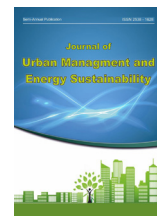


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## ORIGINAL RESAERCH PAPER

### Low-cost Housing Model Considering Economic-Social Factors (Case Study: The Architecture of Kerman's Contemporary Residential Buildings)

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#### ABSTRACT

Housing is the particular center of people's activity and a part of Iranian society's identity according to their social, economic, and cultural conditions. Socio-economic concerns have always been significant in residential complexes, but they are particularly vital in low-cost housing, such as Maskan-e-Mehr, because of the complex's isolation from the city and the residents' lack of familiarity. Therefore, social continuity is not formed, and people ignore improving their living conditions. This study aimed to evaluate the low-cost housing indicators and the influence of socio-economic factors on its models in Kerman, Iran, considering that because of real estate housing syndrome, socio-economic factors produce quantitative and qualitative indicators of low-cost housing. This case study was conducted using various information sources with qualitative and quantitative results, and the data were analyzed using ANP and AHP methods. The research objective was to provide a low-cost housing formation model considering economic-social factors. The results showed that the administrative bureaucracy sub-criteria are the most effective among the project's components. The sub-criteria of weakness in the contract due to execution type, contract incompatibility, exclusivity in material supply, and transportation costs were placed in the following priorities.

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## 1. INTRODUCTION

One of the critical elements in comprehending the citizens' total social, cultural, and economic existence is the house. According to the entirety of the social, cultural, and economic systems dominating society, several aspects of residential spaces are researched among people of any ethnicity or nation (Kami Shirazi et al., 2017). The housing sector can be regarded as one of the most critical areas of development in a society because it encompasses a wide range of economic, social, cultural, environmental, and physical aspects that serve to comprehensively represent the characteristics and image of the society as a whole (Azizi, 2004). Despite the significance of housing in human life, it is currently a challenge for human civilizations to provide adequate shelter for everyone (Shwai, 1996). The populace shifted from the war-torn areas to the major cities at that time due to the Islamic Revolution's victory and the imposed war on Iran. The problems mentioned above, together with the effects of the conflict and the government's economic policies, presented significant challenges for the policies of adjustment or liberalization of large cities, particularly in terms of housing for this expanding population (Gassem Sharifi, 2018). In the housing market, there is an imbalance between supply and demand. Due to the economic circumstances in the socio-economic group with the lowest average income, there is a considerable demand for small and inexpensive homes (Chegini, 2016). The low-cost housing concept has recently attracted attention because it affects tenants' quality of life, psychological issues, and cultural-social repercussions on the urban texture and landscape. The process of providing housing in the post-revolutionary era to grant concessions in line with the ruling vision for homeownership and the provision of private housing for the public based on the dominant culture is evident and has been given the name "property housing syndrome" due to the lack of consistency expected from the government for actions based on planning. All recurring initiatives continued the goal of as-

sisting a specific population in becoming homeowners, which resulted in the "Moskan-e Mehr" project. This scheme reinstated a precise understanding of housing in the form of property that was neither practical nor effective. In terms of the scope of their actions and duties, no government specifically mentions such a pledge in any of the descriptions of their obligations (<http://www.ireconomy.ir>). The spatial organization of Moskan-e Mehr Kerman has nothing to do with the customs and conduct of its inhabitants. As a result, a conflict has developed between the inconsistently planned space and its users' various behavior patterns and lifestyles, resulting in a lack of a sense of community and encouraging both mass migration and the selling of homes by their owners (Heidari, 2014). Due to the project's size, quick implementation, significant impact on people's residential and urban cultures, social works, and significant repercussions in many disciplines, it is deemed that performing this research is necessary. Socio-economic concerns are usually crucial in residential developments, but because Moskan-e Mehr is low-cost housing isolated from the city and its unfamiliar population, this aspect is much more critical. As a result, social continuity does not develop, and residents do not care about preserving and enhancing their living space. This study used a low-cost housing model based on Parsons' interaction theory to explain the connection between the interaction of socio-economic factors and real estate syndrome. Due to the impact of social and economic problems and the considerable obstacles of this time, the architecture of the modern residential buildings in Kerman, Iran, is the examined case. By elucidating the economic-social components and confirming their ratios and other side components, it is possible to create a low-cost house formation model and improved design principles for architects. So, the research question is: How is the model of low-cost housing formed based on economic-social factors? What are the socio-economic factors in low-cost housing formation? How vital is each economic-social factor in low-cost housing formation?

And how is the prioritization of economic-social factors in low-cost housing formation? In that way we have a hypothesis “Socio-economic factors generate quantitative and qualitative indicators of low-cost housing due to the creation of real estate housing syndrome”

The decrease in the percentage of property housing syndrome with quantitative and qualitative indicators in low-cost housing is as follows:

**MATERIALS AND METHODS**

Theoretical Foundations and research literature

According to Saif al-Dini (1994), low-cost housing focuses on the housing requirements of low-income Iranian households and offers adequate living and residential conditions

with the bare minimum of amenities for the occupants’ material and spiritual development. According to Ahari et al. (1988), fulfilling these residential demands must not fall short of the bare minimum necessary-residential requirements and must be appropriate to the amenities, possessions, and social rights of the individual and his family. There were two methods used to implement the low-cost housing construction policy.

- Public house construction (governmental): Public housing was a policy adopted by governments to deal with inadequate housing and build conventional housing for the residents of slums and shacks following the reconstruction or renovation projects of urban areas (Lakoyan, 1985).

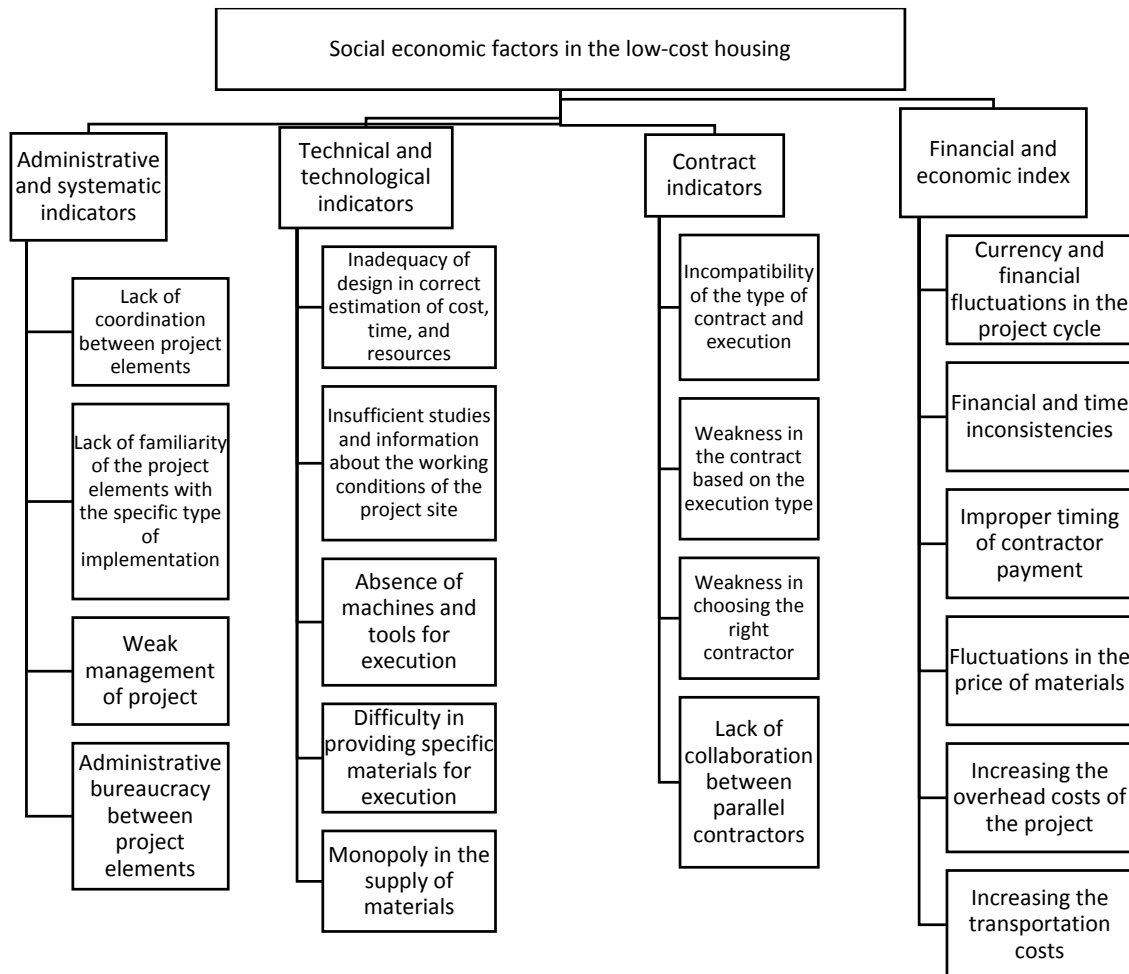


Figure 1. Conceptual model of research

- People house construction: Poor people react differently regarding meeting their shelter needs: creating slums and marginalization. Constructions against the law or on private property without the owner's consent are considered marginalization. Slums, on the other hand, are stable structures under poor conditions due to factors such as construction tolerance, abandonment, and subdivision, which place much strain on the building's essential facilities and equipment.

From a physical perspective, housing has a distinct body with distinct qualities considered a structural unit of the city body. Housing indicators, therefore, address the internal body and the link between this body and other bodies nearby (Azizi, 2004). Physical indicators include housing models (bungalows, apartments, complexes, high-rises), development models, building densities, and occupancy levels (Azizi, 2004; Saeedi, 2004). The housing industry is also regarded as a social, economic, and productive investment. Some of the housing economic indicators are the land price index, the wholesale and retail price index of construction materials, the ratio of housing cost to household income, the ratio of housing cost to the total household cost, and the price index of construction services and labor (Gholipour, 2010).

Social indicators for housing focus on the standard of living and conformity with applicants' social and cultural needs, including housing needs, annual household growth rate, number of households, and urbanization ratio (Azizi, 2004).

Housing planning experiences in Germany

The Weimar Republic's government was crucial to housing provisions following World War One. After World War II, the government attempted to solve the issue by offering social housing. The government's policy was to delegate tasks to the private sector and assist it beginning in the 1950s. The development of house building, the regulation of land use rules, the rehabilitation and revival of dilapidated structures, and the growth of residential units were all outcomes of

housing planning during this time. By balancing the number of houses and households, the government has recently intervened in houses using market policy. More government engagement is required to promote private home ownership and determine the rent in the private housing sector (Ahari and Amini, 1996).

Housing planning experiences in America

The increase in the urban population and the growth of slum regions filled with shacks created a need for more significant government intervention in the housing market. As a result, in 1938, the first government housing program was approved, and housing planning was done to enhance the living conditions of low-income urban populations. In the middle of the 1950s and the beginning of the 1960s, numerous regulations were created to regulate government housing rents and government subsidies. The government's housing programs were unsuccessful because American households can have different choices in housing and tend to live in bungalows. For this reason, the government tried to hand over the housing sector to private producers since the late 1970s (ibid).

Housing planning experiences in China

Since the Chinese revolution, the government has been in charge of two vital housing-related tasks: the concentration of decisions regarding housing allocation and construction and the expansion of housing services with low rents, similar to those in socialist countries. In China's steady history of housing policy, three distinct periods may be identified: the Commodity Economy Policy (1949–1957), the Social Welfare Policy (1956–1979), and the time between the Social Welfare Policy and the Commodity Economy Policy. Since the 1960s, the government has held a significant portion of the housing stock in urban areas. The federal government, local governments, and executive branches are in charge of most housing investment, development, delivery, maintenance, and management. The rapid population expansion in China and a lack of funding for house building are two factors

many analysts point to as the cause of the housing shortages (Lahotifar, 2002). The government debated the commercialization of the housing industry between 1980 and 1982 and launched a reform movement in the rent-to-own and for-sale residential sectors. Two critical variables reportedly influence the commercialization of housing in cities Low pay and an inadequate investing system make it difficult for purchasers to purchase a home. The government began to recognize the importance of banks in the middle of the 1980s, and banks started to repay low-interest loans frequently (Ahari and Amini, 1996). Housing planning experiences in Sri Lanka The Rent Control Act was passed in the initial years following Sri Lanka's independence in 1948. However, the housing sector had fewer investment opportunities due to the unstable economic environment. In the 1950s, the government passed tax incentives for new and larger residences and rent control exemptions. In 1953, the government took over the obligation to provide housing for the employees. Laws governing housing programs, such as rent control, house price limitations, and restrictions on apartment ownership, were approved between 1971 and 1977. The objectives of all housing planning were to prevent several households from occupying a single residential unit and to replace temporary and semi-permanent homes with new and standard homes. Due to the program's failure until the end of 1977, urban low-income groups devised the construction of sheds as a solution to their difficulties as part of the (upgrading sheds and huts) program to find a solution within the resources and facilities of the government. This program solved the problem of rent in low-income households. The construction of 100,000 residential units in the period (1938-1978) was an effective program proposed in the field of housing after 1977. The other program was one million housing units with minimum governmental intervention. In this project, users make decisions, and the government only provides the necessary information and support, and a de-

centralized executive system is used (Lahotifar, 2002).

#### Methodology

This case study used qualitative and quantitative questionnaires based on different data to analyze extensive information. The primary goal was to create a unique, low-cost housing model that could be used in the correct direction of modern low-cost home architecture in the top echelons of the hierarchical structure. Different aspects of the topic have mutual influences. Hence the Analytical Hierarchy Process (AHP) method was employed. The general aspects of design as economic-social elements that affect design are on the next level, and there is a place for indicators connected to those factors as well as practical development plans. This descriptive-analytical, applied, and survey used library and field methods to collect data from architectural engineers of low-cost housing (782 people), and the theoretical saturation method was used to determine the sample size. The data were analyzed using MATLAB software, and T and Pearson tests were utilized to determine the relationship between the variables. Low-cost housing in the post-revolutionary period of Iran in Kerman was chosen as the unit of statistical analysis, and the time domain of that period was considered after the Islamic Revolution of Iran.

## **DISSCOUSION AND FINDINGS**

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### *Data Analysis*

- Identification of final criteria and sub-criteria Initially, the research criteria and sub-criteria were selected. Table 1 shows five criteria, and 19 sub-criteria have been used.

- Using fuzzy AHP to determine model priority The weight of the model's criteria and indicators and that of the hierarchical model were determined using the network analysis technique (AHP). Prioritizing the main criteria based on the objective First, the main criteria were compared in pairs based on the purpose of network analysis using the experts' opinions, which were quantified using a fuzzy scale. The opinion of the experts was

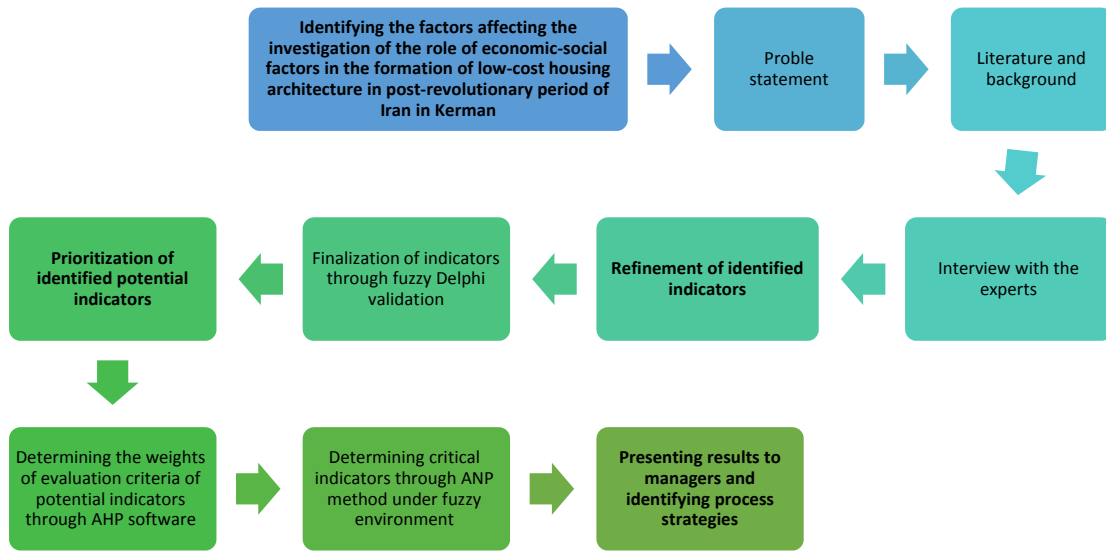


Figure 2. The qualitative structure of the research method

gathered with a spectrum of nine-hour degrees and fuzzifying the opinion of the experts and using the fuzzy average. The particular vector was calculated after forming the matrix of the obtained pairwise comparisons. The degrees of feasibility were calculated, and Crisp number calculations were used for defuzzification based on compatibility and ease of understanding (Figure 3).

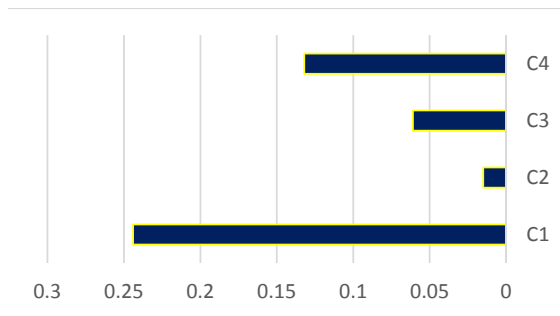


Figure 3. The priority of the main criteria

C1 Criterion using a normal weight, as much as 0.244, has the highest priority.

C4 Criterion using a normal weight, as much as 0.132, is the second priority.

C3 Criterion using a normal weight, as much as 0.061, is the third priority.

C2 Criterion using a normal weight, as much as 0.015, has the lowest priority.

There was an inconsistency rate of 0.07, smaller than 0.1, so the comparisons can be trusted.

Prioritization of sub-criteria

The sub-criteria related to each criterion were compared in pairs in the second step of the AHP technique. The number of experts was 10 to 30, 10 of whom participated due to COVID-19, and the results of three indicators out of six primary indicators were presented (Table 2).

The opinion of experts was aggregated using the fuzzy average. The particular vector was calculated after forming the matrix of the obtained pairwise comparisons. Crisp number calculations were used to de-fuzzify the values. Defuzzifying using Crisp number results are presented in the following:

	X1max	X2max	X3max	Deffuzzy	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

Table 3. Defuzzification of the calculated normal weights of the main variables



	S11-S12			S11-S13			S12-S13		
Expert 1	1	1	1	0.25	0.334	0.5	0.167	0.2	0.25
Expert 2	0.167	0.2	0.25	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

Table 2. Pairwise comparison of financial and economic sub-index (C1)

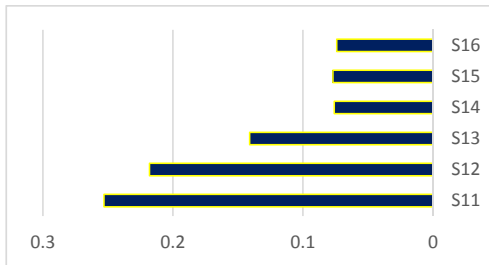


Figure 4. The rank order of indications for criteria C1

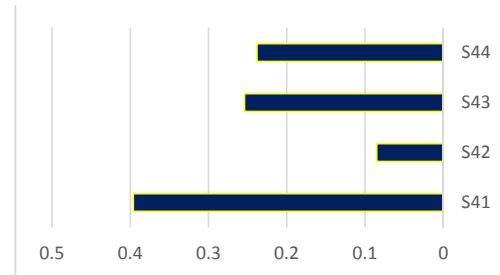


Figure 7. The rank order of indications for criteria C4

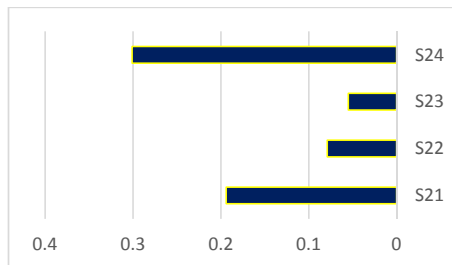


Figure 5. The rank order of indications for criteria C2

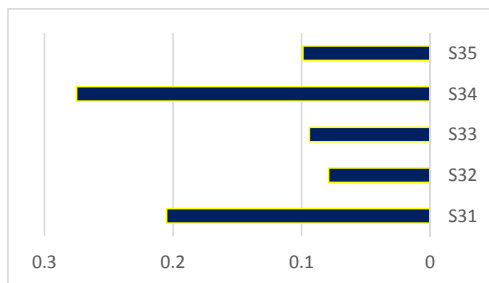


Figure 6. The rank order of indications for criteria C3

Calculation of internal relations with the FANP method

The fuzzy DEMATEL technique reflected the internal relationships between the main criteria (Table 4).

Linguistic variable	Quantitative equivalent	Fuzzy quantitative equivalent		
		l	m	u
Without effect	0	0	1.0	3.0
Low effect	1	1.0	3.0	5.0
Effective	2	1.0	5.0	7.0
high effect	3	5.0	7.0	9.0
Very high effect	4	7.0	9.0	1

Table 4. Fuzzy spectrum and ANP technique, source: Wang and Chang 1995; Wang, 2011

Each expert's point of view was initially fuzzily averaged, and the direct correlation matrix, or M, was created by calculating the fuzzy av-

erage of the experts' points of view. The direct correlation matrix was defuzzified using the CFCS method. Next,  $N = K \times M$ , the normal direct correlation matrix, was computed. The comprehensive connection matrix estimation and network relations map visualization came next. The Network Relationship Map (NRM) should be determined using a threshold value. The threshold value of 2.653 was attained in this study. A causal diagram can be drawn under the relationship model (Table 5):

	D	R	D+R	D-R
Financial and economic index	23.604	14.187	39.791	9.416
Contract indicators	15.810	33.579	49.389	-17.769
Technical and technological indicators	10.576	39.172	49.748	-28.596
Administrative and systematic indicators	7.387	38.697	46.084	-31.311

Table 5. The model of causal relationships of criterion selection indicators

The effectiveness of a factor on other system factors is shown in Table 5 as the total of the elements in each row (D). As a result, the process comes in second, and the support criterion comes in first. The next three are managed change, knowledge, and learning with nearly identical efficacy. Indicators used administratively and systematically also have a small impact. Each factor's influence on other system factors is represented by the sum of its components in the column (R). As a result, both the administrative and systematic indicators and the technical and technological indicators criteria are quite effective. Compared to other factors, the support requirement has a negligible impact.

*The final priority of indicators with the FAHP technique*

The FAHP method was used to determine the final weight of each model index. The importance and rank of the study indicators are determined by considering the internal relationships of the research variables, as demonstrated by

comparing the output of the FAHP and FANP approaches. As a result, the indicator's weight is adjusted to reflect the pairwise comparison of the variables, which yields a more accurate weight. The priority can be established for this purpose using an ANP technique, and the weights determined for the indicators.

*Selection by ANP technique*

ANP technique was used to select the most essential criteria in a case study. The first step was to form a decision matrix, and the next step was to calculate the scaleless matrix. In the third step, the weighted scaleless matrix was formed. Table 6 represents the output of the ANP software based on the calculated values, based on which the most crucial factor option is C1 (financial and economic index).

	d+	d-	value CL
C1	114.0	304.0	728.0
C2	372.0	108.0	228.0
C3	277.0	092.0	248.0
C4	260.0	149.0	364.0

Table 6. The distance of each option from the positive and negative ideal

*Clustering the most effective criteria and outcomes*

*Clustering of financial indicators in the post-revolutionary era of Iran:*

The ANP approach was used to cluster the financial indicators of affordable housing in Iran during the post-revolutionary era to determine the indicators' ultimate and causal criteria. Data analysis showed that the most effective causal criteria for concluding an effective contract are technical and technological indicators (C3) and administrative and systematic indicators (C4).

*Answering the questions*

Question 1: What are the main factors affecting the financial indicators of low-cost housing of Kerman in the post-revolutionary era of Iran?

Based on the studies and research literature, the criteria were given to the construction industry experts in Kerman in a questionnaire, and the answers were scored. The main factors that ob-



tained the highest score above 80% were identified as the leading effective indicators.

Question 2: What are the sub-factors affecting the financial indicators of low-cost housing of Kerman in the post-revolutionary era of Iran?

The sub-factors were extracted from library sources based on the primary factors and the research literature and then scored according to the opinion of experts. Factors that scored higher than 80% were identified as effective indicators.

Question 3: What is the main and sub-factors' governing structure?

The second questionnaire was completed to evaluate the primary and secondary criteria by seven experts after screening the criteria the experts. Then, the governing structures of the primary and secondary factors were obtained using the fuzzy ANP method.

The fourth question and its answer: What is the effect intensity of factors on the financial indicators of low-cost housing of Kerman in the post-revolutionary era of Iran?

The results are reported in Table 7.

	Criteria		Subcriteria	Final w	W	r - c	r + c	c	r	cause and effect
C1	Financial and economic	S1	How can currency and financial oscillation affect low-cost housing architecture considering financial and economic indicators in the project cycle?	0.040	0.198	-0.36	12.34	6.35	5.99	Effect
		S2	How can financial and time incompatibility affect low-cost housing architecture considering financial and economic indicators in the project cycle?	0.042	0.211	-0.32	13.17	6.75	6.42	Effect
		S3	How can improper timing of contractor payment affect low-cost housing architecture considering financial and economic indicators in the project cycle?	0.039	0.194	-1.22	12.03	6.63	5.40	Effect
		S4	How can improper fluctuations in the price of materials affect low-cost housing architecture considering financial and economic indicators in the project cycle?	0.038	0.187	1.10	11.56	5.28	6.38	Cause
		S5	How can increasing overhead costs affect low-cost housing architecture considering financial and economic indicators in the project cycle?	0.042	0.211	0.81	13.13	6.16	6.97	Cause
		S6	How can increasing transportation costs affect low-cost housing architecture considering financial and economic indicators in the project cycle?	0.040	0.198	-0.36	12.34	6.35	5.99	Cause
C2	Contractual	S7	How can the incompatibility of the type of contract and execution affect low-cost housing architecture considering contractual indicators in the project cycle?	0.054	0.265	0.441	2.054	0.807	1.248	Cause
		S8	How can weakness in the contract based on the execution type affect low-cost housing architecture considering contractual indicators in the project cycle?	0.062	0.303	0.095	2.400	1.152	1.248	Cause
		S9	How can weakness in choosing the right contractor affect low-cost housing architecture considering contractual indicators in the project cycle?	0.089	0.432	-0.536	3.390	1.963	1.427	Effect
		S10	How can a lack of collaboration between parallel contractors affect low-cost housing architecture considering contractual indicators in the project cycle?	0.039	0.194	-1.22	12.03	6.63	5.40	Effect

	Criteria		Subcriteria	Final w	W	r - c	r + c	c	r	cause and effect
C3	Technical and technological	S11	How can inadequacy of design in correct estimation of cost, time, and resources affect low-cost housing architecture considering technical and technological indicators in the project cycle?	0.029	0.143	-1.188	13.064	7.126	5.938	Cause
		S12	How can insufficient studies and information about the working conditions of the project site affect low-cost housing architecture considering technical and technological indicators in the project cycle?	0.036	0.181	-0.297	16.532	8.415	8.118	Cause
		S13	How can the absence of machines and tools for execution affect low-cost housing architecture considering technical and technological indicators in the project cycle?	0.034	0.172	1.176	15.650	7.237	8.413	Cause
		S14	How can difficulty in providing specific materials for execution affect low-cost housing architecture considering technical and technological indicators in the project cycle?	0.036	0.180	0.411	16.431	8.010	8.421	Effect
		S15	How can monopoly in the supply of materials affect low-cost housing architecture considering technical and technological indicators in the project cycle?	0.032	0.162	0.271	14.806	7.268	7.538	Effect
C3	Administrative and systematic	S16	How can the lack of coordination between project elements affect low-cost housing architecture considering administrative and systematic indicators in the project cycle?	0.054	0.265	0.441	2.054	0.807	1.248	Effect
		S17	How can the lack of familiarity with the project elements with the specific type of implementation affect low-cost housing architecture considering administrative and systematic indicators in the project cycle?	0.062	0.303	0.095	2.400	1.152	1.248	Cause
		S18	How can weak management of projects affect low-cost housing architecture considering administrative and systematic indicators in the project cycle?	0.089	0.432	-0.536	3.390	1.963	1.427	Effect
		S19	How can administrative bureaucracy between project elements affect low-cost housing architecture considering administrative and systematic indicators in the project cycle?	0.039	0.194	-1.22	12.03	6.63	5.40	Cause

Table 7. Cause and effect of subcriteria and sum of cause and effect values

**CONCLUSION AND RESULTS**

Table 8 shows the final prioritization of the research indicators. Based on the results, contractual, financial and economic, and technical and technological indicators were prioritized among the first three.

Final rank	Main indicators
Contract indicators	1
Financial and economic index	2
Technical and technological indicators	3
Administrative and systematic indicators	4

Table 8. Prioritization of main criteria

The prioritization of sub-criteria is shown in Table 9.

The project's component measuring administrative bureaucracy performed the best. The following priorities are assigned to the sub-criteria of contract weakness resulting from execution type, contract type incompatibility, rising transportation costs, and monopoly in material supply. These results are acceptable in comparison with previous studies.

Research on the financial indicators of low-cost housing in the post-revolutionary era of Iran was conducted to choose the best supplier. However, this study evaluated the factors affecting financial indicators of low-cost housing in the post-revolutionary period of Iran in Kerman, distinguishing this research from the previous one.

Sub-criteria	Sub-criteria weight	Sub-criteria final weight	R+C	Rank	Sub-criteria	Sub-criteria weight	Sub-criteria final weight	R+C	Rank
S1	0.198	0.040	12.34	11	S11	0.172	0.034	15.650	16
S2	0.211	0.042	13.17	9	S12	0.180	0.036	16.431	15
S3	0.194	0.039	12.03	12	S13	0.162	0.032	14.806	18
S4	0.187	0.038	11.56	13	S14	0.163	0.033	14.900	17
S5	0.211	0.042	13.13	10	S15	0.255	0.050	16.284	5
S6	0.265	0.054	2.054	4	S16	0.237	0.047	15.156	8
S7	0.303	0.062	2.400	3	S17	0.255	0.050	16.352	6
S8	0.432	0.089	3.390	2	S18	0.253	0.050	16.252	7
S9	0.143	0.029	13.064	19	S19	0.500	0.098	28	1
S10	0.181	0.036	16.532	14					

Table 9. Prioritization of sub-criteria

Indicators	Rank in the present study	Dixon [12]	Weber [1]	Baboli [11]	Shorbariki [8]
Contract indicators	2	2	2	4	2
Financial and economic index	1	1	3	1	1
Technical and technological indicators	3	Not available	Not available	Not available	3
Administration and systematic indicators	4	11	8	Not available	4

Table 10. Comparison of results with previous studies

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