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Structural equation based csr evaluation model in construction industry and empirical analysis

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ABSTRACT

In order to realize effective management of Corporate Social Responsibility (CSR) in construction industry, a major issue in current researches is to establish a scientific and reasonable CSR evaluation model in construction industry. This paper is based on Carroll's "Stakeholder/Responsibility" matrix theory, and proposes a CSR evaluation indicator system for construction industry in views of the objective measurement of behaviors and launches empirical studies on the CSR evaluation model in construction industry by using structural equations. It is found through verifications of the models that the CSR evaluation model established in this paper can explain the influence on CSR in construction industry by differences in CSR practices in the industry and other factors, so as to provide new references and technical supports for enterprises and government authorities to establish and improve their CSR guidelines and policies in the construction industry.

KEYWORDS

Construction industry; Social responsibility; Sustainable development; Stakeholder; Structural equation.

INTRODUCTION

The construction industry is a producing sector engaged in civil engineering, house building, equipment installation as well as engineering investigations and design, and is a pillar industries in Chinese economy. Thanks to the rapid development of national economy and urbanization, the construction industry has created huge wealth and job opportunities for the society, however, there are still noises, such as jerry-buildings, appeals for payments to laborers, production accidents, poor integrity, lack of public charity and environmental pollutions, which badly harmed the images of the construction industry and the healthy development of construction market. Currently, construction enterprises in China are confronted with lack of performance capacity of their social responsibilities to various extents, which arouses severe social responses, in which context the development and establishment of a SCR evaluation model have definitely attracted extensive social attentions in order to effectively improve the performance of CSR of construction enterprises.

There have been some research documentations on Corporate Social Responsibility (CSR) evaluation systems in China. Currently, the relatively influential evaluation systems include the *CSR Evaluation System for Chinese Private Enterprises* proposed by Jiang Wanjun (2006) and the CSR Evaluation Indicator System for Chinese Enterprises proposed by Li Liqing (2006). Both the two evaluation systems are systematically build and measurable, however, the data are collected by objective measurements. Since there has been no specialized database available in China, the objective indicators and data result in lack of specimen and loss of data and distortion of data. In addition, Qi Liyun (2013) defines the eight major social expectations by using the G3 standard and ISO26000 standard, including responsibility management, economic development, human rights, labor practice, environment, fair operation, consumer issues and community development, on such basis she established a CSR evaluation model by applying the structural equation. Mai Sheng (2012) also built a CSR evaluation model from scientific development perspectives by using the TOPSIS method. But such rational evaluation models did not take full considerations of the characteristics in the industry and the comments of insiders on CSR. The content of CSR may vary significantly by industries, therefore the CSR evaluation system should also be industry specific. However, few researches were found on CSR in the construction industry, and an object and mature CSR evaluation system and model are far from being available at the time being. As such, this paper launches researches and discussions on CSR evaluation model in the context of construction industry, through objective data collection and by using the structural equation theories.

THEORY BASIS

Structural equation based modeling

Structural Equation Modeling analyzes the relations between variables on basis of the covariance matrix of variables and discusses on macro rules from perspective of micro individuals. It takes factors that cannot be directly measured by expected to study as a potential variable. The potential variables are reflected by some observational variables (variables that can be directly observed, usually indicators), so as to establish the structural relations between such potential variables. The structure equation modeling includes measurement modeling and structural equation. The measurement equation describes the relations between variables and indicators, while structural equation describes the relations between potential variables. They are in most cases expressed as the following three matrix equations:

$$\begin{cases} y = \Lambda_y + \varepsilon \\ x = \Lambda_x + \delta \\ \eta = \mathrm{B}\eta + \Gamma\xi + \varsigma \end{cases} \quad (1)$$

Wherein, the exogenous potential variable is usually expressed by ξ, and acts as an explanatory variable in the model. It may influence but cannot be influenced by other variables. An inherent variable is usually expressed by η, which can influence and be influenced by other variables. The exogenous observational variable is expressed by x, while inherent observational variable is expressed by y. δ indicates the error of exogenous observational variable x; ε indicates the error of inherent observational variable y. Λx indicates the direct relations between exogenous observational variable and exogenous potential variable, and is a component matrix of exogenous observational variable on the exogenous potential variable; Λy indicates the relations between inherent observational variable and inherent potential variable and is the component matrix of inherent observational variable on exogenous potential variable; B indicates the relations between inherent potential variables and is a path coefficient; Γ indicates the influence of exogenous potential variable on inherent potential variable and is a path coefficient; ζ indicates the parts in the equation that cannot be explained and is a residual term of the structural equation.

In comparison with objective evaluation methods, such as analytic hierarchy process, fuzzy comprehensive evaluation, neural network method and gray correlation method, the structural equation method allows measurement errors of the independent variable and dependent variable, and it can process the measurement relations and structural relations of factors. As such, this paper adopted the structural equation method in building the CSR evaluation model in construction industry.

Stakeholder/social responsibility matrix theory

Mr. Carroll (1996), professor in the University of Georgia, believes that the discussion on content of the CSR should combine two different perspectives: firstly the discussion should be made on "who should the enterprise be responsible for" on basis of the corporate operation, and secondly, the discussion should be made to answer the question of "what should the

enterprise be responsible for" in considerations of the entire society, so that it can propose a stakeholder/responsibility matrix (as shown in TABLE 1). Such combined perspectives is more advantageous for systematic considerations and decision making on the social responsibilities to be taken by the enterprise.

TABLE 1 : Stakeholder/social responsibility matrix (source: carroll (1996))

Types of Stakeholders Tiers of responsibility	Economic responsibility	Legal responsibility	Ethical responsibility	Spontaneous responsibility
Owners				
Consumers				
Employees				
Community				
Competitors				
Suppliers				
Media				
General public				
……				

The first dimension of such matrix includes the stakeholders, which are individuals and organizations affecting or affected by the realization or the process of realization of corporate goals (Freeman, 1984). A "Stakeholder" is proposed as counterpart of "shareholder" of an enterprise. The Stakeholder Theory lays great emphasis on the social responsibilities of shareholders, employees, consumers, community, environment and government, and overturns the "shareholder first" theory. Therefore, modern opinions believe that CSR means an enterprise should create profits and be responsible for interests of its shareholders and should also take social responsibilities for its employees, consumers, partners, government, society and natural environment, mainly including observance of commercial ethics, production safety, occupational health and protection of legal rights and benefits of laborers, environmental protection, supports to charity and donations, etc.

The second dimension in the matrix include tier responsibilities. An enterprise is an enterprise of all stakeholders but cannot satisfy all requirements of the stakeholders. Only interest requirements that are reasonable, legal and compliant with corporate ethnic principles can form the specific content of CSR. Carroll (1979) proposed the theory of "Tier responsibility" theory, which means that the CSR is expectation of the enterprise in certain period in terms of economy, law, ethnic and charity in a shape of a pyramid: the ground tier is the basic responsibility, namely the economy responsibility which means the enterprise should be devoted to reducing costs and producing profits and drive the social economic development. The second tier is the legal responsibilities which means economic activities of the enterprise comply with related CSR laws and regulations as well as national or international standards. The third tier is the ethnic responsibility which means all activities and behavior of the enterprise should comply with fair, just and rightful ethnics; the top tier is the charity responsibilities which means that the enterprise is volunteered to take extra acts, on basis of its values and social expectations to contribute to social prosperity and advance as well as improvement of people's living standard.

The matrix successfully reveals the significance of CSR: the enterprise should not only consider interests of its shareholders in its policies but also the interests of other stakeholders and in terms of properties, CSR should include economic, lawful and ethnic responsibilities and charity responsibilities. Therefore, the matrix is widely accepted in various documents and is taken as a starting point in this paper.

ESTABLISHMENT OF EVALUATION INDICATOR SYSTEM

According to the matrix theory framework of Carroll, firstly inconsideration of the special social influences of the industry, when the stakeholders in construction industry is defined, in addition to shareholders, employees, proprietors, partners and environment that have influences on persistent existence of the enterprise, the stakeholders should also include related government authorities and communities. Then, the specific social responsibilities of stakeholders in the construction industry in terms of economy, law, ethnic and charity, which are widely accepted by international societies and suitable to Chines situations, are expressed in forms of test sentences, in order to test the recognition of interviewees to such CSR.

There is no related CSR database currently available in China, therefore the data collection in forms if questionnaire is a suitable choice for purposes of quantitative analysis. In considerations of the difficulties of objective measurement is practical applications, this paper refers to the rigorous attitude and strict procedures taken by Aupperle (1985) in development of the measurement scale, and focuses on the objective items in preparation of CSR in construction industry, to generate the measurement tool. Firstly, this paper takes reference from findings of similar researches both in and outside China. For instance, the China International Contractors Association (2010) has preliminarily established 145 original items on CSR in construction industry. Then, the CSR behaviors in various documents are verified through interviews with 10 experts in the construction industry. Maybe, additional information may be collected beyond such documents, which can be used as supplementation to the questions. Finally,

through repeated discussion with experts, more importance is paid to the completeness and independence of questions, and the 145 questions are reduced to 86 which can basically cover the main content in CSR in construction industry.

When the library of objective questions are ready, they are screened and classified by the 10 experts entry by entry. A question may be selected only if it is approved by at least six experts, and the questions approved are classified in groups of economy, law, ethnic and charity. In such a way, the questions are prepared. Questions in the four groups are restructured and one question is taken from each group to form a questionnaire set. Totally 15 sets of questionnaire are worked out, with each set including 4 questions and each question corresponds to an issue in CSR. 60 questions are finally selected into the measurement tool. The CSR evaluation indicator system in construction industry established in this paper is as shown in TABLE 1. The evaluation indicator system takes the social responsibilities of stakeholders as the tier 1 indicators, including specifically responsibilities for shareholders (referred to as shareholder responsibility indicated by ηI and similarly hereinafter), employee responsibility η2, proprietor responsibility η3, partner responsibility η4, environmental responsibility η5, community responsibility η6 and government responsibility η7, which further include a number of issues, namely the tier 2 indicators (organization governance y1, employment relationship y2, health and safety y3, training development y4, social benefits y5, democratic administration y6, engineering quality y7, service quality y8, CSR procurement y19, fair competition y10, environmental protection y11, sewage discharge reduction y12, energy saving and consumption reduction y13, community involvement and law compliance y15. Then, such issues are further broken down to questions in four tiers, which are the tier 3 indicators (they are not listed in details due to content restrictions).

In consideration of the volume of specimens, this paper will not carry out direct factor verification analysis on the 60 questions or observational variables, but on 14 questions. The score of each item is the mean score obtained in the four groups of economy, law, ethnic and charity. Among them, the CSR is an exogenous potential variable CCSR, the 7 tier 2 variables are inherent potential variables and measured by 15 tier 3 indicators. Assumption is made that errors occurs to each potential variable and connected to the previous residual. The structural equation so established is as shown in TABLE 2.

TABLE 2 : CSR evaluation system in construction industry

Tier 1 indicators	Tier 2 indicators	Tier 3 indicators	Responsibility properties
Shareholder responsibility η1	Organization governance y1	Maintain and increase assets value	Economy
		Protect legal interests of shareholders	Law
		Establishment of effective corporate governance	Ethical
		Lead shareholder responsibility investment	Charity
	Employment relationship y2	Payment of wages in full and on time	Economy
		Standardized employment	Law
		Complete employee wage growth plan	Ethical
		Cares to employees	Charity
Employee responsibility η2	Health and safety y3	Payment of safety measures in full and in time	Economy
		Provide safe and healthy working conditions	Law
		Establish occupational health management system	Ethical
		Development measures to reduce safety risks	Charity
	Training development y4	.....	.....
	Democratic management y5	.....	.....
	Social benefits y6	.....	.....
Proprietor responsibility η3	Construction project y7	.....	.....
	Service quality y8	.....	.....
Partner responsibility η4	CSR procurement y9	.....	.....
	Fair competition y10	.....	.....
Environmental responsibility η5	Environmental protection y11	.....	.....
	Reduction of sewage discharge y12	.....	.....
	Energy saving and consumption reduction y13	.....	.....
Community responsibility η6	Community involvement y14	.....	.....
Government responsibility η7	Law compliance y15	.....	.....

EMPIRICAL ANALYSIS

Data collection

This paper puts 60 questions together in a questionnaire and the interviewees are asked to mark the questions on basis of the action situations. Since this paper studies the CSR in construction industry, the questions involved covers extensive corporate operation behaviors, requiring that the interviewee knows wells the internal conditions of the company (such as a senior manager, department manager). The scoring system adopts the five-score system developed by Likert, of which 1 stands for "inconformity" and 5 stands for "compliance" and higher score indicates higher extent in terms of compliance with actual situations.

The questionnaires are distributed in E-mails and completed by friends or delegated persons. In March 2013, 20 copies of the questionnaires were distributed and collected in Zhejiang province, which is the hometown of the author of this paper. According to the results of survey and analysis on the structure, difficulties, creditability and effectiveness of the questionnaires, the questionnaires are modified and improved. In the follow-up over 3 months official investigations, and with help of related persons and parties, the questionnaire covered 25 cities in 15 provinces, including Shanghai, Jiangsu, Zhejiang, Guangdong, Beijing, Chongqing. Totally 233 copies were distributed and 188 copies were collected, of which 165 are effective. The recovery rate and rate of effective questionnaires were respectively 80.68% and 87.76%. After the 165 effective questionnaires are sorted, the investigation results showed that most interviewees were senior leaders and department managers who have working experiences of 10 years or longer and have good knowledge of the enterprise. The interviewees could meet the basic requirements.

On basis of the data acquired through the survey, SPSS20.0 statistics software is used to process and sort the data, during which process, abnormal data are removed or corrected, and for questions with no answers, the mean value is used by default. Through calculations, 15 new mean values and standard errors of the observational variables are obtained, as shown in TABLE 3 below.

TABLE 3 : Basic statistic descriptive (analysis N=165)

Indicator	y1	y2	y3	y4	y5	y6	y7	y8
Mean value	3.72	3.45	3.63	3.72	3.23	3.65	3.93	3.68
Standard error	0.939	0.972	1	1.02	1.234	1.093	1.013	0.922
Indicator	y9	y10	y11	y12	y13	y14	y15	
Mean value	3.56	3.56	3.42	3.41	3.4	3.04	3.84	
Standard error	1.036	1.127	1.044	1.136	1.1	1.085	1.019	

Verification of credibility and efficiency

SPSS20.0 software system is used to carry out credibility analysis on the investigation data and the Cronbach's Alpha if Item Deleted (α coefficient) are all higher than 0.86 on all potential variables. The survey shows good coherence on all potential variables with respects to CSR in the construction industry, therefore the questionnaires are of high credibility. Through the factor analysis, it can be found that load values of factors on most indicators are greater than 0.5, indicating good construct validity in the questionnaires.

Overall fitting effect of model

The AMOS20.0 software system is adopted in analysis on basis of the fixed loading method, and the Maxi-Likelihood (ML) is used on estimation of path coefficients of the structural equation. Results show that there is significant correlation between the 15 observational variable, 7 inherent potential variables and 1 exogenous potential variable. The model fitting index CMIN/DF=3.277, GFI=.826, RMR=.029, RMSEA=0.103, NFI=.871 and CFI=.908. All indicators comply with the industrial standard, which means that the models are well fit and acceptable.

Figure 1 shows the model paths that can influence the structural equation of CSR indicators in the construction industry, which provides the relations between various stakeholder responsibility in construction industry and CSR issues, and also describes the standardized path coefficients of the model. From Figure 1, it can be found that the 7 inherent potential variables and their corresponding indicator load are all greater than 0.82, which means that the 15 observational variables are valid on their corresponding variable influence factors.

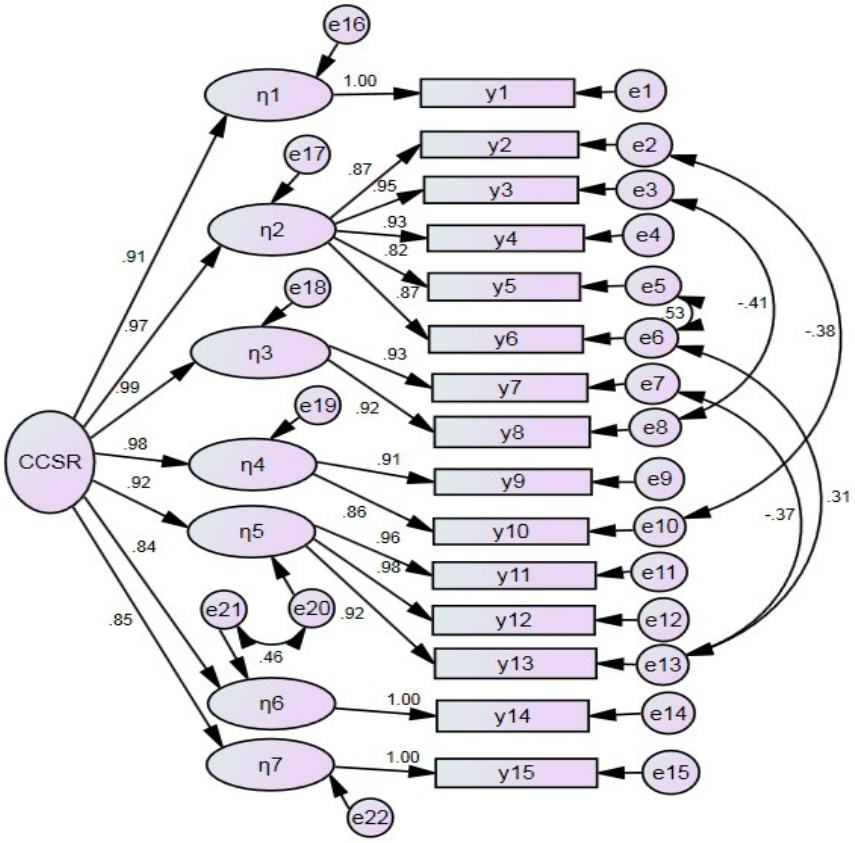

Figure 1 : Shows a model of CSR evaluation structural equation in construction industry (including standard path coefficient).

CONCLUSION

This paper is based on the stakeholder/responsibility matrix theory of Carroll and establishes a set of CSR evaluation model for use in construction industry by applying the structural equations. The CSR in construction industry is jointly affected by 7 inherent variables and 15 observational variable. These structural variables must take into considerations of the theoretical structures and the measurability of indicators, so that the content and extensions of CSR concept is clearly defined. Besides, they can be directly used for measurement, so as to avoid the ambiguity and intersectionality of the original concepts, therefore it is helpful to solve the problems in CSR in construction industry that the indicators can hardly be directly measured. As such it helps to carry out analysis on influence factors on CSR in construction industry and provides governments references and technical supports on corporate social responsibility.

From the path analysis in structural equation model as given in Fig 2 above, a conclusion can be drawn that the seven indicators, including shareholder responsibility (γ1=0.91), employee responsibility (γ2=0.97), proprietor responsibility (γ3=0.99), partner responsibility (γ4=0.98), environment responsibility (γ5=0.92), community responsibility (γ6=0.84) and government responsibility (γ7=0.85) demonstrate prominent positive correlations with CSR in construction industry. Among them, proprietor responsibility, partner responsibility and employee responsibility can produce prominent influence on the CSR in construction industry, environment responsibility and shareholder responsibility also have prominent influences, but government responsibility and community responsibility have less influences. Besides, both construction quality and service quality have very prominent influence on the proprietor responsibility; in comparison with partner responsibility, CSR procurement tends to have better influence; in comparison with employment relations, democratic administration and social benefits, health and safety and training development have greater influence on employee responsibilities; sewage discharge reduction, environmental protection as well as energy saving and reduction of consumption have significant influence on environment responsibility. The findings agree with our understandings. For instance, health and safety and construction quality are always hot topics on construction projects and are also the foundation of the construction industry, therefore enterprises must always stick to the principles of "Quality and Safety Go First".

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