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A Dynamic Model for Corporate Social Responsibility: A Case Study of Chinese Major Coal Producers

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Abstract: Just like sustainability, Corporate Social Responsibility (CSR) has been one of the long range focuses of global concerns. CSR as a path to sustainable development has been well recognized all over the world. With an aim at building capacity to cope with the lack of cognitive level of CSR, through an aggregate methodology of comparison, speculation and a dynamic model of fuzzy Analytic Hierarchy Process (AHP), this study discusses the state-of-the-art CSR in China and builds a fuzzy AHP model for CSR assessment as applied in the minerals industry. The case of Shenhua Group and other three central government owned corporations (COCs) as the major coal producers in China was studied. It is concluded that the responsiveness to CSR are time dependent and corporate behavior with CSR issues changes as economy and society evolve. The dynamic performances of four Chinese central government owned coal corporations recent years on the whole show a continual improvement on the CSR levels and the CSR responses or performance stage of these corporations are behaving from the compliance stage to the strategic stage but far from the civil stage. Corporations are encouraged to be adaptive in taking social responsibilities commensurate to their differentiated capacities and levels.

Key words: CSR, dynamics, fuzzy AHP, assessment

INTRODUCTION

Social responsibility has existed over a very long time (Sheldon, 2003). CSR as a subject of ethics and ideology has attracted much academic attention in recent years as the world's economic globalization evolves and the values of sustainable development are widely accepted. Studies such as social interest theory (Schochet, 1979), stakeholder theory (Freeman, 2010), corporate citizenship (Matten and Crane, 2005) and business ethics (De George, 2006) are all related with the issues of social responsibility. Particularly, Carroll has presented a four-layer pyramid (Carroll, 1991) for Corporate Social Responsibility (CSR), including the major categories of economic, legal, ethical and philanthropic responsibilities.

Publicly, CSR as a path or approach to sustainable development is recognized all over the world. The United Nations Conference on Sustainable Development (UNCSD or Rio+20) which took place in Rio de Janeiro, Brazil in June 2012, is a major step forward in achieving a sustainable future. The outcome document of "The Future We Want" (United Nations, 2012) adopted at Rio+20 also supports national regulatory and policy frameworks that enable business and industry to advance sustainable development initiatives taking into account the importance of CSR and calls on the private sector to engage in responsible business practices, such as those promoted by the UN Global Compact.

Privately, the International Council on Mining and Metals (ICMM) catalyzes environmental and social performance improvement in the mining and metals industry. It brings together 22 mining and metals companies, including mineral giants such as BHP Billiton, Newmont, Rio Tinto, Vale and 35 associations, including Euromines, World Coal Association, Eurometaux, National Mining Association (NMA)-USA, World Gold Council, etc., to address the core sustainable development and CSR challenges, such as accountability, transparency, effects of carbon pricing schemes on competitiveness of the industry, climate change revenue recycling schemes and climate change-related adaptation strategies for the industry.

Civically, a key milestone is laid by the standard of social responsibility guidance (ISO 26000). This standard (ISO, 2010) indicates a worldwide consensus on the CSR issue and its solution among various stakeholders and

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further extends both the concept and the implementation of social responsibility. Based upon international consensus among expert representatives of the main stakeholder groups worldwide, the standard provides a harmonized, international guidance on social responsibility and is intended for use by organizations of all types, in both public and private sectors, in developed and developing countries, as well as in economies in transition.

Academically, the International CSR Conference at the Humboldt-Universitat zu Berlin series, as a platform for multi-stakeholder dialogues since 2004 has been exploring the themes of CSR and sustainability in all their various dimensions, such as new forms of multi-stakeholder governance and the legitimacy and effectiveness of global CSR standards, CSR networks and co-operations, responsible supply chain management, sustainable energies, climate change and carbon footprint strategies, CSR measurement and management models.

To follow such a world-wide movement of social responsibility and character the dynamics of CSR in China, this study discusses the variability of CSR that exists in CSR perception, understanding, consciousness, responsiveness and behavior as related with stages and levels of economic and social development and demands of stakeholders.

Various sustainability indicators have been investigated to address sustainable problems in the mineral industries. For example, Azapagic (2004) gives a framework for sustainability indicators of mining and minerals sector and it comprises economic, environmental, social and integrated indicators and reflects the characteristics of the industry. Worrall *et al.* (2009) develop a sustainability criteria and indicators framework to suit the particular needs of legacy mine land and it consists of 14 criteria and 72 indicators, concerning with the environmental, socio-political and economic aspects of legacy mines. Li *et al.* (2012) outline a hierarchical indicator system for providing tools to assess the sustainability of mining communities and discuss the prevailing issues of mining community sustainability. A set of criteria for sustainability, ethics and human capital is proposed (Vintro and Comajuncosa, 2010) and an easy-to-use CSR performance chart including 31 indicators and a global index is offered as an internal measure of CSR improvements for mining companies. Zhu *et al.* (2007) present an indicator based spatial decision support system and provide a platform for formulating indicators describing biophysical, socio-cultural and economic processes during the entire revegetation period in areas affected by mining activities. Approaches are also reported for addressing the problems and issues such as stakeholder's roles (Carroll and Buchholtz, 2003; Mutti *et al.*, 2012), social and environmental disclosures (Jenkins and Yakovleva, 2006), mine auditing (Kemp *et al.*, 2011), social responsibility and organizational performance (De Waal and Escalante, 2011) and experiences from developing countries (Hilson, 2012).

The analysis of hierarchy of CSR and related indicators are based on a comprehensive literature review which include compacts and standards, evaluation indexes, CSR guidelines in China and research articles. The data sources for CSR assessment in this article according to official site and CSR report of corporations. Table 1 shows the index source for hierarchical framework of CSR and the data sources for CSR assessment.

The current study presents a dynamic model for CSR assessment as applied in the minerals industry. The Chinese central government owned corporation of Shenhua Group and other three COCs as the major and typical coal producers in China were taken as a case for application.

CSR STATE OF THE ART IN CHINA

In view of the CSR development in the United States and Europe and combined with Simon Zadek's organizational learning models, a framework for charactering the dynamics of CSR with economic and social development in China has been built, including patterns of CSR issues as the latent, emerging, consolidating and institutionalized stages and modes of CSR responses as the defensive, compliance, managerial, strategic and civil stages (Zadek, 2004) with corporate CSR behaviors and motives as shown in Fig. 1.

Table 1: Literature reference for CSR indicators and data sources for CSR assessment

Index source for hierarchical framework of CSR				Data sources for CSR assessment	
Compacts and standards	Evaluation indexes	CSR guidelines in China	Research articles	Official site	CSR report
Global reporting initiative	Dow jones	GSRI-CHINA 2.0	Clarkson (1995)	Shanghai stock exchange	Corporate social
UN global compact	sustainability index	CASS-CSR3.0	Matten and Moon (2008)	Shenzhen stock exchange	responsibility reports
ISO 14001	FTSE4Good	Guidelines to COCs	Castka and Balzarova (2008)	Wind information	Corporate annual
ISO 9001	FTSE KLD 400	on fulfilling CSR	Lindgreen and Swaen (2010)	CSMAR solution	reports
OHSAS18001	Ethibel sustainability	CSR guidelines on	Dong *et al.* (2014)	CHINDEX	Sustainable
AA1000	index	SMEs	Mutti *et al.* (2012)	Official website of	development
SA8000	Environmental	China CSR recommended	Li (2007)	corporations	reports
ISO 26000	performance index	standard and best practice	Buxton (2012)		

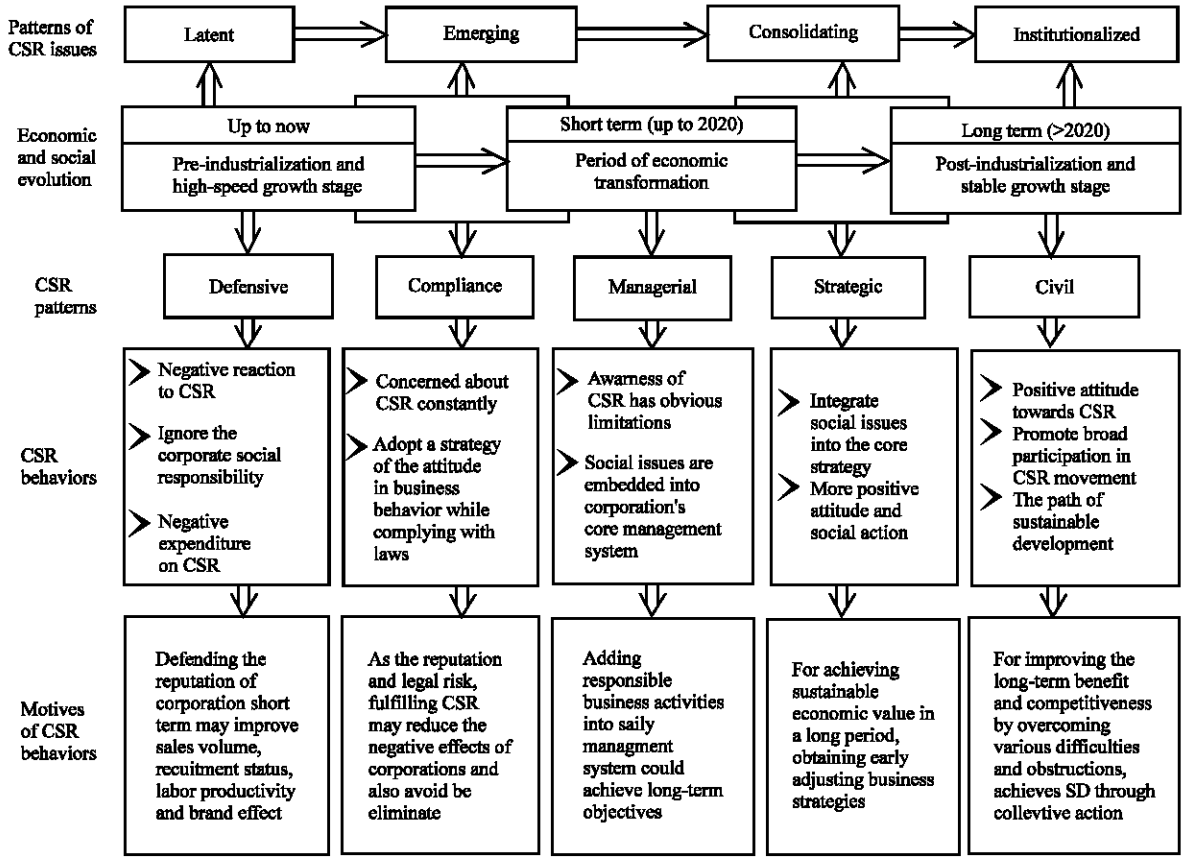

Fig. 1: Dynamics of CSR in China as economy and society evolve

The scope and extent of CSR reflect the public perception and expectations under the social, economic, political, legal, technological, cultural and religious conditions in a specific period with a level of development. In terms of temporal dynamics, the CSR issues as social problems usually evolve through the latent, emerging, consolidating and institutionalized stages and the CSR responses and performances of corporations behave through the defensive, compliance, managerial, strategic and civil stages. This dynamic model of CSR can be more specified with various indicators and methods as applied to assess CSR at different stages of social and economic development with particular conditions.

HIERARCHICAL FRAMEWORK OF CSR INDICATORS

An indicator is a quantitative or qualitative measure derived from a series of observed facts, which can reveal relative positioning in a given area and, when measured over time, could predict the direction of change. The framework was based on the AHP methodology with three layers of indicators, i.e., individual, thematic and composite indicators.

- **Individual indicators:** The individual indicators at the lowest layer on the right in the left-to-right hierarchy were norms for CSR and they are of the utmost concern to corporations. Such individual indicators were selected by consultation with specialists and various stakeholders or derived from relevant statistics to reflect various CSR aspects of corporations
- **Thematic indicators:** Those individual indicators were grouped around the stakeholder theme and the responsibility theme, respectively, at the middle layer in the hierarchy, with the stakeholder theme including stockholder, employee, environment, government, customer, community and business partner stakeholders and the responsibility theme containing economic, legal, ethical and philanthropic responsibilities. Those two groups of thematic indicators were presented separately to reflect the

Table 2: Hierarchy framework of CSR indicators

Thematic indicators	Individual indicators
Composite indicator: Overall CSR stage and behavior (A)	
Stockholders (B_{11})	Rate of return on common stockholders' equity (C_1)
	Respecting for shareholders' rights (C_2)
	Guiding socially responsible investment (C_3)
	Main business's increasing rate of income (C_4)
	Dividend per share (C_5)
Employees (B_{12})	Measures of reducing the risk of safety and health (C_6)
	Career development plan and implementation (C_7)
	Paying wages on time and in full (C_8)
	No child labor, no discrimination etc. (C_9)
	Signature rate of the contract (C_{10})
	Continual improvement of work environment (C_{11})
	Institutionalization of employment training (C_{12})
	Incidence of occupational disease (C_{13})
Government (B_{13})	Employment contribution rate (C_{14})
	Carrying out state industrial policies (C_{15})
	Social contribution rate (C_{16})
	Responding to the call on charitable activities (C_{17})
	Relationship with local government officials (C_{18})
Customers (B_{14})	Providing continuous supply of minerals (C_{19})
	Guiding consumers for sustainable consumption (C_{20})
	Product accident emergency response mechanism (C_{21})
	Easy language to the contract (C_{22})
	Maintaining proper documentation of consumers (C_{23})
Communities (B_{15})	Obtaining community resources legally (C_{24})
	Rate of public welfare donation (C_{25})
	Local employment rate (C_{26})
	Local procurement ratio (C_{27})
Business partners (B_{16})	Promoting anti-corruption by business partners (C_{28})
	Abiding by the credit agreement (C_{29})
	Rationality of the price and periodical payment (C_{30})
	Promoting responsible procurement system (C_{31})
Environment (B_{17})	Environmental cost rate (C_{32}),
	Processing ratio of three wastes (C_{33})
	Setting up budget of environment assessment (C_{34})
	Environmental accident emergency plan (C_{35})
Economic responsibilities (B_{21})	C_1, C_4, C_5, C_8, C_{19}, C_{27}, C_{30}, C_{32}, C_{34}
Legal responsibilities (B_{22})	C_2, C_9, C_{10}, C_{15}, C_{21}, C_{22}, C_{24}, C_{29}, C_{35}
Ethical responsibilities (B_{23})	C_7, C_{12}, C_{14}, C_{18}, C_{23}, C_{26}, C_{28}, C_{31}, C_{33}
Philanthropic responsibilities (B_{24})	C_3, C_6, C_{11}, C_{13}, C_{16}, C_{17}, C_{20}, C_{25}

CSR levels for each stakeholder and each responsibility category and integrated into one composite indicator (index) at the highest layer to reflect the overall CSR level of corporations

- **Composite indicators:** The composite index was used to indicate the overall CSR level of corporations. It could also be a valuable tool for analyzing the gradual change in the CSR level of corporations over time or the comparative advantage of one corporation over others in the CSR level of various corporations

With the reference for CSR related indicators in Table 1, a hierarchical framework of indicators was used for assessing the CSR level of corporations as shown in Table 2.

METHODS AND CASE STUDY OF CHINESE MINING CORPORATIONS

Dynamic model for CSR: This study used analytic hierarchy process and extended this with fuzzy logic to have a precise result. AHP is a structured technique for organizing and analyzing complex decisions. Based on mathematics and psychology, it was developed by Thomas L. Saaty in 1971, widely used for multicriteria decision-making and has successfully been applied to many practical decision-making problems (Saaty, 1988).

The CSR stages and behaviors of mining corporations was classified into the five levels of civil, strategic, managerial, compliance and defensive according to CSR responses in Fig. 1. Fuzzy set theory was used for the assessment of the CSR membership levels. Two groups of thematic indictors, namely, the stakeholder group and the responsibility group were devised to calculate the overall composite index.

Let L be vector of membership degree for the overall composite index or the stakeholder thematic indicators and responsibility thematic indicators, W be vector of weights for thematic indicators or individual indicators and U be matrix of membership degrees for thematic indicators or individual indicators.

Then, the CSR stage and behavior can be assessed by the fuzzy AHP model as follows:

$$\begin{cases} L_{ij} = \{l_{ijk}\} = W_{ij} \cdot U_{ijk} \\ W_{ij} = \{w_{ij}\} \\ U_{ijk} = \{u_{ijk}\} \\ 0 \le l_{ijk} \le 1,\ j = 0 \text{ to } 7 \text{ for } i = 1,\ j = 0 \text{ to } 4 \text{ for } i = 2, \text{ and } k = 1 \text{ to } 5 \end{cases} \quad (1)$$

Pair-wise comparison of indicators: According to the AHP methodology, preferences for indicators should be compared in pairs to judge which of each pair has a greater amount of impacts on CSR. Such pair-wise comparison matrices were obtained by a participatory process of consultation in which a group of mining experts and stakeholders, including local governmental officers, various social and environmental NGO members, concerned community citizens and prominent business people, were selected to answer a questionnaire of indicator comparisons.

For the overall composite index of CSR level for mining corporations, the matrix ($\{a_{ij}\}$) of pair-wise comparisons between the responsibility group of thematic indicators that is, economic, legal, ethical and philanthropic responsibility is shown in Table 3 as processed by the Saaty scale (Saaty, 2008), where element $a_{ii} = 1$, $a_{ij} = 1/a_{ji}$ and $0 < a_{ij} \neq \infty 8$ for all i, j = 1, 2, 3, 4.

For each of the responsibility thematic indicators and for the stakeholder group of thematic indicators with each of stakeholder thematic indicator, a similar matrix of pair-wise comparisons between the corresponding indicators could be constructed but were omitted here for conciseness.

Weighting of indicators: For the overall composite index of CSR level, the weights of the stakeholder thematic indicators have been calculated and normalized as:

$$W_{10} = (w_{101}, w_{102}, w_{103}, w_{104}, w_{105}, w_{106}, w_{107}) = (0.22, 0.21, 0.12, 0.09, 0.08, 0.09, 0.18)$$

And the weights of the responsibility thematic indicators have been calculated and normalized as:

$$W_{20} = (w_{201}, w_{202}, w_{203}, w_{204}) = (0.47, 0.28, 0.16, 0.10)$$

The consistency of matrix is measured by the Consistency Ratio (CR) as shown in Table 4.

The results show that the requirement for the consistency of weights is satisfied.

For the stakeholder thematic, the weights for the individual indicators are calculated and normalized as shown in Table 5.

The consistency of matrix is measured by the consistency ratio as shown in Table 6.

The results show that judgement matrix set with expert consistency and the weights based on judgement matrix is reasonable.

For the responsibility thematic indicators including economic, legal, ethical and philanthropic responsibility, the weights for the individual indicators are calculated and normalized as shown in Table 7.

Similarly the consistency of matrix is measured by the CR as shown in Table 8.

The results show that the requirement for the consistency of weights is satisfied. To clearly express

Table 3: Comparison matrix of preferences for the responsibility thematic indicators

A	B_{21}	B_{22}	B_{23}	B_{24}
Economic (B_{21})	1	2	3	4
Legal (B_{22})	1/2	1	2	3
Ethical (B_{23})	1/3	1/2	1	2
Philanthropic (B_{24})	1/4	1/3	1/2	1

Table 4: Consistency check of judgment matrix for overall composite index

Judgment matrix	Largest eigen value λ_{max}	Consistency index	Random consistency index RI	CR
A-B_{1n} (n = 7)	7.6887	0.1148	1.36	0.0844
A-B_{2n} (n = 4)	4.0310	0.0103	0.90	0.0116

Table 5: Weights of individual indicators for stakeholder thematic indicators

Stakeholder thematic indicators	Weights of individual indicators							
Stockholder (w_{11n}, n = 5)	0.27	0.17	0.09	0.18	0.29			
Employee (w_{12n}, n = 8)	0.12	0.10	0.21	0.10	0.15	0.09	0.10	0.13
Government (w_{13n}, n = 5)	0.38	0.14	0.27	0.08	0.13			
Customer (w_{14n}, n = 5)	0.32	0.10	0.22	0.19	0.17			
Community (w_{15n}, n = 4)	0.27	0.16	0.33	0.24				
Business partner (w_{16n}, n = 4)	0.25	0.32	0.20	0.23				
Environment (w_{17n}, n = 4)	0.19	0.39	0.17	0.25				

Table 6: Consistency check of judgment matrix for stakeholder thematic indicator

Judgment matrix	Largest eigen value λ_{max}	Consistency index CI	Random consistency index RI	CR
B_{11}-C_n (n = 5)	5.0385	0.0096	1.12	0.0086
B_{12}-C_n (n = 8)	8.1599	0.0228	1.41	0.0162
B_{13}-C_n (n = 5)	5.1201	0.0300	1.12	0.0268
B_{14}-C_n (n = 5)	5.0708	0.0177	1.12	0.0158
B_{15}-C_n (n = 4)	4.1331	0.0444	0.90	0.0493
B_{16}-C_n (n = 4)	4.0151	0.0050	0.90	0.0056
B_{17}-C_n (n = 4)	4.0559	0.0186	0.90	0.0207

Table 7: Weights of individual indicators for responsibility thematic indicators

Responsibility thematic indicators	Weights of individual indicators								
Economic (w_{21n}, n = 9)	0.18	0.15	0.13	0.24	0.07	0.07	0.05	0.03	0.08
Legal (w_{22n}, n = 9)	0.05	0.06	0.29	0.11	0.12	0.13	0.13	0.07	0.05
Ethical (w_{23n}, n = 9)	0.11	0.19	0.10	0.09	0.14	0.05	0.05	0.08	0.19
Philanthropic (w_{24n}, n = 8)	0.06	0.14	0.14	0.32	0.05	0.04	0.16	0.10	

Table 8: Consistency check of judgment matrix for responsibility thematic indicator

Judgment matrix	Largest eigen value λ_{max}	Consistency index CI	Random consistency index RI	CR
B_{21}-C_n (n = 9)	9.9811	0.1226	1.46	0.0840
B_{22}-C_n (n = 9)	9.8713	0.1089	1.46	0.0746
B_{23}-C_n (n = 9)	9.6821	0.0853	1.46	0.0584
B_{24}-C_n (n = 8)	8.3701	0.0529	1.41	0.0375

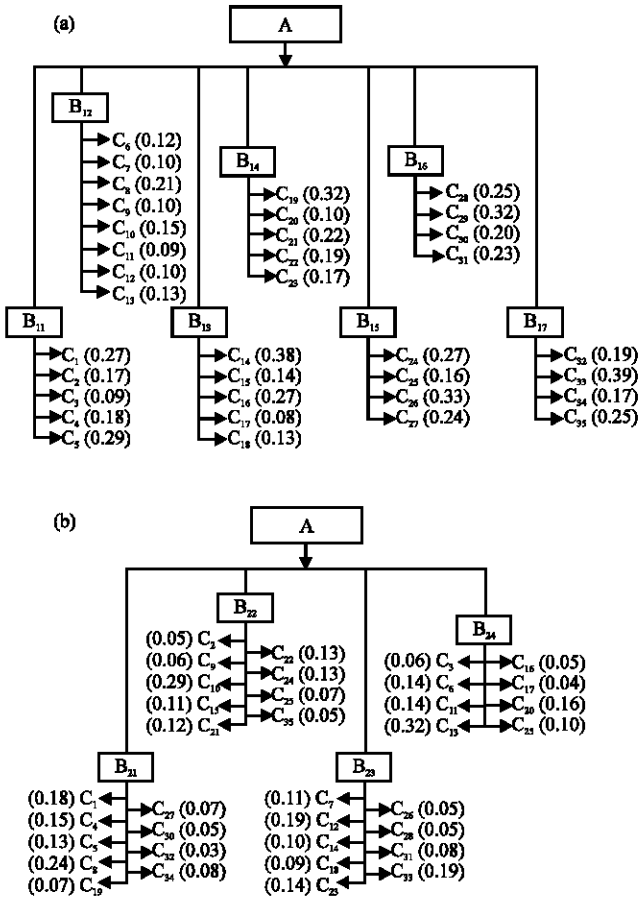

Fig. 2: CSR indicators and their weights (a) For stakeholder theme and (b) For responsibility theme

these two groups of thematic indicators and corresponding individual indicators, the CSR indicators and their weights are shown in Fig. 2.

RESULTS AND DISCUSSION

To further illustrate the methodology and the assessment results, the following calculations are taken for examples and the remaining ones are similar and omitted for conciseness.

For example, let U_{11k} be matrix of membership degrees for the individual indicators of stockholder theme and p_k be the number of expert votes that were in favor of an indicator for the CSR level and then $u_{ijk} = \{p_k/N\}^T$ be column vector of membership degrees for the individual indicators, where N = 35 was the number of experts for evaluation. All the experts provide the results on the basis of the data as shown in Table 1 from Shenhua Group in the year of 2013 for CSR assessment. The results are shown in Table 9.

Table 9: Number of votes and membership degrees for individual indicators of stockholder

Individual indicators for stockholder	Civil		Strategic		Managerial		Compliance		Defensive	
	p_1	u_{111}	p_2	u_{112}	p_3	u_{113}	p_4	u_{114}	p_5	u_{115}
C_1	2	0.06	30	0.86	3	0.08	0	0.00	0	0.00
C_2	2	0.06	28	0.80	5	0.14	0	0.00	0	0.00
C_3	5	0.14	0	0.00	30	0.86	0	0.00	0	0.00
C_4	3	0.08	16	0.46	16	0.46	0	0.00	0	0.00
C_5	2	0.06	5	0.14	28	0.80	0	0.00	0	0.00

Table 10: CSR membership degrees and performing stages of Shenhua Group in 2013

Thematic and composite indicators	CSR membership degrees					CSR stage
	Civil	Strategic	Managerial	Compliance	Defensive	
Overall CSR stage (L_{10})	0.1552	0.4312	0.3443	0.0521	0.0172	Strategic
CSR for stockholder (L_{11})	0.0697	0.4960	0.4342	0.0000	0.0000	Strategic
CSR for employee (L_{12})	0.0486	0.7423	0.1645	0.0313	0.0130	Strategic
CSR for government (L_{13})	0.1932	0.5899	0.1614	0.0555	0.0000	Strategic
CSR for customer (L_{14})	0.2842	0.0111	0.5835	0.1212	0.0000	Managerial
CSR for community (L_{15})	0.4036	0.0736	0.3926	0.0654	0.0647	Civil
CSR for business partner (L_{16})	0.2422	0.1482	0.3291	0.1840	0.0966	Managerial
CSR for environment (L_{17})	0.1406	0.4017	0.4293	0.0284	0.0000	Managerial
Overall CSR stage (L_{20})	0.1423	0.4705	0.3245	0.0503	0.0146	Strategic
Economic responsibility (L_{21})	0.1099	0.4911	0.3463	0.0365	0.0161	Strategic
Legal responsibility (L_{22})	0.1689	0.4864	0.2773	0.0552	0.0123	Strategic
Ethical responsibility (L_{23})	0.1632	0.4660	0.3126	0.0502	0.0081	Strategic
Philanthropic responsibility (L_{24})	0.1885	0.3304	0.3753	0.1041	0.0252	Managerial

Then:

$$U_{11k} = \begin{pmatrix} 0.06 & 0.86 & 0.08 & 0.00 & 0.00 \\ 0.06 & 0.80 & 0.14 & 0.00 & 0.00 \\ 0.14 & 0.00 & 0.86 & 0.00 & 0.00 \\ 0.08 & 0.46 & 0.46 & 0.00 & 0.00 \\ 0.06 & 0.14 & 0.80 & 0.00 & 0.00 \end{pmatrix}$$

$$L_{11} = W_{11} \bullet U_{11k}$$

$$= (0.27,\ 0.17,\ 0.09,\ 0.18,\ 0.29) \begin{pmatrix} 0.06 & 0.86 & 0.08 & 0.00 & 0.00 \\ 0.06 & 0.80 & 0.14 & 0.00 & 0.00 \\ 0.14 & 0.00 & 0.86 & 0.00 & 0.00 \\ 0.08 & 0.46 & 0.46 & 0.00 & 0.00 \\ 0.06 & 0.14 & 0.80 & 0.00 & 0.00 \end{pmatrix}$$

$$= (0.07,\ 0.50, 0.43, 0, 0)$$

$$L_{10} = W_{10} \bullet U_{10k}$$

$$= (0.22,\ 0.21,\ 0.12,\ 0.09,\ 0.08,\ 0.09,\ 0.18) \begin{pmatrix} 0.07 & 0.50 & 0.43 & 0.00 & 0.00 \\ 0.05 & 0.74 & 0.17 & 0.03 & 0.01 \\ 0.19 & 0.59 & 0.16 & 0.06 & 0.00 \\ 0.29 & 0.01 & 0.06 & 0.12 & 0.00 \\ 0.40 & 0.07 & 0.39 & 0.07 & 0.07 \\ 0.24 & 0.15 & 0.33 & 0.18 & 0.10 \\ 0.14 & 0.40 & 0.43 & 0.03 & 0.00 \end{pmatrix}$$

$$= (0.16, 0.43, 0.34, 0.05, 0.02)$$

Similarly, all the results of CSR membership degrees for both categories of themes and their corresponding composite indices were calculated and shown in Table 10.

Quite obviously, the model could be used to compare CSR stages and behaviors among different coal corporations or measure changes in the CSR stage of a specific corporation over time when updated data are available.

It is observed that Shenhua Group has achieved the stage of strategic to fulfill the CSR in 2013 either in stakeholder perspective or the view of responsibility for CSR which demonstrates its great attention on CSR and a better performance.

The model was applied to evaluate the stage of CSR in other three COCs of coal producers including China National Coal Group Corp (ChinaCoal), China Coal Technology & Engineering Group Corp (CCTEG) and China National Administration of Coal Geology (CNACG) in coal mining and washing industry, which was using as a vertical comparison, meanwhile the consequences of the four COCs was used as a horizontal comparison over time.

Given the importance of stakeholders in coal enterprises and the special needs of social responsibility, the difference and variation tendency of CSR stages and behaviors were discussed based on stakeholder theme. Its CSR membership degrees and social responsibility stages were shown in Table 11.

The difference and variation tendency of CSR performing stages of the four coal COCs therefore could be obtained as shown in Fig. 3.

Overall, from 2007-2013, the dynamic performances of four Chinese central governments owned coal corporations show a continual improvement on the CSR levels from compliance to managerial and strategic stage.

Table 11: CSR membership degrees and performing stages of four coal COCs

Composite indicators of four coal COCs	Year	Matrix of CSR membership degrees	CSR stage
Shenhua group	2007	(0.1056, 0.3099, 0.3656, 0.2164, 0.0025)	Managerial
	2009	(0.1688, 0.3722, 0.3865, 0.0599, 0.0126)	Managerial
	2011	(0.1552, 0.4312, 0.3443, 0.0521, 0.0172)	Strategic
	2013	(0.0895, 0.5276, 0.3161, 0.0668, 0.0000)	Strategic
CCTEG	2007	(0.1255, 0.1026, 0.3367, 0.4001, 0.0351)	Compliance
	2009	(0.3265, 0.1696, 0.3488, 0.1322, 0.0229)	Managerial
	2011	(0.3069, 0.1787, 0.3629, 0.1301, 0.0214)	Managerial
	2013	(0.2654, 0.1902, 0.4566, 0.0733, 0.0145)	Managerial
China Coal	2007	(0.0476, 0.2012, 0.2988, 0.3568, 0.0956)	Compliance
	2009	(0.3089, 0.1255, 0.4003, 0.1374, 0.0279)	Managerial
	2011	(0.0181, 0.2122, 0.5016, 0.2265, 0.0416)	Managerial
	2013	(0.2054, 0.4892, 0.1875, 0.0942, 0.0237)	Strategic
CNACG	2007	(0.0607, 0.1123, 0.2366, 0.3326, 0.2578)	Compliance
	2009	(0.1285, 0.1548, 0.3197, 0.1689, 0.2281)	Managerial
	2011	(0.0723, 0.1166, 0.2056, 0.5123, 0.0932)	Compliance
	2013	(0.0844, 0.2313, 0.4869, 0.1562, 0.0412)	Managerial

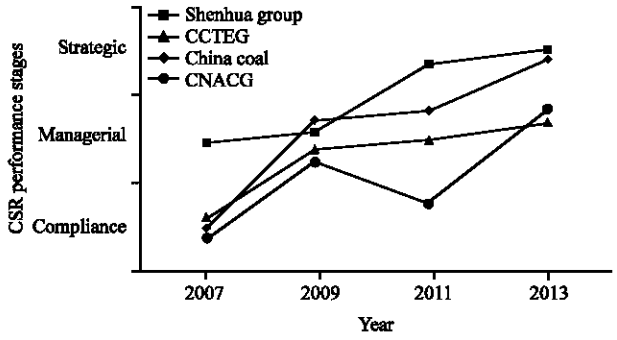

Fig. 3: Variation tendency of CSR performing stages of four coal COCs

Longitudinally, Shenhua group has been in a higher development stage of social responsibility since it has integrated CSR tactics into corporate strategies and every aspect of corporate management and progressively, Shenhua has been establishing and optimizing its management structure for its corporate social responsibilities.

Horizontally, the four corporations have different degrees of progress. ChinaCoal has been the fastest growing corporation which has developed from compliance to strategic stage from 2007-2013. Recent years ChinaCoal has achieved remarkable progress in comprehensively improve social responsibility management in terms of corporate governance and regulated management, operation in good faith, safety production, energy conservation, emission reduction, independent innovation and technological advancement.

CONCLUSION

CSR is characterized by temporal dynamics due to changes in corporate capacity, operating contexts and stakeholder expectations and the CSR issues in China evolves over the stages such as latent, emerging, consolidating and institutionalized ones and CSR performance matures through the stages such as defensive, compliance, managerial, strategic and civil ones.

A fuzzy AHP model for assessing CSR was established and the four major Chinese COCs as coal producers including Shenhua Group, ChinaCoal, CCTEG and CNACG were taken as a case study for applying the model. The model could be used for comparing the CSR performing stages of different corporations or measuring the CSR changes of corporations over time. The results indicated that the responses and performance of four COCs as Chinese key coal producers are behaving from the compliance to the managerial and strategic stage.

As a developing economy in transition, China is developing national regulatory and policy frameworks to support business and industry for advancing sustainable development initiatives and engaging in responsible business practices. To contribute to sustainable development and gain social license to operate, corporations should be responsive, proactive and adaptive in taking social responsibilities, commensurate to their differentiated capacities and temporal dynamics with economy and society evolve.

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