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PROVIDING A MULTI-LEVEL MODEL FOR RISK MANAGEMENT OF ROAD CONSTRUCTION PROJECTS BASED ON KEY STAKEHOLDERS (A HYBRID APPROACH: META-ANALYSIS AND STRUCTURAL INTERPRETIVE MODELING)

Mohsen Sadeghi Panah[1], Mohammad Sedigh Sabeti*[2], Heirsh Soltanpanah[3], Adel Fatemi[4]

[1]Department of Civil Engineering, Sa.C., Islamic Azad university, Sanandaj, Iran.
Mohsen.sadeghipanah@iau.ac.ir
[2]Department of Civil Engineering, Sa.C., Islamic Azad university, Sanandaj, Iran. (corresponding Author)
sabeti.ms@iau.ac.ir
[3]Department of Civil Engineering, Sa.C., Islamic Azad university, Sanandaj, Iran.
heresh@iau.ac.ir
[4]Department of Civil Engineering, Sa.C., Islamic Azad university, Sanandaj, Iran.
fatemi@iau.ac.ir

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***ABSTRACT*:**

Risk management in road construction projects is of particular importance due to their technical, economic, and social complexities. This study aims to provide a multi-level model for risk management of road construction projects based on key stakeholders. In this study, a hybrid approach of meta-analysis and structural interpretive modeling (ISM) has been used. First, using meta-analysis, key risks of road construction projects were extracted and categorized from previous studies. Then, using structural interpretive modeling, the relationships between risks and the roles of key stakeholders (such as the employer, contractor, consultant, and local community) in managing these risks were analyzed. The results of the study indicate a multi-level model in which project risks are classified into three levels: strategic, operational, and environmental, and stakeholder interactions at each level are identified to reduce the negative effects of risks. This model can be used as a guide for project managers to improve decision-making and reduce uncertainty in road construction projects.

Keywords*: Risk Management, Road Construction Projects, Structural Interpretive Modeling.*

INTRODUCTION

Risk management is a new branch of management science that, despite its young age, is rapidly expanding and growing and has been welcomed by experts and managers in various fields and has found its place in a wide range of matters such as investment, trade, insurance, safety, health and treatment, industrial and construction projects, and even political, social and military issues. Therefore, it can be concluded that risk management has a special place in project management and has common features with it, including the uniqueness of the project, uncertainty in the project's assumptions, goals and requirements, etc. In general, the environmental factors governing the project are the roots of uncertainty and the source of risk in projects. Cases such as uncertainty in the project's foundations and initial estimates, uncertainty in the project's design and procurement, and uncertainty in its goals, make the conditions of projects very risky and make risk management in projects unavoidable. Risk management is the process of making and implementing decisions that minimize the negative effects of risk on an organization. The destructive effect of risk can be objective or measurable, such as insurance premiums and claims costs, or subjective, which is difficult to quantify, such as damage to reputation or reduced productivity. Carrying out construction projects undoubtedly involves many risks. Often, risks are ignored in project implementation or are assigned to departments that do not have sufficient knowledge, resources, and capacities to manage them effectively, which results in increased costs, reduced quality of work, and ultimately project delays. Risk identification and assignment are two powerful factors in risk management decisions. Road construction projects are among the projects where decisions about existing risks can play a fundamental role in the success or failure of the project. At each stage of a road construction project, there are different risks that prevent projects from achieving the main project goals, namely time, cost, and quality. From a project management perspective, analyzing and controlling these risks is of great importance. It is clear that the huge amount of capital involved and the relatively long implementation time of road construction projects all confirm the special attention paid to this category and the conduct of applied research in the field of roads and road construction. The main function of roads is to provide accessibility and mobility. Currently, developing countries around the world have prioritized the improvement and interconnection of their road networks. Considering that a good road network contributes to economic development and national growth, road projects are mentioned as a major focus in their national budgets (Razi, 2021). Therefore, road projects must be completed according to the schedule to meet the immediate needs of stakeholders. Unfortunately, delays in road construction projects are one of the major problems faced by construction professionals for various reasons. It has been proven that the inability to complete projects on time with a given budget remains a persistent issue worldwide (Mohajari et al., 2021). Although the causes of delays in developing countries are quite comparable, several factors are clearly related to local industries, socio-economic contexts, cultural issues, and project characteristics, such as land topography and road opposition issues (Deep, 2021). Given that road construction projects have created many problems for society, including heavy traffic and increased likelihood of road accidents, project personnel also face the consequences of project failure, reduced profits, etc., therefore, completing a road project on time is very important.

Inflation and price increases, shortage of quality raw materials, defects in design and design documents, delays in delivery of materials and equipment, poor management performance on site, delays in funding, poor or incorrect selection of contractors, failure to establish an efficient and appropriate system in project management, errors in planning and increased project completion time.

Based on the results of the studies and considering the complexity and uniqueness of each construction project in the field of road construction, the possibility of increasing the implementation time due to implementation constraints is not far from expected. The purpose of identifying the causes of the increase in time is to eliminate or reduce the effects of those factors. So that the project can be completed with minimal changes compared to the initial schedule. According to research, it can be concluded that the need to move away from traditional management and implement modern management, especially the existence of a project management system in metropolitan cities, is obvious, and the application of the science of time management, cost, quality, risk, communications, procurement and human resources and stakeholders are among the categories that are vital to pay attention to in the project management system.

Also, as the role of road transportation systems as one of the most important infrastructures in the growth and development of any country is considered, its important and influential role in environmental degradation cannot be ignored. Generally, road routes must be expanded over time or new routes must be built, which means that more interventions are made in the environment. The impact of human development activities on the environment tends to be more negative and destructive, and research shows that in Iran and other similar countries, efforts have been made to advance development projects while simultaneously protecting the environment. Establishing an HSE system in development projects is important in that research shows that developing a safety management strategy, preparing a safety plan (HSE Plan), the number of experts and safety officers in the workshop, using personal safety equipment, and training workers are closely related to the safety of road construction workshops and reducing accidents (Zandi et al., 1401). Unfortunately, the extensive advances in risk management in recent years have not yet had a significant impact on the construction sector. This lack of impact has been even more serious in the area of worker safety in road construction sites. On average, one in 12 road construction workers has experienced exposure to road construction accidents. This figure is very high and significant compared to the number of accidents at work in other industries. Research shows that in order to do the above in order to establish an HSE system in construction projects adequately and effectively, a cost of about 2% of the initial work estimate will be required. What is considered today as the cost of establishing a health, safety, and environment (HSE) and labor protection system based on the guidelines contained in the contract documents is tens of times smaller than this number. As a result, fatal accidents occur in projects, which impose significant financial costs on employers and contractors in addition to human costs.

Stakeholders are an important issue in project risk management. The issue of stakeholder management in construction projects for project planning and implementation has been emphasized in many studies. Project stakeholder management includes the precise identification of the influential or impactful groups of a project and the analysis and quantification of the power, influence, and impacts they have on the project. Identifying and analyzing stakeholders can lead to effective communication policies and increasing their level of participation in the project. This is an important factor in achieving project success (Khanzadi et al., 2017). Accurate

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identification, analysis, and profiling of stakeholders can lead to the adoption of effective communication policies and, as a result, gain support or increase the level of their participation in the project. This issue is considered one of the key factors in the success of a project. Providing accurate and timely information to stakeholders will lead to greater commitment to project activities and greater enthusiasm for the project when faced with challenges. On the other hand, given that most construction projects are assigned to contractors with a conventional execution system, it is necessary to pay attention to identifying and allocating risks related to them when preparing documents for these types of contracts. In this regard, the aim of the present study is to answer the main question of how to present a multi-level risk management model for road construction projects based on key stakeholders?

RESEARCH METHOD

The present study is an applied research in terms of its objectives and is a descriptive and exploratory field research in terms of the research process.

The statistical population of the research is experts in road construction projects, which include university professors, project managers, employers, and contractors. The sample size was determined by a non-random method. In this section, the experts were first selected for interviews and helped develop the factors identified from the research literature. The interview continued until no new factors were identified. In the Delphi section, the experts were also collected through a Delphi questionnaire to examine their level of theoretical agreement regarding the identified factors. One of the steps that is very effective in the quality of the responses is the correct selection of experienced and knowledgeable people in the field of the subject under study.

RESEARCH FINDINGS

Qualitative analysis findings

This section was conducted using SPSS software.
Sample size adequacy test: Variables that are more suitable for model analysis are at the distance measurement level, but in some cases, ordinal and nominal variables are also used. The output of this test can be seen in Table 1.

Table 1 Sample adequacy measurement

Statistics		Test
0.873	Sample adequacy measurement	Kaiser-Meir-Olkin (KMO)
12143.4532	Chi-square approximation	Bartlett's sphericity test
24	Degrees of freedom	
0.000	Significance	

Since the KMO index value is 0.873 and the number of samples is sufficient for analysis. Also, the significance value of Bartlett's test is smaller than 0.05, which indicates that the desired analysis is suitable for identifying the model structure.

Findings from interviews and research literature: As mentioned, qualitative analysis and meta-analysis approaches were used to obtain the dimensions of the initial model. In the meta-synthesis method, a search was first conducted with the keywords of road construction project risk, risk management in road construction projects, risk management of stakeholders in domestic and reputable information sources such as MAGIRAN, Irandoc, CIVILICA, SID, Normags and foreign sources such as ScienceDirect, Taylor & Francis, Springer, ProQuest, DOAJ in the period 2000 to 2024.

Delphi findings

The Delphi technique was implemented in three stages, and in each stage, a number of indicators were eliminated based on the average Kendall coefficient and the experts' opinion in the model, and the next stage was repeated by eliminating weak indicators. Finally, three stages of the Delphi technique were conducted, and in the third stage, the results show that we reached a collective agreement and that the indicators are final. The results of the Delphi technique stages are shown in Table 2

Table 2 Results of the third round of Delphi

Proportion coefficient			*Components of each dimension*	Dimensions
Result	Agreement coefficient	Average		
Confirm	87 .0	47 .6	Identifying the right stakeholders for risk assessment	Risk identification
Confirm	88 .0	49 .7	Determining the type of risk	
Confirm	84 .0	35 .6	Awareness of the scope of risks	
Confirm	84 .0	40 .7	Identifying positive and negative risks	
Confirm	73 .0	17 .7	Internal and external risk assessment	
Confirm	74 .0	21 .6	Brainstorming	
Confirm	7 .0	8	Compiling a list of risks	
Confirm	71 .0	11 .6	Probability of occurrence	Risk assessment
Confirm	7 .0	8	Sensitivity analysis	
Confirm	08	3 .7	Qualitative analysis	
Confirm	73 .0	21 .7	Quantitative analysis	
Confirm	84 .0	39 .8	Transparency	
Confirm	71 .0	04 .6	Estimating resources	
Confirm	84 .0	4 .7	Risk classification	
Confirm	73 .0	18 .6	Risk documentation	
Confirm	7 .0	6	Accurate identification of stakeholders	Planning
Confirm	81 .0	3 .6	Communication policies	
Confirm	82 .0	32 .6	Proper and timely information to stakeholders	
Confirm	72 .0	13 .7	Stakeholder commitment	
Confirm	73 .0	17 .7	Stakeholder classification	
Confirm	9 .0	7	Determining stakeholder expectations	
Confirm	88 .0	54 .5	Common interests of stakeholders	
Confirm	89 .0	59 .5	Increasing the level of stakeholder participation	Organizing
Confirm	71 .0	11 .5	Stakeholder support	
Confirm	7 .0	7	Stakeholder power and influence	
Confirm	73 .0	17 .5	Stakeholder social responsibility	
Confirm	74 .0	21 .6	Legitimacy of stakeholders	
Confirm	83 .0	34 .6	Decision-maker composition	
Confirm	8 .0	3 .7	Stakeholder integration	
Confirm	74 .0	21 .8	Stability in company-stakeholder relationships	
Confirm	87 .0	43 .8	Stakeholder control	
Confirm	84 .0	35 .7	Value creation for stakeholders	
Confirm	86 .0	4 .7	Stakeholder collaboration	

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Confirm	71 .0	12 .8	Avoidance	Accountability
Confirm	84 .0	40 .7	Transfer	
Confirm	87 .0	47 .6	Prevention	
Confirm	88 .0	49 .7	Acceptance	
Confirm	98.0	56.99	Response to risks	Control
Confirm	44.0	43.55	Risk records	
Confirm	34.0	23.45	Database	
Confirm	77.0	21.89	Effectiveness	

Findings of the quantitative section

Descriptive findings of sub-components: This section examines the descriptive findings of the sub-components of the model, which can be stated according to the results obtained, considering that the sub-components were measured with a 5-point Likert scale.

Exploratory factor analysis

In order to conduct an exploratory factor analysis, the principal component analysis method and Varimax rotation were used, and 6 dimensions were extracted as dimensions of the model and were examined in this section along with the sub-components. These 6 dimensions generally explain 90.33% of the total variance. The criterion for selecting sub-components, as an indicator for factors, was to have an eigenvalue higher than one and also a factor load of 0.70 and higher, provided that it appears in other factors less than this value, and finally 41 desired sub-components were selected. Each of these indicators, the relevant factors and their factor loadings are shown in Table 3.

Table 3 Results of exploratory factor analysis

Factors / Subcomponents	Risk identification	Risk assessment	Planning	Organization	Accountability	Control
Identifying the right stakeholders for risk assessment	0.764					
Determining the type of risk	0.735					
Awareness of the scope of risks	0.793					
Identifying positive and negative risks	0.744					
Internal and external risk assessment	0.784					
Brainstorming	0.755					
Risk List Development	0.876					
Probability of Occurrence		0.765				
Sensitivity Analysis		0.711				
Qualitative Analysis		0.744				
Quantitative Analysis		0.790				
Transparency		0.773				
Resource Estimation		0.865				
Risk Classification		0.843				

Risk Documentation		0.712				
Accurate Identification of Stakeholders			0.764			
Communication Policies			0.777			
Correct and Timely Informing Stakeholders			0.705			
Stakeholder Commitment			0.815			
Stakeholder Classification			0.790			
Determining Stakeholder Expectations			0.792			
Common Interests of Stakeholders			0.798			
Increasing the level of stakeholder participation				0.766		
Stakeholder support				0.743		
Stakeholder power and influence				0.744		
Stakeholder social responsibility				0.833		
Stakeholder legitimacy				0.732		
Composition of decision-makers				0.762		
Stakeholder integration				0.769		
Stability in company-stakeholder relations				0.755		
Stakeholder control				0.811		
Creating value for stakeholders				0.865		
Collaboration between stakeholders				0.762		
Avoidance					0.833	
Transferring					0.787	
Prevention					0.711	
Acceptance					0.803	
Response to risks						0.788
Risk history						0.796
Database						0.987
Effectiveness						0.721
Total initial eigenvalues	1.24	2.16	3.90	5.34	3.46	4.67
Percentage of variance	12.65	21.78	34.69	54.84	68.98	35.49

Percentage of variance accumulation	12.65	36.56	47.67	54.84	85.67	90.33

Model Quality Assessment

To assess the quality of the model, the redundancy and determination coefficient indices are used. Positive numbers indicate appropriate model quality. The main criterion for evaluating the structural model is the determination coefficient. This index shows how many percent of the changes in the dependent variable are caused by the independent variables. Table 4 shows that 76 percent of the model changes are predicted by the identified subcomponents of the model. If the redundancy index is greater than zero, the observed values are well reconstructed and the model has predictive ability. In this study, this index is above zero for the model.

Table 4 Model Quality Assessment Indices

Redundancy	Coefficient of determination	Model
0/566	0/760	Providing a multi-level risk management model for road construction projects based on key stakeholders

Checking the dispersion of data

The normality of the data distribution should be checked by calculating the skewness and kurtosis to determine the degree of distance of the data dispersion from the normal distribution, although the normal distribution of the data is not a basic condition in the partial least squares method. Examination of Table 5 shows that the data distribution of all sub-components of the model is normal because the degree of skewness and kurtosis is between (1 and -1).

Table 5 Test of normality of data distribution for model dimensions

Elongation	Scattering	Model Dimensions
0.533	0.633	Risk Identification
0.732	0.546	Risk Assessment
0.289	0.656	Planning
0.308	0.376	Organization
0.478	0.409	Responsibility
0.434	0.676	Control

Examining the divergent validity for the dimensions of the research model

One of the methods of measuring this validity is the Fornell-Locker test. Table 6 shows the results obtained for the dimensions of the research model. The following table shows that the constructs are completely separate, that is, the principal diameter values for each latent variable are greater than the correlation of that dimension with other latent reflective dimensions in the model.

Table 6 Fornell-Locker index for examining the discriminant or divergent validity index

6	5	4	3	2	1	Dimensions	row
					1	Risk Identification	1
				1	0/831	Risk Assessment	2
			1	0/886	0/764	Planning	3
		1	0/449	0/789	0/490	Organization	4
	1	0/406	0/891	0/691	0/499	Responsibility	5
1	0/554	0/276	0/232	0/344	0/384	Control	6

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Model Reliability Tests

Cronbach's Alpha Test: It is a classic measure of reliability and a suitable measure for assessing internal consistency (internal consistency).

Table 7 Results of Cronbach's Alpha Coefficients

Cronbach's alpha coefficient	Indicators
0/965	Risk Identification
0/960	Risk Assessment
0/925	Planning
0/862	Organization
0/963	Responsibility
0/435	Control

All Cronbach's alpha coefficients of the research variables are greater than 0.7, so reliability is confirmed from the point of view of this test.

External model tests

Convergent validity tests (construct validity):

Table 8 Results of the mean variance extracted test

Mean extracted variance	Indicators
0/568	Risk Identification
0/578	Risk Assessment
0/684	Planning
0/696	Organization
0/545	Responsibility
0/554	Control

Therefore, all the validity coefficients in this part of the study are reported to be greater than 0.5. Therefore, the validity of the study is also confirmed by this test.

Multi-method and multi-trait test or (HTMT):

The HTMT test was presented by Hensler in SAT 2015 to have all the features of the cross-loading test. In this method, each variable is a trait and each question is a method for measuring the trait. A matrix of traits and methods is created and the HTMT index is obtained during calculations. If this index is less than 0.8, the situation is very excellent and if it is less than 1, it is acceptable. In this method, the variables are pairwise and their HTMT is calculated two by two, and all HTMTs must be less than 1.

Table 9 Results of the multi-method and multi-trait test

6	5	4	3	2	1	Dimensions
						Risk identification
					0. 885	Risk assessment
				0. 662	0. 569	Planning
			0. 335	0. 371	0. 501	Organization

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		0. 539	0. 618	0. 795	0. 805	Responsibility
	0.233	0.288	0.323	0.545	0.565	Control

All HTMT coefficients are less than 1. Therefore, considering the previous two tests, it can be strongly claimed that divergent validity is established, and also, considering the establishment of convergent validity, it can be claimed that the evaluated period derived from the questionnaire data has construct validity. That is, the researcher measured what was supposed to be measured.

Model Quantification

In this section, considering that it was determined what the dimensions of the model were, the sample size is appropriate, and all the identified dimensions are effective on the desired model, the model will be quantified using the partial squares technique and the bootstrapping t-test, and the results are as shown in Table 10.

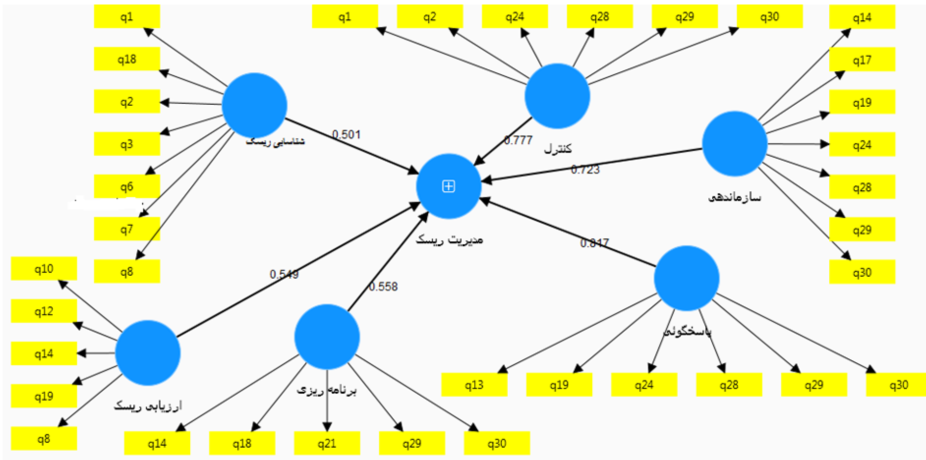

Figure 1 Model in standard mode

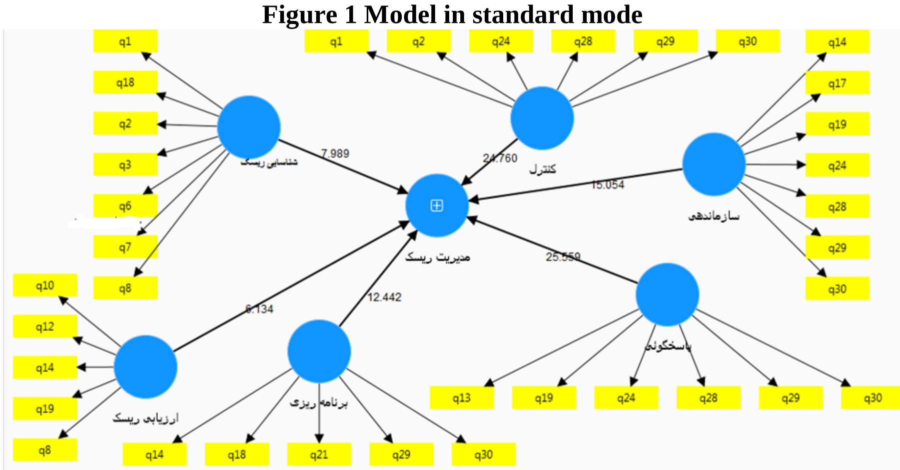

Figure 2: Model in a significant state

The above results show that all the coefficients obtained for the dimensions of the model are positive, which can be concluded that the model is significant and the results obtained can be relied on.

Table 10 Path coefficients

Significance level	t-value	Coefficients	Path factors
0.000	7.989	0.501	Risk identification
0.000	6.134	0.549	Risk assessment
0.000	12.442	0.558	Planning

0.000	15.054	0.723	Organization
0.000	25.559	0.817	Responsibility
0.000	24.760	0.777	Control

MODEL FIT

Next, goodness of fit indices including GFI, AGFI and RMSEA were used to fit the model. The values obtained in Table 11 show that the model results are reliable. Because the GFI and AGFI indices are both estimated to be higher than the desired limit, this statistic was greater than the criterion of 0.90.

Table 11 Statistics related to goodness of fit of the model

Fit indices	Symbol	Criteria	Research values	Fit Result
Chi-square distribution over degrees of freedom	X^2/df	≤3	1.34	Good Fit
Root mean square error of estimation	RMSEA	≤0/08	0.03	Good Fit
Goodness of fit index	GFI	≥0/9	0/94	Good Fit
Adjusted goodness of fit index	AGFI	≥0/9	0/91	Good Fit
Comparative fit index	CFI	≥0/9	0/95	Good Fit
Incremental fit index	IFI	≥0/9	0/93	Good Fit
Soft fit index	NFI	≥0/9	0/92	Good Fit
Non-soft fit index	NNFI	≥0/9	0/96	Good Fit
Coefficient of determination	R2	≥0/67	0/76	Good Fit

Overall model fit:
Since the calculated GOF value is greater than 0.36, it indicates a good fit of the research model. Therefore, it can be said that the overall fit of the research model is very good and approved
Structural and interpretive modeling:

Step 1. Formation of the structural self-interaction matrix
In this step, the relationships between the factors were analyzed in a pairwise manner, using structural interpretive modeling and using the conceptual relationship "leading to". This matrix is a matrix with the dimensions of the factors that are indicated in the rows and columns of the factor matrix. The matrix table consists of the symbols that have the most repetitions in the experts' opinions. The results are as follows in Table 12:

Table 12 Structural Self-Interaction Matrix

6	5	4	3	2	1	Factors
A	O	V	A	V	X	Risk Identification
V	A	O	V	O		Risk Assessment
A	X	O	V			Planning
V	V	A				Organization
A	V					Responsibility
V						Control

Step 2. Initial Access Matrix
To obtain the access matrix, the above symbols must be converted to zero and one. According to the following rules, the initial access matrix can be obtained.

Table 12 Initial Access Matrix

5	4	3	2	1	FactorsI J
0	1	1	1	1	Risk Identification
1	1	0	1	0	Risk Assessment
1	0	1	1	0	Planning
1	1	1	0	0	Organization

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1	0	1	0	0	Responsibility
0	1	0	1	0	Control

Step 3. Final Access Matrix
In this matrix, the influence power and degree of dependence of each stimulus are also shown. The results are given in Table 13 and the numbers marked * indicate that they were zero in the initial access matrix and became one after adaptation.

Power of influence	5	4	3	2	1	FactorsI J
5	*1	1	0	1	1	Risk Identification
4	1	1	*1	0	0	Risk Assessment
2	1	0	0	0	0	Planning
2	0	0	0	1	0	Organization
2	0	0	1	0	*1	Responsibility
2	0	0	1	1	0	Control
	3	3	3	3	4	Dependency

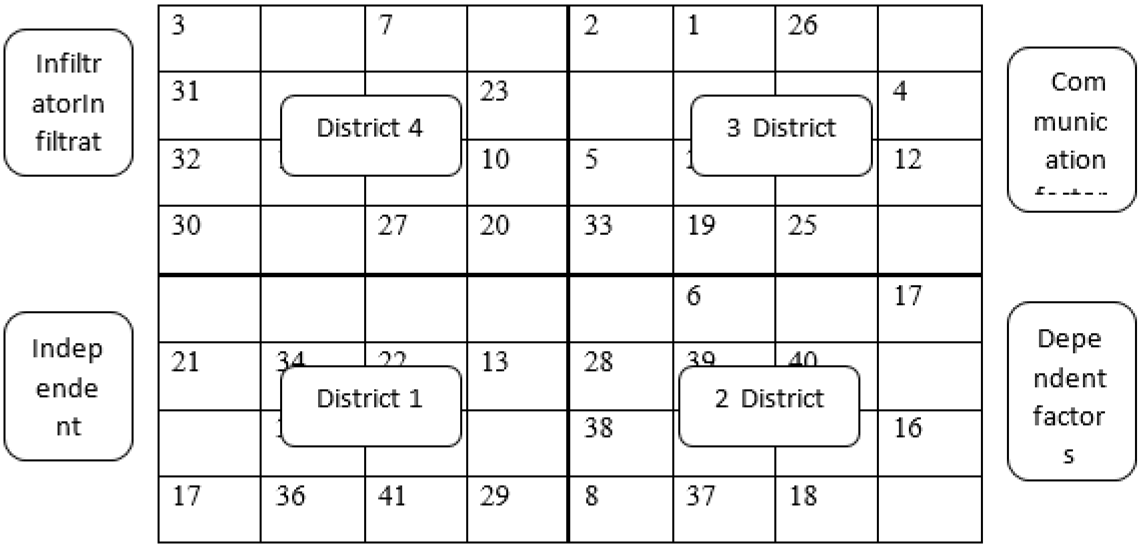
Step 4. Leveling
Typically, factors that have the same output set and the same set of bidirectional or shared relationships constitute the top-level factors of the hierarchy. Therefore, the top-level drivers will not be the source of any other drivers. Once the top-level was defined, it was separated from the other drivers. The results are presented in Table 14.

Table 14 Leveling of Factors

Level	Total common	Output set	Verori Collection	Factors
1	2.3.5.11.12.13	.2.3.4.5.6.11.12.13	1.2.3.5.7	Risk identification
2	.2.4.5	.2.4.5.6.18.19.20.21	.2.4.5.7.14.15.16.17	Risk assessment
3	4	4.22.23.24.25.26	.3.4.6.7.8.27.28.29.30	Planning
4	.4.5.7.8	.4.5.6.7.8.31.32.33.34	.4.5.7.8.35.36.37	Organization
5	2.3.4.5.10	1.2.3.4.5.10	2.3.4.5.6.7.10	Responsibility
6	2	3.7.9.2.38.39	2.4.5.6.40.41	Control

Step 5. Analysis of influence power and degree of dependence
In this step, the influence power-degree of dependence matrix of the factors was extracted, which were divided into four areas according to the influence power and degree of dependence. The four areas are: independence, dependence, connection and influence. The factors that had the least amount of dependence and influence power on other variables were placed in area 1, which is called the independence area. These elements are somewhat isolated from other factors and have few connections. The factors that had a high level of dependence and low influence power on other factors were placed in area 2, which is called the dependence area. The factors that had a high level of influence power and a high level of dependence and in fact had a two-way relationship were placed in the communication area, which is called area 3. Any change in this type of factor causes a change in other factors. Finally, the factors that had a high level of influence and little dependence were placed in the influence area, which is known as area 4.

Influence Power



Degree of dependence

Figure 3 Influence-Dependency Diagram

Figure 3 shows the position of all factors in the influence-dependency diagram. The classification of factors based on their influence and degree of dependence shows that there are no drivers in zone 1 or the independence zone, that is, with low influence and low degree of dependence. Zone 2 is monitored and controlled, and factors that are located in zone 3 and any change in these factors will cause changes in other factors. Zone 4 contains factors that have little dependence on other factors.

DISCUSSION AND CONCLUSION

What are the components and subcomponents of the key stakeholder-based risk management model?
According to the findings, 6 main components were identified: risk identification including the subcomponents of identifying stakeholders suitable for risk assessment, determining the type of risk, awareness of the scope of risks, identifying positive and negative risks, internal and external risk assessment, brainstorming and compiling a risk list, risk assessment including the subcomponents of probability of occurrence, sensitivity analysis, qualitative analysis, quantitative analysis, clarification, resource estimation, risk classification and risk documentation, planning including the subcomponents of accurate identification of stakeholders, communication policies, accurate and timely information to stakeholders, stakeholder commitment, stakeholder classification, determining stakeholder expectations and common interests of stakeholders, organization including the subcomponents of increasing the level of stakeholder participation, stakeholder support, stakeholder power and influence, stakeholder social responsibility, stakeholder legitimacy, combination of decision makers, integration of stakeholders, stability in Stakeholder relations, stakeholder control, value creation for stakeholders and collaboration between stakeholders, accountability includes the subcomponents of avoidance, transfer, prevention and acceptance and control includes the subcomponents of risk response, risk records, database and effectiveness.
How is the leveling of the components and subcomponents of the risk management model for road construction projects based on key stakeholders?

A structural and interpretive method was used to answer this question. The findings showed that risk identification was at the first level, risk assessment at the second level, planning at the third level and organization, accountability and control at the fourth to sixth levels, where the position of all factors is shown in the influence-dependency diagram. In the context of project risk management, risk identification refers to the process of identifying and documenting risks that can affect the project. A variety of individuals and groups can participate in this activity, including the project manager, project team members, the risk management team (if assigned), customers, subject matter experts outside the project team, end users, other project managers, stakeholders, and

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risk management. While these individuals play an important role in identifying risks, it is important to encourage all team members to participate and identify potential risks. The risk management plan provides key inputs to the risk identification process, including the assignment of roles and responsibilities, the allocation of resources for risk management activities in the budget and schedule, and the risk categories, which are sometimes presented in a risk decomposition structure. Reviewing activity cost estimates to identify risks is valuable by providing a quantitative assessment of the expected cost to complete the planned activities. Ideally, these estimates are expressed as ranges that reflect the level of risk. Reviewing estimates can determine whether they are sufficient to complete the activity (or pose a risk to the project) during the planning phase. The organization should establish plans to anticipate and respond to future risks. This includes establishing an early warning system, identifying strengths and weaknesses, training employees, establishing critical processes and procedures, determining manpower and resource requirements, establishing communication and information systems, determining corrective and recovery strategies, and determining processes for analyzing and learning from events. The goal of this stage is to increase the organization's ability to deal with adverse risks and reduce their impact on organizational performance.

The organization should continuously monitor and evaluate the risk management process, which is a dynamic process. This includes reviewing the effectiveness of risk management solutions, assessing changes in the business environment, and updating strategies and solutions. The purpose of control is to continuously improve the risk management process and ensure that the organization is sufficiently resilient to risks. By effectively implementing this management process, organizations will be able to increase their resilience and adaptability to potential risks, prevent harm and losses, and ensure improved performance. Risk management is a continuous and dynamic process that helps businesses identify potential risks, assess the likelihood and possible impact of these risks, and respond strategically. Risk assessment is a critical part of this process, which focuses on identifying potential risks and analyzing conceivable risks in an organization’s immediate work environment. There are many aspects of potential risks and losses during construction projects, as well as a diverse mix of interactions that may affect them. These complex relationships include direct, indirect, explicit, implicit or unpredictable risks. Quality, time and cost control are the three key objectives of project management. Construction risk and loss management is a key element in construction risk management. Performance against the project schedule is closely and inextricably linked to the planned target cost.

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