The Tenth International Symposium on Operations Research and Its Applications (ISORA 2011)
Dunhuang, China, August 28–31, 2011

Fuzzy Comprehensive Evaluation of Social Responsibility of State Grid Corporation of China

Caiqing Zhang, Mengmeng Cao

School of Business Administration, North China Electric Power University
Baoding, China
daguduiyuan2006@126.com

Abstract According to the 12 indicators of social responsibility proposed by the <State Grid Corporation Social Responsibility Report 2009>, a fuzzy comprehensive evaluation model of social responsibility of State Grid Corporation of China is built on the basis of Delphi method, and an example is also put forward to demonstrate the feasibility of the model. This approach helps our government officials and the public understand whether the social responsibility of State Grid Corporation of China is carried out properly or not.

Keywords State Grid Corporation of China; Corporate Social Responsibility (CSR); Delphi method; fuzzy comprehensive evaluation

1. Introduction

<State Grid Corporation Social Responsibility Report 2010> is released on Feb.16th, 2011 in Beijing. As the first social responsibility report in China's twelfth five-year plan, this report shows that State Grid Corporation of China becomes the first corporation which releases annual social responsibility report for six consecutive years at present [1].Based on a real, objective, timely and fully reflection of responsibility practice, this report describes systematically the purposes of releasing social responsibility reports, the full logic of social responsibility practice as well as its close relationship with comprehensive value creations for the first time. And at the same time, for the first time it produces special reports to disclose the major social responsibility issues that most stakeholders concern.

CSR refers to the responsibility and obligations that enterprise should bear for their stakeholders while creating profits. At present, State Grid Corporation of China has become a model of CSR implementation, causing more and more scholars' concern. Wang Yongli introduced the background and content of the CSR strategy proposed by State Grid Corporation of China and summarized its inadequacies in the process of its implementation, while bringing up the correspondingrecommendations at the same time [2]. Zhu Limin analyzed the disclosure form and specific content of its CSR report based on <State Grid

Corporation Social Responsibility Report 2007> and compared its differences with traditional financial reports, proposing some recommendations on CSR report disclosure [3]. Li Weiyang gave a qualitative analysis on State Grid Corporation of China's comprehensive management of CSR [4]. However, there is hardly any quantitative analysis on State Grid Corporation of China's CSR made by scholars.

Therefore, a fuzzy comprehensive evaluation model of social responsibility of State Grid Corporation of China is built on the basis of the 12 indicators of social responsibility proposed by the <State Grid Corporation Social Responsibility Report 2009>.

2. A fuzzy comprehensive evaluation model of State Grid Corporation of China's CSR

Fuzzy comprehensive evaluation is a method of comprehensive evaluation to quantify factors that are ill-defined and difficult to quantify and evaluate the subjections of targets from various factors based on fuzzy mathematics and fuzzy compositional principles. Usually, there are factors set, evaluation set and the weight set in a fuzzy comprehensive evaluation model, and the mathematical model is divided into single-stage model and the multilevel model, this paper identifies the evaluation object as a second-order model.

2.1 Determining the evaluation factors set

Evaluation factor set consists of various factors that affect the evaluation object, and it is crucial to judge whether the fuzzy comprehensive evaluation model is scientific and rational, and it can be expressed as $U=\{u_1,u_2,\cdots,u_n\}$,among which $u_i(i=1,2,\cdots,n)$ stands for various factors. We need to design a set of accurate and illustrative evaluation factors set in order to evaluate the CSR of State Grid Corporation of China.

According to the 12 indicators of social responsibility proposed by the <State Grid Corporation Social Responsibility Report 2009>, this paper constructs thevaluation factors set of the CSR of State Grid Corporation of China, as is shown in table 1. This indicators set includes two layers: secondary indicators ofthe evaluation factors setis $U=(u_1,u_2)$;third indicators of the evaluation factors set is$U_i=(u_{i1},u_{i2},\cdots,u_{in})$, among which $U_1=(u_{11},u_{12},u_{13},u_{14},u_{15},u_{16})$, $U_2=(u_{21},u_{22},u_{23},u_{24},u_{25},u_{26})$.

2.2 Establishing the evaluation model reviews set

A review set is composed by the judgment results of evaluation objects, which can be expressed as $V=\{v_1,v_2,\cdots,v_n\}$, among which $v_i(i=1,2,\cdots,n)$ stands for several possible judgment results. This paper divides the judgment results of the factors affect the CSR of State Grid Corporation of China into four grades, namely,

$$V=\{v_1,v_2,v_3,v_4\}=\{very\quad good\quad fulfillment,\ good\quad fulfillment,ordinary\quad fulfillment,bad\quad fulfillment\}$$

TABLE1. The evaluation indicatorfactors set of the CSR of State Grid Corporation of China

First-grade indicators layer	*Secondary indicators layer*	*Third-grade indicators layer*	
CSR of State Grid Corporation of China	Shared responsibilities U_1	Responsibilities for scientific development	U_{11}
		Responsibilities for safe power supply	U_{12}
		Responsibilities for Excellent management	U_{13}
		Responsibilities for technological innovation	U_{14}
		Responsibilities for communication and cooperation	U_{15}
		Responsibilities for global vision	U_{16}
	Specific responsibilities U_2	Responsibilities for high-quality services	U_{21}
		Responsibilities for rural services	U_{22}
		Responsibilities for staff development	U_{23}
		Responsibilities for a win-win partnership	U_{24}
		Responsibilities for an enterprise citizen	U_{25}
		Responsibilities for environmental conservation	U_{26}

2.3 Determining the weights of evaluation indicators

There are many approaches to determine the weights of evaluation indicators, and Delphi method is used in this paper to determine the weight of each index. The weights of secondary indicators and third-grade indicators are scored by experts, i.e. organizing some experts to score them and filling the four grades corresponding to each index weights. Specific steps are as follows:

Weights of secondary indicators: $W = (w_1, w_2)$;

Weights of third-grade indicators: $W_1 = (w_{11}, w_{12}, w_{13}, w_{14}, w_{15}, w_{16})$,

$W_2 = (w_{21}, w_{22}, w_{23}, w_{24}, w_{25}, w_{26})$

Determine therespective weights of the four levels for each indicator by using Delphi method:

If there are n experts involved in the scoring, m experts consider the CSR of State Grid Corporation of China has reached the level of v_j for indicator i, then the evaluation possibility to this indicator of State Grid Corporation of China's CSR is $r_{ikj} = \frac{m_{ikj}}{n}, (j = 1,2,3,4)$.

The result above stands for the evaluation results of a single index, a row matrix of individual indicators can be achieved by analyzing the frequency statistical dataof this result, namely:

$$R_{ik} = (r_{ik1}, r_{ik2}, r_{ik3}, r_{ik4}) = \left(\frac{m_{ik1}}{n}, \frac{m_{ik2}}{n}, \frac{m_{ik3}}{n}, \frac{m_{ik4}}{n} \right)$$

After reorganizing the evaluation matrix we can see:

$$R_i = \begin{bmatrix} R_{i1} \\ R_{i2} \\ \cdots \\ R_{ik} \end{bmatrix} = \begin{bmatrix} r_{i11} & r_{i12} & r_{i13} & r_{i14} \\ r_{i21} & r_{i22} & r_{i23} & r_{i24} \\ \cdots & \cdots & \cdots & \cdots \\ r_{ik1} & r_{ik2} & r_{ik3} & r_{ik4} \end{bmatrix} (i = 1,2)$$

The subscript'k' stands for the number of indicators contained in the evaluation indicators set, and it amountsto 6 here in this paper; the subscript'i' stands for the number of indicators included in secondary indicators layer, and it amounts to 6 here in this paper; the subscript'j' stands for the number of evaluation levels, and it amounts to 4 here in this paper.

2.4 Establishing the fuzzy comprehensive evaluation model

The fuzzy comprehensive evaluation model of third-grade indicators layer is: $B_i = W_i \times R_i$

The fuzzy comprehensive evaluation model of secondary indicators layer is: $B = W \times R$

Operation results are as follows:

$$B_i = (b_{i1} \quad b_{i2} \quad b_{i3} \quad b_{i4}) =$$

$$(w_{i1} \quad w_{i2} \quad \cdots \quad w_{ik}) \begin{bmatrix} r_{i11} & r_{i12} & r_{i13} & r_{i14} \\ r_{i21} & r_{i22} & r_{i23} & r_{i24} \\ \cdots & \cdots & \cdots & \cdots \\ r_{ik1} & r_{ik2} & r_{ik3} & r_{ik4} \end{bmatrix}$$

Then we get a general evaluation matrix R:

$$R = \begin{bmatrix} B_1 \\ B_2 \end{bmatrix} = \begin{bmatrix} b_{11} & b_{12} & b_{13} & b_{14} \\ b_{21} & b_{22} & b_{23} & b_{24} \end{bmatrix}$$

Based on the weights of secondary indicators and the fuzzy comprehensive evaluation model of secondary indicators layer we can get:

$$B = (w_1 \quad w_2) \begin{bmatrix} b_{11} & b_{12} & b_{13} & b_{14} \\ b_{21} & b_{22} & b_{23} & b_{24} \end{bmatrix} = (b_1 \quad b_2 \quad b_3 \quad b_4)$$

In conclusion, $B = (b_1 \quad b_2 \quad b_3 \quad b_4)$ is our final evaluation result.In accordance with the maximum membership degree principle, the corresponding level of the biggest number of b_j is the standard level of State Grid Corporation of China's CSR.

3 An application

Based on the above fuzzy comprehensive evaluation model, CSR of State Grid Corporation of China is evaluated. Weights determined by Delphi method are as follows:

Weights of secondary indicators: $W = (0.6 \quad 0.4)$

Weights of third-grade indicators:

$W_1 = (0.15 \quad 0.15 \quad 0.25 \quad 0.25 \quad 0.10 \quad 0.10)$

$W_2 = (0.30 \quad 0.15 \quad 0.10 \quad 0.10 \quad 0.20 \quad 0.15)$

According to theweights and reviews collection of the evaluation indicators above, we can get the following fuzzy matrix by judging the various indicators of CSR of State Grid Corporation of China.

$$R_1 = \begin{bmatrix} 0.25 & 0.35 & 0.30 & 0.10 \\ 0.30 & 0.50 & 0.15 & 0.05 \\ 0.05 & 0.45 & 0.35 & 0.15 \\ 0.15 & 0.30 & 0.36 & 0.19 \\ 0.18 & 0.46 & 0.20 & 0.16 \\ 0.05 & 0.25 & 0.50 & 0.20 \end{bmatrix} \quad R_2 = \begin{bmatrix} 0.28 & 0.45 & 0.20 & 0.07 \\ 0.05 & 0.51 & 0.38 & 0.06 \\ 0.20 & 0.33 & 0.21 & 0.26 \\ 0.10 & 0.34 & 0.36 & 0.20 \\ 0.23 & 0.25 & 0.33 & 0.19 \\ 0.30 & 0.50 & 0.10 & 0.10 \end{bmatrix}$$

The overall evaluation results based on the above fuzzy comprehensive evaluation model are as follows:

$B = W \times R = (0.1783 \quad 0.393 \quad 0.291 \quad 0.1377)$

Evaluation results indicate: among this group of experts, 17.83% considering the fulfillment of CSR of State Grid Corporation of China is very good; 39.3% considering the fulfillment of CSR of State Grid Corporation of China is good; 29.1% considering the fulfillment of CSR of State Grid Corporation of China is ordinary; 13.77% considering the fulfillment of CSR of State Grid Corporation of China is bad. Based on the maximum membership degree principle, we can conclude that this group of experts consider that performance of CSR of State Grid Corporation of China is good.

4 Conclusion

A fuzzy comprehensive evaluation model of social responsibility of State Grid Corporation of China is built on the basis of the 12 indicators of social responsibility proposed by the <State Grid Corporation Social Responsibility Report 2009> and Delphi method. Besides, this paper also uses an instance to prove that this model is simple and convenient to evaluate the performance of CSR of State Grid Corporation of China. In a word, this model is of great practical value.

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