Identifying and evaluating the most compatible financing methods in projects infrastructure construction in Tehran municipalities

Seyed Azim Hosseini*, Mehdi Alibakhshi

Department of Civil Engineering, South Tehran Branch, Islamic Azad University, Tehran, Iran

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Abstract

The main goal of this article is to identify the most appropriate financing methods to minimize delays in the infrastructure projects of Afhidran municipalities, as well as to identify methods to finance the construction projects of executive bodies or government companies. The method used for this research is the group AHP method and paired comparison questionnaires, and the calculations were done by expert choice software. Then we will calculate the consistency for each of the decision matrices. It should be noted that the selected options and indicators in the questionnaire have been adopted based on micro-groups. At first, based on the studied articles, various indicators were selected to determine the best financing option, which was further reduced to 7 indicators based on brainstorming. The research indicators have been described as the availability of financing methods, expected returns, the existence of Islamic and legal restrictions, easy guarantee conditions, restrictions related to the use of financial instrument funds, risks related to financial instruments and the volume of financing. The decision options (Alternatives) also include the Sukuk method, mutual sale contracts, housing investment funds, Islamic Development Bank and partnership bonds. According to the results of the research, the decision options of this research include the sukuk method (with a score of 0.239), mutual sales contracts (with a score of 0.157), housing investment fund (with a score of 0.189), Islamic Development Bank (with a score of 0.202) and in the last contribution was (with a score of 0.213).

Keywords: financing, Tehran municipalities, construction projects
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1 Introduction

How to finance and prepare the necessary executive budget to carry out infrastructure projects and use the products and services resulting from them is currently considered as one of the most important challenges facing developing countries. Considering the special situation of developing countries and the financial crises in these countries, it is not easy to provide the capital needed to implement large projects, so choosing the appropriate financing method is an important issue in their case [5].

In many projects, due to issues such as the high amount of capital required, the high sensitivity of the project in terms of political, economic and security issues, and the reluctance of foreigners to participate and invest, the issue

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*Corresponding author

Email addresses: azim_hosseini@azad.ac.ir (Seyed Azim Hosseini), mehdialibakhshi@yahoo.com (Mehdi Alibakhshi)

of financial provision is brought to the attention of government officials. In a number of projects, with the support and credits of the government, the required funds can be provided, but in the important and infrastructural projects needed by the country, it is not possible to provide their full funds to the government, such as oil, gas, petrochemical projects and many of For other industries, there is a basic need for the presence of foreign investment and the use of the facilities of foreign and domestic banks and institutions for the development of infrastructures [9]. Thinking of a suitable and reliable solution to provide the financial resources needed for the project is one of the first steps to ensure the completion of the project. In choosing the appropriate method of financing in the feasibility stage of the project, one should take into account all the issues and demands of the various departments involved in the project, from the project host country, the industry related to the project, contractors, buyers, suppliers, lending banks, the issue of risks and so on. Kelli paid attention to all the departments involved in the project and then chose the appropriate method according to the priority and importance of each of them.

In addition, it should be noted that the structure used to finance the project in one country may not be effective in another country due to differences in its laws and conditions, while it may be used effectively in another country. The important point is to choose the right form of financing according to the conditions of each project and the country hosting the project. In Iran, receiving foreign finance in conditions where international sanctions have limited the possibility of using financing from international sources, has created many problems for employers and executive managers of projects, as far as the tendency to use foreign finance with the current trend of the country's conditions, every day it seems less and less accessible.

According to the stated obstacles, the research question will be, which financing method will the construction projects face with fewer delays? Therefore, the purpose of the research is to identify the method that is easy to access by examining the common methods of financing. In this regard, the implementation projects of Tehran municipalities with economic problems in the field of financing will be studied.

2 Theoretical

All projects related to construction and development are called construction projects. Among these, there are several government construction projects; Special projects that the government defines every year in its program and approves its budget. The government construction project has its own advantages and instructions and is completely subject to the general conditions of the contract. The founders of such projects are government bodies, which are legal in nature [4]. Public-private partnership is a contract between the private and public sectors in which, to provide a service and implement a project, the private sector partner undertakes the largest share of financing the project [1]. Public-private partnership is a mechanism in which the public sector (government and other governmental institutions) provides services (including water and sewage, transportation, health, education, etc.) from the capacities of the private sector (including knowledge, experience and resources) financial) uses; In other words, the private sector plays a role on behalf of the government in some of the duties and responsibilities of providing these services [10]. Public-private partnership is a procurement method that has been used to provide government projects around the world, and in the broadest sense, it is any operation between the public sector and the private sector to provide public services [7]. In 1992, the British Conservative government created the Pioneer Financing Program (PFI) to encourage public-private partnership programs to create such contracts. This program focused more on reducing the public sector's need for borrowing [8] in Iran, despite the many needs, in this field, in some laws, including the law of the fifth development program and the budget laws of 2014 and 2013 this issue has been discussed [11]. Maslov et al. in [5] determined the optimal share of civil participation and financing credit for investment projects. In this article, a method for accepting portfolio analysis to find the optimal share of public investment and credit finance for the same project is described and presented. Mohammadi et al. in [7] investigated the barriers to public sector financing for construction projects in Isfahan province with a multi-criteria approach. The results of the research showed that: public-private partnership contracts are the lowest barriers, including service contracts, rent management, construction and operation, transfer, concession and joint investment. Mehrbanpour and Raei Ezabadi [6] in their research, identified and prioritized investment requirements in holding companies from the perspective of resistance economy policies. The results of the research showed that: using Dimetal's technique, the internal relationships between these components have been determined and their influence on/from each other has been determined. Finally, by using the Network Analysis Process (ANP) method, the components of the resistance economy effective on the selection of the investment portfolio in holding companies have been prioritized. The three components of "export-oriented industry", "resilience against sanctions" and "changes in exchange rates" were given the highest priority. Kebriti in [2] in a research to investigate and evaluate and prioritize various project financing methods. Payment of civil works. The results of the research showed that: one of the most common economic obstacles to the implementation process of the projects was related to the stage of determining the financing method of the project. Based on this, one of the important issues in

projects is their financing method, so that they face fewer delays. Therefore, the use of the Sukuk method in financing construction projects is recommended. Khodamoradi and Raei Ezzabadi in a research [3] identified and prioritized financing methods in holding companies. The results of the research showed that: managers Holding companies prefer internal financing, or in other words, the use of the internal capital market mechanism over external financing, because the use of the internal capital market mechanism can lead to a reduction in the company's financial risk and capital cost.

In this research, we intend to choose a method by examining financing methods, so that if the contractors are faced with the problem of non-payment of the status statement from the employer, they can continue the project as long as possible. In this regard, according to the articles mentioned in the International Journal of Project Management, it can be concluded that our research is a step in the direction of completing the presented articles and especially in the direction of localizing these solutions for our country, Iran.

When research is conducted to apply the results of its findings to solve a specific problem, such research is called applied research. The current research is descriptive research in terms of practical purpose and terms of nature and method.

3 Research methodology

The statistical population of this research includes all managers and design and implementation experts of Tehran municipalities. who should have at least a relevant university degree and on the other hand, they all have the experience and power to comment on the ways of financing the infrastructure projects of Tehran municipalities. With these interpretations, the number of people questioned is equal to 27 people. After the delivery of the questionnaires, 3 questionnaires were not been returned and according to the decision and due to the possibility of inaccuracy in completing the questionnaires, the number of 2 more samples was also targeted. Finally, the number of people who completed the questionnaire is equal to 22 people. The method of data collection was initially the library method and then the field method. Data analysis is done by group AHP method and paired comparison questionnaires, and calculations are done by expert choice software.

4 Research findings

These financing methods and related indicators have finally been summarized to the items listed below based on brainstorming and holding meetings of the technical department, financial and administrative department, contract affairs and feasibility team with the organization's project management specialist group and the board of directors. First, we will code the decision options and research indicators, and then we will use the code instead of titles for ease.

Table 1: Questionnaire on the availability of financing methods

Bonds	Islamic Development Bank	Housing investment fund	Contracts of mutual sale	Sukuk method	Financing method
1	2	3	4		Sukuk method
2	2	1			Contracts of mutual sale
2	2				Housing investment fund
3					Islamic Development Bank
					Bonds

	A1	A2	A3	A4	A5
A1		4.0	3.0	2.0	1.0
A2			1.0	2.0	2.0
A3				2.0	2.0
A4					3
A5	Incon: 0.25				

Figure 1: Availability of financing method

Table 2: Expected return questionnaire

Bonds	Islamic Development Bank	Housing investment fund	Contracts of mutual sale	Sukuk method	Financing method
		Expected return			
2	2	3	5		Sukuk method
1	3	2			Contracts of mutual sale
1	1				Housing investment fund
2					Islamic Development Bank
					Bonds

		A1	A2	A3	A4	A5
A1			5.0	3.0	2.0	2.0
A2				2.0	3.0	1.0
A3					1.0	1.0
A4						2.0
A5		Incon: 0.32				
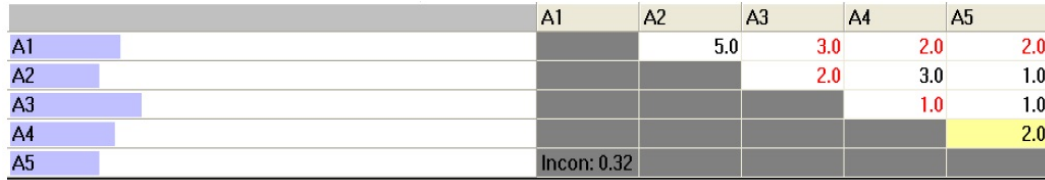
Figure 2: Expected return

Table 3: Questionnaire on the existence of religious and legal restrictions

Bonds	Islamic Development Bank	Housing investment fund	Contracts of mutual sale	Sukuk method	Financing method
		Existence of sharia and legal restrictions			
4	1	2	2		Sukuk method
1	2	2			Contracts of mutual sale
2	2				Housing investment fund
2					Islamic Development Bank
					Bonds

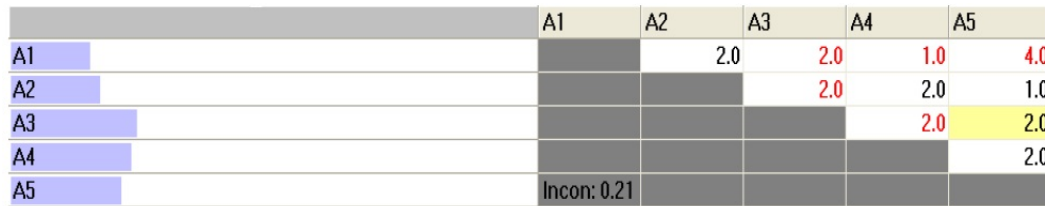|		A1	A2	A3	A4	A5
A1			2.0	2.0	1.0	4.0
A2				2.0	2.0	1.0
A3					2.0	2.0
A4						2.0
A5		Incon: 0.21				

Figure 3: Existence of sharia and legal restrictions

Table 4: Easy guarantee conditions questionnaire

Bonds	Islamic Development Bank	Housing investment fund	Contracts of mutual sale	Sukuk method	Financing method
		Easy warranty conditions			
1	1	2	2		Sukuk method
4	2	2			Contracts of mutual sale
2	3				Housing investment fund
1					Islamic Development Bank
					Bonds

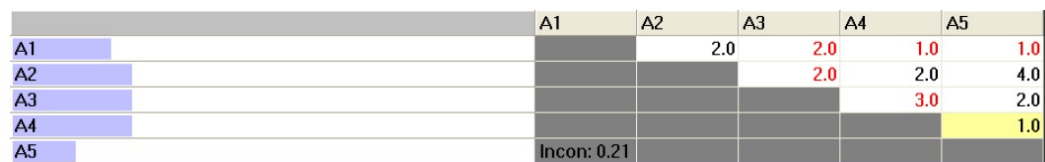|		A1	A2	A3	A4	A5
A1			2.0	2.0	1.0	1.0
A2				2.0	2.0	4.0
A3					3.0	2.0
A4						1.0
A5		Incon: 0.21				

Figure 4: Easy warranty conditions

Table 5: Questionnaire of restrictions related to the place of use of funds of financial instruments

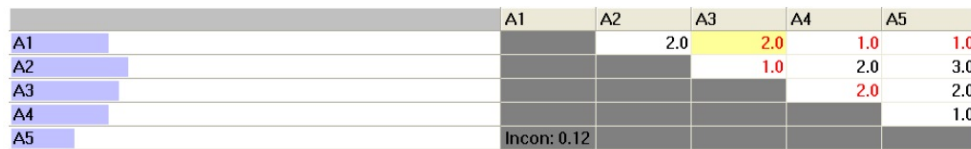| Bonds	Islamic Development Bank	Housing investment fund	Contracts of mutual sale	Sukuk method	Financing method
1	1	2	2		Sukuk method
3	2	1			Contracts of mutual sale
2	2				Housing investment fund
1					Islamic Development Bank
					Bonds

Figure 5: Restrictions on the place of use of funds of financial instruments

Table 6: Questionnaire of risks related to financial instruments

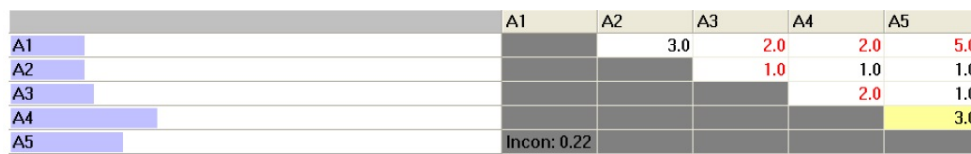| Bonds	Islamic Development Bank	Housing investment fund	Contracts of mutual sale	Sukuk method	Financing method
5	2	2	3		Sukuk method
1	1	1			Contracts of mutual sale
1	2				Housing investment fund
3					Islamic Development Bank
					Bonds

Figure 6: Risks associated with financial instruments

Table 7: Questionnaire of financing volume

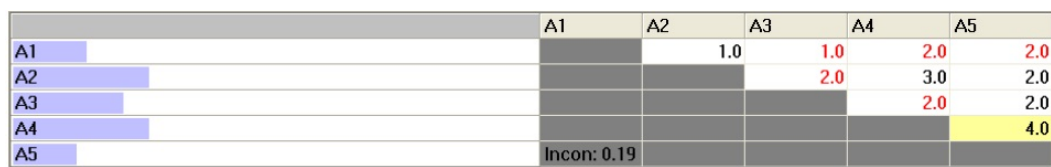| Bonds	Islamic Development Bank	Housing investment fund	Contracts of mutual sale	Sukuk method	Financing method
2	2	1	1		Sukuk method
2	3	2			Contracts of mutual sale
2	2				Housing investment fund
4					Islamic Development Bank
					Bonds

Figure 7: Funding volume

4.1 Determining the weight of comparative indicators

In the following, the final matrix of the combined pairwise comparisons of experts' opinions between financing indicators is displayed. The values of 22 questionnaires are entered separately in the software and finally the following matrix is displayed as a combined matrix.

Table 8: matrix of paired comparisons of experts' opinions between financing indicators

	C1	C2	C3	C4	C5	C6	C7
C1		4.646	2.484	1.199	3.528	1.267	2.316
C2			1.591	1.241	1.143	1.225	2.913
C3				1.308	1.374	1.204	1.767
C4					2.036	1.036	2.447
C5						1.237	1.214
C6							1.471
C7	Incon: 0.03						

Using problem modeling in the Expert choice software environment, the weight of each criterion has been determined.

Priorities with respect to:
Goal

C1	.277
C2	.111
C3	.135
C4	.170
C5	.094
C6	.137
C7	.076

Inconsistency = 0.03
with 0 missing judgments.

Figure 8: Determining the weights of the indicators

Based on the results, the ranking of financing indicators and the weight of each of them will be as follows:

1. Availability of financing methods (0.277)
2. Easy guarantee terms (0.170)
3. Risks related to financial instruments (0.137)
4. Existence of religious and legal restrictions (0.135)
5. Expected return (0.111)
6. Restrictions related to the place of use of funds of financial instruments (0.094)
7. Volume of financing (0.076)

Also, the value of compatibility coefficient equal to 0.03 has been obtained, which in comparison with the value of 0.1 or less, shows that the answers obtained and the comparison made to determine the weight of the criteria are reliable.

4.2 Mutual evaluation of decision options

Here we will evaluate the decision options of this research according to each of the seven indicators.

4.2.1 Index of availability of financing methods (C1)

In Table 9, for a selected sample of the statistical population, the matrix of paired comparisons of experts' opinions is displayed according to the index of availability of financing methods.

Table 9: matrix of paired comparisons of experts' opinions according to the index of availability of financing method

	A1	A2	A3	A4	A5
A1		1.0	2.0	3.0	2.0
A2			2.0	1.0	1.0
A3				2.0	3.0
A4					3.0
A5	Incon: 0.07				

In the following, the compatibility coefficient for the indicator of the availability of financing methods is presented in general and for the statistical population.

Table 10: Compatibility coefficient for the index of availability of financing method

PID	Name	Overall	C1 (L: .277)
		#Factors	5 Alts
0	Facilitator	.0287	.0149

Considering that the calculated compatibility index is much lower than the value of 0.1, it can be said that the pairwise comparisons of the group in the integration matrix between the options have a good compatibility with respect to the index of the availability of the financing method and the model is completely meaningful in dimensions.

4.2.2 Expected return index (C2)

In Table 11, for a selected sample of the statistical population, the matrix of paired comparisons of experts' opinions with regard to the expected return index is displayed.

Table 11: The matrix of paired comparisons of experts' opinions according to the expected return index

	A1	A2	A3	A4	A5
A1		4.0	3.0	2.0	2.0
A2			1.0	1.0	3.0
A3				2.0	2.0
A4					3.0
A5	Incon: 0.04				

In the following, the consistency coefficient for the expected return index is presented in general and for the statistical population.

Table 12: Compatibility coefficient for the expected return index

PID	Name	Overall	C2 (L: .111)
		#Factors	5 Alts
0	Facilitator	.0287	.0367

Considering that the calculated compatibility index is much less than 0.1, it can be said that the pairwise comparisons of the group in the integrated matrix between the options have a good compatibility with respect to the expected efficiency index and the model is completely meaningful in dimensions.

4.2.3 Index of the existence of religious and legal restrictions (C3)

In Table 13, for a selected sample of the statistical population, the matrix of paired comparisons of experts' opinions is displayed according to the Shari'a and legal restrictions index.

Table 13: The matrix of paired comparisons of experts' opinions according to the index of Shari'a and legal restrictions

	A1	A2	A3	A4	A5
A1		5.0	3.0	2.0	2.0
A2			2.0	2.0	1.0
A3				1.0	1.0
A4					2.0
A5	Incon: 0.02				

In the following, the compatibility coefficient for the Sharia and legal restrictions index is presented in general and for the statistical population.

Table 14: Compatibility coefficient for Sharia and legal restrictions index

PID	Name	Overall	C3 (L: .135)
		#Factors	5 Alts
0	Facilitator	.0287	.0235

Considering that the calculated compatibility index is much lower than the value of 0.1, therefore, it can be said that the pairwise comparisons of the group in the integrated matrix between the options have a good compatibility with respect to the Sharia and legal restrictions index, and the model is completely meaningful in dimensions.

4.2.4 Index of easy guarantee conditions (C4)

In table 15, for a selected sample of the statistical population, the matrix of paired comparisons of experts' opinions with regard to the index of easy guarantee conditions is displayed.

Table 15: matrix of paired comparisons of experts' opinions according to the index of easy guarantee conditions

		A1	A2	A3	A4	A5
A1			2.0	2.0	2.0	2.0
A2				2.0	2.0	4.0
A3					2.0	2.0
A4						2.0
A5		Incon: 0.03				

In the following, the consistency coefficient for the index of easy guarantee conditions is presented in general and for the statistical population.

Table 16: Compatibility coefficient for easy guarantee conditions index

PID	Name	Overall	C4 (L: .170)
		#Factors	5 Alts
0	Facilitator	.0287	.0183

Considering that the calculated compatibility index is much less than 0.1, it can be said that the pairwise comparisons of the group in the integrated matrix between the options have a good compatibility with regard to the index of easy guarantee conditions and the model is completely meaningful in dimensions.

4.2.5 Index of restrictions related to the place of use of financial instruments (C5)

In Table 17, for a selected sample of the statistical population, the matrix of consolidated pairwise comparisons of experts' opinions is shown according to the index of restrictions related to the place of use of financial instruments.

Table 17: The matrix of paired comparisons of experts' opinions according to the index of restrictions related to the place of use of funds of financial instruments

		A1	A2	A3	A4	A5
A1			2.0	2.0	2.0	1.0
A2				2.0	2.0	2.0
A3					2.0	1.0
A4						1.0
A5		Incon: 0.07				

In the following, the consistency coefficient for the index of restrictions related to the place of use of financial instruments is presented in general and for the statistical population.

Table 18: Compatibility coefficient for the index of restrictions related to the place of use of financial instruments

PID	Name	Overall	C5 (L: .094)
		#Factors	5 Alts
0	Facilitator	.0287	.0255

Due to the fact that the calculated consistency index is much less than 0.1, it can be said that the pairwise comparisons of the group in the integrated matrix between the options have a good consistency and the model is completely meaningful in terms of the index of restrictions related to the place of use of financial instruments.

4.2.6 Index of risks related to financial instruments (C6)

In Table 19, for a selected sample of the statistical population, the matrix of consolidated pairwise comparisons of experts' opinions according to the index of risks related to financial instruments is displayed.

Table 19: matrix of paired comparisons of experts' opinions according to the index of risks related to financial instruments

	A1	A2	A3	A4	A5
A1			4.0	2.0	2.0	6.0
A2				2.0	1.0	2.0
A3					1.0	2.0
A4						3.0
A5	Incon: 0.02				

In the following, the compatibility coefficient for the index of risks related to financial instruments is presented in general and for the statistical population.

Table 20: Compatibility coefficient for the financing volume index

PID	Name	Overall	C6 (L: .137)
		#Factors	5 Alts
0	Facilitator	.0287	.0310

Due to the fact that the calculated consistency index is much less than 0.1, it can be said that the pairwise comparisons of the group in the integrated matrix between the options have a good consistency with respect to the index of risks related to financial instruments, and the model is quite meaningful in terms of dimensions.

4.2.7 Financing volume index (C7)

In Table 21, for a selected sample of the statistical population, the matrix of paired comparisons of experts' opinions with regard to the financing volume index is displayed.

Table 21: matrix of paired comparisons of experts' opinions according to the index of financing volume

	A1	A2	A3	A4	A5
A1			1.0	2.0	3.0	4.0
A2				2.0	1.0	3.0
A3					1.0	3.0
A4						4.0
A5	Incon: 0.06				

In the following, the consistency coefficient for the financing volume index is presented in general and for the statistical population.

Table 22: Compatibility coefficient for the financing volume index

PID	Name	Overall	C7 (L: .076)
		#Factors	5 Alts
0	Facilitator	.0287	.0283

Considering that the calculated consistency index is much less than 0.1, it can be said that the pairwise comparisons of the group in the integration matrix between the options have a good consistency with respect to the financing volume index and the model is completely significant in dimensions.

4.2.8 Final comparison of options

After examining the decision options according to the seven indicators, we proceed to aggregate the values according to the obtained weights of the indicators. At first, the compatibility indices for all the desired criteria (C1 to C7) have been presented. The values shown in table 23 show the compatibility index of each of the criteria raised in

Table 23: compatibility index of different criteria

PID	Name	Overall	Goal	C1 (L: .277)	C2 (L: .111)	C3 (L: .135)	C4 (L: .170)	C5 (L: .094)	C6 (L: .137)	C7 (L: .076)
		#Factors	7	5 Alts	5 Alts	5 Alts	5 Alts	5 Alts	5 Alts	5 Alts
0	Facilitator	.0287	.0331	.0149	.0367	.0235	.0183	.0255	.0310	.0283

the research. Also, the compatibility values of the values for the final goal (Goal) and the coefficient of all answers (Overall) are also provided.

According to the compatibility index of different criteria, it can be seen that the obtained values are less than 0.1 and the results are valid from the perspective of compatibility. It is also possible to graphically compare and observe the comparative process between different alternatives based on the selection criteria:
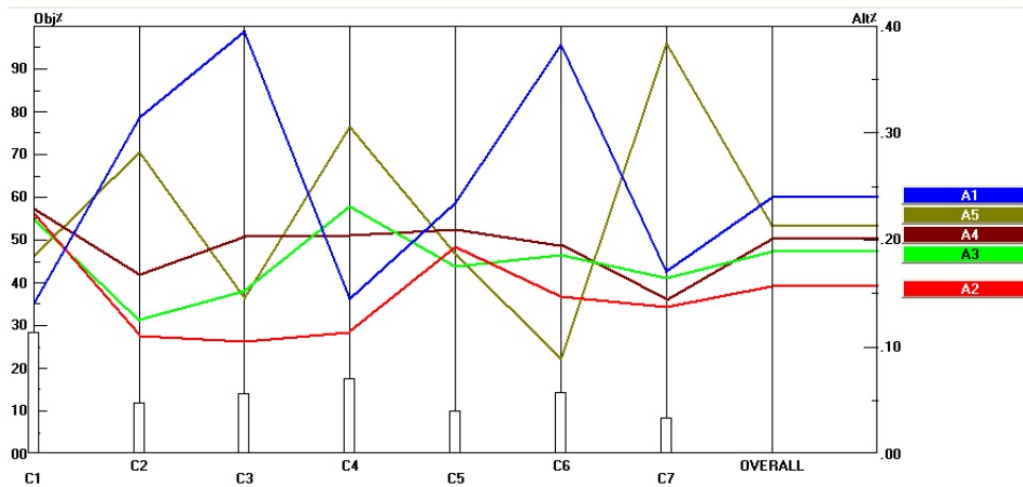

Figure 9: The graphical process of comparing different financing options

Based on Figure 9, it can be seen that the investigated criteria had different effects on different financial methods. Therefore, the A1 method (Sukuk financing method) has won the most points according to the C3 criteria (existence of Shariah and legal restrictions) and C6 (risks related to financial instruments). In total, the proposed criteria of sukuk method has a high and appropriate score compared to other proposed methods, and only in criterion C1 (availability of financing method), it has the lowest score compared to other methods, which indicates the lack of widespread implementation. This method is in Iran.
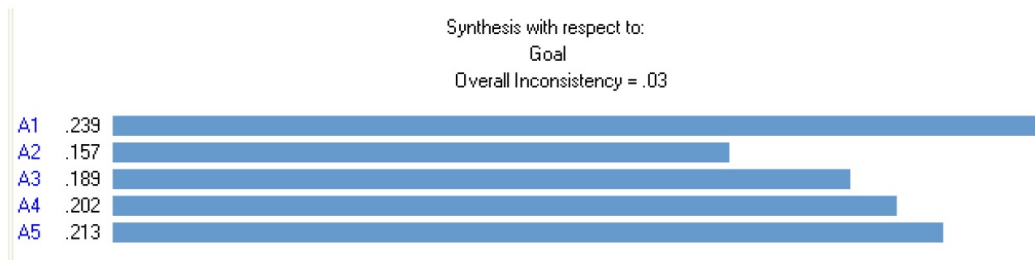

Figure 10: Presenting the values of the research problem

Figure 10 shows the ranking of alternatives for the financing method resulting from AHP analysis in the Expert choice software environment. Finally, according to the table, the priority order of financing methods in the infrastructure projects of Tehran municipalities and the decision options of this research will have points in the following order:

1. Sukuk method (0.239)
2. Partnerships (0.213)
3. Islamic Development Bank (0.202)

4. Housing investment fund (0.189)
5. Mutual sale contracts (0.157)

5 Conclusion

Based on the results and findings of the research, the order of priority of financing methods in the projects of Tehran municipalities has been obtained. The method of sukuk bonds has gained the most value in the analyzes conducted using the AHP method and has been recognized as more suitable than other methods. According to the obtained results, the second proposed option of the financing method has been determined by the method of partnership bonds. According to the final results, the decision options of this research will have points in the following order.

1. Sukuk method (0.239)
2. Partnerships (0.213)
3. Islamic Development Bank (0.202)
4. Housing investment fund (0.189)
5. Mutual sale contracts (0.157)

Based on this, it is recommended to use the sukuk method in financing the projects of Tehran municipalities. Considering the structural similarity between the sukuk method and the partnership bond method, these two methods have the highest score, however, being Islamic and meeting the needs of society has led to the superiority of this method over the partnership bond method. Also, the two criteria of Sharia and legal restrictions as well as the risks associated with financial instruments in the sukuk method are significantly higher than other financing methods, and compliance with these two items has led to the superiority of this financing method in the projects of Tehran municipalities. The results obtained in this study show that:

1. Sukuk is a new, tested and suitable tool for the financing process, both for government and non-government companies.
2. Sukuk can be used as a complementary tool or a substitute for participation bonds for liquidity control.
3. Sukuk is a legal, acceptable and effective tool that can be used in Iran, although it needs to provide infrastructure, which are briefly:
   (a) Standardizing the assets used in sukuk and their evaluation process
   (b) Facilitating matters related to the issuance and rating of sukuk bonds and the creation of rating institutions
   (c) Creating a suitable secondary market for buying and selling sukuk bonds and facilitating their liquidation.

Therefore, the government can take an important step in the implementation of the usury-free banking law with a proper planning and background for the use of this new financial tool. Also, the use of this new financial tool can solve many problems related to the financial provision of economic enterprises, all of which are inherent duties of the Islamic government to achieve sustainable development.

5.1 Offers

The following are suggested to complete the studies:

- Evaluating the efficiency of sukuk financing method in field projects

- Examining and comparing the studied methods with other financing methods Comparing the studied methods with other methods such as fuzzy methods

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