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# The ISM Analysis on Influence Factors of Cost Control in the Wind Power Construction Project

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**Abstract**

Cost control in the wind power construction project is essential under the trend of developing wind power in China. In order to carry out cost control effectively, structural interpretation model(ISM) is used to identify and analyze the major factors that affect the implementation of cost control and the hierarchy relationships between each other. In this way, the surface causes, the middle causes and the underlying causes that affect the cost control in the wind power construction project have been found, which provides decision theory for the smooth implementation of cost control in China's current wind power construction projects.

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Keywords:wind power construction project; cost control; interpretive structural modeling(ISM)

## 1.Introduction

With the continuous progress and development of human society, the importance of energy issues has become increasingly prominent. The three main energy, Coal, oil and natural gas, are at nearly depletion, and cause a large number of toxic and harmful gas emissions in the course of use, which lead to severe pollution to the environment. Therefore, all governments around the world decide to develop new energy sources, and wind energy is one of them. However, due to the high cost of wind power plant construction, the equipment investment, the backward level of our current construction and management and the obsolete management model[1-3], huge investment in the construction and serious waste have been caused, which leads to tremendous difficulties in building the wind power plants, and greatly hinders the development of wind power in China. In view of this, the in-depth analysis for the influence factors of the cost of wind power projects are needed to better understand the hierarchy relationships between them.

With the help of interpretive structural model (ISM)[4], a variety of factors that affect the cost of wind power construction can be identified, and their relationships can be represented visually with the multi-level hierarchical structure. Thus a theoretical proposals for the macro-control of the capital cost of wind power can be provided.

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## 2.Interpretative structural modeling and the specific implementation

Interpretative structural modeling(ISM) is a structural modeling technique. ISM's working procedures are as follows: (1) organize the implementation panel; (2) set the key issues, and choose the leading factors that constitute the system and affect the key issues; (3)cite the relevance of the leading factors; (4)according to the relevance of the elements, establish the adjacency matrix and the reachability matrix; (5)up to the decomposition of the reachability matrix, establish the structural model; (6)according to the structural model, establish the explaining structural model[5-6].

### *2.1.Determine the Influence Factors of the Cost of Wind Power Construction Project, Establish the Adjacency Matrix*

First of all, ISM group determine 18 representative factors that affect the cost of wind power projects by collecting and reading a lot of relevant literature and conducting in-depth analysis, and summarize them as the tender offer($S_1$), labor costs($S_2$), materials costs($S_3$), equipment costs($S_4$), indirect costs($S_5$), the position of cost management in the enterprise($S_6$), the sense of cost competition($S_7$), adaptability to the market($S_8$), the implementation of responsibilities costs($S_9$), quality costs($S_{10}$), costs of safety in production($S_{11}$), one feeder monitoring mechanism($S_{12}$), reward and punishment mechanism($S_{13}$), the cost management system($S_{14}$), the cost accounting system ($S_{15}$), the quality of people in the construction enterprise($S_{16}$), the experience of cost management ($S_{17}$), theoretical and cultural level($S_{18}$).

ISM team members determine the relationship between 18 influence factors by analyzing and discussing for many times and obtain the adjacency matrix A, which expresses the structural relations of different cost influence facts.

TABLE I ADJACENCY MATRIX A

| Factors | $S_1$ | $S_2$ | $S_3$ | $S_4$ | $S_5$ | $S_6$ | $S_7$ | $S_8$ | $S_9$ | $S_{10}$ | $S_{11}$ | $S_{12}$ | $S_{13}$ | $S_{14}$ | $S_{15}$ | $S_{16}$ | $S_{17}$ | $S_{18}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $S_1$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $S_2$ | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $S_3$ | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $S_4$ | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $S_5$ | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $S_6$ | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| $S_7$ | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| $S_8$ | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| $S_9$ | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| $S_{10}$ | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $S_{11}$ | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $S_{12}$ | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| $S_{13}$ | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| $S_{14}$ | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $S_{15}$ | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 |
| $S_{16}$ | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| $S_{17}$ | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| $S_{18}$ | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |

*2.2.Establish the Reachability Matrix*

Reachability matrix (with R expressing) is a matrix form to describe the level of directed connection graph between nodes, which can be reached after a certain length access. The calculation method: use Boolean algebra rules, and set $A_1 = A + I$. If $A_1 \neq A_2 \neq ... \neq A_{r-1} = A_r$, $r \neq n-1$ (n: order for the matrix), where $A_n = (A + I)^n$, $R = A_{r-1} = (A + I)^{r-1}$. In the adjacency matrix above, set $A_1 = A + I$, and use Boolean algebra rules to obtain $A_2$, $A_3$, $A_4$…, and eventually come to $A_1 \neq A_2 = A_3 = A_4$. Therefore, reachability matrix $R = A_2 = (A + I)^2 = (A + I)^3$.

*2.3.Divide the Reachability Matrix on Inter-stage and Establish the ISM*

First, according to the reachability matrix, set up
Reachable Set R(Si), First Set A(Si) and Common Set C(Si) of each factor. After identifying the most senior factors of level 1, delete the rows and columns of all the most senior factors of level 1 from the reachability matrix. Then find the most senior factors of level 2 from the rest of the reachability matrix; do it again until you find the most senior factors of each level. And then reorder the reachability matrix according to the results of level-division. As a result, the most senior facts set of each level can be obtained: $L1=\{S_1\}$, $L2=\{S_2,S_3,S_4,S_5\}$,$L3=\{S_{10},S_{11}\}$,$L4=\{S_{12},S_{13},S_{16}\}$,$L5=\{S_{14},S_{15},S_{17},S_{18}\}$,$L6=\{S_6\}$,$L7=\{S_7,S_8,S_9\}$. Than establish the ISM as shown below:

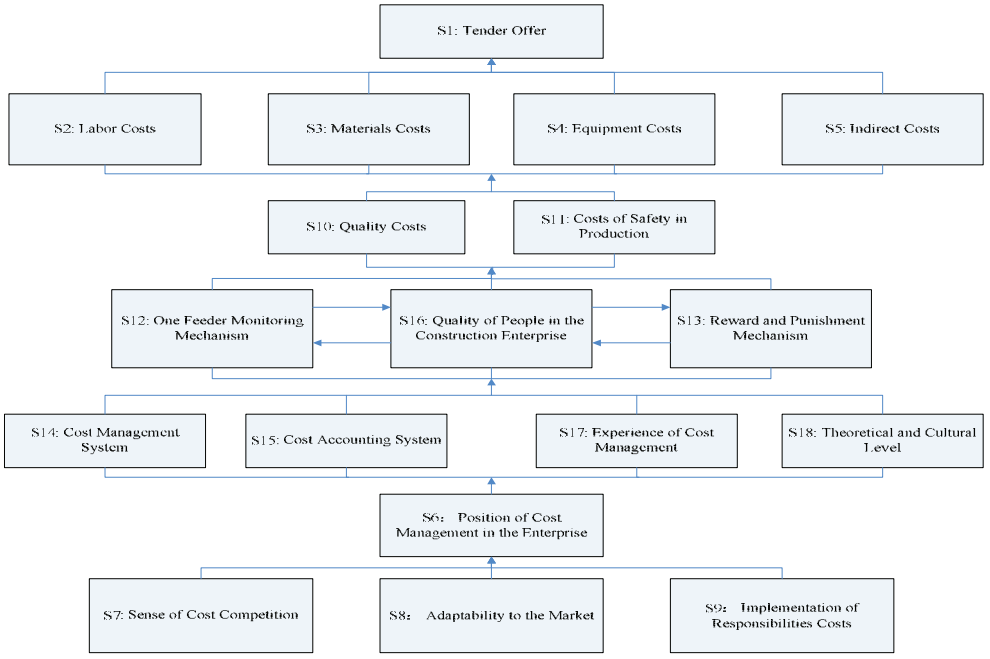


Figure1. Structural interpretation model

## 3.The analysis and conclusions of structural interpretation model(ISM)

By analysing the structural interpretation model we can see that, in the factors that influence the cost of wind power construction project, the sense of cost competition, adaptability to the market and the implementation of responsibilities costs are the key factors that affect the overall situation. At the same time, these three factors are the most difficult facts to be controlled in the cost control of wind power. The position of cost management in the enterprise are affected by the three factors above and also influence the cost management system, the cost accounting system, the experience of cost management and theoretical and cultural level. One feeder monitoring mechanism, reward and punishment mechanism, and the quality of people in the construction enterprise are in the middle layer of the model, and play connecting roles. Quality costs and costs of safety in production are affected by the three facts above and also directly influence on labor costs, material costs, equipment costs and indirect costs, thereby affecting the tender offer. Therefore, in the process of cost control of wind power construction project, these factors should be on the main regulation. According to their different positions in the model, they should be controlled at different levels. The main factors at the bottom of the model should be controlled with great efforts so that the problem of huge investment and serious waste in the wind power project can have a fundamental solution.

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