

Analysis of Social Responsibility of Chinese Overseas Construction Enterprises Based on Combination Empowerment Method

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Abstract: In the context of the development of the "Belt and Road Initiative", in order to ensure that Chinese overseas construction enterprises can better fulfill their corresponding social responsibilities in the international market, this paper, from the perspective of stakeholders, constructs a social responsibility evaluation index system of Chinese overseas construction enterprises, including 5 first-level indexes such as customers, employees, environment, community and local government responsibilities, and 21 second-level indexes. Using AHP and entropy weight method to determine the weight of each relevant evaluation index, then taking the PKM project in Pakistan undertaken by the overseas division of Chinese construction company as a practical case, and using the extreme value method to conduct dimensionless processing of some indexes. In addition, the relevant indexes of the enterprise are analyzed and classified, so as to obtain the grade of the enterprise's social responsibility, and then encourage the relevant similar enterprises in China to better fulfill their social responsibility in the construction process.

1 INTRODUCTION

With the rapid development of the "Belt and Road Initiative" policy, Chinese construction and engineering enterprises are playing an increasingly important role around the world. Under the current situation, the issue of green development and social stability have gradually attracted attention, especially in the countries along the "Belt and Road Initiative". As an important factor to improve the sustainability of major projects, social responsibility has gradually attracted the attention of overseas construction enterprises.

In recent years, domestic scholars have conducted extensive research on the social responsibility of construction enterprises. Wang Xuetong et al. (2020) conducted an empirical analysis of different types of CSR expectations of construction enterprises in countries along the "Belt and Road Initiative" and found that Chinese construction enterprises should fully consider their CSR expectations in these countries. Xie Linlin et al. (2018) believe that construction enterprises have a one-sided

understanding of social responsibility, pay too much attention to the construction process and ignore the completion, and have insufficient understanding of community public welfare and weak awareness of information disclosure. Pang Yongshi et al. (2012) calculated the importance of each attribute of the most reduced set according to the existing disclosure of the social responsibility of construction enterprises, converted the importance of each attribute into the weight of the index through normalization processing, and obtained the weight distribution of the first-level index and the second-level index of the evaluation. From the perspective of stakeholders, Wan Dongjun et al. (2020) combined with the characteristics and current situation of international projects, adopted the empirical determination method to construct the CSR performance evaluation index system of international construction enterprises, and then determined the direction that should be paid attention to in the CSR performance of international enterprises.

At present, foreign countries, especially European and American countries, have a good overall

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awareness and implementation of social responsibility of construction enterprises, and the research results are relatively rich. Liao et al. (2017) conducted a comparative study on the CSR reports of international project contractors and Chinese construction enterprises and found that the CSR awareness and overall implementation in Europe are better, while the CSR construction of Chinese overseas construction enterprises is relatively low. Based on the research of existing literature at home and abroad, Jiang(2015) compared the research status of the social responsibility of construction industry and corporate social responsibility, and proposed that the research on the social responsibility of construction enterprises is in the preliminary stage.

Existing studies have proved that the implementation of social responsibility of construction enterprises is conducive to improving the competitiveness of enterprises and creating a good image and reputation for enterprises, but there is still a lack of research on the definition of social responsibility content and how to effectively implement it. Therefore, this paper aims to: (1) understand the social responsibility awareness and current situation of Chinese overseas construction enterprises through the text analysis of social responsibility report; (2) establish a set of scientific evaluation index system by reviewing literature and consulting experts' opinions, and determine the index weight to make the evaluation more objective and reasonable, so as to help Chinese overseas construction enterprises to clarify their social responsibilities and better guide the construction of corporate social responsibility in the process of the "Belt and Road Initiative".

2 TO ESTABLISH A SOCIAL RESPONSIBILITY EVALUATION INDEX SYSTEM OF CHINESE OVERSEAS CONSTRUCTION ENTERPRISES

2.1 Identification of Risk Factors

Due to the differences between overseas and domestic construction projects, this paper selects the relevant responsibilities of overseas construction enterprises in full life cycle as customers, employees, environment, community and local government, which based on the analysis of existing literature and

combined with the general implementation process and characteristics of international construction projects.

2.2 Selection of Evaluation Indexes

Table 1: Social responsibility evaluation index system of Chinese overseas construction enterprises.

First-level index	Second-level index	Unit	Nature
Responsibilities of Customers(A_1)	Quality acceptance rate of overseas project (A_{11})	%	Quantitative
	Quality management system(A_{12})		Qualitative
	Customer satisfaction rate(A_{13})	%	Quantitative
Responsibilities of Employees(A_2)	Rate of wage payment(A_{21})	%	Quantitative
	Labor contract signing rate of overseas employees(A_{22})	%	Quantitative
	Overseas employee satisfaction(A_{23})	%	Quantitative
	Injury death rate of overseas employees(A_{24})	‰	Quantitative
	Situation of production and safety protection for employees(A_{25})		Qualitative
	Annual per capita training funds for overseas employees(A_{26})	yuan	Quantitative
	Care of female employees(A_{27})		Qualitative
Responsibilities of Environment(A_3)	Environmental acceptance rate of construction project completion(A_{31})	%	Quantitative
	Green building construction system(A_{32})		Qualitative
	Disposal utilization rate of construction waste(A_{33})	%	Quantitative
	Processing compliance rate of construction noise and dust(A_{34})	%	Quantitative
Responsibilities of Community(A_4)	Promote the construction of local infrastructure(A_{41})		Qualitative
	Whether to respect local customs and culture(A_{42})		Qualitative

	Degree of participation in community activities(A ₄₃)		Qualitative
	Resource investment in materials purchasing(A ₄₄)	year	Quantitative
Responsibilities of Local government(A ₅)	Promote the development of local enterprise system(A ₅₁)		Qualitative
	Tax rate on assets(A ₅₂)	%	Quantitative
	Local employment contribution rate(A ₅₃)	%	Quantitative

At present, in addition to domestic or foreign standards, there are also CSR reports issued by large construction enterprises every year for the social responsibility indexes screening of Chinese overseas construction enterprises, so the representative indexes can be selected as the research indexes (Zhu Jigao et al., 2019). Finally, 5 first-level evaluation indexes and 21 second-level evaluation indexes of Chinese overseas construction enterprises' social responsibility are obtained, as shown in Table 1.

3 DETERMINING INDEXES WEIGHTS

In this paper, the subjective and objective methods are combined to determine the weight of indexes. Firstly, AHP and entropy weight method are used to calculate the weight, and then the required combined weight value is calculated according to the principle of minimum information entropy.

3.1 Analytic Hierarchy Process (AHP) to Determine the Indexes Weights

The AHP method is used to compare each index of the same dimension, construct the judgment matrix between them, and finally determine the weight of the indexes through the consistency test. In order to make the scoring results objective enough, we invited 20 experts working in different positions in overseas construction companies, among which 40% were engaged in Party A management, 30% were engaged in third-party consulting services such as project supervision, and 30% were from local management personnel of the host country. The work experience of these experts in the field of construction is more than 10 years, and they are very familiar with the characteristics of overseas construction industry. The

relevant discriminant matrix formed by the above evaluation indexes can be constructed, and the eigenvector of the matrix, namely the weight of each factor, can be calculated by the root method. Multiply each row of elements in the matrix to get the product of each row of elements "K_i":

$$K_i = \prod_{j=1}^n b_{ij} \tag{1}$$

Using square root method to calculate the weight of evaluation indexes, and calculating the NTH root of "K_i" to get "V*":

$$V^* = \sqrt[n]{K_i} \tag{2}$$

After the normalization of "V*", "V_i" representing the weight of each index is obtained:

$$V_i = \frac{V^*}{\sum_{i=1}^n V^*} \tag{3}$$

3.2 Entropy Weight Method to Determine the Indexes Weights

When determining the weight of each quantitative index, the entropy weight method should be used to confirm (Da Kening et al., 2018), in order to avoid the error caused by human subjective factors affecting the difference size of objective samples. The specific processing process is as follows: suppose there are n indexes, and define X_i={X₁, X₂, ..., X_n}. Through the standardization of each index data, the value is obtained as "Y₁, Y₂, ..., Y_n", and then the normalization process is carried out.

$$y_{ij} = \frac{x_{ij} - \min(x_{ij})}{\max(x_{ij}) - \min(x_{ij})} \tag{4}$$

Then the normalized matrix is obtained:

$$Y = \begin{bmatrix} y_{11} & y_{12} & \dots & y_{1n} \\ y_{21} & y_{22} & \dots & y_{2n} \\ \dots & \dots & \dots & \dots \\ y_{m1} & y_{m2} & \dots & y_{mn} \end{bmatrix} m^* n \tag{5}$$

According to the above standardized matrix, the entropy of risk index is calculated:

$$e_j = -k \sum_i^m p_{ij} \ln p_{ij} \tag{6}$$

In the formula, k>0, k = 1 / ln m. The difference degree of the JTH index is defined as "d_j=1-e_j", and the defined weight of the evaluation index is obtained as "w_j = d_j / sum_{j=1}ⁿ d_j".

3.3 Combination Weighting Method to Determine the Comprehensive Indexes Weights

In the weight distribution of indexes, the internal statistical rules and authoritative values between index data should be considered. In order to make up for the deficiency caused by single weighting, this paper adopts the combination weighting method to determine the weight, that is, the subjective weight is

calculated by AHP, and the objective weight is calculated by the entropy weighting method.

The comprehensive weight coefficient " Q_j " of each index is:

$$Q_j = \frac{v_j w_j}{\sum_{j=1}^n v_j w_j} \tag{7}$$

" V_j " is the weight coefficient calculated by AHP, " W_j " is the weight coefficient calculated by entropy weight method. The final calculated combination weights are shown in Table 2.

Table 2: Index weights based on AHP-entropy weight combination weighting method.

First-level index	Weight	Second-level index	Weight	Combination weight
Responsibilities of Customers(A_1)	0.3257	Quality acceptance rate of overseas project (A_{11})	0.4216	0.1373
		Quality management system(A_{12})	0.3125	0.1018
		Customer satisfaction rate(A_{13})	0.2659	0.0866
Responsibilities of Employees(A_2)	0.2762	Rate of wage payment(A_{21})	0.1467	0.0405
		Labor contract signing rate of overseas employees(A_{22})	0.1127	0.0311
		Overseas employee satisfaction(A_{23})	0.1413	0.0390
		Injury death rate of overseas employees(A_{24})	0.1749	0.0483
		Situation of production and safety protection for employees(A_{25})	0.2682	0.0741
		Annual per capita training funds for overseas employees(A_{26})	0.0827	0.0228
		Care of female employees(A_{27})	0.0735	0.0203
Responsibilities of Environment(A_3)	0.1048	Environmental acceptance rate of construction project completion(A_{31})	0.2578	0.0270
		Green building construction system(A_{32})	0.1737	0.0182
		Disposal utilization rate of construction waste(A_{33})	0.4326	0.0453
		Processing compliance rate of construction noise and dust(A_{34})	0.1359	0.0142
Responsibilities of Community(A_4)	0.1279	Promote the construction of local infrastructure(A_{41})	0.3577	0.0457
		Whether to respect local customs and culture(A_{42})	0.1726	0.0221
		Degree of participation in community activities(A_{43})	0.1852	0.0237
		Resource investment in materials purchasing(A_{44})	0.2845	0.0364
Responsibilities of Local government(A_5)	0.1654	Promote the development of local enterprise system(A_{51})	0.2187	0.0362
		Tax rate on assets(A_{52})	0.3579	0.0592
		Local employment contribution rate(A_{53})	0.4234	0.0700

4 EMPIRICAL ANALYSIS

4.1 Introduction to Case

This paper takes the PKM project undertaken by China State Construction Group Co., Ltd. in Pakistan as the case, and makes an empirical analysis of the social responsibilities undertaken by Chinese overseas construction enterprises in the construction process, so as to test the fulfillment of the social responsibilities of the enterprises in the construction process.

The PKM project (Sukkur-Multan section) starts from Sukkur City of Sindh Province in the south and ends in Multan, the economic center of Punjab Province in the north, with a total length of 392km. It is designed as a two-way 6-lane highway with ITS (Intelligent Transportation System) and access control. It is the first highway in Pakistan adopting ITS, with a contract value of \$2.889 billion. EPC contract mode is adopted, and the contract period is 36 months. In the process of construction, there are difficulties in project organization, design communication and coordination, technical difficulties, construction resources organization, severe security situation and other engineering construction difficulties.

4.2 Treatment of Standardization

Part of the data selected in this paper are from the social responsibility reports released by enterprises, such as the quality acceptance rate of overseas project and tax rate on assets, etc. Some of them come from within the enterprise and are obtained through communication with the enterprise, such as the customer satisfaction rate and labor contract signing rate of overseas employees. And we choose expert scoring to identify some unavailable data, qualitative indexes and indexes requiring comprehensive analysis. According to the rating value of the evaluation factors, the comment set is adopted accordingly, and the evaluation set is established according to the evaluation index system. Finally, the comment set is quantified and expressed by the

hundred-mark system interval, that is, "excellent, good, general, poor, very poor" corresponds to the ideal score of each evaluation level, which is [100,90], (90,80), (80,70), (70,60), (60,0] respectively.

Since the dimensions of each evaluation index data is different, it is necessary to carry out dimensionless processing. In this paper, extreme value method is selected, and the specific method is as follows:

(1) Processing of positive indexes. Set the index standardized score corresponding to the maximum value of each index of social responsibility of overseas construction enterprises to 100 points, and the index standardized score corresponding to the minimum value to 60 points. And the standardized scores of other indexes corresponding to the value of this index are obtained with the linear difference between 60 and 100 points.

$$E_i = 60 + \frac{40 * (X_i - B_i)}{(B_i - C_i)} \tag{8}$$

(2) Processing of negative indexes. Set the index standardized score corresponding to the minimum value of each index of social responsibility of overseas construction enterprises to 100 points, and the index standardized score corresponding to the maximum value to 60 points. And the standardized scores of other indexes corresponding to the value of this index are obtained with the linear difference between 60 and 100 points.

$$E_i = 60 + \frac{40 * (B_i - X_i)}{(B_i - C_i)} \tag{9}$$

Finally, the comprehensive evaluation value of social responsibility of this case is obtained by summing up the product of the standardized score of each index and its weight.

$$F = \sum_{i=1}^{21} E_i * W_i \tag{10}$$

(3) Standardization of qualitative indexes. Qualitative indexes are difficult to be processed by quantitative standards, so the qualitative indexes are scored according to the opinions of relevant experts, as shown in Table 3.

Table 3: Evaluation criteria of qualitative indexes.

Index	[0,60)	[60,70)	[70,80)	[80,90)	[90,100]
A_{12}	very imperfect	less perfect	general	relatively perfect	perfect
A_{25}	very poor	poor	general	good	excellent
A_{27}	very poor	poor	general	good	excellent
A_{32}	very imperfect	less perfect	general	relatively perfect	perfect

A_{41}	very poor	poor	general	good	excellent
A_{42}	very disrespectful	less respectful	general	relatively respectful	respectful
A_{43}	very poor	poor	general	good	excellent
A_{51}	very poor	poor	general	good	excellent

4.3 Comprehensive Value of Case Social Responsibility Evaluation

Table 4: Comprehensive score table of social responsibility indexes.

Index	B_i (max)	C_i (min)	X_i	E_i	W_i	F	Level of case
A_{11}	100%	80%	96%	92.00	89.45	87.33	good
A_{12}	100	60	90.32	90.32			
A_{13}	100%	85.46%	94.32%	84.37			
A_{21}	100%	80%	93%	86.00	91.33		
A_{22}	98.27%	85.33%	94.30%	87.72			
A_{23}	100	60	89.82	89.82			
A_{24}	0.15‰	0	0.01‰	97.33			
A_{25}	100	60	93.47	93.47			
A_{26}	2200 yuan	1300 yuan	1945.9yuan	88.71			
A_{27}	100	60	91.26	91.26			
A_{31}	99.3%	91.5%	92.8%	66.67	78.22		
A_{32}	100	60	81.26	81.26			
A_{33}	95%	73%	87%	85.45			
A_{34}	80%	46.2%	57.4%	73.25			
A_{41}	100	60	91.35	91.35	85.08		
A_{42}	100	60	77.23	77.23			
A_{43}	0.95	0.65	0.82	82.67			
A_{44}	874 million yuan	456 million yuan	699.3million yuan	83.28			
A_{51}	100	60	86.41	86.41	84.00		
A_{52}	7.02%	2.53%	4.97%	81.73			
A_{53}	30%	10%	22.34%	84.68			

Note: The data in the table are based on China Construction Annual Social Responsibility Report, statistical yearbook, Belt and Road Portal, relevant literature, questionnaire, etc.

Combined with each index and weight, the standardized scores of 21 indexes were calculated respectively, and the comprehensive value of the social responsibility evaluation indexes of this case was further calculated, so as to determine the grade of the corporate social responsibility. The specific results are shown in Table 4.

As can be seen from Table 4, the overall index comprehensive score of the case is 87.33, indicating that the overseas branches of China Construction Group Co., Ltd. perform well in their overall social responsibilities. Among the first-level indexes, the score of "Responsibilities of Employees" is 91.33 points, indicating excellent performance. Meanwhile,

among the second-level indexes, the "Injury death rate of overseas employees" has the highest score, indicating that Chinese overseas construction enterprises attach great importance to construction safety, people-oriented, and pay attention to the training and care of employees in the construction process. The score of "Responsibilities of Environment" is 78.22 points, which is relatively low. The performance of environmental acceptance rate of construction project completion is poor, which indicates that the overseas construction enterprises in China should strengthen environmental management in the process of construction and protect the surrounding environment at the same time. In terms

of customers, communities and local government, the score of "Responsibilities of Local government" is 84.00, indicating that Chinese construction enterprises should abide by the laws and regulations of the host country, actively cooperate with the relevant policies of the host country government, and promote the better development of local enterprises in the process of undertaking overseas project construction. In the process of fulfilling social responsibilities in local communities, the awareness of social responsibility should be strengthened, and sufficient attention should be paid to community voluntary service, local market employment and enterprise cooperation.

5 CONCLUSIONS

Based on the construction of the social responsibility evaluation index system of overseas construction enterprises under the background of the "Belt and Road Initiative" and the adoption of reasonable evaluation methods, this paper makes a detailed analysis of their social responsibility construction according to the actual situation of Chinese overseas construction enterprises. From the theoretical level, it is clear that the content orientation of overseas construction enterprises should include 21 indexes from 5 dimensions of "customers, employees, environment, community and local government", and the problems existing in the fulfillment of social responsibilities of Chinese overseas construction enterprises are analyzed. It also points out that enterprises should pay attention to the cultivation of employees, environment, community public welfare and other dimensions in the process of cultivating social responsibility, which can help enterprises understand social responsibility more comprehensively and provide theoretical basis for their choice of social responsibility behavior.

REFERENCES

- Da Kening, Peng Yifeng, Guo Baorong(2018). Research on Urban Business environment based on entropy weight method -- A case study of Shenyang City. *J. Journal of Shenyang Jianzhu University (Social Science Edition)*. 20(03): 250-255.
- Jiang W, Wong J KW. Corporate Social Responsibility in Construction: A Critical Review on Research [C]//Proceedings of the 19th International Symposium on Advancement of Construction Management and Real Estate. Springer Berlin Heidelberg, 2015: 1195-1206.
- Liao P, Xia N, Wu C, et al(2017). Communicating the corporate social responsibility (CSR) of international contractors: Content analysis of CSR reporting. *J. Journal of Cleaner Production*. 156: 327-336.
- Pang Yongshi, Wang Ying (2012). Evaluation index weight determination of construction enterprises' social responsibility based on Rough set. *J. Journal of Engineering Management*. 26(03):109-113.
- Wang Xuetong, Zhang Guanqiao, Song Xiangnan, Xian Dixi (2020). Research on the social responsibility expectations of construction enterprises in countries along the "Belt and Road Initiative". *J. Journal of Engineering Management*. 34(04): 16-21.
- Wan Dongjun, Ma Xuerui, Sun Chengshuang (2020). Research on CSR Performance Evaluation Index System of international engineering contractors. *J. Journal of Beijing University of Civil Engineering and Architecture*. 36(01):91-98.
- Xie Linlin, Han Ting, Hu Yi, Le Yun (2018). Chinese construction enterprise social responsibility index system. *J. Journal of Civil Engineering and Management*. 35(06):36-42.
- Zhu Jigao, Wang Yi, Tang Guliang(2019). Research on Central Enterprises' Fulfillment of social responsibility under the "Belt and Road Initiative": from the perspective of strategic social responsibility and reactive social responsibility. *J. China Industrial Economics*. (09):174-192.