## Research Article
## Establishment of CSR Matter-Element Evaluation Model in Perspective of Low Carbon Economy in China

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**Abstract:** With the development of CSR concept, more and more enterprises begin to bring CSR into practice. Especially in the era of low-carbon economy develops quickly, CSR practice is going to mature. In order to make a scientific evaluation on CSR and promote the comprehensive development of CSR, this study develop a new CSR evaluation model under requires of low-carbon economy development. This CSR evaluation model combined G1 weighting method with the Matter-Element Model and finally verified by an example. What we do in this study will provide a good guidance for the development of CSR evaluation and practices.

**Keywords:** CSR, G1 weighting method, low carbon economy, matter-element model

### INTRODUCTION

Corporate Social Responsibility (CSR) is the responsibility and obligation for the state, the society, the individual and the environment that corporate should bear in the process of development. And the practice of CSR must be under the guidance of the economic rules and moral rules. Modern CSR ideological trend appeared in the early of 20th century in America; Maurice Clark first proposed the modern CSR concept in his book "The changing economic responsibility basis". After 1960s, the CSR got a rapid development (Hou, 2010).

In China, CSR begins to be focused on from the 1980s and a few of scholars have studied CSR evaluation in the 1990s. Now, there exist many CSR evaluation methods, including AHP, linear interpolation, fuzzy mathematic and cluster. Those methods mentioned above have been applied in CSR evaluation and achieved good results. However, with the rise of the low-carbon economy and the sustainable development deeply rooted in the peoples' hearts, the evaluation system and methods of CSR needs to be further improved. Therefore, this study will establish a CSR evaluation system based G1 weighting method and matter-element model from the perspective of rich and innovative CSR evaluation in low-carbon economy era.

### INDEX SYSTEMS FOR CSR EVALUATION

**The principles of index selection:** The establishment of evaluation system is the key to making assessment research. It is related to the accurance and rationality of evaluation results whether the index system is clear. According to the theory and the experience, selecting index must obey the following principles: independence, scientific, representative, comparability and feasibility (Du *et al*., 2008).

**Description of previous research on CSR index:** For the establishment of China's CSR evaluation index system, many Chinese scholars have mentioned in their previous research. In recent years, Liu *et al*. (2011) developed a 7-dimension indexes system on state-owned corporates' CSR by studying lots of state-owned corporate. He and Xun (2011) built an index system for electric corporate consists of electric supplying, economic laws, environment protecting and energy saving, social harmony. Song and Chunyan (2009) established a CSR evaluation index based on the stakeholder theory. Chen (2007) designed a 6-index evaluation system, including employees' rights, environment protecting and sustainable development, corporate integrity, consumer rights and community relationships, social welfare and charitable activities, social responsibility management. Futhur earlier, Ma and Yan (1995) believed that the selection of CSR index must take country, consumers, employees, energy, community and ecology in consideration.

Just like the descriotion above, different schlors have set different CSR index system in different perspectives and most of them don't meet the requirements of low-carbon economy development. In 2009, Chinese Academy of Social Sciences built an

index system for CSR evaluation and they improved it in 2010. The system reflects the trends of low-carbon economy and has become the most authoritative one recently. For this reason, it is also the main reference in this research.

**Establishment of CSR evaluation index system:** Through the analysis of previous studies and consider the practical needs of the development of low-carbon economy, we decide to use the evaluation index system of the established by Chinese Academy of Social Sciences in this research. This index system consists of 4 first level indicators, including responsibility management, market liability, social responsibility and environment responsibility. Under the 4 indicators, there are 14 secondary indicators and the system is shown in Fig. 1. The index system shown above with reference to international CSR initiatives and index system, China CSR initiatives, the ISO 26000 international standards of CSR as well as the current situation of low-carbon economy development, is the main basis for the publishing of CSR Blue Book of China. Therefore, using the system to evaluate the CSR practice level in China not only conforms to the main trend, also meets the needs of low-carbon economy development.

**Establishment of CSR evaluation model index weights calculation:** Before calculate the index weights; we make an analysis on different weighting methods. On this basis, this study uses G1 weighting method to calculate the index weights. Suppose that the index set is $C = (c_1, c_2, \cdots, c_n)$ and the process of weighting is shown as follows:

- Organizing some experts in the field of CSR evaluation to order the indicators according to their importance and create a new indicator set. Shown as $U = (u_1, u_2, \ldots, u_n)$ in this set, $u_{k-1} \succ u_k$, $k = 2, 3, \ldots, n$
- Determining the ratio of adjacent indicators according to the importance. Shown as:

$$r_k = \frac{u_{k-1}}{u_k} (k = 2, 3, \cdots, n) \tag{1}$$

In this process, we use 1.0-1.8 scale method to obtain the results of the adjacent indicators' ratio. The specific meaning of each number is shown in Table 1.

- Calculating the weight of the last indicator by using the following formula:

$$W_n = \left(1 + \sum_{k=2}^{n} \prod_{i=k}^{n} r_i\right)^{-1} \tag{2}$$

Table 1: The meaning of the importance ratio

| Ratio | Meaning |
|---|---|
| 1.0 | The adjacent indicators is equally important |
| 1.2 | The former to the latter is slightly important |
| 1.4 | The former to the latter is obviously important |
| 1.6 | The former to the latter is strongly important |
| 1.8 | The former to the latter is extremely important |
| 1.1, 1.3, 1.5, 1.7 | The importance between similar score |

- Calculating the weights of other indicators by using the formula (3):

$$\left. \begin{array}{c} w_{n-1} = r_n w_n \\ \vdots \\ w_{k-1} = r_k w_k \\ \vdots \\ w_2 = r_3 w_3 \\ w_1 = r_2 w_2 \end{array} \right\} \tag{3}$$

After this step, we will get all indicators' weight value.

- On the basis of above, reverting the indicators to the original order and get the weights set in right order, $w = (w_1, w_2, \ldots, w_n)$.

By using G1 weighting method, we carried out a survey on 20 experts in CSR field and calculated the indicators' weight according to the survey results. Finally, we got the weights of CSR index by formula (1-3) as follows:

$$W = (0.05, 0.05, 0.05, 0.05, 0.10, 0.08, 0.08, 0.06, 0.08, 0.09, 0.06, 0.05, 0.10, 0.10)$$

**The Choice of evaluation method:** In order to enhance the objectivity and the accuracy of the evaluation results, we choose extension and matter-element model to evaluate besides G1 weighting method. Extension and matter-element theory is a new one proposed by a Chinese scholar named Cai Wen in 1983. It studies the possibilities to expand of things and the rules for innovation in a formalized form. The theory not only can be used to evaluate the state of an object, but also can define the boundary between a state and next state in a quantitative characterization (Li, 2002). Suppose that a corporate has n CSR indexes, which shown as characters $c_1, c_2, \ldots, c_n$. And we divide the CSR into m grades. And the process of extension and matter-element model is shown as follows:

- Bulid the typical CSR matter-element, which is indicated as $R$:

$$R = R(N, C, V) = \begin{bmatrix} N & N_1 & N_2 & \cdots & N_m \\ c_1 & v_{11} & v_{12} & \cdots & v_{1m} \\ c_2 & v_{21} & v_{22} & \cdots & v_{2m} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ c_n & v_{n1} & v_{n2} & \cdots & v_{nm} \end{bmatrix}$$

$$= \begin{bmatrix} N & N_1 & N_2 & \cdots & N_m \\ c_1 & [a_{11},b_{11}] & [a_{12},b_{12}] & \cdots & [a_{1m},b_{1m}] \\ c_2 & [a_{21},b_{21}] & [a_{22},b_{22}] & \cdots & [a_{2m},b_{2m}] \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ c_n & [a_{n1},b_{n1}] & [a_{n2},b_{n2}] & \cdots & [a_{nm},b_{nm}] \end{bmatrix} \quad (4)$$

In the formula (4), $N_j$ $(j = 1, 2,\ldots, m)$ indicates that the CSR level belongs to the $j$ th level.

$$v_{ij} = [a_{ij},b_{ij}](i=1,2,\cdots,n; j=1,2,\cdots,m)$$

Shows the value range of character $c_i$ under jth level.

- Build the section domain matter-element, which is shown as $R'$:

$$R' = (N,C,V') = \begin{bmatrix} N & c_1 & v'_{1k} \\ & c_2 & v'_{2k} \\ & \vdots & \vdots \\ & c_n & v'_{nk} \end{bmatrix} \begin{bmatrix} N & c_1 & [a_{1k},b_{1k}] \\ & c_2 & [a_{2k},b_{2k}] \\ & \vdots & \vdots \\ & c_n & [a_{nk},b_{nk}] \end{bmatrix} \quad (5)$$

In the formula (5), $N$ represents the whole level, $v'_{ik} = [a_{ik},b_{ik}](i=1,2,\cdots,n;k=1,2,\cdots,m)$ represents the permissible range of values that each CSR character $c_i$ will be given.

- Determine the matter-element that to be evaluated in accordance with the analysis data and the statistical results. t is shown as $\bar{R}$:

$$\bar{R} = (P,C,\bar{V}) = \begin{bmatrix} P & c_1 & \bar{v}_1 \\ & c_2 & \bar{v}_2 \\ & \vdots & \vdots \\ & c_n & \bar{v}_n \end{bmatrix} \quad (6)$$

In the formula (3), $P$ represents the corporates to be evaluated. $\bar{v}_i(i=1,2,\cdots,n)$ represents the value of the $i$ th evaluation index $c_i$.

- Calculate the correlation function $K_j$ $(\bar{v}_i)$, which represents the degree that evaluation index $c_i$ belongs to the $j$th level. The formula for calculating $K_j$ $(\bar{v}_i)$ is shown as follows:

$$K_j(\bar{v}_i) = \begin{cases} \dfrac{\rho(\bar{v}_i,v_{ij})}{\rho(\bar{v}_i,v'_{ik})-\rho(\bar{v}_i,v_{ij})}, & \bar{v}_i \notin v_{ij} \\ -\dfrac{\rho(\bar{v}_i,v_{ij})}{|v_{ij}|}, & \bar{v}_i \in v_{ij} \end{cases} \quad (7)$$

In the formula (7), $\rho(\bar{v}_i,v_{ij})$ represents the distance between the point $\bar{v}_i$ and the interval $v_{ij} = [a_{ij},b_{ij}]$. $\rho(\bar{v}_i,v'_{ik})$ represents the distance between the point $\bar{v}_i$ and the interval $v'_{ik} = [a_{ik},b_{ik}]$. $|v_{ij}|$ represents the length of the interval $[a_{ij},b_{ij}]$, which is $|b_{ij} - a_{ij}|$. The formula to calculate $\rho(\bar{v}_i,v_{ij})$ and $\rho(\bar{v}_i,v'_{ik})$ are shown as formula (8) and formula (9), no matter $\bar{v}_i \in v_{ij}$ or $\bar{v}_i \nexists v_{ij}$ $\bar{v}_i \notin v_{ij}$:

$$\rho(\bar{v}_i,v_{ij}) = \left|\bar{v}_i - \frac{1}{2}(a_{ij}+b_{ij})\right| - \frac{1}{2}(b_{ij}-a_{ij}) \quad (8)$$

$$\rho(\bar{v}_i,v'_{ik}) = \left|\bar{v}_i - \frac{1}{2}(a_{ik}+b_{ik})\right| - \frac{1}{2}(b_{ik}-a_{ik}) \quad (9)$$

- According to the weights of each evaluation indicators, we can get the comprehensive correlation $k_j$ $(P)$, which is shown as formula (10):

$$K_j(P) = \sum_{i=1}^{n} W_i K_j(\bar{v}_i) \quad (10)$$

If $k_j = \max k_j$ (P) $(j = 1, 2 ,.., m)$, it means that the evaluation unit $P$ belongs to the level $j$. It means that the CSR level is $j$.

Table 2: Dividing standard of CSR rank

| Indicators | Bystander | Starter | Runner | Leader | Excellenter |
|---|---|---|---|---|---|
| Responsibility governance $c_1$ | (0, 20) | (20, 40) | (40, 60) | (60, 80) | (80, 100) |
| Responsibility promoting $c_2$ | (0, 20) | (20, 40) | (40, 60) | (60, 80) | (80, 100) |
| Responsibility communication $c_3$ | (0, 200 | (20, 40) | (40, 60) | (60, 80) | (80, 100) |
| Law-abiding $c_4$ | (0, 20) | (20, 400) | 940, 60) | (60, 80) | (80, 100) |
| Responsibility to clients $c_5$ | (0, 20) | (20, 40) | (40, 60) | (60, 80) | (80, 100) |
| Responsibility to partners $c_6$ | (0, 20) | (20, 40) | (40, 60) | (60, 80) | (80, 100) |
| Responsibility to shareholders $c_7$ | (0, 20) | (20, 40) | (40, 60) | (60, 80) | (80, 100) |
| Responsibility to government $c_8$ | (0, 20) | (20, 40) | (40, 60) | (60, 80) | (80, 100) |
| Responsibility to employees $c_9$ | (0, 20) | (20, 40) | (40, 60) | (60, 80) | (80, 100) |
| Produce safety $c_{10}$ | (0, 20) | (20, 40) | (40, 60)) | (960, 80) | (80, 100) |
| Responsibility to community $c_{11}$ | (0, 20) | (20, 40) | (40, 60) | (60, 80) | (80, 100) |
| Environment management $c_{12}$ | (0, 20) | (20, 40) | (40, 60) | (60, 80) | (80, 100) |
| Saving energy and sources $c_{13}$ | (0, 20) | (20, 40) | (40, 60) | (60, 80) | (80, 100) |
| Pollution reduction $c_{14}$ | (0, 20) | (20, 40) | (40, 60) | (60, 80) | (80, 100) |

Table 3: CSR correlation function value of GK group

| Indicators | Bystander | Starter | Runner | Leader | Excellenter |
|---|---|---|---|---|---|
| Responsibility governance $c_1$ | -0.47 | -0.29 | 0.12 | -0.06 | -0.35 |
| Responsibility promoting $c_2$ | -0.51 | -0.34 | -0.01 | 0.02 | -0.33 |
| Responsibility communication $c_3$ | -0.55 | -0.41 | -0.11 | 0.22 | -0.31 |
| Law-abiding $c_4$ | -0.75 | -0.66 | -0.49 | 0.02 | -0.02 |
| Responsibility to clients $c_5$ | -0.48 | -0.30 | 0.09 | -0.04 | -0.34 |
| Responsibility to partners $c_6$ | -0.38 | -0.17 | 0.50 | -0.17 | -0.37 |
| Responsibility to shareholders $c_7$ | -0.37 | -0.16 | 0.49 | -0.17 | -0.38 |
| Responsibility to government $c_8$ | -0.38 | -0.18 | 0.47 | -0.16 | -0.37 |
| Responsibility to employees $c_9$ | -0.43 | -0.24 | 0.29 | -0.11 | -0.36 |
| Produce safety $c_{10}$ | -0.49 | -0.32 | 0.05 | -0.02 | -0.34 |
| Responsibility to community $c_{11}$ | -0.30 | -0.06 | 0.19 | -0.23 | -0.39 |
| Environment management $c_{12}$ | -0.64 | -0.51 | -0.27 | 0.46 | -0.24 |
| Saving energy and sources $c_{13}$ | -0.66 | -0.55 | -0.33 | 0.35 | -0.20 |
| Pollution reduction $c_{14}$ | -0.64 | -0.52 | -0.28 | 0.44 | -0.23 |
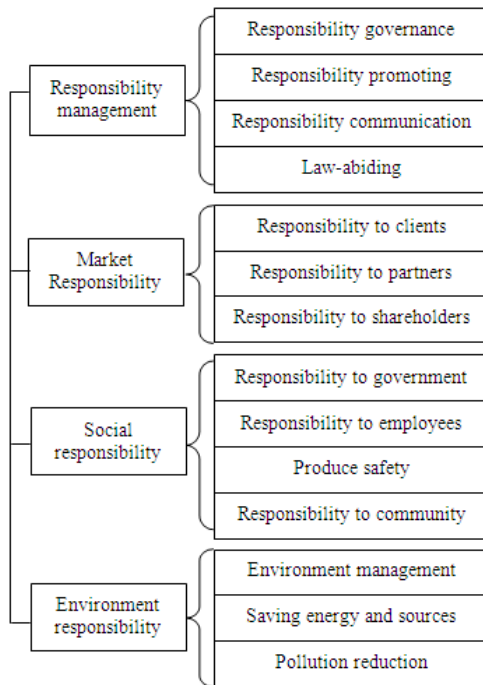


Fig. 1: Index system for CSR evaluation

**The determination of evaluation rank:** In order to determining the evaluation rank more scientific, we reference to some documents like the "CSR Blue Book" and "China CSR Rating Report (2010)" published by Chinese Academy of Social Sciences. And we make a consultation with many CSR experts as well. On this basis, we divide the CSR into 5 levels: bystander, starter, runner, leader and excellenter. The value range of each index is shown in Table 2.

## CASE STUDY

CSR level measures the fulfillment of responsibilities and obligations that to enterprise stakeholders in the process of achieving profit. The establishment of effective CSR evaluation model is benefit to judge CSR practice more scientific and also can clear the direction for CSR development in low-carbon economy era. On the basis of built the CSR evaluation model, we make a case study with GK group in this study to explain the application effect of this model.

According to the dividing standard of CSR and the statistical data from the website of CSR development index, we build the section domain matter-element R` and the evaluating matter-element $\bar{R}$ by using extension and matter-element model:

$$R' = \begin{bmatrix} N & c_1 & [0,100] \\ & c_2 & [0,100] \\ & \vdots & \vdots \\ & c_{13} & [0,100] \\ & c_{14} & [0,100] \end{bmatrix}$$

$$\bar{R} = \begin{bmatrix} P & c_1 & 57.54 \\ & c_2 & 60.47 \\ & c_3 & 64.30 \\ & c_4 & 79.69 \\ & c_5 & 58.13 \\ & c_6 & 50.06 \\ & c_7 & 49.80 \\ & c_8 & 50.67 \\ & c_9 & 54.24 \\ & c_{10} & 59,03 \\ & c_{11} & 43.70 \\ & c_{12} & 70.82 \\ & c_{13} & 73.09 \\ & c_{14} & 71.23 \end{bmatrix}$$

Then, we calculate the correlation funtion $K_j(\bar{v}_i)$ and the comprehensive correlation $K_j(P)$ for GK group by using the formula (7-10), which is shown in Table 3 and 4.

According to the result shown in Table 4, $K_j = \max K_j(P) = K_3(P)$, it means that the level of GK group CSR practice is at the 3th rank, named runner, the

Table 4: CSR comprehensive correlation of GK group

| Rank | Comprehensive correlation |
|---|---|
| Bystander | -0.50 |
| Starter | -0.34 |
| Runner | 0.06 |
| Leader | 0.05 |
| Excellenter | -0.31 |

middle level. In low-carbon economy era, the CSR practice of GK group is not enough and its CSR practice must to be strengthened in the future.

## CONCLUSION

CSR is the responsibility for market, society, environment and ecology in corporate' development and it has become an important part among corporate' strategy. In this study, we build a CSR evaluation model based G1 weighting method and extension and matter-element model and make an empirical analysis on GK group by using the evaluation model. Finally, we get the conclusion that the practice level of GK group is "runner". Through case study, it approves that the CSR evaluation model established in this study is applicable and effective.

It is a useful attempt that builds the CSR evaluation model by using G1 weighting method and extension and matter-element model. It will promote the CSR practice extensively in more China's corporate and international corporate.

## ACKNOWLEDGMENT

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