami, 2018). As one of the essential sectors of development, housing significantly affects urban characteristics, contributing to economic stability, social integration, and environmental outcomes (Riazi & Emami, 2018; Wang & Li, 2024). Satisfaction with housing and its environmental conditions has been shown to influence overall wellbeing and residential stability (Tang, 2024). Despite the centrality of housing, providing adequate housing for all remains a global challenge. Structural imbalances between housing supply and demand, rising costs, and socio economic inequalities have created persistent affordability issues in both developed and developing contexts (Akinsulire et al., 2024; Birkner, 2025). In many countries, these shortages are compounded by inequitable access to services and social exclusion of vulnerable groups (Wang & Li, 2024; Tang, 2024). Urban housing research highlights that residents' satisfaction responds not only to basic shelter provision but also to built environment qualities and neighbourhood conditions including access to amenities, proximity to workplaces, and public services (Mouratidis, 2020). Studies emphasize that location and neighbourhood amenities are central determinants of residential well-being, shaping patterns of daily interaction and mobility that influence overall life quality (Mouratidis, 2020). In this multidimensional view, housing satisfaction emerges as a composite measure of economic security, physical comfort, and socio-spatial interaction within neighbourhoods (Nguyen & Ho, 2025). Structural and spatial attributes such as density, connectivity, and walkability have also been linked to higher satisfaction and accessibility outcomes (Frank & Pivo, 1994). Additionally, multi-context research indicates that community and social support networks within housing environments can mitigate negative effects of economic hardship, reinforcing residents' sense of belonging and social cohesion (Lim, 2025). Housing satisfaction studies in post-industrial cities show how intercultural and social support factors enhance wellbeing for diverse and mobile populations, particularly among foreign residents and migrants in urban cores (Lim, 2025). Such findings underscore the interplay between social integration, policy frameworks, and environmental design in achieving sustainable housing satisfaction outcomes at the neighbourhood and metropolitan levels (Chu, 2025). In Iran, rapid population growth after the Islamic Revolution, coupled with internal migration and socio-economic stressors such as the Iran–Iraq War, placed significant pressure on housing systems (Pouyanmehr & Sadeghi Naeini, 2019). Government responses included large-scale affordable housing initiatives such as the Mehr Housing Project, aimed at expanding housing access for low-income groups (Pouyanmehr & Sadeghi Naeini, 2019). Although Mehr expanded housing supply at scale, research highlights shortcomings related to design quality, infrastructure integration, and resident satisfaction (Ahmadi, 2023; Pouyanmehr & Sadeghi Naeini, 2019). Empirical studies demonstrate that residential satisfaction in affordable housing depends not only on affordability but also on physical characteristics, neighbourhood relations, and environmental quality (Riazi & Emami, 2018; Ahmadi, 2023). For example, surveys in low-cost housing in northern Iran showed that physical features, facilities, and neighbourhood quality significantly influence satisfaction levels among residents (Ahmadi, 2023; Riazi & Emami, 2018). Comparable research in public housing contexts such as Beijing illustrates that the sense of stability and community environment can be more determinative of satisfaction than dwelling characteristics alone (Liu & Ma, 2021). Similarly, findings from subsidized housing estates in post-reform China show that both built environment qualities and social environments including neighbourly relationships and community activities elevate residents' satisfaction levels. These studies reinforce the multidimensional nature of residential satisfaction, where built and social environments interact to influence lived experience outcomes (Tang et al., 2024). International evidence further underscores that residential satisfaction arises through multiple factors including security, access to services, and institutional support structures (Mohit & Al-Khanbashi, 2025). In Malaysia and other tropical low-cost housing environments, socio-demographic variables and spatial constraints shape residents' satisfaction experiences, highlighting the importance of context-sensitive policy approaches (Kuok et al., 2025). Public housing studies highlight the role of neighbourhood environment and allocation schemes on satisfaction outcomes (Li et al., 2015). Research focusing on eco-friendly housing design also reveals that environmental quality, indoor air quality, and sustainable infrastructure positively correlate with residential satisfaction (Wang et al., 2025). Beyond individual determinants, global comparative research shows that affordable housing policies contribute to economic growth, poverty reduction, and social stability when integrated with broader socio-economic frameworks (Akinsulire et al., 2024; Sabah, 2025). Effectiveness of these policies often depends on systemic factors such as accessibility, inclusivity, and sustainability of housing systems across urban contexts (Sabah, 2025; Syed et al., 2025). Sustainable and innovative housing strategies, particularly in African cities, emphasize the need to address both physical quality and socio-economic resilience for low-income households (Kang & Ma, 2024). Moreover, meta-analyses of global urban housing studies show that building quality, green space, and sense of security consistently emerge as critical indicators of residential satisfaction, aligning with international sustainability goals and policy frameworks (Chu, 2025). Large scale housing projects also reveal the complexities in policy implementation, stakeholder coordination, and spatial integration, which ultimately shape residents' lived experiences and satisfaction levels (Storch et al., 2025). Such research underscores the importance of synergizing economic feasibility, social inclusion, and spatial design to enhance housing outcomes for vulnerable populations (Wang & Li, 2024; Sabah, 2025). Given this comprehensive context, the present study aims to explain the relationship between socio-economic component action and property housing syndrome within a low-cost housing model based on interaction theory. Focusing on contemporary residential complexes in Kerman developed after the Islamic Revolution of Iran, this research examines how socio economic structures and spatial design interact to shape residential satisfaction. The study seeks to develop a conceptual model for low cost housing formation and propose design principles that support effective spatial use by analysing the interrelationships among socio economic components within selected samples.

MATERIALS AND METHODS

John Turner (1967, 1978, and 1982) is one of the most authoritative studies in housing policies and programs, discussing housing for the poor. According to this study, governments cannot provide housing for the poor and only provide water, electricity, etc., to the urban poor. Benrooz and Dorit (2009) proposed a comprehensive system for mass custom housing to reduce housing costs. Mary Austin Turner and Thomas Kingsley (2008) studied the housing policy of low-income groups in the United States. Richard Harris and Synovin Giles (2003) described the evolution of international housing policies in three stages, including social housing policy (1945 to 1960), land and services policy (1972-

1980), and empowerment policy (1980 to the present). According to the cases mentioned above, examining low-income housing planning experiences in different countries can explain the appropriate model of low-cost housing planning in Iran.

Methodology

This survey research qualitatively and quantitatively analyzes the role of socio-economic factors in forming low-cost housing architecture, which is applied in terms of objective. Questionnaires will be designed for the executive method of implementing the risk management process. Considering that the optimal decision should be based on a series of criteria in three-dimensional space in multi-criteria decision-making models, there is no hypothesis and hypothetical testing in this research.

The population will include experts and project engineers of commercial, executive, and civil complexes who know and understand the specific conditions of the research (782 people).

The theoretical saturation method will be used to determine the sample size in this study. It has been tried to use experts, managers, engineers, and organizations directly related to the subject. Experts have been purposefully selected so that the expert can provide thoughtful opinions and suggestions. Using Cronbach's number method, the following methods can be used to assess the validity of the questionnaire:

-Cronbach's alpha

-Test-retest

The Cronbach's alpha method will be used for the reliability of the measurement tool, which is one of the most common methods for determining validity using the following equation.

$$r_a = \frac{j}{j-1}\left(1 - \frac{\sum S_j^2}{S^2}\right)$$

DISCUSSION AND FINDINGS

The researcher prepared a frequency distribution table and distribution ratios after collecting, extracting, and classifying the data to analyze the data. The researcher should direct and analyze the information and data according to the objective, responding questions, and testing hypotheses. Multi-criteria decision models, as well as AHP and ANP models with a fuzzy approach, were used to identify the relationships and determine the priority of the criteria of the present study. Microsoft Excel and MATLAB coding software were used to analyze the obtained data, and the results of the analysis are described below.

Identifying the final criteria and sub-criteria

In the first step, five criteria and 19 sub-criteria were identified, shown in Tab. 2.

Table 2: Final criteria and sub-criteria for deciding the project process

Symbol	Criteria	Sub-criteria	Symbol
C1	Financial and economic indicators	How much will the currency and financial fluctuations affect the formation of low-cost housing architecture considering the financial and economic indicators?	S11
		How much will the Financial and temporal incompatibility affect the formation of low-cost housing architecture considering the financial and economic indicators?	S12

C1	Financial and economic indicators	How much will the incorrect timing of the payment affect the formation of low-cost housing architecture considering the financial and economic indicators?	S13
		How much will the fluctuations in material prices affect the formation of low-cost housing architecture considering the financial and economic indicators?	S14
		How much the increase of overhead costs will affect the formation of low-cost housing architecture considering the financial and economic indicators?	S15
		How much will the increase in transportation costs affect the formation of low-cost housing architecture considering the financial and economic indicators?	S16
C2	Contractual indicators	How much will the disproportion of contract and execution affect the formation of low-cost housing architecture considering the contractual indicators?	S21
		How much will the weakness in the contract due to the type of execution affect the formation of low-cost housing architecture considering the contractual indicators?	S22
		How much will the weakness in selecting the right contractor affect the formation of low-cost housing architecture considering the contractual indicators?	S23
		How much will the lack of coordination between parallel contractors affect the formation of low-cost housing architecture considering the contractual indicators?	S24
C3	Technical and technological indicators	How much will the disproportion of design in the correct estimation of cost, time, and resources affect the formation of low-cost housing architecture considering the technical and technological indicators?	S31
		How much the insufficient studies and information on the working conditions of the project site will affect the formation of low-cost housing architecture considering the technical and technological indicators?	S32
		How much will the lack of machinery and tools specific to the execution of work affect the formation of low-cost housing architecture considering the technical and technological indicators?	S33
		How much will the lack or difficulty in securing the specific materials subject to implementation affect the formation of low-cost housing architecture considering the technical and technological indicators?	S34
		How much will the exclusivism in the supply of materials affect the formation of low-cost housing architecture considering the technical and technological indicators?	S35

C4	Administrative and systematic indicators	How much will the lack of coordination between project elements affect the formation of low-cost housing architecture considering the administrative and systematic indicators?	S41
		How much with the unfamiliarity of the project pillars the specific type of implementation will affect the formation of low-cost housing architecture considering the administrative and systematic indicators?	S42
		How much will poor management of project elements affect the formation of low-cost housing architecture considering the administrative and systematic indicators?	S43
		How much will the administrative bureaucracy between the project pillars affect the formation of low-cost housing architecture considering the administrative and systematic indicators?	S44

Determining the priority of model elements using fuzzy AHP technique

The network analysis (AHP) technique was used to determine the weight of model criteria and indicators. The hierarchical model is plotted in Figure 1 using the AHP technique. In addition, the research criteria and sub-criteria are named as Table 2 with a numerical index to be easily traced and studied during the research.(Fig. 1)

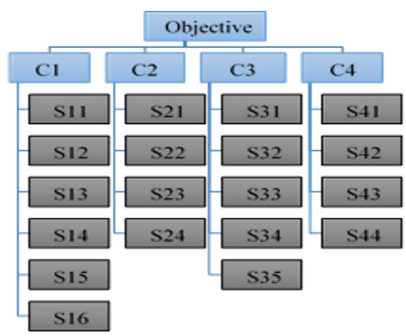

Figure 1: The hierarchical model of research

Table 3: The scale of linguistic variables with fuzzy triangular numbers

Value	Comparison of i to j	Fuzzy numbers			Inverse fuzzy numbers		
		L	m	u	L	m	u
1	Equally Preferred	1	1	1	1	1	1
2	Intermediate	1	2	3	0.333	0.5	1
3	Preferred moderately	2	3	4	0.25	0.333	0.5
4	Intermediate	3	4	5	0.2	0.25	0.333
5	Preferred Strongly	4	5	6	0.166	0.2	0.25

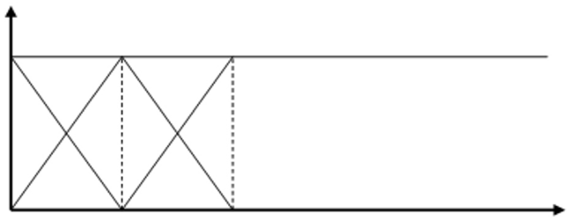

Figure 2: The scale of linguistic variables with fuzzy triangular numbers

The views of experts have been gathered after collecting the experts' opinions by a nine-degree spectrum and fuzzification of experts' opinions using the fuzzy average. The fuzzy average will be calculated as follows to calculate the average of n respondents' opinions:

$$F_i = (l_i m_i u_i)$$

$$fuzzyaverage = \left[\frac{l_1 + l_2 + \cdots + l_n}{n} \frac{m_1 + m_2 + \cdots + m_n}{n} \frac{u_1 + u_2 + \cdots + u_n}{n}\right]$$

The pairwise comparison matrix is given in Table 3 using the fuzzy average of the experts' opinions.

Table 4: Fuzzy average of the priority of the main research criteria

	c1			c2			c3			c4		
c1	1	1	1	7.1	7.6	8.1	6.3	7.0	7.7	4.5	5.4	6.3
c2	0.123	0.132	0.141	1	1	1	0.625	0.667	0.750	0.171	0.210	0.275
c3	0.130	0.143	0.159	1.333	1.500	1.600	1	1	1	0.208	0.269	0.383
c4	0.159	0.185	0.222	3.636	4.773	5.854	2.609	3.723	4.800	1	1	1

The eigenvector is calculated after the formation of the Pairwise Comparison Matrix (PCM).

$$\sum_{j=1}^{n} M_{g_1}^{j}$$

For example, the fuzzy expansion of the first element of the research criterion will be as follows:

$$\sum_{j=1}^{9} M_{g_1}^{j} = (111)\oplus(7,1007,6008,100)\oplus(6,3007,0007,700)\oplus(4,5005,4006,300) = (41,247,253,2)$$

Therefore, the fuzzy expansion of the preferences of each of the main criteria will be as follows:

$$\sum_{j=1}^{n} M_{g_1}^{j} = (41.200,\ 47.200,\ 53.200)$$

$$\sum_{j=1}^{n} M_{g_1}^{j} = (2.686,\ 2.916,\ 3.316)$$

$$\sum_{j=1}^{n} M_{g_1}^{j} = (9.533,\ 11.670,\ 13.870)$$

$$\sum_{j=1}^{n} M_{g_1}^{j} = (20.362,\ 25.337,\ 30.309)$$

Then, the fuzzy sum of the total elements of the preferences column is calculated:

$$\sum_{i=1}^{n} \sum_{j=1}^{n} M_g^j$$

The sum of the elements of the preferences column of the main criteria will be as follows:

$$\sum_{i=1}^{4} \sum_{j=1}^{4} M_g^j = (161{,}731\ 192{,}674\ 223{,}648)$$

The sum of the criterion values must be divided by the sum of all the preferences (column elements) to normalize the preferences of each criterion. The fuzzy sum of each row is multiplied by the inverse of the sum.

$$F_1^{-1} = \left({}^{1}/_{u_1}\ {}^{1}/_{m_1}\ {}^{1}/_{l_1}\right)$$

$$\left(\sum_{i=1}^{n} \sum_{j=1}^{n} M_g^j\right)^{-1} = (0{,}006\ 0{,}005\ 0{,}004)$$

$$S_k = \sum_{i=1}^{n} M * \left(\sum_{i=1}^{n} \sum_{j=1}^{n} M_g^j\right)^{-1}$$

Therefore the results of normalization of the obtained values will be as follows:

C1= (0.184 0.245 0.329)
C2= (0.012 0.015 0.021)
C3= (0.043 0.061 0.086)
C4= (0.091 0.131 0.187)

Each of the obtained values of fuzzy and normalized weight corresponds to the main criteria. There are various methods for defuzzification such as the degree of feasibility and calculating the crisp number. Both the degrees of feasibility and the crisp calculations have been calculated in this study. Finally crisp calculations were used for defuzzification due to the consistency of the results and the simplicity. Defuzzification to calculate the crisp number is as follows:

$$x^1_{max} = \frac{l+m+u}{3}$$
$$x^2_{max} = \frac{l+2m+u}{4}$$
$$x^3_{max} = \frac{l+4m+u}{6}$$

Crisp number = Z* = max = {x_max^1x_max-^2x_max^3 }

The calculations performed to determine the priority of the main criteria are as follows:

Table 5: Defuzzification of normally calculated weights of the main study variables

Crisp	x^1_{max}	x^2_{max}	x^3_{max}	Deffuzy	Normal
C1	0.253	0.250	0.249	0.253	0.244
C2	0.016	0.016	0.016	0.016	0.015
C3	0.063	0.062	0.062	0.063	0.061
C4	0.137	0.135	0.134	0.137	0.132

According to Tab. 5 the eigenvector of the priority of the main criteria will be in the form of W1.

$$W_1 = \begin{pmatrix} 0{,}244 \\ 0{,}015 \\ 0{,}061 \end{pmatrix}$$

According to the eigenvector:

The 1C criterion with a normal weight of 0.442 has the highest priority.

The 4C standard with a normal weight of 0.231 is the third priority.

The 3C standard with a normal weight of 0.160 is the third priority.

The 2C criterion with a normal weight of 0.510 has the lowest priority.

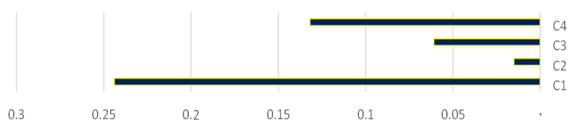

Figure 3: Graphic representation of the priority of the main research criteria

Calculating the incompatibility rate

Trying to calculate the rate of incompatibility with manual calculations will be complicated. The method of calculating the incompatibility rate is explained step by step to get acquainted:

1.In the first step the pairwise comparison matrix of the indicators is multiplied by the obtained relative weights.

2.In the second step the answer is divided by the relative weights of the indicators to obtain the compatibility vector.

3. In the third step the arithmetic mean of the elements of this vector is obtained which is called λ.

4.In the fourth step the incompatibility index is calculated as follows:

$$\Pi = \frac{\lambda - n}{n-1}$$

In the fifth step of the IRI index based on n (number of indicators) the following random matrix is extracted from the incompatibility index table and the incompatibility rate (IR) is calculated from the following equation:

$$IR = \frac{\Pi}{IRI}$$

The table of random matrix incompatibility index is as follows:

Incompatibility index table.(Tab. 5)

The incompatibility rate of the comparisons is 0.07 which is less than 0.1 so the comparisons can be trusted.

Comparison and prioritization of sub-criteria

In the second step of the AHP technique the sub-criteria related to each criterion are compared pairwise. First the calculations performed for the fuzzification of the average opinion of experts are presented in Table 6 to determine the priority of the sub-criteria of the financial and economic index (C1) (given on three variables as an example). Since this criterion consists of three indicators three pairwise comparisons have been performed. The number of experts is 10 to 30 people and ten experts were considered given limited access due to COVID-19. The results of 3 indicators out of 6 initial indicators are presented as examples in Tab. 6.

Table 5:The table of random matrix incompatibility index is as follows

X	14	13	12	11	10	9	8	7	6	5	4	3	2	n
1.59	1.57	1.56	1.48	1.51	1.49	1.45	1.41	1.32	1.24	1.12	0.9	0.58	0	R.I

Table 6: Pair comparison of financial and economic sub-index (1C)

	S11-S12			S11-S13			S12-S3		
Expert 1	1	1	1	025	0334	05	0167	02	025
Expert 2	0167	02	025	4	5	6	4	5	6
Expert 3	1	1	1	2	3	4	2	3	4
Expert 4	1	1	1	1	1	1	1	1	1
Expert 5	4	5	6	4	5	6	6	7	8
Expert 6	1	1	1	1	1	1	1	1	1
Expert 7	0.112	0.112	0.112	1	1	1	9	9	9
Expert 8	1	1	1	1	1	1	1	1	1
Expert 9	2	3	4	0.25	0.334	0.5	1	1	1
Expert 10	0.167	0.2	0.25	0.167	0.2	0.25	4	5	6

CR= 0.083

The experts' opinions were collected using the fuzzy average and the resulting pairwise comparison matrix is shown in Tab. 7.

Table 7: Fuzzy average of financial and economic sub-index priority (C1)

	S11			S12			S13		
S11	1	1	1	1.145	1.351	1.561	1.467	1.787	2.125
S12	0.641	0.740	0.876	1	1	1	2.917	3.320	3.725
S13	0.471	0.560	0.682	0.268	0.301	0.616	1	1	1

The eigenvector is calculated after forming the pairwise comparison matrix. First, the fuzzy sum of each row is calculated. Then, the fuzzy expansion of the preferences of each of the main criteria is as follows:

$\sum_{j=1}^{3} M_{g1}^{j}$= (3.611, 4.138, 4.686)

$\sum_{j=2}^{3} M_{g1}^{j}$= (4.557, 5.060, 5.599)

$\sum_{j=1}^{3} M_{g1}^{j}$ = (1.739, 1.861, 2.025)

The sum of the elements of the preferences column of the main criteria is as follows:

$\sum_{i=1}^{3}\sum_{j=1}^{3} M_{g}^{j}$ = (9,908 11,059 12,310)

$(\sum_{i=1}^{n}\sum_{j=1}^{n} M_{g}^{j})^{-1}$ = (0,081 0,090 0,101)

Therefore the results of normalization of the obtained values are as follows:

S11 = (0.293 0.374 0.473)
S12 = (0.370 0.458 0.565)
S13= (0.141 0.168 0.204)

Each of the obtained values of fuzzy and normalized weight corresponds to the main criteria. Crisp number calculations were used for defuzzification and the results by the Crisp number are as follows:

Table 8: Defuzzification of normal weights calculated by the main variables of the research

	X^1max	X^2max	X^3max	Deffuzy	Normal
S11	0.380	0.379	0.377	0.380	0.374
S12	0.464	0.463	0.461	0.464	0.457
S13	0.171	0.171	0.170	0.171	0.169

According to Table 8 the eigenvector of the priority of the main criterion indices is W1.

$$W_1 = \begin{pmatrix} 0{,}374 \\ 0{,}457 \\ 0{,}169 \end{pmatrix}$$

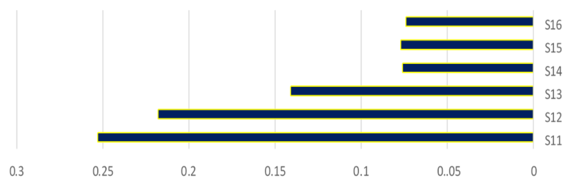

Figure 4: Graphic representation of the priority of the indicators related to the C1 criterion

Repetition of fuzzy calculations was omitted due to its length and the similarity of the steps taken to determine the priority of each of the sub-criteria. In the following the priority of the sub-criteria of each cluster is shown in the form of a graph.

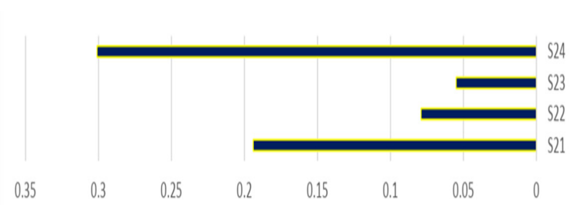

Figure 5: Graphic representation of the priority of the indicators related to the C2 criterion

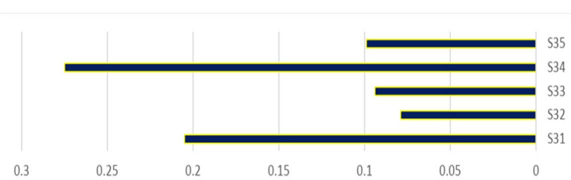

Figure 6: Graphic representation of the priority indicators related to the C3 criterion

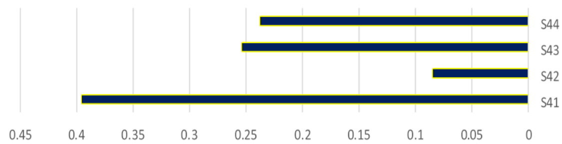

Figure 7: Graphic representation of the priority of the indicators related to the C4 criterion

Calculation of internal relations with FANP technique

The incompatibility rate index is calculated by the software using ANP method and is declared to be used to examine the concept of reliability. This index is designed to show the inconsistency and incompatibility of the experts' answers and in case the incompatibility is higher than the declared quorum (105) it is necessary to re-evaluate. The questionnaire reliability was calculated according to which the incompatibility rate of the comparisons was 0.07 (less than 0.1). Thus the comparisons can be trusted.

Validity

The validity is confirmed considering that the ANP method questionnaire is approved by the subject experts.

The next step of the model is to calculate the internal relationships of the identified indicators to obtain the W22 W main standard relationship matrix. The Fuzzy ANP technique has been used to reflect the internal relationships between the main criteria. Therefore experts can express their views on the effects (effect direction and intensity) among the factors with more mastery. The matrix obtained from the DEMATEL technique (internal management matrix) shows both the causal relationship between the factors and the effectiveness of the variables (Tab. 9).

Linguistic variable	Quantitative equivalent	Equivalent quantitative fuzzy		
		l	m	u
No effect	0	0	0.1	0.3
Low effect	1	0.1	0.3	0.5
Effective	2	0.1	0.5	0.7
High effect	3	0.5	0.7	0.9
Very high effect	4	0.7	0.9	1

Calculation of the direct relation matrix (M) (M)

A simple arithmetic mean of opinions is used in group ANP technique that is when the views of several experts are used to direct relation matrix (M) or M. First the opinion of each expert is fuzzy and the direct correlation matrix or M is calculated by calculating the fuzzy average of the experts' opinion.

Table 10: Fuzzy direct relation matrix (M) (M)

C4	C3	C2	C1	
(0 0.1 0.3)	(0.3 0.5 0.7)	(0.5 0.7 0.9)	(0 0.1 0.3)	C1
(0 0.1 0.3)	(0.1 0.3 0.5)	(0 0.1 0.3)	(0.7 0.9 1)	C2
(0.5 0.7 0.9)	(0 0.1 0.3)	(0.7 0.9 1)	(0.5 0.7 0.9)	C3
(0 0.1 0.3)	(0 0.1 0.3)	(0 0.1 0.3)	(0 0.1 0.3)	C4

Fixing the direct relation matrix

CFCS technique has been used for defuzzification of the direct relation matrix. The CFCS technique is a five-step algorithm as follows:

- Normalization of values

$$xr_{ij}^{n} = (r_{ij}^{n} - minl_{ij}^{n})/\Delta_{min}^{max}$$
$$xm_{ij}^{n} = (m - minl_{ij}^{n})/\Delta_{min}^{max}$$
$$l_{ij}^{n} = (l_{ij}^{n} - minl_{ij}^{n})/\Delta_{min}^{max}$$

- Calculating the upper and lower bounds of normal values

$$xrs_{ij}^{n} = xr_{ij}^{n}/(1 + xr_{ij}^{n} + xm_{ij}^{n})$$
$$xls_{ij}^{n} = xm_{ij}^{n}/(1 + xm_{ij}^{n} + xl_{ij}^{n})$$

- Calculating the total normalized crisp values

$$xl_{ij}^{n} = [xls_{ij}^{n}(1 - xls_{ij}^{n} + xrs_{ij}^{n} \times xrs_{ij}^{n}]/[1 - xls_{ij}^{n} + xrs_{ij}^{n}]$$

- Calculating crisp values (definite)

$$Z_{ij}^{n} = minl_{ij}^{n} + (X_{ij}^{n} \times \Delta_{min}^{max})$$

- Aggregation of fixed values

$$Z_{ij}^{n} = 1/h(Z_{ij}^{1} + Z_{ij}^{2} + \cdots + Z_{ij}^{h})$$

According to the CFCS algorithm, the determined values of the direct management matrix are as

Table 12: Main criteria of direct relation matrix (M)

	C1	C2	C3	C4
C1	0.071	0.917	0.738	0.080
C2	0.738	0.071	0.917	0.080
C3	0.548	0.357	0.071	0.080
C4	0.071	0.071	0.738	0.080

*Calculating the normal direct relation matrix: N = K * M*

First, the sum of all rows and columns is calculated, and the inverse of the largest number of rows and columns k. According to Tab. 13, the largest number is 5.65, and all values are multiplied by the inverse of this number to normalize the matrix.

$$k = \frac{1}{max\sum_{j=1}^{n} a_{ij}} = \frac{1}{5{,}65} = 0{,}177$$
$$\Rightarrow M, N = 0{,}177$$

Table 13: Main criteria of normalized matrix (N)

C1	C2	C3	C4	C5
C2	0.401	5.183	4.173	1.455
C3	4.173	0.401	5.183	0.455
C4	3.096	2.019	0.401	0.455
C5	0.401	0.401	4.173	0.455

Calculating the complete communication matrix

An identity matrix is formed to calculate the complete communication matrix. Then, the identity matrix is deduced by the normal matrix, and the resulting matrix becomes inverted. Finally, the normal matrix is multiplied by the inverse matrix:

$T=N.(1-N)^{-1}$

- Calculating the upper and lower bounds of normal values

$$xrs_{ij}^{n} = xr_{ij}^{n}/(1 + xr_{ij}^{n} + xm_{ij}^{n})$$
$$xls_{ij}^{n} = xm_{ij}^{n}/(1 + xm_{ij}^{n} + xl_{ij}^{n})$$

- Calculating the total normalized crisp values

$$xl_{ij}^{n} = [xls_{ij}^{n}(1 - xls_{ij}^{n} + xrs_{ij}^{n} \times xrs_{ij}^{n}]/[1 - xls_{ij}^{n} + xrs_{ij}^{n}]$$

- Calculating crisp values (definite)

$$Z_{ij}^{n} = minl_{ij}^{n} + (X_{ij}^{n} \times \Delta_{min}^{max})$$

- Aggregation of fixed values

$$Z_{ij}^{n} = 1/h(Z_{ij}^{1} + Z_{ij}^{2} + \cdots + Z_{ij}^{h})$$

According to the CFCS algorithm, the determined values of the direct management matrix are as follows:

Table 14: Main criteria of direct relation matrix (M)

C1	C2	C3	C4	C5
C2	0.071	0.917	0.080	0.080
C3	0.738	0.071	0.917	0.080
C4	0.548	0.357	0.071	0.080
C5	0.071	0.071	0.738	0.080

Network Relation Map

The threshold value must be calculated to determine the network relations map (NRM) in which the partial relationships can be omitted, and a network of significant relationships can be plotted. Only relationships whose values in the T matrix are greater than the threshold value will be displayed in (NRM). The mean of the T-matrix values should be calculated to obtain the relationship threshold. After the threshold intensity is determined (2.653), all values of the matrix T that are smaller than the threshold become zero, i.e., the causal relationship is not considered. The model of the significant relationships is as follows:

Table 15: Significant relationships in the main criteria of the model

C1	C2	C3	C4	C5
C2	×	3.839	3.533	4.422
C3	×	×	3.343	×
C4	×	×	×	×
C5	×	×	×	×

According to the relationship model, a causal diagram can be plotted:

Table 16: Model of causal relationships of criterion selection indicators

C1	D	R	D+R	D-R
Financial and economic indicators	604.23	187.14	791.39	416.9
Contractual indicators	810.15	579.33	389.49	-769.17
Technical and technological indicators	576.10	172.39	748.49	-596.28
Administrative and systematic indicators	-311.31	084.46	697.38	-311.31

Tab. 16 indicates the sum of each row (D) elements as the influence of that factor on other system factors, and the support criterion is the most influential factor. Process metrics are second, followed by change management, knowledge management, and learning with almost similar effects. Administrative and systematic indicators have the least effect.

The sum of the column elements (R) or each factor indicates the extent to which that factor is affected by other factors in the system. Accordingly, the criteria of technical and technological indicators, as well as administrative and systematic indicators, have a very high level of influence, and the criterion of support has the least effect among other criteria.

Final priority of indicators by FAHP technique

One of the limitations of the hierarchical analysis process technique is ignoring the internal relationships of the model elements. The internal priority vectors, i.e., the calculated Ws, are inserted into the appropriate matrix columns to achieve overall priorities in an interacted system. Consequently, a supermatrix (partitioned matrix) is achieved in which each part represents the relationship between two clusters in a system. In other words, the supermatrix is a matrix of relationships between network components obtained from the priority vectors of these relationships. This matrix provides a framework for determining the relative importance of options after pairwise comparisons.

An unweighted supermatrix is obtained based on the calculations performed in the first to fourth steps. In the next step, the unweighted supermatrix is transformed into a weighted supermatrix using the concept of normalization. The sum of the elements of all the columns becomes equal to one in the weighted supermatrix. The next step is to calculate a limited supermatrix by the exponentiation of all the elements of the weighted supermatrix. This operation is repeated until all the elements of the supermatrix are similar. In this case, all entries of the supermatrix will be equal to zero, and only subcriteria entries will be repeated in all rows related to that element. The limited matrix calculated in MATLAB is as follows:

Table 17: Final weight of indicators based on limited supermatrix

symbol	Description of the index	Total weight	Normal weight	Rank
S11	How much will the currency and financial fluctuations affect the formation of low-cost housing architecture considering the financial and economic indicators?	0,0065	0,0069	14
S12	How much will the Financial and temporal incompatibility affect the formation of low-cost housing architecture considering the financial and economic indicators?	0,0026	0,0028	17

S13	How much will the incorrect timing of the payment affect the formation of low-cost housing architecture considering the financial and economic indicators?	0,0019	0,0020	18
S14	How much will the fluctuations in material prices affect the formation of low-cost housing architecture considering the financial and economic indicators?	0,0101	0,0108	12
S15	How much will the increase of overhead costs affect the formation of low-cost housing architecture considering the financial and economic indicators?	0,0043	0,0045	15
S16	How much will the increase in transportation costs affect the formation of low-cost housing architecture considering the financial and economic indicators?	0,0016	0,0017	18
S21	How much the disproportion of contract and execution will affect the formation of low-cost housing architecture considering the contractual indicators?	0,0334	0,0354	6
S22	How much will the weakness in the contract due to the type of execution affect the formation of low-cost housing architecture considering the contractual indicators?	0,0130	0,0138	11
S23	How much will the weakness in selecting the right contractor affect the formation of low-cost housing architecture considering the contractual indicators?	0,0153	0,0163	10
S24	How much will the lack of coordination between parallel contractors affect the formation of low-cost housing architecture considering the contractual indicators?	0,0449	0,0476	3
S31	How much will the disproportion of design in the correct estimation of cost, time, and resources affect the formation of low-cost housing architecture considering the technical and technological indicators?	0,0445	0,0472	4
S32	How much the insufficient studies and information on the working conditions of the project site will affect the formation of low-cost housing architecture considering the technical and technological indicators?	0,0095	0,0101	13
S33	How much will the lack of machinery and tools specific to the execution of work affect the formation of low-cost housing architecture considering the technical and technological indicators?	0,0285	0,0303	7
S34	How much will the lack or difficulty in securing the specific materials subject to implementation affect the formation of low-cost housing architecture considering the technical and technological indicators?	0,0268	0,0284	8

S35	How much will the exclusivism in the supply of materials affect the formation of low-cost housing architecture considering the technical and technological indicators?	0,0031	0,0033	16
S41	How much will the lack of coordination between project elements affect the formation of low-cost housing architecture considering the administrative and systematic indicators?	0,0406	0,0431	5
S42	How much will the unfamiliarity of the project pillars with the specific type of implementation affect the formation of low-cost housing architecture considering the administrative and systematic indicators?	0,0863	0,0916	1
S43	How much will poor management of project elements affect the formation of low-cost housing architecture considering the administrative and systematic indicators?	0,0610	0,0648	2
S44	How much will the administrative bureaucracy between the project pillars affect the formation of low-cost housing architecture considering the administrative and systematic indicators?	0,0163	0,0173	9

MATLAB output can be used to determine the final priority of criteria and sub-criteria based on calculations and the limited supermatrix.
The final weight of each model index is calculated by the FAHP technique according to the calculations. The comparison of the FAHP technique with the output of the FANP technique indicates the change in importance and rank of study indicators by considering the internal relations of research variables. The weight of the indicators changes under the pairwise comparison between the variables, and a pairwise comparison leads to more accurate weight. For this purpose, the calculated weights for the indicators can determine the priority with a technique, such as ANP.

Selection by ANP technique
The ANP technique proposed by Huang and Yoon (1891) was used to select the essential criteria in a case study. This method is one of the best multi-criteria decision-making methods to choose the best solution, which is the greatest distance from the negative factors and the least distance from the positive factors.
Forming a Decision Matrix:
Table 2 represents 19 indicators for decision-making, and the scoring matrix of options is based on the criteria. The experts' opinions and the Likert spectrum were used to score the options based on each indicator. Fuzzy values equivalent to each response are used according to Tab. 18 and Fig. 8.

Table 18: Valuation of indicators towards each other

Verbal variable	Fuzzy number	l	m	u
very low	(0, 0, 0.25)	0	0	0.25
Low	(0,0.25,0.5)	0	0.25	0.5
Moderate	(0.25, 0.5, 0.75)	0.25	0.5	0.75
High	(0.5, 0.75, 1)	0.5	0.75	1
Very high	(0.75, 1, 1)	0.75	1	1

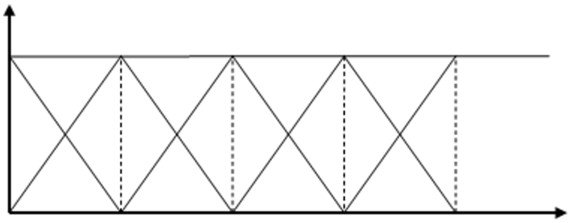

Figure 8: Triangular fuzzy numbers in the valuation of indicators towards each other

The decision matrix with n indicators and m options will be calculated as follows:

$$\tilde{D} = \begin{bmatrix} \widetilde{x_{11}} & \widetilde{x_{12}} & \dots & \widetilde{x_{1n}} \\ \widetilde{x_{21}} & \widetilde{x_{22}} & \dots & \widetilde{x_{2n}} \\ , & , & , & , \\ , & , & , & , \\ , & , & , & , \\ \widetilde{x_{m1}} & \widetilde{x_{m2}} & \dots & \widetilde{x_{mn}} \end{bmatrix}$$

$$\widetilde{w} = \widetilde{w1}\widetilde{w2} \dots \widetilde{w}n$$

In which n is the number of decision indicators (44) m is the number of decision options (9) and the decision matrix is D9.44. In the second step decision matrix descaling is done with the norm shown by N and each entry is indicated by nij. Each nij is calculated by dividing the corresponding entry in the initial matrix by the square root of the squares of the corresponding column entries and is calculated as follows:

$$n_{ij} = \frac{a_{ij}}{\sqrt{\sum_1^m a_{ij}^2}}$$

The following equation is used to normalize when the fuzzy approach with fuzzy triangular numbers is used:

$$d_{ij} = (l_{ij} m_{ij} u_{ij})$$

$$n_{ij} = \left({}^{l_{ij}}/_{u_{ij}} \, m_{ij} \, {}^{u_{ij}}/_{u_{ij}} \right)$$

The following equation can also be used:

$$\tilde{R} = [\tilde{r}_{ij}]$$

$$\tilde{r}_{ij} = \left(\frac{a_{ij}}{c_j^*} \frac{b_{ij}}{c_j^*} \frac{c_{ij}}{c_j^*} \right)$$

In the third step the descaled weighed fuzzy matrix V̆ should be formed. Having the weights of the indicators represented by the vector (w_ij ̆):

$$\tilde{V} = [\widetilde{V_{ij}}]_{m \times n} i = 12 \dots mj = 12 \dots n$$

$$\widetilde{V_{ij}} = \widetilde{n_{ij}}, \widetilde{w_{ij}}$$

The following equation can also be used:

In this step the descaled matrix (N) must be converted to a descaled weighed matrix (V). The weights of the indicators should be applied to achieve the descaled weighed matrix. The weight of each indicator is calculated using the Fuzzy Network Analysis (FAHP) technique which is shown in Table 16. To this end the descaled matrix is multiplied by the square matrix (Wn.n) whose main diameter elements are the weights of the indicators and the other elements are zero. The resulting matrix is the descaled weighed matrix (V) (Momeni and Sharifi 2018: 153).

$V = N.W_{nxn}$

In the next step the positive and negative ideals must be calculated:

$$A^+ = (\tilde{V}_1^* \tilde{V}_2^* \dots \tilde{V}_n^*)$$

$$A^- = (\tilde{V}_1^- \tilde{V}_2^- \dots \tilde{V}_n^-)$$

For this purpose the V-matrix is first defuzzification and then the positive and negative ideals are calculated using the following equations.

The positive ideal is the largest value of the corresponding column in the matrix v for each positive index.

The positive ideal is the smallest value of the corresponding column in the matrix v for each positive index.

The negative ideal is the smallest value of the corresponding column in the matrix v for each positive index.

The negative ideal is the largest value of the corresponding column in the matrix v for each positive index.

The distance of each option from the positive and negative ideal is displayed with d+ and d- respectively.

$$d_i^* = \sum_{j=1}^n d(\tilde{v}_{ij} - v_{ij}^*) i = 12 \dots m$$

$$d_i^- = \sum_{j=1}^n d(\tilde{v}_{ij} - v_{ij}^-) i = 12 \dots m$$

The final step is to calculate the ideal solution. In this step the relative proximity of each option to the ideal solution is calculated by the following equation:

$$CL_i^* = \frac{d_i^-}{(d_i^- + d_i^+)}$$

The value of CL is between zero and one and the closer this value is to one the closer the solution is to the ideal solution.

The collected data are given ad decision matrix in Tab. 19 after forming the decision matrix (D9.44) and obtaining the experts' opinions.

Table 19: A. Evaluation matrix before fuzzy

	S11	S12	S13	S14	S15	S16	S21	S22	S23	S24
C1	2	5	3	3	4	4	1	3	2	3
C2	4	2	3	1	4	1	3	2	4	2
C3	4	5	3	1	3	3	5	1	4	5
C4	1	1	3	4	4	2	2	5	1	1
C1	S31	S32	S33	S34	S35	S41	S42	S43	S44	
C2	4	1	4	4	1	1	4	1	4	
C3	1	4	4	2	2	4	3	5	4	
C4	4	4	1	2	4	1	1	2	4	

Table 20: B- Evaluation fuzzy matrix

	S11			S12			S13			S14		
c1	0	0.25	0.5	0.75	1	1	0.25	0.5	0.75	0.25	1.5	0.75
c2	0.5	0.75	1	0	0.25	0.5	0.25	0.5	0.75	0	0	0.25
c3	0.5	0.75	1	0.75	1	1	0.25	0.5	0.75	0	0	0.25
c4	0	0	0.25	0	0	0.25	0.25	0.5	0.75	0.5	0.75	1
	S15			S16			S21			S22		
C1	0.5	0.75	1	0.5	0.75	1	0	0	0.25	0.25	0.5	0.75
C2	0.5	0.75	1	0	0	0.25	0.25	0.5	0.75	0	0.25	0.5
C3	0.25	0.5	0.75	0.25	0.5	0.75	0.75	1	1	0	0	0.25
C4	0.5	0.75	1	0	0.25	0.5	0	0.25	0.5	0.75	1	1
	S23			S24			S31			S32		
C1	0	0.25	0.5	0.25	0.5	0.75	0.5	0.75	1	0	0	0.25
C2	0.5	0.75	1	0	0.25	0.5	0	0	0.25	0.5	0.75	1
C3	0.5	0.75	1	0.75	1	1	0.5	0.75	1	0.5	0.75	1
C4	0	0	0.25	0	0	0.25	0	0.25	0.5	0	0.25	0.5
	S33			S34			S35			S41		
C1	0.5	0.75	1	0.5	0.75	1	0	0	0.25	0	0	0.25
C2	0.5	0.75	1	0	0.25	0.5	0	0.25	0.5	0.5	0.75	1

C3	0	0	0.25	0	0.25	0.5	0.5	0.75	1	0	0	0.25
C4	0	0	0.25	0	0	0.25	0.25	0.5	0.75	0.25	0.5	0.75
	S42			S43			S44					
C1	0.5	0.75	1	0	0	0.25	0.5	0.75	1			
C2	0.25	0.5	0.75	0.75	1	1	0.5	0.75	1			
C3	0	0	0.25	0	0.25	0.5	0.5	0.75	1			
C4	0.5	0.75	1	0.75	1	1	0	0	0.25			

The next step is to calculate the descaled matrix by ANP software output for N descaled matrix:

Table 21: Descaled decision matrix

	S11			S12			S13			S14		
c1	0.00	0.50	1.00	0.75	1.00	1.00	0.33	0.67	1.00	0.33	0.67	1.00
c2	0.50	0.75	1.00	0.00	0.50	1.00	0.33	0.67	1.00	0.00	0.00	1.00
c3	0.50	0.75	1.00	0.75	1.00	1.00	0.33	0.67	1.00	0.00	0.00	1.00
c4	0.00	0.00	1.00	0.00	0.00	1.00	0.33	0.67	1.00	0.50	0.75	1.00
	S15			S16			S21			S22		
C1	0.50	0.75	1.00	0.50	0.75	1.00	0.00	0.00	0.25	0.25	0.50	0.75
C2	1.00	1.50	2.00	0.00	0.00	0.50	0.50	1.00	1.50	0.00	0.50	1.00
C3	0.25	0.50	0.75	0.25	0.50	0.75	0.75	1.00	1.00	0.00	0.00	0.25
C4	2.00	3.00	4.00	0.00	1.00	2.00	0.00	1.00	2.00	3.00	4.00	4.00
	S23			S24			S31			S32		
C1	0.00	0.25	0.50	0.25	0.50	0.75	0.50	0.75	1.00	0.00	0.00	0.25
C2	1.00	1.50	2.00	0.00	0.50	1.00	0.00	0.00	0.50	1.00	1.50	2.00
C3	0.50	0.75	1.00	0.75	1.00	1.00	0.50	0.75	1.00	0.50	0.75	1.00
C4	0.00	0.00	1.00	0.00	0.00	1.00	0.00	1.00	2.00	0.00	1.00	2.00
	S33			S34			S35			S41		
C1	0.00	0.75	1.00	0.50	0.75	1.00	0.00	0.00	0.25	0.00	0.00	0.25
C2	1.00	1.50	2.00	0.00	0.50	1.00	0.00	0.50	1.00	1.00	1.50	2.00
C3	0.50	0.00	0.25	0.00	0.25	0.50	0.50	0.75	1.00	0.00	0.00	0.25
C4	0.00	0.00	1.00	0.00	0.00	1.00	1.00	2.00	3.00	1.00	2.00	3.00

	S42			S43			S44			
C1	0.50	0.75	1.00	0.00	0.00	0.25	0.50	0.75	1.00	
C2	0.50	1.00	1.50	1.50	2.00	2.00	1.00	1.50	2.00	
C3	0.00	0.00	0.25	0.00	0.25	0.50	0.50	0.75	1.00	
C4	2.00	3.00	4.00	3.00	4.00	4.00	0.00	0.00	1.00	

In the third step a weighed descaled matrix defuzzification is done and shown in Tab. 22:

Table 22: Defuzzificated weighed descaled matrix

V	S11	S12	S13	S14	S15	S16	S21	S22	S23	S24	S31	S32	S33	S34	S35	S41	S42	S43	S44
C1	0.021	0.048	0.012	0.011	0.033	0.006	0.000	0.005	0.002	0.002	0.003	0.000	0.003	0.002	0.000	0.000	0.001	0.000	0.003
C2	0.031	0.025	0.012	0.003	0.066	0.001	0.012	0.005	0.010	0.002	0.000	0.005	0.007	0.002	0.003	0.004	0.002	0.021	0.007
C3	0.031	0.048	0.012	0.003	0.022	0.004	0.011	0.000	0.005	0.003	0.003	0.003	0.000	0.001	0.005	0.000	0.000	0.003	0.003
C4	0.007	0.008	0.012	0.012	0.132	0.008	0.012	0.039	0.001	0.001	0.004	0.003	0.001	0.001	0.014	0.006	0.006	0.041	0.001

The distance of each option from the positive and negative ideal is calculated after r calculating the weighted descaled matrix. First positive and negative ideals are obtained:

V^+ = 0.031 0.048 0.014 0.012 0.132 0.008 0.012 0.039 0.010 0.003 0.004 0.005 0.007 0.002 0.014 0.006 0.006 0.041 0.007

V^- = 0.007 0.008 0.003 0.003 0.011 0.001 0.000 0.000 0.001 0.001 0.000 0.000 0.000 0.001 0.000 0.000 0.000 0.000 0.001

The distance of each option of positive ideal from d+ and negative ideal from d- is demonstrated. The relative proximity of each option to the ideal solution is calculated to achieve the ideal solution. The closer the CL value is to one the more the criterion is closer to the ideal solution as the more important criterion.

ANP output for these equations is as follows:

Table 23: Distance of each option from the positive ideal and the negative ideal

	d^+	d^-	value CL
C1	0.114	0.304	0.728
C2	0.372	0.228	0.228
C3	0.277	0.092	0.248
C4	0.260	0.149	0.364

The calculated values in Tab. 23 indicated factor C1 as the most important option regarding the financial and economic index.

DISCUSSION AND FINDINGS

This research investigated the socio-economic factors influencing the formation of low-cost housing architecture after Iran's Islamic Revolution with a focus on the Mehr Housing project in Kerman. Using an integrated fuzzy AHP and ANP approach the study identified screened and prioritized the effective indicators through a combination of literature review expert interviews and questionnaire-based evaluations. In addition cause–effect relationships among the indicators were analyzed using a CRM-based network framework to capture the complex interdependencies within the housing system. The results of the prioritization process presented in Tab. 23 indicate that contractual indicators rank as the most influential factor in shaping low-cost housing architecture followed by financial and economic indicators and technical and technological indicators while administrative and systematic indicators occupy the lowest rank. This ranking demonstrates that the challenges of low-cost housing in post-revolutionary Iran are rooted primarily in institutional and economic structures rather than solely in technical or physical design limitations. The dominance of contractual indicators highlights the critical role of contract structure contractor selection and coordination among parallel executors in determining housing outcomes. Weak contractual frameworks intensify financial risks and contribute to inefficiencies during implementation ultimately affecting spatial quality and construction performance. Financial and economic indicators ranked second act as fundamental drivers within the system influencing other criteria through currency fluctuations rising material and transportation costs payment delays and budgetary instability. These factors directly constrain architectural flexibility and reinforce standardized inflexible housing solutions. Technical and technological indicators although ranked third were found to be highly dependent on financial and contractual conditions. This finding suggests that technical deficiencies in low-cost housing projects are largely symptomatic of upstream economic and institutional problems rather than independent causes. Administrative and systematic indicators despite their lower rank play a mediating role by translating macro-level policies into operational practices; inefficiencies in this domain exacerbate coordination problems and limit effective project management. A comparison of the present findings with previous studies as summarized in Tab. 24 confirms both the consistency and the distinct contribution of this research. While the high importance of financial and economic indicators aligns with earlier studies by Soto Bican and Mualam the prioritization of contractual indicators as the most critical factor represents a notable distinction. This difference reflects the contextual conditions of post-revolutionary housing policies in Iran and the specific implementation challenges observed in the Mehr Housing project in Kerman. Unlike previous research that primarily focused on financial indicators to identify optimal suppliers or cost-efficient solutions this study emphasizes the causal mechanisms underlying financial indicators and their interaction with contractual technical and administrative factors. By adopting a system-oriented analytical framework the research provides a more comprehensive understanding of how socio-economic structures shape low-cost housing architecture and influence residents' lived experiences. Overall the findings underscore that low-cost housing architecture should be approached as a multidimensional socio-economic system rather than a purely physical or cost-driven product. Addressing contractual inefficiencies stabilizing financial mechanisms and aligning technical capacities with institutional frameworks are essential steps toward improving the quality functionality and social sustainability of low-cost housing in post-revolutionary Iran.

Table 24: Prioritization of main criteria

Main indicators	Final rank
Contractual indicators	1

Financial and economic indicators	2
Technical and technological indicators	3
Administrative and systematic indicators	4

The research results can be confirmed in comparison with the results of other types of research.

Table 25: Comparison of research results with other types of research

Indicators	Rank in the present study	Bican	Soto	Lucchi	Mualam
Contractual indicators	2	2	2	4	2
Financial and economic indicators	1	1	3	1	1
Technical and technological indicators	3	Not available	Not available	Not available	3
Administrative and systematic indicators	4	11	8	Not available	4

Many studies were conducted on financial indicators of low-cost housing after Iran's Islamic Revolution to select the best supplier. However this study evaluated the factors causing financial indicators of low-cost housing after Iran's Islamic Revolution in Kerman which can make it different compared to previous studies. Considering the evaluation of financial indicators of low-cost housing after Iran's Islamic Revolution in Kerman the indicators of other sections are recommended to be investigated. Future studies are recommended to examine managerial facilities and structures and their effect on the financial indicators of low-cost housing after the Islamic Revolution of Iran.

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