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INTERPRETIVE STRUCTURAL MODELLING IN MUNICIPAL PROJECTS RISK MANAGEMENT

Abstract: There is risk in all projects, a correct understanding of project risk can help project managers to complete it. Therefore, the purpose of this study is to identify and rank the risk components of municipal infrastructure projects based on the Structural-Interpretive Approach (ISM).

Finally, there were 41 indicators in the subset of 8 dimensions, which included (Organizational risk, Individual risk, and Environmental risk, Familiarity of employees with project control, Financial burden imposed, Initial miscalculation and incomplete definition of stakeholder needs, Interpersonal risk, Internal processes of organizational culture). Component (Organizational risk, Individual risk, and Environmental risk) is in the first level, component (Familiarity of employees with project control) is in the second level, component (Financial burden imposed, Initial miscalculation and incomplete definition of stakeholder needs, Interpersonal risk) is in the third level and component (Internal processes of organizational culture) is in the fourth level.

Keywords: Structural-Interpretive Approach (ISM), risk taking, MICMAC analysis method, municipal projects

JEL classification: G31

Research novelty: The present research is applied in terms of nature and purpose, qualitative research in terms of data search and descriptive-analytical in terms of data method. Using in-depth and semi-structured interviews, the statistical sample was asked to answer the interview questions based on the dimensions and risk components of the municipal project. Sampling in this part of the study was purposeful and 15 people from the research community were selected as the research sample in this section. Finally, using MICMAC analysis method, the graph of penetration power and dependence of structural-interpretive components was determined.

Introduction

Researchers have cited some of the reasons for the many failures in service organizations' projects as the inadequacy of risk management mechanisms and processes, as well as the negligence of project managers in implementing them. Projects whose risks are not effectively managed will face greater risks [1]. However, as the projects of service organizations become more complex and important, there is a need to implement a systematic approach to deal with project issues and risks to ensure greater project success [2]. In the book (Measures, Key Performance Indicators, and Project Management Indicators), Harold Krzner, a leading professor of project management, states that about 70% of projects in the world are delayed [3]. It is observed that delays in world projects are a natural thing that indicates poor performance in various areas of projects. In Iran, which is another developing country, delays in implementation projects are enormous.

In 1985, the Center for Research and Development of Project Management conducted a study and published a report on the

reasons for the delays in the country's projects. The report states that the average project time in the second development plan was 6/8 years, in the third development plan was 5/9 years, and in the first year of the fourth development plan was 11 years, and the duration of Iran's national projects was 5/2 years (equal to the global duration). In its report, the Development and Renovation Organization of Iran also mentioned that the duration of large-scale projects at the international level is 3 years, which is about 9 to 11 years in Iran. Risk identification involves the process of determining the risks affecting the project and documenting their characteristics.

Risk assessment examines project risks according to their characteristics such as probability, severity and risk response to progress. In addition, strategies are selected and implemented with the aim of reducing risk exposure. Risk response plays an important role in reducing the negative severity of project risks [1]. In this research, an attempt has been made to provide a model by interpretive structural equations that can show the risk components of municipal infrastructure projects.

Methodology

The present research is applied in terms of nature and purpose, qualitative in terms of data search in terms of research and descriptive-analytical in terms of data analysis. The interpretive structural method is an effective and efficient method for topics in which Qualitative variables interact with each other at different levels of importance. Using this technique, the relationships and dependencies between the qualitative variables of the problem can be discovered. This methodology examines the order and direction

of the complex relationships between the elements of a system, by which the complexity between the elements can be overcome [4].

Data collection tools in this study were library studies, interviews and interpretive structural questionnaires. The statistical population of the study includes all professors and project experts, managers of Tehran Municipality. In the first step, by studying theories, models, approaches and using library resources, searching the Internet and databases of valid domestic and foreign electronic publications, the risk-taking components of Tehran Municipality were identified. In the continuation of this section, using in-depth and semi-structured interviews, the statistical sample was asked to answer the interview questions based on the dimensions of risk-taking.

Municipalities respond. It should be noted that sampling in this part of the study was purposeful until 15 people were interviewed to achieve theoretical saturation. In this part, participation in this research was completely free by individuals and they were assured that their answers would remain confidential. Semi-structured and interactive-participatory method was used to conduct interviews and collect data. The number of interviews continued until the theoretical saturation was reached. Also, interviews were conducted in person, meetings were held and online through virtual networks. The interview time varied from 25 to 45 minutes.

After collecting the data, the first stage of Delphi semi-structured questionnaires were designed based on it and the participants in the research were asked to identify the important dimensions and risk components of infrastructure projects, as well as the dimensions and indicators. Add other possible items to the list. Then, according to the results of the preliminary questionnaire,

the second stage questionnaire (Delphi) was designed to achieve consensus on effective indicators based on the Likert scale. Questionnaire options including: very high (5 points), high (4 points), medium (3 points), low (2 points), very low (1 point) were considered and the research participants were asked to rate each of the components. Give.

In this study, the validity of the ISM questionnaire has been obtained through content. To determine the content validity of the questionnaire was used by experts, administrators and university professors and the validity of the questionnaire was confirmed. Also, to ensure the reliability of the research, detailed and accurate note-taking and anonymous coding were used with the help of coding who were not part of the research team.

Findings

Step 1: Identifying the risk components of infrastructure projects

In this study, in order to identify the risk-taking components of municipal infrastructure projects, it was based on the available literature and the background of research on the dimensions and components of risk-taking in each dimension, which were more comprehensive and general, were identified. Finally, with the collective agreement of experts, a total of 25 indicators were identified in a subset of 8 dimensions, which can be seen in Table 1.

In the continuation of the research, the second stage of interpretive structural modeling method has been used to determine the type of correlation between the risk components of infrastructure projects. At this stage, the relationships between

dimensions are analyzed using interpretive structural modeling and the conceptual relationship of "lead".

Table 1. Risk components

Risk components	Row
Familiarity of employees with project control	F1
Financial burden imposed	F2
Initial miscalculation and incomplete definition of stakeholder needs	F3
Internal processes of organizational culture	F4
Organizational risk	F5
Individual risk	F6
Environmental risk	F7
Interpersonal risk	F8

That is, the "two in two" comparison is done by experts in a table between the row dimension (row) and the column dimension, and the result is written as a symbol at the intersection of the row and the column. If the row coefficient can be the background of the column coefficient, the symbol is V; if there is a two-way relationship between the row coefficient and the column, the symbol X; if the column factor can be the background of the row coefficient, it is the symbol A; If there are no rows or columns, the symbol O is used in this conceptual relation [5].

Step 2: Formation of self-structured interactive matrix (SSIM)

The structural self-interactive matrix consists of project risk components and their comparison using four conceptual modes. This matrix has been completed in the form of a questionnaire by

researchers and researchers in the field of risk and professors and academic experts in the field of risk taking. The information obtained from the questionnaire was summarized based on interpretive structural modeling.

Step 3: Determining the relationship between the risk components

To implement this first step, a questionnaire was designed that has a shape similar to Table 2, and thus the 8 selected dimensions are mentioned in the first row and column of the table, and the respondents were asked to pay attention to the introduced symbols. (V, A, X, O) Specify the type of connections of the components in pairs. Thus, the most common responses were selected. In fact, the logic of interpretive structural modeling corresponds to non-parametric methods and operates on the basis of fashion in frequencies. Finally, the final structural self-interaction matrix was formed based on the relationships seen in Table 2:

Step 4: Getting the Matrix

The received matrix is obtained by converting the structural interaction matrix itself into a matrix of two values (zero and one). To extract the received matrix, in each row the number one must replace the symbols X, V and the number zero in its structural interactive matrix must replace the symbols (A, O). After converting all the rows, the result is called the initial received matrix (Table 3).

After receiving the primary matrix, the secondary relationships between the dimensions were checked, that is, after the initial received matrix was obtained, its internal compatibility was also examined.

Table 2. Self-interactive matrix of risk components of municipal infrastructure projects

Fac - tors	F1	F2	F3	F4	F5	F6	F7	F8
F1		A	X	X	A	A	X	A
F2			V	V	X	X	V	X
F3				V	X	A	A	X
F4					V	A	V	A
F5						V	V	A
F6							A	A
F7								A
F8								

Table 3. Initial received matrix of risk components of municipal infrastructure projects

Fac-tors	F1	F2	F3	F4	F5	F6	F7	F8
F1	1	0	1	1	0	0	1	0
F2	1	1	1	1	1	1	1	1
F3	1	0	1	1	1	0	0	1
F4	1	0	0	1	1	0	1	0
F5	1	0	1	1	1	1	1	0
F6	1	1	1	0	1	1	0	0
F7	1	0	0	0	1	1	1	0
F8	1	1	0	1	0	1	1	1

For example, if the variable "a" leads to the variable "b" and the variable "b" also leads to the variable "c", the variable "a" must also lead to the variable "c", and if this is the case in the received matrix

No, the matrix must be modified and the relationships that exist directly between the dimensions; But it is not mentioned in the table that they should be replaced. At this stage, with the consensus of experts, the relationship between other factors was adjusted and if there was an indirect relationship between the factors, it was considered at this stage and the final changes were made in the table scores.

By identifying the secondary relations, the modified received matrix was obtained; then the modified table was provided to the experts or the consensus of the experts on the relationship between other risk components of infrastructure projects was examined and if there was an indirect relationship between the dimensions, it was considered at this stage. The results are presented in Table 4.

Table 4. Determining the relationships and levels of risk components

Factors	Input set	Output set	Joint collection	Level
F1	1,2,3,4,5,6,7,8	1,3,4,7	1,3,4,7	2
F2	2,6,8	1,2,3,4,5,6,7,8	2,6,8	3
F3	1,2,3,5,6	1, 3,4,5,8	1,3,5	3
F4	1,2,3,4,5 ,8	1, 4,5,7	1,4	4
F5	2,3,4,5,6,7	1,3,4,5,6,7	3,4,5,6,7	1
F6	2,5,6,7,8	1,2,3, 5,6,7,8	2,5,6,7,8	1
F7	1,2, 4,5,6,7,8	1,5,6,7,8	1,5,6,7,8	1
F8	2,3,6,7,8	1,2,4 ,6,7	2,6,7	3

Step 5: Determining relationships and leveling dimensions

To determine the relationships and level the dimensions, a set of outputs and a set of inputs must be extracted for each dimension

of the received matrix. The set of outputs includes the dimension itself and the dimensions that are affected by it. The set of inputs includes the dimension itself and the set of dimensions that affect it. Then determine the set of bilateral relations of each of the dimensions; That is, the number of dimensions that are repeated in both input and output sets. Dimensions are graded based on the resulting sets. Typically, dimensions that have the same output set and two-way relationship set constitute the top-level dimensions of the hierarchy. In other words, if the output of the output set and the input set (common set) are equal to the output set, it should be at the highest level in the ISM hierarchy; therefore, the dimensions of the upper surface of the source will be no other dimension. Once the upper level is defined, it is separated from the other dimensions. The next levels are then identified by an identical process. The results for the components of risk-taking are presented in Table 4.

According to Table 4 and the leveling of the risk component, it was determined that the dimensions are in 4 levels.

Step 6: Drawing the model and network of interactions of risk components

Then, the third step of method (ISM) was used to draw the model and level the risk components. In this step, the network of interactions between the dimensions of the research can be plotted as a model. For this purpose, the components were first drawn from top to bottom in terms of their level according to the data in Table 4 (Determining the relationships and levels of risk components) (Figure 1).

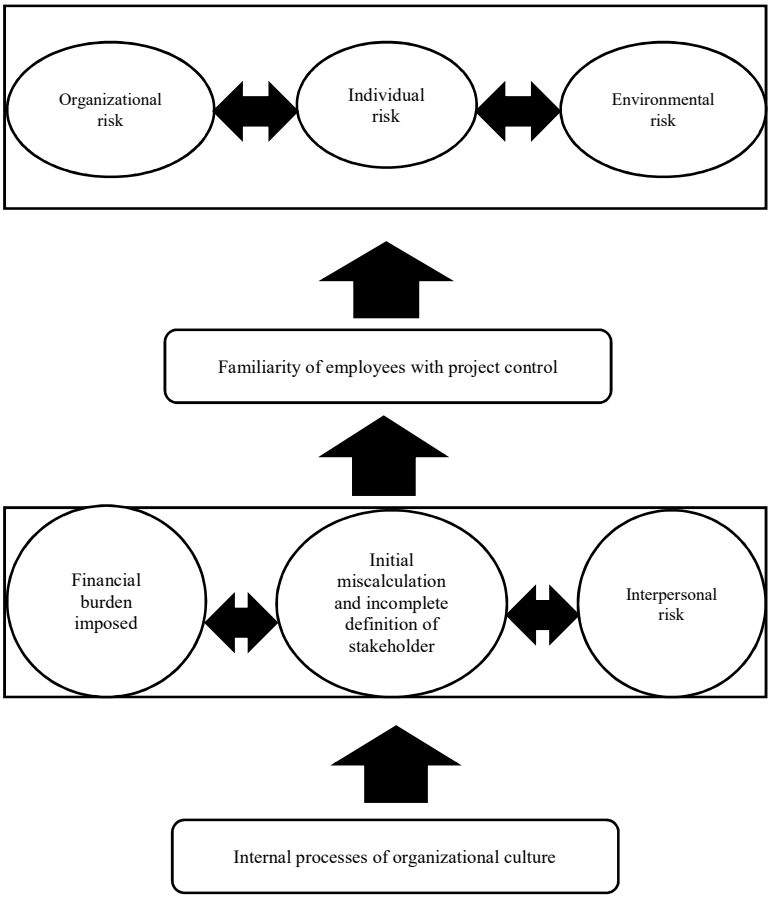

Figure 1. Interpretive structural model of risk components

As shown in Figure 1, the risk components are classified into 4 levels. In model (ISM), interactions and influences between components and the relationship of different components are visible. In the first level, there are components (Organizational risk, Individual risk, Environmental risk), the dimensions of which affect each other in pairs. In the continuation of the leveling of the

components, the components (Familiarity of employees with project control) and finally in the third level (Financial burden imposed, Initial miscalculation and incomplete definition of stakeholder needs, Interpersonal risk) and in the fourth level (Internal processes of organizational culture) are located respectively and act as the foundation stone of the model to provide the ground for the emergence and realization of other factors at the top levels of the model.

Discussion and Conclusion

Risk-taking is one of the most important components in infrastructure projects that can help managers in project management. Therefore, the present study examined the identification of risk components of municipal infrastructure projects. In this regard, citing the sources in the literature and the research background in the field of risk components and factors affecting each dimension, which were more comprehensive and general, were identified. Finally, 8 components (Organizational risk, Individual risk, Environmental risk) were extracted. According to the model and network of interactions, the risk components of municipal infrastructure projects (Familiarity of employees with project control) are in the first level and all affect each other. (Financial burden imposed, initial miscalculation and incomplete definition of stakeholder needs, Interpersonal risk) Is in the second level. (Internal processes of organizational culture). Research streams determine the factors influencing the risk-taking process. But these studies ultimately limit risk-taking to cost-benefit calculations to determine the actual output of projects. This stream ignores non-monetary costs and benefits.

The consequences and strategies of risk-taking, as revealed in this study, largely fill the gap, but there is an urgent need to separate these factors and separate their relative effects on risk-taking. Future research should focus more on non-monetary considerations in project risk-taking. Project risk research is a process that includes studies that begin mostly with the minds of project managers and follow the steps until the final choice of risk.

These studies should further consider the internal and external environmental factors and the context and consequences of risk that became clear in the present study. More empirical studies are needed to determine the relationships between project managers' minds and underlying factors. Also, political, cultural and social environments can be introduced as an impact on project risk, which itself requires empirical studies.

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Ռեզա Բարաթի
Ասպիրանտ, ՀԵՀ

ՄՈՒՆԻՑԻՊԱԼ ԾՐԱԳՐԵՐԻ ՌԻՍԿԵՐԻ ԿԱՌԱՎԱՐՄԱՆ ԿԱՌՈՒՑՎԱԾՔԱՅԻՆ ՄԵԿՆԱԲԱՆՈՒԹՅՈՒՆՆԵՐՈՎ ՄՈԴԵԼԱՎՈՐՈՒՄԸ

Բանալի բառեր - կառուցվածքային-մեկնաբանական մոտեցում (ISM), ռիսկերի ընդունում, MICMAC վերլուծության մեթոդ, քաղաքային նախագիծ

Ռիսկը առկա է բոլոր նախագծերում, և ծրագրի ռիսկի ճիշտ ըմբռնումը կարող է օգնել մունիցիպալ նախագծերի ղեկավարներին այն հաջողությամբ ավարտին հասցնել: Այս ուսումնասիրության նպատակն է բացահայտել և դասակարգել քաղաքային ենթակառուցվածքային նախագծերի ռիսկային բաղադրիչները՝ հիմնված կառուցվածքային - մեկնաբանական մոտեցման վրա (ISM):

Այս առումով, Թեհրանի քաղաքապետարանի օրինակով, ընտրվել է 41 ցուցիչ՝ 8 չափորոշիչների ենթախմբում, որոնք ներառում են կազմակերպչական ռիսկ, անհատական ռիսկ և բնապահպանական ռիսկ, աշխատակիցների ծանոթություն ծրագրի վերահսկողության հետ, պարտադրված ֆինանսական բեռ, նախնական սխալ հաշվարկ և շահագրգիռ կողմերի կարիքների թերի նույնականացում, միջանձնային ռիսկ, ներքին

ռիսկ, կազմակերպչական մշակութային գործընթացներ: Մոդելավորված ուսումնասիրության մոտեցումը ցույց է տալիս, որ կազմակերպչական ռիսկի, անհատական ռիսկի և բնապահպանական ռիսկի բաղադրիչները գտնվում են առաջին մակարդակում: Փոխարենը երկրորդ մակարդակում է աշխատակիցներին ծրագրի կառավարմանը ծանոթացնելու բաղադրիչը, իսկ երրորդում՝ պարտադրված ֆինանսական բեռի, սկզբնական սխալ հաշվարկի և շահագրգիռ կողմերի կարիքների ոչ լիարժեք նույնականացման բաղադրիչը: Եվ, վերջապես, կազմակերպչական մշակույթը գտնվում է մունիցիպալ նախագծերի ռիսկերի կառավարման չորրորդ մակարդակում:

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