RESEARCH ON RISK MANAGEMENT OF COMMUNICATION PROJECTS BASED ON AHP

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*Abstract***—The construction of communication network project is a process with a great amount of investment, long period, high technical requirement and complex system. Unknown factors, random factors and fuzzy factors are abound in the process and are changing constantly, the resulting risk directly threatens the successful implementation of project. The risk of communication network project enlarges as the investment scale increases, thus the research on risk management of communication project is becoming increasingly important. In this paper, risk identification is carried out by a real case on the three levels: macro-environment, enterprise level and the project level, and also the RBS structure diagram is given. On this basis, this paper will focus on risk analysis of the project-level risk in the communication network project based on AHP method and makes the useful conclusion. This article has important significance for the risk management practice of the communication network project.**

Keywords- Risk Management, Communication Projects, AHP

I.INTRODUCTION

The goal of communication network is to achieve any person can communicate with one another from anywhere at any time by any way. The wide uses of communication network technology and communication business mark a key historical development opportunity of the communication industry. Along with the issuance of 3G licenses, major operators have seized the opportunity to carry out large-scale communication network constructions, therefore the investment scale of communication projects increase gradually. The construction of communication network has many characteristics including large investment, wide range, high technology and long project cycle, all these show the multilevel nature of risks, thus study effectively on risk management of communication network project can fully identify, analyze and assess the variety of risks that may arise during the project process, and also can propose rationally for engineers and managers to help them circumvent, transfer or reduce the risks. These can not only ensure quality projects completed on time, but also can practically guide the risk management activities of the follow-up projects.

II.LITERATURE REVIEW

A. Analytical Hierarchy Process

AHP (Analytical Hierarchy Process) is developed by professor T.L.Saaty at the University of Pittsburgh in the 1970s, it is considered a qualitative and quantitative evaluation method. The basic idea is: in accordance with the nature of the problem and the overall objective, the problem can be broken down into various elements, which then are affiliation with groups according the interrelationship, and form orderly hierarchical structure. Through pairwise comparison to determine the relative importance of various elements in each level and based on the above to determine the weight of all these various elements in decision-making, ultimately ascertain the importance of sub-targets to the overall goal. The basic steps of AHP include: hierarchy structure; comparison method to determine all judgment matrixes, as well as consistent judgment. Due to space limitation, this article does not elaborate all the steps, only list the meaning of element values in the following table.

Analytic Hierarchy Process as a comprehensive evaluation method has a great advantage of combining qualitative and quantitative analysis, it can resolve complex issues, provide policy makers with a scientific basis for the right decision-making when they facing numerous and complicated situation. At present, major applications of AHP are in the safety evaluation and environmental risk assessment, and seldom in communications network risk assessment.

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TABLEI. METHOD TO DETERMINE THE VALUE OF ELEMENT AIJ IN WEIGHT JUDGMENT MATRIX

Aij	Results of the two factors' comparison
1	Ai and Aj is equally important
3	Ai is slightly important than Aj
5	Ai is important than Aj
7	Ai is more important than Aj
9	Ai is extremely important than Aj
2,4,6,8	between the two adjacent results above
Reciprocal of the numbers above	Comparison of the two factors in turn

B. *Project risk management*

Project risk management is a series of system process including the identification and analysis of project risks, taking measures to cope with the risks, etc. In the industrialized western countries, project risk management already has a wide range of applications. The study of risk in our country has been from the beginning of the macro-economic risk assessment, environmental risk assessment, investment and financial risk assessment to expand to areas such as real estate, water conservancy project, chemical engineering, roads and bridges.

Jianshe Wang (2006) summed up the risk management procedures of risk identification, risk analysis and risk response in coal mining project. Lingling Mou (2007) summarized the research results of software project risk management at home and abroad over the past 30 years. Zhifeng Wang (2007) conducted water project risk planning. Tengyun Yu (2007) applied risk management theory to a tourism project, measured and controlled its development risks and operation risks. Haizhong Zheng (2007) discussed the procedures and methods of geological engineering risk management, combined with China Geo-Engineering project implementation status. Wenchao Ma (2008) exposited the basic idea and processes of real estate projects risk management, and analyzed the application of the specific case. Haoyang Sun (2008) developed the concept of highway project risk management, correspondingly the measures to prevent and control highway risks[1-7].

To sum up, compared with foreign countries, our project risk management is still in the introduction, absorption and digestion stage, the study on communication networks risk assessment is far from sufficient. It is time for domestic scholars in the field to go further study so as to improve the accuracy of risk assessment.

III. CASE STUDY

The following example illustrates the specific application of AHP method in a communication network project. First, identify risk factors. Risk factors mainly have three categories: macro-environmental risks, enterprise level risks and project level risks. Macroeconomic environment risks include: political risk, economic risk, market risk, technical risk and force majeure. Enterprise level risks were mainly due to the adjustment in organization structure and senior management personnel, and also the organization structure and management mode are uncertain during enterprise restructuring process, the change of senior manager or project leader will also lead to adjustment in the project implementation plan. In addition the confused management, uncertain staff position will also be important source of risks. Starting from the project itself, the project level risks include: contract risks (B1), requirement change risks (B2), design risks (B3), personnel risks (B4), computer room environmental risks (B5), sub-contractors risks (B6) and supervisor risks (B7). Based on the information above, with decision-making objectives and evaluation criterions to build the project hierarchy model is shown below:

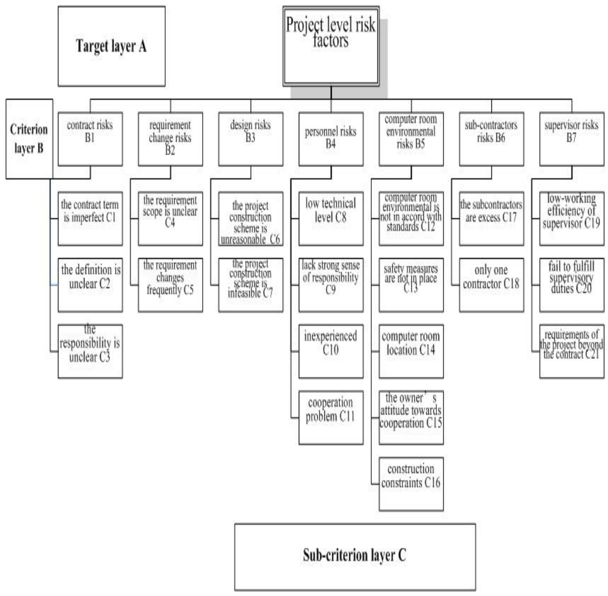

Figure 1. Hierarchical Structure Model

Methods an anonymous questionnaire was conducted among 125 respondents which resulted in 76 sample return. The following takes project level risks as the research object, systematically elaborate the application of AHP method in this project risk management.

First, determine judgment matrix form of the first level:

TABLEII. JUDGMENT MATRIX FORM A FOR THE FIRST LEVEL

A	B1	B2	B3	B4	B5	B6	B7
B1	1	1/2	3	2	7	2	5
B2	2	1	4	2	8	3	6
B3	1/3	1/4	1	1/2	4	1/2	2
B4	1/2	1/2	2	1	6	2	4
B5	1/7	1/8	1/4	1/6	1	1/5	1/2
B6	1/2	1/3	2	1/2	5	1	3
B7	1/5	1/6	1/2	1/4	2	1/3	1

Then, determine judgment matrix form of the second level:

(1) Contract Risks: the contract term is imperfect (C1), the definition is unclear (C2), and the responsibility is unclear (C3).

TABLEIII. B1 HIERARCHY JUDGMENTAL MATRIX

B1	C1	C2	C3
C1	1	3	7
C2	1/3	1	5
C3	1/7	1/5	1

(2) Requirement change risks: project requirements include the implementation range, quality requirements, profit or cost targets and time objectives. The relationships of quality, cost, time and security are interinhibitive in a certain scope.The requirements often change during the project process, resulting in workload and costs increase, also time delay. Even a significant demand change may lead to the suspension of the project. The requirement change risks mainly include: the requirement scope is unclear (C4); the requirement changes frequently (C5).

TABLEIV. B2 HIERARCHY JUDGMENTAL MATRIX

B2	C4	C5
C4	1	1/3
C5	3	1

(3) Design risks: the project construction scheme is unreasonable (C6), or even infeasible (C7), suppressing the normal proceeding of the project.

TABLEV. B3 HIERARCHY JUDGMENTAL MATRIX

B3	C6	C7
C6	1	7
C7	1/7	1

(4) Personnel risks: They come from the parties involved in the construction projects, including technical staff and managers. The risks mainly list as follows: low technical level (C8), lack strong sense of responsibility (C9), inexperienced (C10) as well as the cooperation problem (C11). In short, there still exist some problems in personnel quality, personnel capability and team cooperation.

TABLEVI. B4 HIERARCHY JUDGMENTAL MATRIX

B4	C8	C9	C10	C11
C8	1	1/7	1/3	1/9
C9	7	1	5	1/3
C10	3	1/5	1	1/7
C11	9	3	7	1

(5) Computer room environmental risks: the computer room environmental is not in accord with standards (C12), safety measures are not in place (C13). In addition, the room location (C14) will also become a potential risks source, since there will be inaccessible or restricted trip if the room location is in the central areas or key control areas. If the room is rented from other operators or owners, the owner's attitude towards cooperation (C15) and construction constraints (C16) are also destabilizing factors.

TABLEVII. B5 HIERARCHY JUDGMENTAL MATRIX

B5	C12	C13	C14	C15	C16
C12	1	1/5	1/4	3	5
C13	5	1	3	7	9
C14	4	1/3	1	5	7
C15	1/3	1/7	1/5	1	3
C16	1/5	1/9	1/7	1/3	1

(6) Sub-contractors risks: the sub-contractors are excess (C17) will lead to difficulties in project coordination and management. Conversely, only one contractor (C18) would result in too strong dependence.

TABLEVIII. B6 HIERARCHY JUDGMENTAL MATRIX

B6	C17	C18
C17	1	1/9
C18	9	1

(7) Supervisor risks: mainly show in the low-working efficiency of supervisor (C19), fail to fulfill supervisory duties (C20), or requirements of the project beyond the contract (C21).

TABLEIX. B7 HIERARCHY JUDGMENTAL MATRIX

B7	C19	C20	C21
C19	1	1/7	5
C20	7	1	9
C21	1/5	1/9	1

Based on the hierarchy judgmental matrixes constructed above, we can determine the eigenvector of each judgmental matrix, and then get the relative weight coefficient of inter-layer Wi, using the method of square-root to approximately solve each judgmental matrix. Omit the intermediate process, results are in the following table:

TABLEX. JUDGMENTAL MATRIX FORM

Bi / Ci	B1 0.1047	B2 0.1162	B3 0.0902	B4 0.0984	B5 0.1079	B6 0.0924	B7 0.0969	BiCj
C1	0.6491							0.0671
C2	0.279							0.0292
C3	0.0719							0.0075
C4		0.25						0.0291
C5		0.75						0.0872
C6			0.875					0.0789
C7			0.125					0.0118
C8				0.0424				0.0042
C9				0.2903				0.0286
C10				0.085				0.0084
C11				0.5824				0.0573
C12					0.1213			0.0131
C13					0.5058			0.0546
C14					0.2771			0.0299
C15					0.0631			0.0068
C16					0.0326			0.0035
C17						0.1		0.0092
C18						0.9		0.0832
C19							0.1734	0.0168
C20							0.772	0.0748
C21							0.0546	0.0053

People's subjective judgments cause inconsistency in the judgment matrixes establishment process. In order to ensure the validity of the evaluation analysis, consistency check is needed, calculated as follows:

Solving judgment matrix A-B, the weight coefficients which Bi contribute to the overall objective of the project listed as follows:

$$W= (0.2297, 0.3234, 0.0828, 0.1685, 0.0275, 0.1220, 0.0462)^T$$

$$AW= (1.6443, 2.3142, 0.5879, 1.2045, 0.1970, 0.8706, 0.3252)^T$$

Maximum eigenvalue λ_{max}=1/7

(1.6443/0.2297+2.3142/0.3234+0.5879/0.0828+1.2045/

0.1685+0.1970/0.0275+0.8706/0.1220+0.3252/0.0462)=

7.1296

Consistency Index C.I. = (7.1296-7) / (7-1) =0.0216

When n=7, Mean Random Consistency Index R.I. =1.32 is obtained through checking table.

Random consistency Ratio C.R.=0.0216/1.32=0.0164 <0.1, so the consistency test of judgment matrix A meet the requirement.

Similarly, the consistency tests of judgment matrix Bi-C are listed as follows:

For judgment matrix B1-C, C.R. =0.0557<0.1, satisfy the consistency requirement.

For judgment matrix B4-C, C.R. =0.0614<0.1, satisfy the consistency requirement.

For judgment matrix B5-C, C.R. =0.0652<0.1, satisfy the consistency requirement.

For judgment matrix B7-C, C.R. =0.0499<0.1, satisfy the consistency requirement.

The comprehensive important degree: the weight results from the above table show that the weight C5 (the requirement change frequently) impact the project level risks up to 0.0872, which means that the frequent demand change is the biggest risk effect factor. The second major risk effect factor is C18 (only one contractor) with weight 0.0832.The third largest risk effect factor is C6 (the project construction scheme is unreasonable) with weight 0.0789. C16 (construction constraints) is the smallest risk effect factor. All these show the actual situation of this project. Therefore, this project risk management should focus on the requirement scope as well as the tightness and rationality of the contract terms so as to effectively guard against the risk of project quality, process and cost, also minimize potential risk. Besides, C18 (only one contractor) indicates that company should try to avoid or reduce dependence on the only sub-contractor to create effective competition.

IV.CONCLUSIONS

Risks are inevitable in communication network project life cycle, posing a threat to the achievement of project goals. So accuracy risk assessment is an important prerequisite to effectively identify and control the risks. Applying qualitative and quantitative method of appraisal, this paper analyses quantities relationship of communication network risk factor's significance and draw a conclusion that the requirement changes frequently , only one contractor and the project construction scheme is unreasonable are the three most risk effect factors in the communication network construction project. Operators should focus on such areas, epurate communication project risk management elements, sum up general project item risk counter-measure in order to avoid risk according to co-persistence. The method described in this article is suitable for multiple index and multi-level risk management, and could provide a feasible solution for the large and medium-sized project risk assessment under certain conditions.

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