Analyze on Risk Structure Based on ISM Model in Grid project schedule

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Abstract

This paper analyzes the risk factors with the ISM model during grid projects schedule, and identify the intrinsic link among various risks, ultimately get the recommendation to avoid risks. The results showed that natural risk, economic risk and financial risk are fundamental risks affecting the overall situation, and these risks will increase the probability of the occurrence of other controllable risks, we should pay attention to control these types of risks.

Keywords

Grid projects schedule, risk structure, ISM model, risk management.

1. Introduction

In the project construction projects, investment, quality and progress are important control goals. Progress of the project is often used as the primary control objectives, in particular the power grid construction. Grid project will face many risks, such as natural risk, economic risk, management risk, social risk, legal risk, etc., and the occurrence of these risks will inevitably affect the schedule to achieve its objectives. However, these risks are not completely independent, clarifying the relationship among them can help project managers start from the source of risk, strangle risks in the cradle to achieve schedule the project objectives. Based on systems theory point of view, ISM model regards grid project as a system and analyze the status and relationship among elements within the system, so as to achieve progress control.

2. Interpretative structural modeling, ISM model

Interpretative structural modeling technique (ISM), proposed by the American scholar J. Warfield in 1973, is a systematic method developed for analyzing complex issues related to the socio-economic system. It analyzes the overall structure of a complex system using correlation matrix theory, combines with practical experience and knowledge, computer help, eventually forms a multi-level hierarchical structure model, so that the status and relationship among elements within the system at a glance.

While using ISM to analyze problems, the general basis having the following steps:

(1) Determine the key factors affecting the system;

(2) List the correlation of each factor;

(3) Establish adjacency matrix and reachability matrix;

(4) decompose reachability matrix, and establish structure model;

(5) Establish and analyze Interpretive Structural Modeling.

3. Application Example for Risk structure in grid projects schedule

(1)Grid projects schedule risk category

Assume R represents a risk system in grid projects schedule, and Ri represents risk factors, then R=(R1, R2, …Rn). R1~ R8 Represent the natural risk, economic risk, social risk, financing risk, political and legal risk, technology risk, manage risk and environmental risk.

(2) Determine the relevance of each factor

Combined with the actual characteristics of the power grid project and the views of industry experts, analyze the interaction relationship among 8 class schedule risk in accordance with the following rules, results are shown in Table 1:

1) Ri has a direct impact on Rj, fill 1; Ri has no direct influence on Rj, fill in 0;

2) When Ri and Rj each other directly affected, the impact is quite, the respective assignment 1; When Ri and Rj has no direct impact on each other, each assigned to 0.

Table1 Grid project schedule risk relationship

	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8
R_1	1	0	0	0	0	0	1	1
R_2	0	1	1	1	0	0	1	1
R_3	0	0	1	0	0	0	0	1
R_4	0	1	1	1	0	0	1	1
R_5	0	1	1	1	1	0	1	1
R_6	0	0	1	0	0	1	1	1
R_7	0	0	0	0	0	0	1	1
R_8	0	0	0	0	0	0	0	1

(3) Set up a reachability matrix

Corresponding 8 ×8 matrix A can be obtained from Table 1,and reachability matrix can be obtained through the following calculation:

A1=A,A2=A2, A3=A3…….

According to the above method after successively calculates, we can obtain:

A1≠A2≠A3≠…≠Ar-1=Ar=Ar+1

Ar=Ar,r≤7. Take M=Ar, so M=Ar=Ar+1.

$$M=\begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 1 & 1 \\ 0 & 1 & 1 & 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 \\ 0 & 1 & 1 & 1 & 0 & 0 & 1 & 1 \\ 0 & 1 & 1 & 1 & 1 & 0 & 1 & 1 \\ 0 & 0 & 1 & 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

Reachability matrix is to describe the degree of each element can reach in correlation matrix after a certain length of path. Reachability matrix has a significant characteristic –on the law, which means that when Ri directly get to Rj through the path of 1 length, and Rj directly get to Rk through the path of 1 length, then Ri can surely get to Rk through the path of 2 length.

(4) Divide level

According to Reachability matrix M, following set can be obtained.

P(Ri)= {Rj | mij=1} ;

Q(Rj)= {Rj | mij=1} ;

P(Ri)∩Q(Ri)=T(Ri).

Wherein P (Ri) was Reachability set, starting from the elements of Ri can reach all the elements of a collection, Q (Rj) is the first set, which can reach all the elements of a collection of Ri, T (Ri) is a set of common, which is the intersection set of the first set and Reachability set. through calculation, while P (Ri) and T (Ri) contains the same factor, the uppermost unit can be obtained. Then delete rows and columns that factors in common set is located from the original matrix. Similarly, Secondary unit can be obtained, in turn divided down, the last factors can be divided into a multi-step structure.

According to the principle of stratification, schedule risk can be divided into four classes. From the top to bottom are:

First level: L1={R8};

Second level: L2={R3,R7};

Third level:L3={R1,R2,R4,R6};

Fourth level: L4={R5}.

Thereby draw the grid project schedule risk associated hierarchy is shown in Figure 1. As can be seen from the figure, the natural risk, economic risk, financing risk is the fundamental risk of affecting the overall situation, the risk of occurrence of these classes will increase the probability of the occurrence of other types of controllable risks. For uncontrollable risks, we must strengthen the previous forecast of risk, the risk in the event is necessary and timely treatment.. When choosing circumvention or adaptation approach, not only should consider effects of the risk caused by the project itself, but also consider the impact of this risk and other risks that may arise due to the progress of the project.

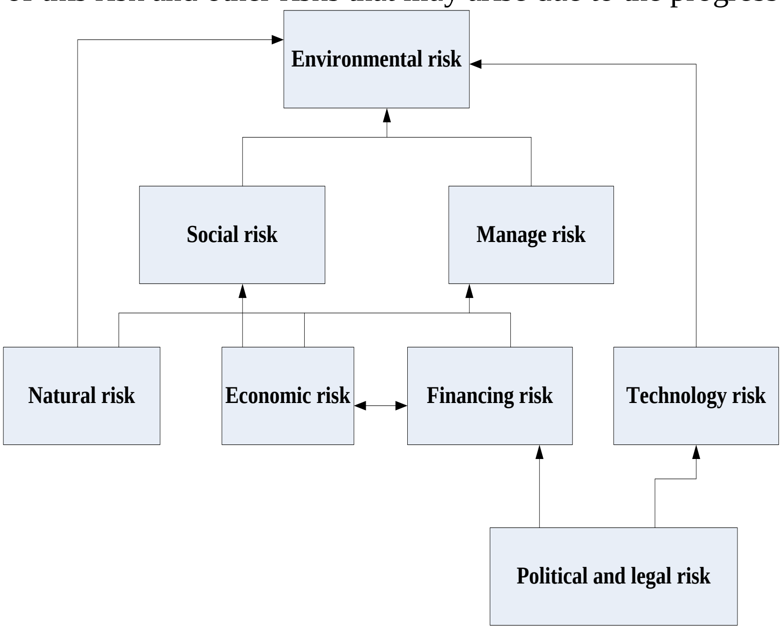

Fig.1 Risk hierarchical graph in Grid Projects Schedule

4. Conclusion

This paper analyzes the factors that influence the risk of power grid projects and the establishment of ISM model utilizes systems engineering approach, finally obtain a clear hierarchy, context clear risk architecture. It established a framework for risk managers, to provide some positive effect on management, which will help managers sort out the various risk factors inherent relationship and clearly grasp the key risk factors, thus avoid the risk priorities. The results show that the natural risk, economic risk, financing risk is the fundamental risk of affecting the overall situation, the project manager in the project construction process should pay attention to these types of risk prevention, take precautions to avoid the risk of the project and the project cost and schedule loss of quality targets caused.

References

[1] Y.L. Wang. Systems Engineering. Beijing Machinery Industry Press,2012:200-267
[2] Y.L. Xiao. Systems Engineering Theory and Methods (revised edition). Beijing Machinery Industry Press 2014:170-180
[3] X.Y. Wu, D.W. Ma, Y.L. Qiao. Interpretative structural model for VCDs and DVDs of weapons development based on risk analysis. Systems Engineering and Electronics, 2015, 27（9）: 1590-1593.
[4] W.J. Zhang, W.J. Xie. Application of ISM in Risks Structure Analysis. Business Research, 2012, 239 (2);1-3.