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Research Article

ANALYSIS OF KEY FACTORS AFFECTING RISK TOLERANCE IN PROJECT-ORIENTED FIRMS USING HYBRID FUZZY DEMATEL-ISM: AN EMPIRICAL STUDY

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Abstract: Project risk management is one of the project management knowledge areas that identifies, analyzes and deals with project risks. One of the important factors influencing the decision-making of a project-based organization is the level of risk tolerance of organization. This study focuses on the factors affecting the level of risk tolerance of project-based organizations. For this purpose, in the first step, the potential factors affecting risk tolerance are extracted by reviewing the related literature. In the next step, the factors affecting the organization's risk tolerance level are identified by using the Fuzzy Delphi method in several steps. The most effective factors are identified by experts' judgment using a questionnaire. Then, the relationships between these factors are determined by using the Interpretive Structural Modeling (ISM) method. The intensity of these relationships and the intensity of the effect of the factors are investigated by using the Fuzzy DEMATEL method. Finally, the factors are ranked based on their weights by utilizing the Fuzzy DEMATEL method. In this study, 13 external and internal factors are ranked using questionnaires based on the experts' opinions. Four

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external factors include political conditions and international relations, the conditions of the capital markets such as stock market, investment security and government support. These factors have significant influence on the other factors as well as the project-based organization. The findings of this study direct project managers to accurately identify the risk tolerance level of the key project stakeholders in order to efficiently plan and implement project risk management and achieve project goals.

Keywords: Project risk management, risk tolerance level, project-based organization, interpretive structural modeling, fuzzy DEMATEL.

MSC: 08A72, 90B50, 91B06

1. INTRODUCTION

Depending on the level of risk-taking, project-oriented organizations, like other types of organizations, accept a level of risk. The level of risk-taking plays an important role in the success of the organization. It can be seen that factors such as technology, size and complexity of the organization, external and internal environment, goals of the organization, history of the organization, number of employees and their education level, and the possibility of using credit benefits can affect the level of risk tolerance of organizations. In addition, the three factors of time, cost, and performance are considered as the main factors affecting the level of risk taking of organizations. The main problem addressed in the present research is to identify the effective factors on the level of risk-taking of project-oriented organizations such as contractors, which is influenced by various stakeholders. On the other hand, the relationships between these factors are analyzed to measure the level of risk-taking more accurately. In addition, the relationships between these factors are considered in order to prioritize and evaluate these factors.

One of the most important parts of project planning is project risk management. To manage risks effectively, risks should be defined and measured first [1, 2]. Many criteria can be considered for risk assessment; however, two criteria of likelihood and consequence are the most important ones, which are most frequently used for risk measurement [3]. Project-based organizations usually accept projects with how risk level and reject risky projects. The important question is what is the difference level between risk rejection or acceptance. This level is called the risk tolerance level. Another important question is how to identify and measure this level. To answer these questions, we must first identify the factors that affect the organizations' risk tolerance levels, and examine how they relate to each other and the risk tolerance level of the organization. It is clear that the success of the organization depends on the success of the projects, and the success of the projects is influenced by the risks that need to be identified and measured properly based on the organization's risk tolerance level. Therefore, the risk tolerance level can play an important role in the success of project-based organizations.

The main objectives and goals of the present research can be mentioned as follows:

- Identifying factors affecting the risk taking levels of project-based organizations,
- Prioritizing influencing factors using the Fuzzy DEMATEL and ISM methods,
- Analyzing the impact of each factor on the risk taking level and determining its value,
- Providing a step-by-step approach to investigate and determine the risk-taking level of project-based organizations according to the factors affecting it.

There exist several studies on project risk management which can be generally divided into two quantitative and qualitative approaches [4]. Despite many studies that have addressed project risk management [5, 6, 7, 8, 9], limited studies have been conducted on the risk tolerance level of organizations and their interrelationships. The level of risk tolerance is the boundary that individuals and organizations use to accept or reject risk. The risk tolerance levels of project managers, organizations and stakeholders in project-based organizations depend on knowledge and culture of employees, organization's revenue, and projects' goals, respectively [10]. For this purpose, a hybrid Fuzzy Delphi and Fuzzy DEMATEL approach integrated with Interpretive Structural Modeling (ISM) method is presented in this paper to identify, analyze, and prioritize the factors affecting the risk tolerance level of organizations. In order to achieve this objective, this paper introduces a comprehensive and innovative approach that combines the Hybrid Fuzzy Delphi method alongside the Fuzzy DEMATEL technique, which has been integrated with the Interpretive Structural Modeling (ISM) method. This integrated framework is specifically designed to effectively identify, thoroughly analyze, and systematically prioritize the various factors that significantly influence the risk tolerance levels of organizations. This approach aims to provide a detailed understanding of how these factors interact with one another and impact organizational decision-making in the context of risk management. By utilizing this integrated method, we seek to enhance the ability of organizations to navigate and assess their risk tolerance in a structured manner.

Studies showed that stakeholders pay more attention to the development of an efficient integrated risk management system [11]. Other studies indicated that risk management has a significant effect on efficiency and income [12]. In most of the studies conducted so far, the effect of organization size on organizational risk management has been recognized as a positive and significant factor. Also, some studies showed that profit and change of liquidity variable have a positive relationship with organizational risk management [13]. Financial status is a positive and meaningful factor for organizational risk management. In fact, risk management reduces potential losses in financial crises in organizations with high financial capabilities [14]. Yilmaz and Flouris [15] investigated the relationship between risk management and resource dependence as well as the relationship between corporate management strategies with uncertain resources in Turkish airline business. Giambona et al. [16] examined the relationship between managers' risk tolerance level and managers' perception of political risks and risk management and the amount of investment in countries with higher political risks. As aforementioned, few studies have examined the effect of these factors on each other. Also, the uncertainty in the experts' opinions has not been addressed so far. In this research, the uncertainty is taken into account using the fuzzy set theory. Studies on risk management can be classified into quantitative and qualitative approaches [4]. Frijns et al. [17] examined the risk tolerance levels of senior managers of organizations and the impact of factors such as culture on their risk tolerance levels as well as the effect of risk tolerance levels on managers' decisions. John et al. [18] studied the factors influencing the risk tolerance levels of organizations' managers in investment, and identified the internal factors of organizations as stronger and more important than the external factors. Khalilzadeh et al. [19] identified and prioritized the factors affecting the risk tolerance level organizations using Taxonomy method and risk breakdown structure. Table 1 shows a number of studies in this field, it is noteworthy that none of them have examined

the factors affecting the risk tolerance level of organizations with a hybrid method considering uncertainty, which demonstrates the contributions of the current research.

Table 1: The summary of literature review

Author(s)	Subject	Methods			
		Fuzzy Delphi	Fuzzy DEMATEL	ISM	Other
Kwak and Laplace [10]	Analysis of risk tolerance level in project-based organizations and the affecting factors				■
Frijns et al. [17]	Investigating the effect of national culture on managers' decisions and the risk tolerance level of organizations				■
John et al. [18]	Investigating the factors affecting the financial risk tolerance level				■
Khalilzadeh et al. [19]	Identifying and ranking the factors affecting the risk tolerance level of organization				Taxonomy and TOPSIS
Ullah et al. [20]	Identification of Factors Affecting Risk Appetite of Organizations in Selection of Mega Construction Pro-jects				Interview
Tamošaitienė et al. [25]	Investigating the Factors influencing the risk of construction projects				TOPSIS
Nieto-Morote & Ruz-Vila [26]	Risk analysis of construction projects using fuzzy set theory				AHP
Samvedi and Jain [27]	Investigating the relationships between supply chain risk criteria		■		
Pfohl et al. [28]	Investigating the relationships between factors affecting supply chain risks			■	
Kumar and Dash [29]	Investigating the disruptions and risks of digital projects	■	■		
Sorourkhah [30]	Selecting the strategies under turbulent environment			■	
Noori Doabi et al. [31]	Exploring automated auditing on Blockchain platforms			■	
Faghidian and Fathizade [32]	Determining and prioritizing factors influencing electronic banking services in fuzzy environment	■			
Bazrkar [33]	Identification and prioritization of managers' crucial competencies	■			
Rezaei and Hemati [34]	A hybrid fuzzy technique for prioritizing employees' needs	■			
Fakhrhosseini and Kaviani [35]	Prioritizing employees' performance evaluation indicators		■		
Faghidian and Mahmodi [36]	Evaluating the enablers of Total Quality Management		■		
This study	Investigating the factors affecting the risk tolerance level of project-based organizations and their relationships	■	■	■	

Ullah et al. [20] identified the factors influencing the risk appetite of organizations regarding the selection of mega construction projects using the semi-structure interviews. Nabeeh [21] explored sustainable road transport's environmental and economic factors, emphasizing reducing carbon emissions, enhancing energy efficiency. Abouhawwash and Jameel [22] specified crucial factors for installing solar power facilities and exploited the CRiteria Importance Through Inter-criteria Correlation (CRITIC) method to weigh the criteria. Gamal et al. [23] utilized the DEMATEL method for prioritizing key factors and strategies. They also employed the CRADIS method for enhancing supply chain responsiveness. Abdelhafeez et al. [24] applied the ELECTRE method under neutrosophic environment to the healthcare waste management field.

As can be seen in Table 1, there are several studies on project risk management, but only few studies have identified and evaluated the factors affecting the risk-taking levels of organizations. The organizational risk-taking level has a great impact on the risk management of the organization and the decisions of the managers. However, the relationships between the factors affecting the risk-taking levels of project-based organizations have been neglected. This research examines these relationships to gain better knowledge of these factors and their importance. In this paper, a combination of Fuzzy Delphi, Fuzzy DEMATEL and Interpretive Structural Modeling (ISM) methods is used to take advantage of each of these methods for identifying and ranking the factors affecting the risk-taking levels of project-based organizations based on their mutual relationships.

2. MATERIALS AND METHODS

The ISM and DEMATEL techniques seem to be proper approaches for illustrating hierarchical structures since these two methods explicitly present the relationships in a system [37, 38].

In this paper, a hybrid approach including three methods of Fuzzy Delphi, Fuzzy DEMATEL, and ISM is presented to identify and rank the factors affecting the risk-taking level of project-based organizations. These two techniques are utilized since the ISM method identifies the influence level of the factors on each other, and determines the interrelationships between the factors. Also, the ISM method is suitable for analyzing the effects of factors on each other. Moreover, this technique identifies and prioritizes the level of factors within the system. However, the ISM method cannot determine the intensity degree of relationships and interactions between the factors; this deficiency and shortcoming is overcome by combining the ISM and DEMATEL methods. Furthermore, the Fuzzy DEMATEL method is utilized to deal with the inherent uncertainty associated with the decision-making process. The Fuzzy DEMATEL technique employs fuzzy linguistic variables for facilitating decision-making under uncertainty conditions [39]. This method has been broadly applied to various fields such as social sciences, project and production management, manufacturing, organizational management, and information [40, 41]. Also, the Fuzzy DEMATEL method has been exploited to solve the problems of organizations by using group decision-making under fuzzy conditions [42, 43]. The hybrid of Fuzzy ISM and Fuzzy DEMATEL techniques illustrates relationships between the factors in the best possible manner [44]. Figure 1 displays the steps of the proposed methodology.

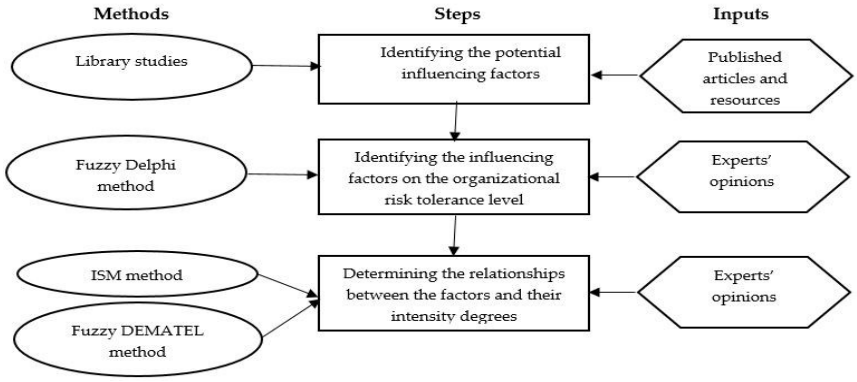

Figure 1: Steps of the research methodology.

First, the related studies in this field were reviewed through the library research to identify some potential factors affecting the risk-taking levels of project-based organizations. These initial factors were used in the next step of the Delphi method so that experts could judge their importance. Next, the factors extracted from the literature were judged by the experts in four steps using four types of questionnaires to be informed of their opinions. For this purpose, 14 managers of a project-based company in Iran were selected based on judgmental sampling technique as the statistical population for this research. These experts had more than ten years of practical experience and bachelor's degree or higher. Kendall rank correlation coefficient and Cronbach's alpha were applied to assess the validity and reliability of the questionnaires, respectively.

2.1. The Fuzzy Delphi method

The Delphi technique is a powerful process based on the structure of group communication. This method was first presented by Olaf Helmer and Norman Dalkey in 1950s for the Rand Corporation. This method is used in cases where incomplete and uncertain knowledge is available or limitations are observed in terms of the application of rules, formulas, and mathematical models. For this purpose, experts' opinions and judgments are collected in a certain area. In other words, judgment is left to the experts. The Delphi method is mainly aimed at discovering creative and reliable ideas or providing appropriate information for decision-making. This method examines the attitudes and judgments of individuals and expert groups and to form consensus and harmony between viewpoints. These surveys are conducted through several steps using questionnaires and without requiring people to attend a specific location. At the end of summarizing, valuing, and analyzing the collection of people's opinions, the basis for setting goals, formulating plans or making decisions is placed.

Among the advantages of the Delphi method, the following can be mentioned:

- Rapid consensus,
- No geographic restrictions for participants,
- Ability to cover a wide range of experts,
- Preventing the dominance of group thinking and silence of the minority,
- Forming creative ideas,
- Predictive power of complex one-dimensional subjects [42].

However, one of the existing problems is that in many real situations, the judgment of experts cannot be expressed and interpreted in the form of definite crisp numbers; In other words, definitive data and numbers are insufficient to model real-world systems due to ambiguity and uncertainty in decision-makers' judgments. In order to overcome this problem, the theory of fuzzy sets was presented by Lotfi Zadeh in 1965 [43]. It is a suitable tool to deal with ambiguity and uncertainty in the decision-making process [44]. Therefore, in this research, the Fuzzy Delphi method is used to confirm and screen the identified indicators [45]. This method is a combination of the Delphi method and the theory of fuzzy sets, which was presented by Ishikawa et al. This method has two main steps, in the first stage, experts' opinions are collected using fuzzy numbers and through questionnaires, and in the next step, factors are checked, confirmed, or screened to reach a consensus.

After identification of research indicators using a comprehensive review of the theoretical foundations of research, the steps of the Fuzzy Delphi method are as follows [46]:

(1) Collecting the opinions of experts: In this step, after identifying the indicators, a decision-making group consisting of experts related to the research topic is formed and questionnaires are sent to them in order to determine the relevance of the identified indicators to the main topic of the research and screening, in which the linguistic variables presented in Table 2 are used to express the importance of each indicator. In this research, the triangular fuzzy numbers are utilized.

Table 2.:Verbal expressions and corresponding fuzzy numbers

Verbal expressions	Triangle fuzzy numbers
Very low	(0,0,0.25)
Low	(0,0.25,0.5)
Average	(0.25,0.5,0.75)
High	(0.5,0.75,1)
Very high	(0.75,1,1)

(2) Verification and screening of indicators: in this step, the acquired value of each index is compared with the threshold value. The threshold value is also obtained from the mean of the fuzzy numbers. First, the triangular fuzzy numbers corresponding to the experts 'opinions must be determined, then the fuzzy mean of *n* respondents' opinions must be calculated. The corresponding fuzzy numbers are calculated using the following equations [36]:

$$\bar{a}_{ij} = \left(a_{ij}, b_{ij}, c_{ij}\right),\ j = 1..n\ \ j = 1..m. \tag{1}$$

$$a_j = \min\left(a_{ij}\right). \tag{2}$$

$$b_j = \left(\prod_{i=1}^{n} b_{ij}\right)^{1/n}. \tag{3}$$

$$c_j = \max\left(c_{ij}\right). \tag{4}$$

and *j* refers to the criterion. Also, the difuzzified value of the mean fuzzy number is obtained from the following equation. There are other difuzzification methods that can be used [35].

$$crisp = \frac{a+b+c}{3}. \tag{5}$$

2.2. Interpretive structural modeling (ISM)

In the following step, the relations between the affecting factors are examined using the third questionnaire and Interpretive Structural Modeling (ISM) technique. The ISM method was introduced by Sage in 1977 with the purpose of classifying the factors and identifying their relationships [47-48].

Step 1. The structural self-interaction matrix. In this step, the pairwise comparisons are conducted as follows, that is, in each comparison between two criteria the letters V, A, X, O are used based on the following definitions:

V: The row *i* factor triggers the column *j* factor,
A: The column *j* factor triggers the row *i* factor,
X: Both row *i* and column *j* factors trigger each other,
O: There is no mutual relationship between the row *i* and column *j* factors.

Step 2. The initial reachability matrix. By converting the symbols of the self-interaction matrix to 0 and 1 numbers, the initial reachability matrix is obtained as follows:

- If the letter V is the symbol of the cell *ij*, number 1 is put in that cell and number 0 is put in the symmetrical cell.
- If the letter A is the symbol of the cell *ij*, number 0 is put in that cell and number 1 is put in the symmetrical cell.
- If the letter X is the symbol of the cell *ij*, number 1 is put in that cell and number 1 is put in the symmetrical cell.
- If the letter O is the symbol of the cell *ij*, number 0 is put in that cell and number 0 is put in the symmetrical cell.

Step 3. Normalization. In the initial reachability matrix, this rule must be checked that if ($i,j = 1$ and $j,k = 1 \rightarrow i,k = 1$) that is, if criterion A is related to criterion B and criterion B is related to criterion C, then criterion A must also be related to criterion C.

Step 4. Determination of the level of factors. In this step, the set of inputs and outputs was identified for each factor, then the common factors were specified. In this step, the factor on the highest level is the factor whose output set is equal to the common set. After identifying this factor(s), their corresponding rows and columns are removed from the table and the operation is repeated for other factors.

Step 5. Formation of the ISM graph. In this step, the graph of interactions is drawn according to the levels of the factors and the relationships between them. The first level is chosen as the most influential level and the last level is chosen as the most influenced level.

Step 6. Group Interpretative Structural Modeling (ISM) method. If there are several experts, each of which has a structural self-interaction matrix, they must be merged [41, 49].

2.3. The Fuzzy DEMATEL

After identifying the relationships, the Fuzzy DEMATEL method is used to obtain the intensity of the relationships between the factors through the fourth questionnaire [50, 51].

To measure the relationships between factors, we need to put them in a square matrix and ask the experts to make pairwise comparisons according to the intensity of their impacts on each other. In this survey, the experts expressed their opinions based on the

fourth questionnaire. Supposing we have n factors and p experts; we have p fuzzy matrices, each of which corresponds to the opinions of an expert with the triangular fuzzy numbers as its cells [41]. Then, to normalize the fuzzy direct relationship matrix, the linear scale conversion was used as the normalization formula to convert the scales of the factors to the comparable factors.

$$\tilde{a}_{ij} = \sum_{j=1}^{n} \tilde{Z}_{ij} = \left(\sum_{j=1}^{n} l_{ij}, \sum_{j=1}^{n} m_{ij}, \sum_{j=1}^{n} r_{ij}\right) and\ r = \max_{1 \le i \le n}\left(\sum_{j=1}^{n} r_{ij}\right). \quad (6)$$

$$\tilde{X}_{ij} = \frac{\tilde{z}_{ij}}{r} = \left(\frac{l_{ij}}{r}, \frac{m_{ij}}{r}, \frac{r_{ij}}{r}\right). \quad (7)$$

Then, to calculate the fuzzy matrix of the total relationship, we first calculate the inverse of the normal matrix, then subtract it from the matrix I, and finally multiply the normal matrix by the resulting matrix.

$$\left[l''_{ij}\right] = X_l(I - X_l)^{-1}. \quad (8)$$

$$\left[m''_{ij}\right] = X_m(I - X_m)^{-1}. \quad (9)$$

$$\left[r''_{ij}\right] = X_r(I - X_r)^{-1}. \quad (10)$$

Finally, to analyze these factors, we first calculate the sum of the elements of each row (Di) and the sum of the elements of each column (Ri) of the fuzzy matrix. Then we easily get the values D + R and D-R. To draw a causal diagram, we must difuzzify these two values, like the definitive DEMATEL method. Here we use conventional methods to difuzzify these two values.

The sum of the cells of each row (D) for each factor indicates the extent to which that factor affects other factors in the system.

The sum of the cells of the column (R) for each factor indicates the degree to which that factor is affected by other factors in the system.

Therefore, the horizontal vector (D + R) indicates the sum of the intensity of a factor based on both influencing and being influenced. In other words, the higher the value of D + R factor, the more it interacts with other factors.

The vertical vector (D - R) indicates the intensity power of each factor. In general, if D - R is positive, the factor is causal, and if it is negative, the factor is caused [43].

Finally, a Cartesian coordinate system is drawn, in which the longitudinal axis is D + R and the horizontal axis is D - R. The position of each factor is determined by a point with coordinates (D + R, D - R). In this way, a graphic diagram is obtained [43].

3. RESULTS

In this section, the steps presented in the previous section were implemented in the case of study and the results were obtained. A leading project-based company which was established in 1986 was considered as a real case study. This company officially introduced itself as an investment and executive group in the country's construction industry in 1995 and has a serious and continuous presence in this field until today. This company is ranked 1st in terms of sales efficiency index in the mass construction and real estate group of the country and has 15 active construction projects in 7 cities of Iran.
Potential factors extracted from relevant studies are as follows:

- **Size of the organization:** This factor includes the number of personnel, the volume of financial transactions and cash flow, and the dimensions of the completed projects.
- **Organization's field of work:** The range of activities of project-based organizations is very wide ranging from construction projects to software projects. Organizations' risk tolerance level can be different according to their field of work.
- **Age of the organization:** The age of organizations can affect their risk tolerance level. For example, organizations with a high age are more risk-taking or vice versa.
- **Goals of the organization:** The goals and vision of the organization can influence its risk tolerance level. For example, organizations that have improvement plans for their future may be more risk-taking than other organizations.
- **Stakeholders' risk tolerance level:** Project-based organizations consist of numerous persons whose risk tolerance level can affect the organization's risk tolerance level [52].
- **Education level of the stakeholders:** The education level of the stakeholders, especially related to risk management, can influence the stakeholder and organization's risk tolerance level.
- **Economic and political conditions of the country:** Project-based organizations, like other organizations, are affected by the economic and political conditions of the country in which they are located. For example, organizations that are in difficult economic conditions will naturally have less risk tolerance. International organizations are also vulnerable to the economic and political conditions of the countries in which they operate.
- **Number and status of competitors:** Project-based organizations are usually located in a competitive environment, and the position of organizations in this environment and the strength of their competitors greatly affect the risk tolerance level of the organizations.
- **Income and liquidity of the organization:** Income and liquidity of the organizations can affect their risk tolerance level.

3.1. The results of the Fuzzy Delphi method

In this study, the Fuzzy Delphi method was used to investigate the importance level of the aforementioned factors. The average level is considered to be 0.5 and all the aforementioned factors have this level, so they remain in the questionnaire in the next step. The output of the first step of the Fuzzy Delphi method is displayed in Table 3.

Table 3: The output of the first step of the Fuzzy Delphi method

Factor	Total			Average
Size of the organization	0.25	0.71	1	0.653
Organization's field of work	0.25	0.69	1	0.645
Age of the organization	0.25	0.55	1	0.599
Goals of the organization	0	0.72	1	0.574
Stakeholders' risk tolerance level	0	0.51	1	0.502
Education level of the stakeholders	0	0.51	1	0.504
Economic conditions of the country	0.25	0.84	1	0.697
Number and status of competitors	0.25	0.76	1	0.671
Income and liquidity of the organization	0.25	0.72	1	0.656

In Table 4, the factors suggested by the experts are presented. Important factors with more frequency are added in the next step.

Table 4: Factors introduced in the first step of the Fuzzy Delphi method

Factor	Importance level	Expert number	Factor	Importance level	Expert number
Failure to pay claims on time	Average	1	Decrease in consumer purchasing power	Very high	8
High investment risk for foreign companies	High	1	Currency transfer problems	Very high	8
Multi-rate currency	High	1	Absence of specific laws for export	Very high	8
Lack of encouraging domestic investors	Average	2	Free choice	High	9
Lack of government support from the private sector	Average	2	Lack of risk controllability	High	9
Instability of prices	Very high	2	Lack of familiarity with risk	Very high	9
Reluctance to invest	High	3	Unawareness of employees in facing risk	Average	10
Lack of supporting the production of quality goods	Very high	3	Lack of employee satisfaction	High	10
Lack of monitoring the performance of the housing market and exchange rate	Very high	3	Inflation	Very high	10
Supply and demand mismatch	High	4	Economic sanction	High	11
Non-uniform implementation of rules	High	4	Market fluctuations	Average	11
Cumbersome rules for large companies	Very high	4	Lack of raw materials	Very high	11
Failure to legally submit projects in tenders	High	5	Too many changes in the production rules and regulations	High	12
Lack of security in domestic investments	High	5	Economic instability	Very high	12
Market instability	Very high	5	Lack of investment security	Very high	12
Economic instability	Very high	6	Lack of support for investment and the private sector	Very high	13
Uncontrollable inflation	Very high	6	Laws and regulations and their instability	Very high	13
Import restrictions	High	6	High bank interest	High	13
Shipment price	High	7	Fluctuation of exchange rate and gold price	Average	14

Lack of raw materials	High	7	Influence of international conditions on the market	High	14
Instability of prices	Very high	7	Economic instability	High	14

Some factors such as inflation were considered as a subset of the country's economic and political conditions, however, they were emphasized by experts which shows that this factor should be broken down into subfactors. Therefore, this factor is divided into the following five subfactors.

Economic stability: This subfactor refers to the economic situation of the country [53]. Inflation and unemployment rate can be included in this factor.

Political conditions and international relations: This subfactor refers to the political situation that can affect the status of organizations in that country.

Investment security and government support: This subfactor refers in more detail to the economic conditions of a country for project-based organizations. Government support policies for such companies and investment security are among the important components of this subfactor.

Conditions of financial markets and exchange rate: As we know, capital markets affect each other. Therefore, the conditions of project-based organizations are affected by financial markets. It should be noted that the exchange rate also affects project-based organizations because these organizations may buy materials and machinery from foreign companies or have financial relationships with other international organizations.

Laws and their implementation method: Laws related to project-based organizations are also effective on their risk tolerance level. It should be noted that in addition to written laws, their implementation methods are important.

The second questionnaire was updated with 13 factors and the results obtained from the second step are presented in Table 5. All factors are of great importance and no factor can be eliminated.

Table 5: The output of the second step of the Fuzzy Delphi method

Factor	Total			Average
Size of the organization	0.25	0.71	1	0.65
Organization’s field of work	0.50	0.77	1	0.76
Knowledge in the organization about risk management	0.25	0.72	1	0.61
Age of the organization	0.25	0.59	1	0.61
Goals of the organization	0.50	0.89	1	0.80
Stakeholders' risk tolerance level	0	0.51	1	0.66
Number and status of competitors	0.50	0.82	1	0.77
Economic stabilityof the country	0.25	0.88	1	0.71
Income and liquidity of the organization	0.25	0.76	1	0.67
Political conditions and international relations	0.25	0.73	1	0.66
Investment security and government support	0.25	0.73	1	0.66
Laws and their implementation method	0	0.63	1	0.54
Conditions of financial markets and exchange rate	0.25	0.70	1	0.65

The factors suggested by experts can be seen in Table 6. No new factors are found among them. These factors were either present in the list of the previous factors or are far from the scope of this research.

Table 6: Factors introduced in the second step of the Fuzzy Delphi method

Factor	Importance level	Expert number	Factor	Importance level	Expert number
Failure of banks to support investors	High	1	Exchange rate instability	Very high	8
Conflict of instructions and directives	High	2	Instability of prices	Very high	9
How to face risks	High	3	Heavy sanctions	Very high	10
Failure to recognize the threat	High	4	Lack of production support	Very high	11
Cultural factors	High	5	Momentary inflation	Very high	12
Inadequacy of supply and demand	Very high	6	Mismatch of supply and demand	Very high	13
Inflation	Very high	7	Lack of proper supervision of production and import	high	14

Then, the validity and reliability of the questionnaires were examined. For this purpose, the values of Kendall's coefficient and Cronbach's alpha are obtained as shown in Table 7.

Table 7: Validity and reliability of the Fuzzy Delphi method

	Kendall's coefficient value	Cronbach's alpha	Reliability
First step	0.506	0.877	acceptable
Second step	0.935	0.908	acceptable

3.2. The results of the ISM method

Subsequently, the relationships between the factors were identified using the Interpretive Structural Modeling (ISM) method. The summation matrix of the experts' opinions is displayed in Table 8.

To find out the influencing and influenced factors, the number of “1” in the columns and rows was counted (shown in Table 9). The results indicate that the factors such as economic stability of the country, political conditions and international relations, and laws and their implementation method are the influencing factors because these factors are environmental and cannot be controlled by the organization. On the other hand, factors such as income and liquidity of the organization, number and status of competitors, and the goals of the organization are the influenced factors. These factors are internal and influenced by external conditions.

Table 8: Structural self-interaction matrix

	Size of the organization	Organization field of work	Age of the organization	Goals of the organization	Stakeholders' risk tolerance level	Knowledge in the organization about risk management	Number and status of competitors	Income and liquidity of the organization	Economic stability of the country	Political conditions and international relations	Investment security and government support	Laws and their implementation method	Conditions of financial markets and exchange rate
Size of the organization		0	0	1	0	0	1	1	0	0	0	0	0
Organization's field of work	0		0	1	0	0	1	1	0	0	0	0	0
Age of the organization	0	0		1	0	0	1	1	0	0	0	0	0
Goals of the organization	0	0	0		0	0	0	1	0	0	0	0	0
Stakeholders' risk tolerance level	0	0	0	0		0	0	0	0	0	0	0	0
Knowledge in the organization about risk management	0	0	0	0	1		0	0	0	0	0	0	0
Number and status of competitors	1	0	0	1	0	0		1	0	0	0	0	0
Income and liquidity of the organization	1	0	0	1	0	0	1		0	0	0	0	0
Economic stability of the country	0	0	0	1	0	0	1	1		1	1	1	1
Political conditions and international relations	0	0	0	1	0	0	1	1	1		1	1	1
Investment security and government support	0	0	0	1	0	0	1	1	1	1		0	1
Laws and their implementation method	0	0	0	1	0	0	1	1	1	1	1		1
Conditions of financial markets and exchange rate	0	0	0	1	0	0	1	1	1	1	1	0	

Table 9: Influencing and influenced factors based on the ISM method

Factor	Influenced degree	Influencing degree
Size of the organization	2	3
Organization's field of work	0	3
Age of the organization	0	3
Goals of the organization	10	1
Stakeholders' risk tolerance level	1	0
Knowledge in the organization about risk management	0	1
Number and status of competitors	9	3
Income and liquidity of the organization	10	3
Economic stability of the country	4	7
Political conditions and international relations	4	7
Investment security and government support	4	6
Laws and their implementation method	2	7
Conditions of financial markets and exchange rate	4	6

Figure 2 displays the relationships between these factors. As can be seen, the factors of "Knowledge in the organization about risk management" and "Stakeholders' risk tolerance level" are almost independent factors. The factors such as "Income and liquidity of the organization", "Number and status of competitors", and "Goals of the organization" are dependent factors. The factors such as "Size of the organization", "Age of the organization", and "Organization's field of work" are autonomous factors. Other factors are linkage factors.

Another important point is that the four factors of "Economic stability of the country", "Conditions of financial markets and exchange rate", and "Political conditions and international relations" formed a complete graph and are related to each other. This graph comprises very important factors that have a significant effect on other factors.

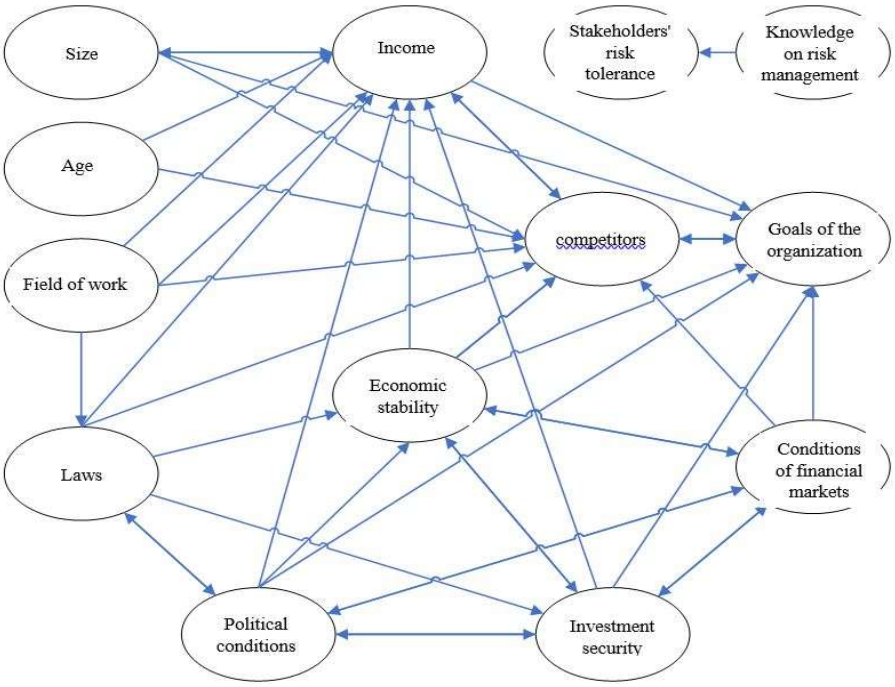

Figure 2: Relations between the factors.

3.3. The results of the Fuzzy DEMATEL technique

As aforementioned, the relationships between factors were identified using the ISM method. In this section, the identified relationships were measured by using the Fuzzy DEMATEL technique to determine the intensity degree of the relationships between the factors. The results are presented in Table 10.

Table 10: Intensity degree of the relationships obtained by the Fuzzy DEMATEL technique

	Size of the organization	Organization field of work	Age of the organization	Goals of the organization	Stakeholders' risk tolerance level	Knowledge in the organization about risk management	Number and status of competitors	Income and liquidity of the organization	Economic stability of the country	Political conditions and international relations	Investment security and government support	Laws and their implementation method	Conditions of financial markets and exchange rate
Size of the organization	0.046	0.000	0.000	0.051	0.000	0.000	0.131	0.206	0.000	0.000	0.000	0.000	0.000
Organization's field of work	0.052	0.000	0.000	0.231	0.000	0.000	0.165	0.209	0.033	0.012	0.037	0.140	0.038
Age of the organization	0.043	0.000	0.000	0.145	0.000	0.000	0.128	0.187	0.000	0.000	0.000	0.000	0.000
Goals of the organization	0.024	0.000	0.000	0.025	0.000	0.000	0.023	0.149	0.000	0.000	0.000	0.000	0.000
Stakeholders' risk tolerance level	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Knowledge in the organization about risk management	0.000	0.000	0.000	0.000	0.169	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Number and status of competitors	0.178	0.000	0.000	0.210	0.000	0.000	0.050	0.237	0.000	0.000	0.000	0.000	0.000
Income and liquidity of the organization	0.172	0.000	0.000	0.177	0.000	0.000	0.166	0.082	0.000	0.000	0.000	0.000	0.000
Economic stability of the country	0.081	0.000	0.000	0.313	0.000	0.000	0.231	0.357	0.082	0.068	0.206	0.009	0.233
Political conditions and international relations	0.108	0.000	0.000	0.389	0.000	0.000	0.322	0.457	0.334	0.099	0.291	0.152	0.346
Investment security and government support	0.101	0.000	0.000	0.395	0.000	0.000	0.308	0.425	0.244	0.201	0.120	0.028	0.275
Laws and their implementation method	0.103	0.000	0.000	0.377	0.000	0.000	0.315	0.429	0.239	0.083	0.269	0.012	0.273
Conditions of financial markets and exchange rate	0.103	0.000	0.000	0.391	0.000	0.000	0.325	0.423	0.287	0.237	0.303	0.033	0.151

The obtained weights as well as the amounts of D and R for the factors are provided in Table 11.

Table 11: Output of the DEMATEL technique

Factors	D	R	D+R	D-R	Score	Ranking
Political conditions and international relations	2.50	0.70	3.20	1.80	0.19	1.00
Conditions of financial markets and exchange rate	2.25	1.32	3.57	0.94	0.17	2.00
Laws and their implementation method	2.10	0.37	2.47	1.73	0.16	3.00
Investment security and government support	2.10	1.23	3.32	0.87	0.16	4.00
Economic stability of the country	1.58	1.22	2.80	0.36	0.12	5.00
Organization's field of work	0.92	0.00	0.92	0.92	0.07	6.00
Number and status of competitors	0.67	2.17	2.84	-1.49	0.05	7.00
Income and liquidity of the organization	0.60	3.16	3.76	-2.56	0.05	8.00
Age of the organization	0.50	0.00	0.50	0.50	0.04	9.00
Size of the organization	0.43	1.01	1.45	-0.58	0.03	10.00
Goals of the organization	0.22	2.70	2.92	-2.48	0.02	11.00
Knowledge in the organization about risk management	0.17	0.00	0.17	0.17	0.01	12.00
Stakeholders' risk tolerance level	0.00	0.17	0.17	-0.17	0.00	13.00

In Table 12, the score obtained by the Fuzzy DEMATEL method is displayed. As mentioned, these scores were obtained from the relationships between the factors. The factors such as "Knowledge in the organization about risk management" and "Stakeholders' risk tolerance level" have a score of zero since they were not present in the graph, while these factors have internal importance. The output of the Fuzzy Delphi method was used to measure the intrinsic value of each factor. For ranking, it is appropriate to pay attention to both the intrinsic value and the value obtained from the relationships of these factors. Table 12 presents the final ranking obtained from the average score of these two approaches.

Table 12: Final ranking of factors

Factors	Delphi	DEMATEL	Total	Ranking
Political conditions and international relations	0.550	1	0.770	1
Conditions of financial markets and exchange rate	0.508	0.902	0.705	2
Investment security and government support	0.544	0.839	0.691	3
Economic stability of the country	0.693	0.632	0.663	4
Organization's field of work	0.886	0.367	0.626	5
Number and status of competitors	0.913	0.270	0.592	6
Goals of the organization	1	0.088	0.544	7
Laws and their implementation method	0.157	0.841	0.499	8
Income and liquidity of the organization	0.580	0.239	0.410	9
Size of the organization	0.519	0.174	0.346	10
Stakeholders' risk tolerance level	0.529	0	0.265	11
Knowledge in the organization about risk management	0.383	0.068	0.227	12
Age of the organization	0	0.202	0.101	13

3.4. Sensitivity analysis

In the present study, sensitivity analysis was performed on the number of decision-making panel members in the Fuzzy DEMATEL method in order to identify the sensitivity of the obtained results to the decrease or increase in the number of decision-makers. For this purpose, the number of decision makers, which was considered 14 in the research, was reduced to 7 and increased to 20 in the sensitivity analysis. Therefore, the ranking results based on the opinions of 7 experts, 14 experts, and 20 experts are presented in Table 13.

Table 13: Sensitivity analysis results

	Number of Expert					
	7		14		20	
Factors	DEMATEL Score	Ranking	DEMATEL Score	Ranking	DEMATEL Score	Ranking
Political conditions and international relations	1	1	1	1	1	1
Conditions of financial markets and exchange rate	0.871731	2	0.901926	2	0.934101	2
Investment security and government support	0.857763	3	0.839547	4	0.866211	4
Economic stability of the country	0.732886	5	0.632507	5	0.549917	5
Organization's field of work	0.433791	6	0.366731	6	0.335603	7
Number and status of competitors	0.364208	7	0.270053	7	0.347122	6
Goals of the organization	0.204921	10	0.088317	11	0.100476	11
Laws and their implementation method	0.850074	4	0.840704	3	0.874910	3
Income and liquidity of the organization	0.219634	9	0.239288	8	0.237113	8
Size of the organization	0.181462	11	0.173619	10	0.104107	12
Stakeholders' risk tolerance level	0	13	0	13	0	13
Knowledge in the organization about risk management	0.059822	12	0.067701	12	0.111462	10
Age of the organization	0.245019	8	0.201702	9	0.221883	9

Finally, the research factors were also ranked using the SWARA method and its results were compared with the DEMATEL method. In this method, each expert determines the importance of each factor based on the implicit knowledge, information,

and experience and plays an important role in evaluating the weights. The results are presented in Table 14.

Table 14: Comparison of results from the DEMATEL and SWARA methods.

Factors	Weight of SWARA	Ranking by SWARA	Ranking by DEMATEL
Political conditions and international relations	0.087589	1	1
Conditions of financial markets and exchange rate	0.085049	2	2
Investment security and government support	0.077078	5	4
Economic stability of the country	0.076290	6	5
Organization's field of work	0.080144	4	6
Number and status of competitors	0.07629	7	7
Goals of the organization	0.075589	9	11
Laws and their implementation method	0.084173	3	3
Income and liquidity of the organization	0.07629	8	8
Size of the organization	0.075589	10	10
Stakeholders' risk tolerance level	0.065341	13	13
Knowledge in the organization about risk management	0.067881	12	12
Age of the organization	0.072699	11	9

The sensitivity analysis performed on the number of members of the decision-making panel in the DEMATEL method indicates differences with the ranking of the research factors. The differences between the DEMATEL method with 7 decision-makers and with 14 decision-makers were greater, so that different ranking factors were observed in 6 factors. While the differences between the results of the DEMATEL method with 14 decision-makers and with 20 decision-makers were reduced to 4 factors. This is despite the fact that the same rating was obtained in most of the factors. The sameness of the ranks in most of the factors shows a consistent line of thought in the entire organization. In other words, the results demonstrate the transparency and clarity of the organization's strategies and policies to achieve the goals, and there is collective awareness among the organization's managers.

Also, the results of the sensitivity analysis display that the increase in the number of members of the decision-making panel leads to greater convergence in the results of the data presentation, so that in calculations with 20 decision-makers, the number of differences in the ranking of factors was reduced to 4 factors. It should be noted that the greater number of decision-makers leads to better results in situations where all of the decision-makers are experts in the field of research.

Finally, research factors were ranked using the SWARA method. The results of the ranking with the two fuzzy DEMATEL and SWARA methods were different from each other in 5 factors. This difference is reasonable and acceptable due to the difference in the characteristics of the methods.

4. DISCUSSION AND CONCLUSION

The purpose of the present research was to identify and analyze the factors affecting the risk tolerance level of project-based organizations. For this purpose, a leading project-based organization in the country with 15 active projects in 7 cities was considered as a real case study. The findings indicate that thirteen factors including external and internal factors affect the risk tolerance level of the studied project-based organization. Internal factors such as "Size of the organization" and "Income and liquidity of the organization" are related to the characteristics of the organization. But the external factors are caused by the environment, country, government, and other organizations. In this research, the external factors were more important than the internal factors and the reason is that in addition to their intrinsic importance, they are also very influential on the internal factors of the organization. These results can be affected by the current particular condition of the country that affects the success of the organization. In general, according to the results, it can be said that the more influencing the factors are, the more important they are, which indicates the correctness of the proposed approach.

The factors influencing the risk tolerance level of the organization are as follows in order of importance: 1 - Political conditions and international relations, 2 - Conditions of financial markets and exchange rate, 3 - Investment security and government support, 4 - Economic stability of the country, 5 - Organization's field of work, 6 - Number and status of competitors, 7 - Goals of the organization, 8 - Laws and their implementation method, 9 - Income and liquidity of the organization, 10 - Size of the organization, 11 - Stakeholders' risk tolerance level, 12 - Knowledge in the organization about risk management, and 13 - Age of the organization.

From a managerial point of view, this study can direct the project-based organizational managers to have a better understanding of the organization's risk tolerance level in order to be more successful in making decisions, especially in the field of risk management. For example, in the current state of the country's economy, which has been faced with several problems due to international sanctions and the capital market crisis, the risk-taking level of organizations has increased greatly since carrying out a project in the current condition is too risky. On the other hand, the movement of capital and liquidity towards the foreign currency and gold has made project-based companies face various problems. The risk tolerance level of the organization has a great influence on the decisions of the organizational managers, especially in the field of project risk management. By knowing the crucial role of the risk-taking level and the factors affecting the organization's risk-taking level, managers can make better and more informed decisions. It should be noted that some factors extracted from this research are not under the control of the organization and should be considered as opportunities and threats, although some factors are under the control of the organization's managers so that they can have a better performance by knowing the importance of the internal factors. However, it should be mentioned that the operational recommendations and guidelines related to the risk tolerance level are outside the scope of this research.

The comparison of the results of this study with previous similar research indicates that due to the specific economic and political condition of the country, external factors have a stronger role on the risk tolerance level of the organization. In this research, the external factors were divided into 5 subfactors according to the opinions of experts, and the role of each subfactor on other subfactors and on the risk tolerance level of the organization was examined, which was the most important contribution of the current

research as these factors and their roles in the risk tolerance level of the organization have been neglected in previous studies.

The importance of the factors affecting the risk-taking of the project-based organization is due to the inherent importance of these factors and their effects on other factors. In this research, both of these matters have been taken into consideration. Intrinsic importance was extracted using the Fuzzy Delphi method and the relationships between the factors were also examined by Fuzzy DEMATEL and ISM methods, and finally, the factors were ranked. The factors affecting the risk-taking of the organization were divided into two categories: internal factors and external factors. Internal factors such as the size and income of the organization are related to the characteristics of the organization itself. But the external factors are caused by the external environment, country, government, and other organizations. The findings showed that the external factors were almost more important than the internal factors and the reason is that in addition to their intrinsic importance, they are also very influential on the internal factors of the organization. These results can be affected by the current situation of the studied country, which has affected the success of organizations and other factors. In general, according to the results, it can be said that the more general and influential factors are, the more important they are, and this indicates the correctness of the presented approach. The obtained results can be compared with the relevant studies [17] since the common important factors are income, liquidity, and financial status of the company. However, more external factors such as the economic and political situation of the country have been addressed in this research.

As limitations of the present research, it can be stated that very few studies have addressed the issue of influential factors on the risk tolerance level of project-based organizations and their relationships, hence there were limitations to access the relevant resources and information. Since this study considered a specific case study, the results of this research cannot be extended to other organizations, but the methods proposed in this study can be utilized to investigate the factors affecting the risk tolerance level of project-based organizations and the relationships between them. The obtained results are affected by the specific economic and political conditions of the country caused by international sanctions, and the consequences can be seen in the results. Hence, the outcomes of this study cannot applied to other cases. Further research is needed to examine this problem in other countries and under normal and stable economic conditions.

As some suggestions for future research, the proposed approach should be employed to identify and analyze the influencing factors on the risk tolerance level of other project-based organizations and the relationships. In addition, the quantitative methods such as systems dynamics should be exploited to examine the interrelationships between factors. Moreover, the multi-criteria decision-making techniques can be utilized for ranking the factors. Considering the difference in the results with different methods, it is suggested that the researchers use several methods for weighting and ranking the factors and aggregate the results by using other methods such as the Copeland‘s method in order to achieve more reliable results.

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