Research on Risk Prediction Model of Contract Terms Based on Big Data

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Abstract: With the rising power industry, the demand for power supplies in the market is gradually expanding, and many power supply companies have poured into the market. Therefore, so as to standardize corporate behavior and make the market procurement behavior more programmatic, a contract for the purchase of power supplies came into being. Meanwhile, the research on the risk prediction model of the material purchase contract terms based on the big data environment is mainly discussed in the paper, in which AHP and fair entropy algorithm are applied to analyze the benefit flow of each core participant, and establish a risk assessment model framework for management projects to realize visual analysis of risk prediction and big data evaluation with an effective risk management method. According to verification by examples, the research content in the paper provides a safety guarantee for the supply of power supplies.

1. Introduction

The procurement of the power industry is generally large-scale power supply machinery which is of high procurement costs and high quality requirements. Therefore, procurement management should be emphasized during procurement, and the utilization of procurement contracts is to better regulate procurement behavior. Moreover, procurement contract management model is implemented to restrict the transaction behavior of both parties and better reduce procurement risks. Meanwhile, the management in the form of contract system effectively avoids the delay of delivery by purchasing enterprise, which greatly improves the efficiency of the procurement work in power enterprises. Besides, the procurement contract is legally regulated and strictly managed in accordance with the law, which protects the legitimate interests of both buyers and sellers, and forms a upper and lower linkage and coordinated on-site material service and performance coordination mechanism to make the material management more scientific, standardized, and legalized[1-2], so that the procurement management of power companies can be strengthened to achieve the unity of economic and social benefits.

Considering the ambiguity and randomness of risk evaluation indicators, analytic hierarchy process is used in the paper to determine the weights of all levels of risk indicators in contract management. What’s more, normal big data are adopted to establish a contract management risk indicator evaluation model to evaluates the risk of a contract project through specific cases.

2. Theoretical Basis of Big Data

2.1 Related Theory on Big Data

Big data is a kind of the combination in randomness and ambiguity of objective events, which achieve the conversion of qualitative concepts to quantitative descriptions through a series of parameter
calculations and data fitting. It can be defined as follows. If $K$ is quantitative interval, and $C$ is random realization on the qualitative concept defined on $K$, the distribution of $x$ in the quantitative interval $K$ is called normal big data. Normal big data is one of the basic algorithms commonly used in big data, whose parameters are represented by three eigenvalues, that is $\bar{E}$ (expectation), $E_n$ (entropy), and $H_e$ (superentropy). An example of normal big data graph is shown in Figure 1[3].

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure.png}
\caption{Normal Big Data Diagram}
\end{figure}

The big data graph shown in Fig. 1 is composed of $n$ data nodes generated by big data generator. Forward big data generator represents the mapping from qualitative to quantitative, and its basic algorithm is as follows[4-5].

1. If $E_n$ is expectation, $H_e$ is standard deviation, normal random number $E_{n_j} = NORM \left(E_n, H_e^2\right)$ can be generated through Python software.

2. If $E_n$ is expectation, $E_{n_j}$ is the standard deviation, normal random number $x_i$ which is the data node can be generated.

3. If the certainty $\mu_i$ of $x_i$ is calculated, the data node coordinates $(x_i, \mu_i)$ will be obtained.

4. Repeat the above operation until $n$ data nodes are generated.

The reverse big data generator represents the conversion from quantitative to qualitative. By calculating $N$ given big data $x_j$, the digital characteristic values $(E_x, E_n, H_e)$ of big data are obtained. The basic algorithm is as follows.

1. Through the given big data $x_j$, the sample mean $\bar{X}$ can be obtained.

   \[ \bar{X} = \frac{1}{N} \sum_{j=1}^{N} x_j, E_x = \bar{X} \quad (1) \]

2. Through $x_j$ and expected value $E_n$, the entropy $E_n$ can be calculated.

   \[ E_n = \sqrt{\frac{\pi}{2} \frac{1}{N} \sum_{j=1}^{N} |x_j - \bar{X}|} \quad (2) \]

3. $H_e = U$. $U$ is a constant, which can be adjusted according to the stability of the variable itself.

3. Construction of Risk Evaluation Big Data

3.1 Establishment of Evaluation Index System and Evaluation Standard Big Data

As shown in Figure 2, according to the comprehensive analysis on the characteristics and status of the contract management model, referring to the results of the contract management project risk identification in [6], four primary risk assessments including project financing risk, market risk, project operation risk and contract management benefit risk Indicators, and 15 second-level risk
assessment indicators are selected in the paper to establish a contract management project risk assessment indicator system in the paper.

![Risk Evaluation Index System of Power Purchase Contract](image)

**Figure 2 Contract risk evaluation index system**

The expert scoring method is used to evaluate the risk indicators of contract management projects with a percentage system.

### 3.2 AHP Method to Determine Index Weight

The analytic hierarchy process is a multi-criteria decision-making method that converts the relative importance among indicators into quantitative expression. The basic steps for determining weights are as follows.

1. A pairwise comparison judgment matrix $A$ is constructed according to Table 1.

$$A = \left( a_{ij} \right) = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} \quad (3)$$

In formula (3), $n$ represents the number of indexes for pairwise comparison. $i$ and $j$ are natural numbers, which are smaller than $n$.

| Serial number | Importance level | Assignment |
|---------------|-----------------|------------|
| 1             | i, j 2 indicators are equally important | 1          |
| 2             | i is slightly more important than j | 3          |
| 3             | i is significantly more important than j | 5          |
| 4             | i is more important than j | 7          |
| 5             | i is extremely important than j | 9          |
| 6             | i is slightly less important than j | 1/3        |
(2) According to equation (4) ~ equation (6), the weights are calculated.

\[
M_i = \prod_{j=1}^{n} a_{ij} \quad (4)
\]
\[
\bar{W}_i = \sqrt[n]{M_i} \quad (5)
\]
\[
\sigma_i = \frac{\bar{W}_i}{\sum_{j=1}^{n} \bar{W}_j} \quad (6)
\]

4. Case Analysis
Taking the power contract project as an example and comparing the actual situation of the project, the mutual importance of the indicators can be compared. Moreover, through formulas (4) to (7), the weight of each index can be calculated, and through formulas (8) to (9), the consistency of the judgment matrix can be verified as well. Besides, taking operational risk as an example, the judgment matrix and weights are shown in Table 2, and the weights are kept to 3 decimal places [7-10].

| U₃ | U₃₁ | U₃₂ | U₃₃ | U₃₄ | U₃₅ | Weights |
|----|-----|-----|-----|-----|-----|---------|
| U₃₁ | 1   | 2   | 3   | 5   | 3   | 0.398   |
| U₃₂ | 1/2 | 1   | 4   | 5   | 3   | 0.322   |
| U₃₃ | 1/3 | 1/5 | 1   | 3   | 1/2 | 0.105   |
| U₃₄ | 1/5 | 1/4 | 1/3 | 1   | 1/5 | 0.050   |
| U₃₅ | 1/3 | 1/2 | 1/2 | 5   | 1   | 0.125   |

Its risk distribution is between intermediate and higher risks, which crosses intermediate risks above a certainty of 0.3 and crosses higher risks below a certainty of 0.2. Therefore, the risk is more biased to intermediate risks. In addition, among the first-level indicators, the risk of benefit risk is relatively high. Therefore, the design and optimization of power contract projects should be strictly controlled, and the technical innovation should be strengthened too. Meanwhile, more rigorous contracts should be signed with power customers to reduce customer payment risks through contract constraints.

5. Conclusion
A contract power management risk evaluation model is established in the paper through a big data model, and the risk indicators are determined as 4 first-level indicators which include project financing risk, power industry market risk, project operation risk and project benefit risk and 15 second-level indicators. Moreover, through analysis, the total risk of contract power management projects is between intermediate and higher risks, which is biased towards higher risks. Besides, by comparing the risks of various first-level indicators through big data, the conclusion benefit risk > financing risk > operational risk > market risk is obtained. In addition, compared with the secondary risk factor indicators of high-risk project benefit risks and project financing risks, the relevant countermeasures are proposed in the paper to reduce risks through big data.
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