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Top 10 Key Risk Factors of GZA Project Implementation Are Identified with Analytic Hierarchy Process

Jiangping Wan, Guangwei Pan

School of Business Administration, South China University of Technology, Guangzhou, China
Email: csjpwan@scut.edu.cn, guangwei_pan@foxmail.com

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Abstract

This paper has established the implementation process of government investment project-GZA with Wuli-Shili-Renli methodology. The risk factors of three levels in GZA project implementation process are identified with literature survey and expert investigation method. The risk factors evaluation model based on Analytic Hierarchy Process to evaluate the risk factors of GZA project is also established. The conclusion is that the most important primary risk factor is the forming target stage. The secondary risk factor is the decision risks. The top 10 key risk factors are in the following: scientificity, policy supporting, design quality, supervisory mechanism, drawing, costing, budget control, organization structure, personnel quality, democratic participation. The study attempts to facilitate designing the specific strategy to avoid risk in order to improve the GZA project implementation.

Keywords

GZA Project, Risk Factors, Analytic Hierarchy Process, Wuli-Shili-Renli Methodology

1. Introduction

Due to the characteristics and mode of operation of government investment projects, there has been a lot of chaos in the project, such as jerry-built project, misappropriation of construction funds and other phenomena. Risk management of government investment project has attracted the close attention from society. We urgently need to study risk factors from theory to practice in the process of government investment projects in order to prevent and control. GZA project is a super large infrastructure project build by Guangdong Province, Hang Kong and Macao with the first cooperation. The bridge that the project build crosses the Pearl River estuary area,

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which is a large sea-crossing passage linking Hongkong, Zhuhai and Macao. The project has characters of difficult construction, complex cooperation, sensitive environment of construction religion, high social attention etc. So it requires more effective risk management than the general projects, and the risk factor analysis is the basis of risk assessment as well as the subsequent risk management.

This paper is organized in the following: Section 2 is literature review, including Wuli-Shili-Renli (WSR) system methodology and project risk management. Section 3 is the research of key risk factors of GZA project implementation. Finally it is conclusions and acknowledgement.

2. Literature Review

2.1. WSR System Methodology

In 1994, on the basis of systematic research, China system scientist Professor Gu Jifa and Dr. Zhu Zhichang, combined with the research results of Tsien Hsueshen, Xu Guozhi, Song Jian, and proposed WSR that "Wuli-Shili-Renli methodology" at HULL University, which was how effectively use the configuration to a system to solve the problem of methodology [1]. The general process of WSR is divided into seven steps: 1) Understanding intention; 2) Forming target; 3) Investing and analyzing; 4) Building strategy; 5) Choosing program; 6) Realizing construction; 7) Coordinating relations. In order to effectively solve the basic engineering "Wuli" problems, we must establish effective "Shili" system to manage and improve management efficiency, it must be people-oriented, build harmonious "people management" system to coordinate the "Renli" system [2].

2.2. Project Risk Management

Since the mid-1980s, various foreign risk management theories were applied to project management, especially the large civil engineering projects with the continuous development of our economy. For example, the Shanghai subway project in the implementation process has been successfully applied in project risk management method [3].

Zh. Y. Zhao, Y. Sh. Liu and H. Ch. Yang introduced the fault tree analysis method of the engineering reliability theory to the risk management of construction projects. The diagram deductive method was proposed to create the project risk fault tree. The project risk made identification and the risk factor quantification was approached. The minimal cut set method for detecting project's weakness was provided. Based on the binary system and the probability theory, the project successful degree was calculated and the minimizing of the costs to reduce the project sick was studied [4].

P. Guo and P. G. Shi proposed the grey clustering theory which could be used to obtain the index grey statistics and structure the project risk fuzzy subjection matrix and establish the comprehensive risk evaluation method of combing grey evaluation with fuzzy evaluation [5].

3. Research of Key Risk Factors of GZA Project Implementation

3.1. Building Risk Factors Evaluation Model of GZA Project Implementation with AHP

Based on WSR system methodology, we divide the working process of GZA project into 7 stages as 7 primary risk factors, including understanding intention, forming target, investing and analyzing, building strategy, choosing program, realizing construction, and coordinating relations. Through literature survey and expert investigation method, we refer to information department bulletin, some report of government investment project, industry association, the government policy, Chinese Journal Full-Text Database etc. 20 secondary risk factors and 82 category 3 risk factors of GZA project are recognized with comprehensive induction. We interview with management experts, government leaders, HD design company, GL Construction Company, HG supervision company, JC consulting firms and other senior experts. By repeatedly talking, constantly adjusting the revision, finally, we establish the indicator system of risk factors and build the Analytic Hierarchy Process (AHP) evaluation model, including 7 primary risk factors, 18 secondary risk factors and 53 category 3 risk factors (**Figure 1**).

The top goal A is the evaluated target: evaluation for GZA project implementation risk factors. The second criterion layer is as the primary risk factor indicators. The third criterion layer is as the secondary risk factor indicators. The fourth layer is category 3 risk factor indicators, which is the concrete manifestation of primary risk factors in GZA project implementation process.

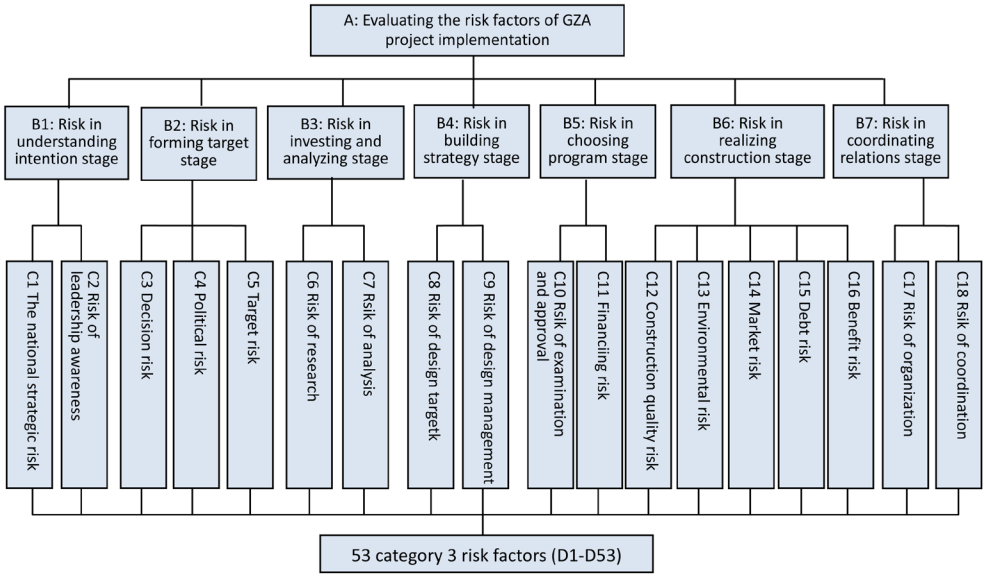

Figure 1. Evaluation model for GZA project implementation risk factors. D1-National development strategy; D2-National macro-control; D3-Government's intention; D4-Blind investment; D5-scienticify; D6-Democratic participation; D7-Supervision mechanism; D8-Cadres' rent-seeking behavior; D9-Policy supporting; D10-Government's administrative efficiency; D11-General framework; D12-Necessity; D13-Feasibility; D14-Object; and content D15-Statistical information; D16-Data analysis; D17-Data prediction; D18-Time; D19-Costing; D20-Design quality; D21-Subcontracting; D22-alteration; D23-Policy; D24-Approval process; D25-Approval supervision; D26-Financing scale; D27-Financial market; D28-Approval Management; D29-Legal system; D30-Drawing; D31-Construction technology; D32-Personnel quality; D33-Building Materials; D34-Policy; D35-Macro-economic; D36-Force majeure; D37-Market price; D38-Market information; D39-Into market timing; D40-Market demand outlook; D41-Lending rates; D42-Budget control; D43-Investment; D44-Debt control mechanism; D45-Market acceptance; D46-Operating expenses; D47-Financial Support; D48-Organization structure; D49-Organizational personnel; D50-Resources and environment; D51-Organizational processes; D52-External coordination; D53-Internal coordination.

3.2. Weight Calculation and Consistency Check on Risk Factors of GZA Project Implementation

8 experts are invited to judge and give scores to the importance of each indicator of criterion relative to the higher criterion layer based on the 1 - 9 scale of AHP method. Thereby judgment matrixes is established, and consistency check on is taken.

We deal with the sores from 8 experts, the original data of judgment matrixes of each layer is got. We get the relative weight of each risk factor in risk factors evaluation model through calculating. Judgment matrixes and calculation results are illustrated in **Tables 1-3**.

In the view of the calculation results, we can see the C.R. values of all judgment matrixes are less than 0.1. Therefore, all judgment matrixes pass the consistency check and the results are proved reliable. Based on the relative weight of each layer of risk factors, calculated the synthetic weights of various risk factors (**Table 4**). Performing a consistency test on total sorts by the Yaahp software, random consistency ratio C.R. of total sorts at all levels is less than 0.1, so the results of total sorts at all levels are satisfactory consistency, the evaluation result is acceptable.

It can be drawn from the results: the most important primary risk factor is the forming target stage, and the secondary risk factor is the decision risks. The top 10 key risk factors are as follows: scientificity, policy supporting, design quality, supervisory mechanism, drawing, costing, budget control, organization structure, personnel quality, and democratic participation.

4. Conclusions

The AHP is applied to establish the risk factors evaluation model for the project GZA implementation. The re-

Table 1. A-B judgment matrix and weights.

A	B1	B2	B3	B4	B5	B6	B7	Wi	
B1	1	1/9	1/2	1/6	1/3	1/7	1/4	0.0271	
B2	9	1	7	3	5	2	4	0.3570	
B3	2	1/7	1	1/4	1/2	1/5	1/3	0.0421	C.R. = 0.0249
B4	6	1/3	4	1	4	1/2	2	0.1636	λ_{max} = 7.2032
B5	3	1/5	2	1/4	1	1/5	1/2	0.0604	
B6	7	1/2	5	2	5	1	4	0.2541	
B7	4	1/4	3	1/2	2	1/4	1	0.0957	

Table 2. B-C judgment matrix and weights.

B1	C1	C2				Wi	
C1	1	2				0.6667	C.R. = 0.0000 λ_{max} = 2.0000
C2	1/2	1				0.3333	For the weight of A: 0.0267
B2	C3	C4	C5			Wi	
C3	1	2	3			0.5390	C.R. = 0.0089
C4	1/2	1	2			0.2973	λ_{max} = 3.0092
C5	1/3	1/2	1			0.1638	For the weight of A: 0.03546
B3	C6	C7				Wi	
C6	1	2				0.6667	C.R. = 0.0000 λ_{max} = 2.0000
C7	1/2	1				0.3333	For the weight of A: 0.0429
B4	C8	C9				Wi	
C8	1	3				0.7500	C.R. = 0.0000 λ_{max} = 2.0000
C9	1/3	1				0.2500	For the weight of A: 0.1632
B5	C10	C11				Wi	
C10	1	3				0.7500	C.R. = 0.0629 λ_{max} = 2.0000
C11	1/3	1				0.2500	For the weight of A: 0.0629
B6	C12	C13	C14	C15	C16	Wi	
C12	1	4	6	2	7	0.4639	
C13	1/4	1	2	1/2	3	0.1365	C.R. = 0.0109
C14	1/6	1\2	1	1/4	2	0.0776	λ_{max} = 5.0487 For the weight of A: 0.2516
C15	1/2	2	4	1	6	0.2731	
C16	1/7	1/3	1/2	1/6	1	0.0488	
B7	C17	C18				Wi	
C17	1	2				0.6667	C.R. = 0.0000 λ_{max} = 2.0000
C18	1/2	1				0.3333	For the weight of A: 0.0971

Table 3. C-D judgment matrix and weights.

C1	D1	D2			Wi	
D1	1	2			0.6667	C.R. = 0.0000 λ_{max} = 2.0000 For the weight of A: 0.0184
D2	1/2	1			0.3333	
C2	D3	D4			Wi	
D3	1	3			0.7500	C.R. = 0.0000 λ_{max} = 2.0000 For the weight of A: 0.0092
D4	1/3	1			0.2500	
C3	D5	D6	D7		Wi	
D5	1	3	2		0.5390	C.R. = 0.0089 λ_{max} = 3.0092 For the weight of A: 0.1911
D6	1/3	1	1/2		0.1638	
D7	1/2	2	1		0.2973	
C4	D8	D9	D10		Wi	
D8	1	1/3	2		0.2299	C.R. = 0.0036 λ_{max} = 3.0037 For the weight of A: 0.1054
D9	3	1	5		0.6479	
D10	1/2	1/5	1		0.1222	
C5	D11	D12	D13		Wi	
D11	1	1/3	1/2		0.1698	C.R. = 0.0176 λ_{max} = 3.0183 For the weight of A: 0.0581
D12	3	1	1		0.4429	
D13	2	1	1		0.3873	
C6	D14	D15			Wi	
D14	1	1/3			0.2500	C.R. = 0.0000 λ_{max} = 2.0000 For the weight of A: 0.0286
D15	3	1			0.7500	
C7	D16	D17			Wi	
D16	1	2			0.6667	C.R. = 0.0000 λ_{max} =2.0000 For the weight of A: 0.0143
D17	1/2	1			0.3333	
C8	D18	D19	D20		Wi	
D18	1	1/3	1/4		0.1226	C.R. = 0.0176 λ_{max} = 3.0183 For the weight of A: 0.1224
D19	3	1	1/2		0.3202	
D20	4	2	1		0.5571	
C9	D21	D22			Wi	
D21	1	3			0.7500	C.R. = 0.0089 λ_{max} = 3.0092 For the weight of A: 0.0472
D22	1/3	1			0.2500	
C10	D23	D24	D25		Wi	
D23	1	2	3		0.5390	C.R. = 0.0089 λ_{max} = 3.0092 For the weight of A: 0.0472
D24	1/2	1	2		0.2973	
D25	1/3	1/2	1		0.1638	
C11	D26	D27	D28	D29	Wi	C.R. = 0.0233 λ_{max} = 4.0623

Continued

D26	1	4	2	3	0.4669	
D27	1/4	1	1/3	1/3	0.0876	
D28	1/2	3	1	1	0.2327	
D29	1/3	3	1	1	0.2127	
C12	D30	D31	D32	D33	Wi	
D30	1	3	2	5	0.4824	
D31	1/3	1	1/2	2	0.2718	C.R. = 0.0054 λ_{max} = 4.0145 For the weight of A: 0.1167
D32	1/2	2	1	3	0.1575	
D33	1/5	1/2	1/3	1	0.0883	
C13	D34	D35	D36		Wi	
D34	1	2	3		0.5390	C.R. = 0.0089 λ_{max} = 3.0092 For the weight of A: 0.0344
D35	1/2	1	2		0.2973	
D36	1/3	1/2	1		0.1638	
C14	D37	D38	D39	D40	Wi	
D37	1	2	3	5	0.4824	
D38	1/2	1	2	3	0.2718	C.R. = 0.0054 λ_{max} = 4.0145 For the weight of A: 0.0195
D39	1/3	1/2	1	2	0.1575	
D40	1/5	1/3	1/2	1	0.0883	
C15	D41	D42	D43	D44	Wi	
D41	1	1/5	1/3	1/2	0.0883	
D42	5	1	2	3	0.4824	C.R. = 0.0054 λ_{max} = 4.0145 For the weight of A: 0.0687
D43	3	1/2	1	2	0.2718	
D44	2	1/3	1/2	1	0.1575	
C16	D45	D46	D47		Wi	
D45	1	1/3	1/5		0.1096	C.R. = 0.0036 λ_{max} = 3.0037 For the weight of A: 0.0123
D46	3	1	1/2		0.3092	
D47	5	2	1		0.5813	
C17	D48	D49	D50	D51	Wi	
D48	1	2	4	6	0.4967	
D49	1/2	1	3	5	0.3135	C.R. = 0.0127 λ_{max} = 4.0340 For the weight of A: 0.0647
D50	1/4	1/3	1	2	0.1213	
D51	1/6	1/5	1/2	1	0.0685	
C18	D52	D53			Wi	
D52	1	3			0.7500	C.R. = 0.0000 λ_{max} = 2.0000 For the weight of A: 0.0324
D53	1/3	1			0.2500	

Table 4. The weight of risk factors.

Target	The primary risk factors	Weight	The secondary risk factors	Weight	Category 3 risk factors	Weight
Evaluating the risk factors of GZA project implementation	B1 Risk in understanding intention stage	0.0276	C1 The national strategic risk	0.0184	D1 National development strategy	0.0123
					D2 State macro-control	0.0061
			C2 Risk of leadership awareness	0.0092	D3 Government intentions	0.0069
					D4 Blind investment	0.0023
	B2 Risk in forming target stage	0.3546	**C3 Decision risk**	0.1911	**D5 Scienticify**	0.1030
					D6 Democratic participation	0.0313
					D7 Supervision machanism	0.0568
			C4 Political risk	0.1054	D8 Cadres' rent-seeking behavior	0.0242
					D9 Policy supporting	0.0683
					D10 Government's administrative efficiency	0.0129
			C5 Target risk	0.0581	D11 General framework	0.0099
					D12 Necessity	0.0257
					D13 Fessibility	0.0225
	B3 Risk in investing and analyzing stage	0.0429	C6 Risk of research	0.0286	D14 Object and content	0.0072
					D15 Statistical information	0.0215
			C7 Risk of analysis	0.0143	D16 Data analysis	0.0095
					D17 Data prediction	0.0048
	B4 Risk in building strategy stage	0.1632	C8 Risk of design target	0.1224	D18 Time	0.0150
					D19 Costing	0.0392
					D20 Design quality	0.0682
			C9 Risk of design management	0.0408	D21 Subcontracting	0.0306
					D22 Alteration	0.0102
	B5 Risk in choosing program stage	0.0629	C10 Risk of examination and approval	0.0472	D23 Policy	0.0254
					D24 Approval process	0.0140
					D25 Approval supervision	0.0077
			C11 Financing risk	0.0157	D26 Financing scale	0.0073
					D27 Financial market	0.0014
					D28 Approval management	0.0037
	B6 Risk in realizing construction stage	0.2516	C12 Construction quality risk	0.1167	D29 Legal system	0.0033
					D30 Drawing	0.0563
					D31 Construction technology	0.0184
					D32 Personnel quality	0.0317
					D33 Building materials	0.0103
			C13 Environmental risk	0.0344	D34 Policy	0.0185
					D35 Macroeconomic	0.0102
					D36 Force majeure	0.0056

Continued

B7 Risk in coordinating relations stage	0.0971	C14 Market risk	0.0195	D37 Market price	0.0094
				D38 Market information	0.0053
				D39 Into market timing	0.0031
				D40 Market demand	0.0017
		C15 Debt risk	0.0687	D41 Lending rates	0.0061
				D42 Budget control	0.0332
				D43 Investment	0.0187
				D44 Debt control mechanism	0.0108
		C16 Benefit risk	0.0123	D45 Market acceptance	0.0013
				D46 Operating expenses	0.0038
				D47 Financial support	0.0071
		C17 Risk of organization	0.0647	**D48 Organization structure**	0.0322
				D49 Organizational personnel	0.0203
				D50 Resources and environment	0.0079
				D51 Organizational processes	0.0044
		C18 Risk of coordination	0.0324	D52 External coordination	0.0243
				D53 Internal coordination	0.0081

sults are in the following: Currently the most important primary risk factors of GZA project implementation is in the forming target stage, which is consistent with the current situation of government investment projects difficult approval. In the secondary risk factors, decision risk is the most important. For government investment projects, the decisions on the phase of project approval have the most significant impact for the entire project. In category 3 risk factors the top 10 key risk factors are scientificity (D5, 0.1030), policy supporting (D9, 0.0683), design quality (D20, 0.0682), supervisory mechanism (D7, 0.0568), drawing (D30, 0.0563), costing (D19, 0.0392), budget control (D42, 0.0332), organization structure (D48, 0.0322), personnel quality (D32, 0.0317), democratic participation (D6, 0.0313). The top 10 risk factors focus on the forming target stage, realizing construction stage and building strategy stage. Therefore, GZA projects need to strengthen risk awareness in the three stages, take the rationalization of management measures.

In the future, we will apply the interpretive structural model to analyze the 10 key risk factors to identify the structure relationship between risk factors and the root of the risk factors in order to design the specific strategy to avoid risk and improve GZA project implementation.

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References

[1] Gu, J.F. and Gao, F. (1998) To See Wuli-Shili-Renli Systems Approach from the View of Management Science. *Systems Engineering Theory and Practice*, **18**, 1-5.

[2] Sheng, Zh.H., You, Q.Zh. and Li, Q. (2008) Methodology and Method of Large Scale Complex Engineering Management: Meta-Synthesis Management. *Science & Technology Progress and Policy*, **25**, 193-197.

[3] 233 Network School (2008) The Classification and Characteristics of Engineering Project Risk Management and Countermeasures. http://www.233.com/jzs1/xmgl/fudao/20080922/085417974.html

[4] Zhao, Zh.Y., Liu, Y.Sh. and Yang, H.Ch. (2002) Application of Fault Tree Analyzing Method to Risk Management of a Construction Project. *Modern Electric Power*, **19**, 95-99.

[5] Guo, P. and Shi, P.G. (2005) Research on Fuzzy-Grey Comprehensive Evaluation Method of Project Risk. *Journal of Xi'an University of Technology*, **21**, 106-109.

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