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Risk Factor Identification of the Information Technology Project based on the DEMATEL-ISM Model

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Abstract

The integration of informationization and industrialization increases continuously with the gradual progress brought by Industry 4.0 and Made in China 2025. Enterprises become positive in exploring an information management system conforming to their characteristics. High-efficiency information construction has gradually become one of the leading development directions of enterprises. It also plays a vital role in lowering operation costs, increasing market shares, and improving enterprise competitiveness. However, information management system development is characterized by high input, long periods, and multiple risk factors. Enterprises have relatively weak consciousness in informationization risk control. Thus, project development may fail in case of improper risk management and inadequate control in the implementation process. Scientific and effective risk factor identification of an information technology (IT) project can determine the implementation effect of the information management system and subsequent improvement directions. In this study, a risk factor system for the information technology (IT) project was established through the expert consultation method. The weights of the IT project risk factors were estimated through decision-making trial and evaluation laboratory analysis (DEMATEL-ISM). The hierarchical relations among the IT project risk factors were depicted by using interpretive structural modeling. Results demonstrate that the causality of the factors inaccurate need analysis (F3), lack of user support (F5), contract risk (F10), and political and legal risks (F15) is higher than 0. These factors occupy the top four positions and directly influence other factors. IT project risk factors can be divided into five levels. The factor inaccurate need analysis (F3) is at the bottom level and is the fundamental influencing factor. It is also crucial to the risk control of IT projects. The obtained conclusions can provide important references to explore the risk factors of enterprise IT projects, evaluate risk levels accurately, and lower risks during IT project development.

Keywords: DEMATEL, ISM, Information technology project, Risk identification

1. Introduction

Nowadays, many countries have viewed information development as a development strategy in the postindustrial era. The level of enterprise informationization becomes a core index to measure the comprehensive competitiveness of a country. In the background of COVID-19 influences on the global economy, a growing number of enterprises in China attempt to optimize their operations and decrease the influence of redundant procedures on overall efficiency by strengthening information technology (IT) project construction. In an IT project, enterprises integrate information projects by combining informationization and management means through communication technology, network technology, and computer technology, thereby improving integration management efficiency. Unlike ordinary engineering projects, information system (IS) development projects have relatively high technological performances and propose high requirements for the professional skills of people. Many IT projects have obvious research and development (R&D) risks due to differences between practical development and expected outcome. China's economy has achieved a rapid growth rate. Moreover, the number of enterprises that have IT projects increases annually.

IT projects have been involved in various industries. Many enterprises cannot easily realize high-efficiency integration of IT projects and daily businesses because of lacking overall reasonable planning, inexplicit needs, and strong blindness in IT project development. Enterprises enjoy conveniences brought by informationization during IT project development. However, enterprises can be easily trapped in informationization once the R&D of an IT project deviates from the preset objective. For instance, many enterprises cannot control IT projects effectively, thereby resulting in inaccurate cost guarantees, delays in the construction period, and poor project quality. In summary, enterprises uncertainly face various known and unknown risks in implementing IT projects. Exploring and identifying IT project risk factors and evaluating risks can help enterprises deepen their understanding of IT project risks and decrease the risks of the whole development process.

As Industry 4.0 comes, a growing number of enterprises explore and develop information management systems according to their characteristics. Nevertheless, information management system development is characterized by high investment, long periods, and multiple risk factors. It may also fail in case of improper risk management and inadequate control during implementation. Additionally, an evaluation method after the information management system implementation is lacking at present. The advantages and

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disadvantages brought by the information management system are complicated. Enterprises cannot easily judge the implementation quality of the system and the follow-up improvement direction. On the one hand, recognizing and classifying risk factors through a scientific method and formulating specific risk control and prevention measures are necessary. On the other hand, exploring a scientific evaluation method, determining the implementation effect of the information management system, and following up on improvement direction are vital. The information construction of enterprises is composed of various subprojects, and it directly improves the service experiences of users. IT project management is responsible for allocating construction resources, progress in scheduling, and other important affairs. In successful IT project management, the possible risk points must be accurately determined during IT project development. In IT project risk management, some risks are crucial to the success of project development. These risks directly determine the final success of the project. On the contrary, some risks can be ignored. The degree of influence is related to the priority of importance and cost. The risk factor identification of an IT project accurately evaluates the risks of every possible problem that may occur during IT project development to plan for the IT project management carefully and adequately. Thus, the risks of IT project development can be decreased to the maximum extent. Proper countermeasures are formulated after the identification, analysis, and prediction of IT project risks to control risks effectively.

2. State of the art

Risk management theories were mainly developed by Western countries, which underwent industrial construction at the beginning of the 20th century. Since then, risk management has developed gradually as a discipline, and independent theoretical systems and application studies have been formed. Risk management began to be developed in the USA as a discipline, and the basic concept of risk management was produced. Meanwhile, independent theoretical systems have been formed gradually. Foreign researchers focusing on the risk management of IT projects concentrate on project risk management and software project risk management. Tah, J. H. M et al. [1] studied the construction risk management of construction projects with respect to the risk identification and risk management of IT projects by using unified modeling language and IDEFO. An effective risk management system convenient for production was also designed. Xiang, P et al. [2] pointed out that information asymmetry is the fundamental cause of construction project risks. Maytorena, E et al. [3] interviewed 51 project managers and used active information searching as the data acquisition method. The results revealed that information searching, education level, and risk management training are crucial to risk identification. Kutsch, E et al. [4] interviewed and investigated barriers that hinder IT project managers from using risk management. He discovered that the IT project risks are mainly caused by ignoring the official risk management process. Zhou, L et al. [5] pointed out that many of the IT project risk factors are produced before the beginning of official projects, and the risk thinking of an IT project shall begin in the early stage to avoid risk damages. Tüysüz, F et al. [6] evaluated the risks of an IT project of a company in Turkey by using the fuzzy analytical hierarchy process. Tah, J. H et al. [7] proposed a consistent risk management method for construction projects. This method is conducive to promoting effective risk management. Moreover, all participants can understand and share the project risks well. Wallace, L et al. [8] set up a questionnaire and investigated 507 software project managers. Then, a clustering analysis was performed. The results showed that many obvious risks related to demands, planning, control, and organization exist in high-risk projects. Pennington, R et al. [9] believed that the accurate risk identification of an IT project is vital to the governance ability of managers. According to analysis results, participants hardly filter information. This finding implies that decision makers cannot handle all information. Androshchuk, A et al. [10] formulated a risk evaluation index system that can decrease risks when nonbusiness organizations implement the automatic IS. Baharuddin, B et al. [11] believed that IS development can be influenced easily by various risks due to overbudget, overdue, and poor quality. He determined the risk factors in IS planning, priority, and relevant action strategies. This model can be used as guidelines for government institutions in risk management. Ahmad, Z et al. [12] demonstrated that building information modeling can solve various risks. He developed a theoretical framework, implemented automatic risk management, and improved the whole project management practices. Moeini, M et al. [13] believed that IT project risks are mainly determined by managers, characteristics, and the organizational environment of IT projects. Vujović, V et al. [14] believed that enterprises can improve the business process and gain competitive advantages by introducing IT projects. The results showed that a deep analysis of IT project risk management is necessary, and educational organization is an influencing factor of IT project risk that cannot be ignored. Keshk, A. M et al. [15] pointed out that time management, cost management, and quality management are the most important contents of project risk management. Moreover, classification, analysis, planning, identification, evaluation, and countermeasures of project risks are essential to improve the project risk management ability. Taghipour, M et al. [16] investigated the risk management of the ESP implementation project of the electric power engineering and development company by using the risk management integration model provided by PMBOK standards and failure mode and effects analysis (FMEA) technology. The research results showed that key risks are classified into five types. Lee, J. S et al. [17] provided a fresh new theoretical perspective for IT project risk management by using cognitive level theory. He found that IT project managers can recognize various risks related to the project because of their psychological understanding. Pramanik, D et al. [18] constructed a new intelligent model by combining the fuzzy Shannon entropy and the fuzzy technique for order preference by similarity to an ideal solution to evaluate the risk of the IS project. This model has an outstanding reference value. Kock, A et al. [19] analyzed samples by combining 181 projects. The information management system risk is related to the complexity of the investment portfolio to some extent. Toljaga-Nikolić, D et al. [20] believed that techniques such as FMEA can prevent invalid and low-efficiency consumption of time and resources in the project, thereby facilitating the success of the project goal. Atasoy, G et al. [21] explored how visualization improves the communication of the project risk information. According to research results, project risks can be exhibited clearly by making risk descriptions according to the introduction of visualization. Soares, R et al. [22] set up an explorative focus group and conducted a series of interviews with practitioners. According to survey results, the project manager is the sole person in charge of risk identification, registering, and monitoring. Managers can spread the collaboration culture and participate in risk management by implementing collaboration tools. The existing associated studies show that the risk identification of IT project is an important process that determines the information construction success of enterprises. Chinese and foreign studies of information construction have achieved results. However, Chinese research concerning risk management and prevention of IT projects is still in the introduction and assimilation stage of theories. The applications of foreign theories, methods, and tools of IT project risk management are mainly studied in some specific cases in China. The risks of software project development are closely related to the social culture and resource background that the organizations have. Thus, directly using the relatively mature research conclusions of foreign developed countries to Chinese studies of software projects may still cause some differences. Hence, the extracted research objects–risk factors are sent to relevant consultant agencies and experts in IS R&D by using the expert consultation method to obtain the risk factor that primarily influences information construction. Among the risk factors, the restrictive relations and mutual influences of risk factors are analyzed by the decision-making trial and evaluation laboratory–interpretive structural modeling (DEMATEL-ISM) model. These restrictive relations can be balanced by summarizing and classifying the risk factors in the IT project construction of enterprises and studying the mutual relations and restrictions of these factors. Thus, solutions to risk management can be obtained.

3. Methodology

3.1 DEMATEL-ISM model

Seyed-Hosseini S M et al. [23] believed that the decision-making trial and evaluation laboratory (DEMATEL) is a systematic factor analysis method. This method determines causality (D-C) among influencing factors and their roles in the system through a quantitative analysis of their D-C and centrality. Meanwhile, interpretive structural modeling (ISM) is a technique that clearly displays the internal correlations among influencing factors by constructing a systematic multilevel hierarchical structural model. ISM has remarkable advantages in analyzing systems involving various influencing factors with complicated relations. DEMATEL and ISM are systemic analysis methods based on matrix and graph theory. However, they emphasize different aspects. DEMETAL emphasizes quantization of mutual dependence among factors, whereas ISM emphasizes influences, level, and influencing paths among relevant factors. These two methods can complement each other when combined. On the one hand, DEMATEL can simplify the calculation process of ISM. On the other hand, DEMATEL can obtain structural and systemic hierarchical relationships by further using ISM when analyzing D-C and the centrality of factors to show the international relations of influencing factors clearly.

First, the influencing factors of the system were determined, which were denoted as a_1, a_2, ..., a_n. Key attention was paid to the influences and influencing degrees among different factors. The influencing factors of IT project risks were evaluated by 0, 1, 2, and 3 according to zero influence, weak correlation, moderate correlation, and strong correlation to express the pairwise influencing degrees. In this study, the direct influencing degrees among different factors were determined by expert scoring. Expert data were processed by calculating the mean to avoid the errors caused by individual knowledge differences among experts. Moreover, a direct influencing matrix (A) of the system was built (Eq. [1]):

$$A = \begin{bmatrix} 0 & a_{12} & \dots & a_{1n} \\ a_{21} & 0 & \dots & a_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ a_{n1} & a_{n2} & \dots & 0 \end{bmatrix} (i,j=1,2,\dots,\mathrm{n}) \tag{1}$$

Then, the direct influencing matrix (A) was normalized according to Eq. (2) to obtain the normalized direct influencing matrix (C). After normalization, $0 < C_{ij} < 1$ was obtained.

$$C = \frac{1}{\max\limits_{1\le j\le n} \sum_{j=1}^{n} a_{ij}} \tag{2}$$

After obtaining the normalized direct influencing matrix, the comprehensive influencing matrix (T) was gained according to Eq. (2) to express the influencing degrees of IT project risk factors on other factors.

$$T = \lim_{n\to\infty}(C + C^2 + \dots + C^n) = C(I - C)^{-1} \tag{3}$$

Where I is the unit matrix. On this basis, the T of the IT project risk factors was calculated. The influencing degree (f_i) and the influenced degree (e_i) were calculated based on T. In particular, f_i reflects the influencing degree of factors on other factors, whereas e_i reflects the degree of a factor influenced by other factors. The calculation formulas are shown in Eq. (4):

$$f_i = \sum_{j=1}^{n} c_{ij} , e_i = \sum_{j=1}^{n} c_{ji} \tag{4}$$

Moreover, the centrality (m_i) is defined as the sum of f_i and e_i of a factor x_i, whereas D-C is the difference between f_i and e_i of a factor x_i. DEMATEL calculation was completed through Eqs. (1)–(4). The reachable matrix of ISM is shown in Eq. (5). Most traditional studies set the threshold (λ) to simplify the overall influencing matrix. In this study, λ was set according to Eq. (5) to decrease human intervention and increase the accuracy of studies.

$$\lambda = \sum_{i,j=1}^{n} T_{i,j} / n^2 + \sqrt{\frac{\sum_{i,j=1}^{n} (T_{i,j} - \overline{T_{i,j}})^2}{n^2 - 1}} \tag{5}$$

Where λ is the sum of the mean and standard deviation of the comprehensive influencing matrix. Thus, the reachable matrix (K_{ij}) in the ISM model can be calculated:

$$K_{ij} = \begin{cases} 1, T_{ij} > \lambda \\ 0, T_{ij} < \lambda \end{cases} \tag{6}$$

Then, the reachable set $R(S_i)$ and the antecedent set $A(S_i)$ can be gained based on K_{ij}. $R(S_i)$ is the column set of factors containing 1 in the row i of K_{ij}. $A(S_i)$ is the row set of factors containing 1 in the Column i of K_{ij}. When $R(S_i) = R(S_i) \cap A(S_i)$, $R(S_i)$ is the top-level factor. The results of the top-level factors were divided according to this principle. This process was repeated after the leveled elements were deleted and until all the influencing factors were leveled.

3.2 Date source

The present study focuses on the project risk management of ISM of companies. According to the review and summary of such project risk management information, the possible causes were recognized, and the weights of these causes were analyzed. The expert consultation method was applied during specific analysis. The detailed process is introduced as follows. First, several associated studies in foreign languages and Chinese were integrated through a literature review. The list of the identified IT project risks was provided preliminarily. Second, 12 professors and project management lecturers in the information field from four universities in Beijing, Jiangsu Province, and Henan Province were invited for interviews about IT project evaluation, risk identification, and solutions for the project. The average interview period was 45 min.

Third, the interview contents were transcribed by a specially assigned person using the iflytek language software. Fourth, the high-frequency words in the interview were calculated using Python language programming. The description frequencies of professors to IT project risks in the project risk factor range were determined. For example, if a specific risk factor occurs at least eight times in the chat with 12 professors, then this risk factor is included in the risk evaluation index system of the IT project. A complete risk evaluation index system for the IT project (Table 1) was gained through the above methods.

Table 1. IT project risk factors

No.	Specific contents	No.	Frequency of occurrence
1	Requirement change risk	F1	12
2	Outsourcing decision risk	F2	12
3	Inaccurate need analysis	F3	11
4	Deviations in the design scheme	F4	10
5	Lack of user support	F5	11
6	Inaccurate evaluation standards	F6	12
7	Excessive expectations of users	F7	11
8	After-sales service risk	F8	9
9	Communication risk	F9	10
10	Contract risk	F10	12
11	Schedule risk	F11	11
12	Cost risk	F12	12
13	Outsourcing risk	F13	11
14	Team management risk	F14	12
15	Political & legal risk	F15	10
16	Supplier selection mistake	F16	9
17	Target cognitive risk	F17	11

4. Results analysis

4.1 DEMATEL analysis

A case study based on Enterprise A in China was carried out to verify the scientificity of the IT project risk index system further. Enterprise A is a new national high-tech enterprise that integrates design, R&D, production, and marketing of high-end home appliances in Suzhou City, Jiangsu Province of China. It has product design centers in Shanghai and Shenzhen. It has become a leading backbone enterprise in high-end kitchen appliances in China. It launched the ERP management system in 2005 and stepped into the room of information management. Subsequently, it launched the UFIDA U8 financial management in 2011 and gradually enriched its information management means. In recent years, the small-sized personalized needs of customers have become increasingly obvious as Enterprise A set up branches or institutions in Chengdu, Xi’an, Lanzhou, and other regions in Western China. The previous information management system and production management mode cannot meet the company management needs in the new form. In 2001, Enterprise A planned to cooperate with a third party in developing and implementing the new IMS integration project to meet the company management needs in the new form. Senior managers, middle-level managers, workshop managers, and workers were chosen as respondents. The research team carried out a 2-week questionnaire survey. Four respondents were chosen randomly for each type of figure for the interview. A field questionnaire survey was chosen, and direct correlation degrees among the influencing factors of the planned IT project of Enterprise A were investigated by 0–3 scales. The scores of all respondents were processed by calculating the mean to obtain the relation matrix. T is gained according to Eqs. (1)–(3) (Table 2).

Table 3 shows that the D-C values of inaccurate need analysis (F3), lack of user support (F5), contract risk (F10), and political & legal risks (F15) are higher than 0. These four factors rank in the top 4. If D-C is higher than 0, then the factor influences other factors instead of being influenced by other factors. In particular, the factor is a cause. In this study, F3, F5, F10, and F15 are major factors influencing other factors. The possible reason is that the inaccurate need analysis (F3) of the IT project does not make reasonable investment decisions according to project size, available funds, and qualification of contractors. Moreover, it has no reasonable expectations and plans for the full development of the IT project in the planning and design stage. Lack of user support (F5) indicates that the users of the IT project have no training, technological support, and after-sales services provided by enterprises.

Thus, the IT project cannot ensure the normal operation of systems. Moreover, low participation degree, negative attitudes, or low support of users for the project can easily make the risks obvious. Contract risk (F10) is mainly caused by content changes in the contract and supplemental agreement that may cause risks. Enterprises have high information complexity and great difficulties in the accurate determination and recognition of needs. Need changes even belong to high probability or certain events, whereas contract changes can potentially bring risks. The factor political and legal risk (F15) is mainly attributed to the profound influences of the political environment on enterprise information. This essential factor must be considered during the IT project implementation. Changes in political events and political relations may adversely affect IT projects.

Table 2. Comprehensive influencing matrix

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17
F1	0.081	0.000	0.000	0.148	0.000	0.000	0.105	0.203	0.217	0.000	0.189	0.105	0.203	0.217	0.000	0.203	0.105
F2	0.009	0.000	0.000	0.018	0.125	0.125	0.010	0.024	0.024	0.000	0.023	0.010	0.008	0.024	0.000	0.024	0.010
F3	0.026	0.125	0.000	0.135	0.016	0.141	0.038	0.151	0.064	0.000	0.021	0.038	0.024	0.064	0.000	0.026	0.038
F4	0.051	0.000	0.000	0.013	0.000	0.000	0.051	0.051	0.152	0.000	0.044	0.051	0.051	0.152	0.000	0.051	0.051
F5	0.018	0.000	0.000	0.131	0.000	0.000	0.030	0.142	0.042	0.000	0.138	0.030	0.017	0.042	0.000	0.142	0.030
F6	0.051	0.000	0.000	0.013	0.000	0.000	0.051	0.051	0.152	0.000	0.044	0.051	0.051	0.152	0.000	0.051	0.051
F7	0.141	0.000	0.000	0.145	0.000	0.000	0.019	0.032	0.046	0.000	0.029	0.019	0.032	0.046	0.000	0.157	0.019
F8	0.094	0.000	0.000	0.036	0.000	0.000	0.192	0.082	0.186	0.000	0.058	0.192	0.082	0.186	0.000	0.082	0.192
F9	0.203	0.000	0.000	0.051	0.000	0.000	0.203	0.203	0.108	0.000	0.177	0.203	0.203	0.108	0.000	0.203	0.203
F10	0.081	0.000	0.000	0.023	0.000	0.125	0.105	0.203	0.217	0.000	0.064	0.105	0.203	0.217	0.000	0.078	0.105
F11	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	0.000	0.000	0.000	0.000
F12	0.135	0.000	0.000	0.019	0.000	0.000	0.013	0.025	0.027	0.000	0.024	0.013	0.025	0.027	0.000	0.025	0.013
F13	0.094	0.000	0.000	0.036	0.000	0.000	0.192	0.082	0.186	0.000	0.058	0.192	0.082	0.186	0.000	0.082	0.192
F14	0.203	0.000	0.000	0.051	0.000	0.000	0.203	0.203	0.108	0.000	0.177	0.203	0.203	0.108	0.000	0.203	0.203
F15	0.081	0.000	0.000	0.148	0.000	0.000	0.105	0.203	0.217	0.000	0.064	0.105	0.203	0.217	0.000	0.078	0.105
F16	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	0.000	0.000	0.000	0.000
F17	0.074	0.000	0.000	0.022	0.000	0.000	0.099	0.196	0.198	0.000	0.059	0.099	0.196	0.198	0.000	0.071	0.099

Table 3. Centrality and D-C among influencing factors

	Influencing degree (D)	The influenced degree (C)	Centrality (D+C)	Causality (D-C)
F1	1.775	1.340	3.115	0.435
F2	0.435	0.125	0.560	0.310
F3	0.906	0.000	0.906	0.906
F4	0.715	0.987	1.702	−0.272
F5	0.762	0.141	0.903	0.622
F6	0.715	0.391	1.106	0.325
F7	0.686	1.415	2.101	−0.729
F8	1.383	1.848	3.231	−0.465
F9	1.861	1.945	3.806	−0.084
F10	1.525	0.000	1.525	1.525
F11	0.000	1.171	1.171	−1.171
F12	0.347	1.415	1.762	−1.068
F13	1.383	1.581	2.964	−0.197
F14	1.861	1.945	3.806	−0.084
F15	1.525	0.000	1.525	1.525
F16	0.000	1.473	1.473	−1.473
F17	1.311	1.415	2.726	−0.104

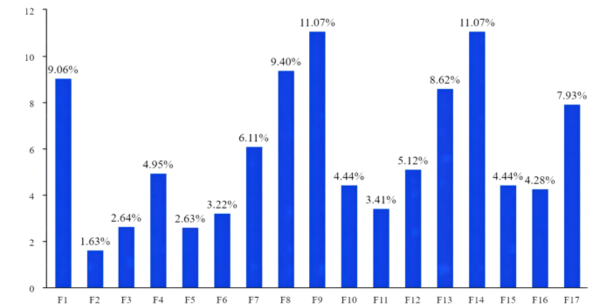

Fig. 1. Weights of 17 factors

4.2 ISM analysis

Programming was carried out using Matlab 2017b. Based on the "adjacent matrix," the sum of the "adjacent matrix" and "unit matrix" was calculated and used to calculate the next "reachable matrix" (Table 4). In Table 4, if the number is 1, then a path from one factor to another exists. If the number is 0, then no path from one factor to another exists.

The reachable set (*R*), antecedent set (*Q*), and their intersection set (*A*) can be gained by decomposing the previously calculated "reachable matrix" (Table 3). R is the set of elements containing 1 in the row corresponding to a factor in the "reachable matrix." *Q* is the set of elements containing 1 in the column corresponding to a factor in the "reachable matrix." *A* is the intersection between *R* and *Q*.

R, *Q*, and *A* were decomposed hierarchically to understand the hierarchical relations of factors. The top level represents the ultimate goal of the system. Each level below represents the causes of the previous level. The bottom level is the primary point cause of the system, and each level above is the consequence of the below level. The relations among the IT project risk factors and hierarchical structure are shown in Fig. 2. This hierarchical structure shows direct influencing factors on the IT project risks and the most fundamental factors that influence all other risk factors in the whole project period. This model helps project constructors see the fundamental and direct risks that shall be avoided. It also provides references for the risk management of the project. As shown in Fig. 2, all influencing factors are divided into five levels. F3 is at the bottom level and called the fundamental influencing factor, indicating that the factor inaccurate need analysis plays a critical role in IT project risk management.

Table 4. Reachable matrix

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17
F1	1	0	0	1	0	0	1	1	1	0	1	1	1	1	0	1	1
F2	1	1	0	1	1	1	1	1	1	0	1	1	1	1	0	1	1
F3	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1
F4	1	0	0	1	0	0	1	1	1	0	1	1	1	1	0	1	1
F5	1	0	0	1	1	0	1	1	1	0	1	1	1	1	0	1	1
F6	1	0	0	1	0	1	1	1	1	0	1	1	1	1	0	1	1
F7	1	0	0	1	0	0	1	1	1	0	1	1	1	1	0	1	1
F8	1	0	0	1	0	0	1	1	1	0	1	1	1	1	0	1	1
F9	1	0	0	1	0	0	1	1	1	0	1	1	1	1	0	1	1
F10	1	0	0	1	0	1	1	1	1	1	1	1	1	1	0	1	1
F11	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
F12	1	0	0	1	0	0	1	1	1	0	1	1	1	1	0	1	1
F13	1	0	0	1	0	0	1	1	1	0	1	1	1	1	0	1	1
F14	1	0	0	1	0	0	1	1	1	0	1	1	1	1	0	1	1
F15	1	0	0	1	0	0	1	1	1	0	1	1	1	1	1	1	1
F16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
F17	1	0	0	1	0	0	1	1	1	0	1	1	1	1	0	1	1

Table 5. Reachable set, antecedent set, and intersection set

Factors	Reachable set (*R*)	Antecedent set (*Q*)	Intersection set *A* = *R*∩*Q*
F1	1,4,7,8,9,11,12,13,14,16,17	1,2,3,4,5,6,7,8,9,10,12,13,14,15,17	1,4,7,8,9,12,13,14,17
F2	1,2,4,5,6,7,8,9,11,12,13,14,16,17	2,3	2
F3	1,2,3,4,5,6,7,8,9,11,12,13,14,16,17	3	3
F4	1,4,7,8,9,11,12,13,14,16,17	1,2,3,4,5,6,7,8,9,10,12,13,14,15,17	1,4,7,8,9,12,13,14,17
F5	1,4,5,7,8,9,11,12,13,14,16,17	2,3,5	5
F6	1,4,6,7,8,9,11,12,13,14,16,17	2,3,6,10	6
F7	1,4,7,8,9,11,12,13,14,16,17	1,2,3,4,5,6,7,8,9,10,12,13,14,15,17	1,4,7,8,9,12,13,14,17
F8	1,4,7,8,9,11,12,13,14,16,17	1,2,3,4,5,6,7,8,9,10,12,13,14,15,17	1,4,7,8,9,12,13,14,17
F9	1,4,7,8,9,11,12,13,14,16,17	1,2,3,4,5,6,7,8,9,10,12,13,14,15,17	1,4,7,8,9,12,13,14,17
F10	1,4,6,7,8,9,10,11,12,13,14,16,17	10	10
F11	11	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,17	11
F12	1,4,7,8,9,11,12,13,14,16,17	1,2,3,4,5,6,7,8,9,10,12,13,14,15,17	1,4,7,8,9,12,13,14,17
F13	1,4,7,8,9,11,12,13,14,16,17	1,2,3,4,5,6,7,8,9,10,12,13,14,15,17	1,4,7,8,9,12,13,14,17
F14	1,4,7,8,9,11,12,13,14,16,17	1,2,3,4,5,6,7,8,9,10,12,13,14,15,17	1,4,7,8,9,12,13,14,17
F15	1,4,7,8,9,11,12,13,14,15,16,17	15	15
F16	16	1,2,3,4,5,6,7,8,9,10,12,13,14,15,16,17	16
F17	1,4,7,8,9,11,12,13,14,16,17	1,2,3,4,5,6,7,8,9,10,12,13,14,15,17	1,4,7,8,9,12,13,14,17

Notes: numbers represent the no. of a factor. For example, 2 represents the influencing factor F2.

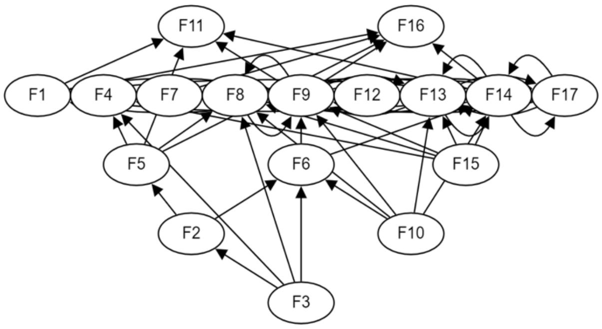

Fig. 2. Hierarchical relations

This finding is consistent with IT project risks in practical work. IT project construction serves users by decreasing business processes and improving business efficiency. Inaccurate need analysis refers to insufficient accuracy and depth in analyzing the feasibility of demands proposed by business departments, thereby resulting in a difference between need analysis and practices. Moreover, inaccurate need analysis can easily cause continuous changes in project needs and expand the project scope. The second, third, and fourth levels are middle-level influencing factors, which cover 14 specific factors. They are transition levels that influence IT project risks and serve as connecting links in the whole system. F11 and F16 are in the first level of the model and belong to direct influencing factors.

5. Conclusions

In this study, an IT project risk factor system is built, and a case study based on Enterprise A in Suzhou, Jiangsu Province of China, is carried out. Moreover, the weights of the IT project risk factors and hierarchical relations among risk factors are discussed using the DEMATEL-ISM method. Main conclusions are drawn as below: (1) The IT project risk factors mainly concentrate on 17 specific aspects according to the expert consultation method. (2) The factors inaccurate need analysis (F3), lack of user support (F5), contract risk (F10), and political & legal risk (F15) have considerable direct influences on other factors. (3) IT project risk factors can be divided into five levels. The factor inaccurate need analysis is at the bottom level. It is also the fundamental influencing factor. However, IT project risk evaluation has extreme fuzziness. In this study, IT project risk factors throughout the service life (planning, implementation, and application stages of the project) are not considered enough. The increasing scale and quality of the questionnaire survey and the combined use of multiple methods (e.g., brainstorming and the Delphi method) should be studied comprehensively.

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