

Research on the Construction of Environmental Management Evaluation Index System of Heavy Pollution Enterprises based on the Competitive Advantage Model

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Abstract: Using competitive advantage model, the paper discusses on the selection of environmental indicators of enterprise environmental management, through the choice of all levels environmental indicators, some relatively important factors are determined in the aspect of enterprise environmental management of most enterprises at present, to guide the environmental management of enterprises at the present stage.

Keywords: Environmental Management; Competitive Model; Selection and Evaluation

1. Introduction

The environmental pollution, energy crisis and resource depletion are becoming more and more outstanding today, the environmental management ability and the level has become the important factor that decides the enterprise competition superiority. An enterprise without the ability of environmental management, or the enterprise that pays no attention to environmental protection, it is impossible to stand in the fierce market competition. Environmental management has become the inevitable choice for modern enterprise innovation and the important source of enterprise competitive advantage.

Environment management takes the environmental protection as the content of the business, its core is to change the traditional mode of production with mass consumption and waste of resources and environment destruction, and establish new resource-saving production methods which are in favor of environmental protection. This new business strategy has been widely accepted by the government and the community, and has become an important part of enterprise development. New competitive advantages of enterprises are not only from Q (quality), C (cost), t (time), s (service), but also in a series of activities of protecting, cherishing and caring for ecological environment like production environment, management environment, marketing environment. The improved enterprise competitive advantages include five elements, namely Q (quality), C (cost), T (time), S (service) and E (environment) [1-3]. In order to be in an invincible position in the fierce competition, the enterprise must choose the environment management index that is suitable for

the enterprise development, and ensure the smooth operation of the enterprise environment management.

Environmental indicators of corporate environmental management relate to the enterprise culture level, system level, production level, have become the focus in the academic research nowadays. In this paper, competitive advantage model is used to research environmental indicators, determine the relative important factors of environmental management, in order to guide environmental management of enterprises at the present stage.

2. The Construction of Environmental Management Evaluation index System for Heavy Pollution Enterprises

From the angle of enterprise environment management indicators, the selection is made, according to the existing research both at home and abroad, on the basis of the existing index system, by the research of experts and scholars and scoring, important indicators of environmental management are selected to build a relatively comprehensive and objective index system, the main indicators are constructed as shown in Table 1.

The various indicators in the table are interpreted as follows:

① Environmental culture index, the use of culture to run enterprises is the highest level of business management. Environmental culture is displayed in the entrepreneur consciousness, enterprise environment concept, enterprise environment image, external environment exchange and so on.

②Environmental strategy index, environmental strategy index refers to the institutional supporting system made in the implementation of environment management of enterprises and for the purpose of the smooth implementation of environment management, which includes environmental policy, management system, information platform and so on.

③ Environmental production and management index, environmental production and management index generates throughout the production and management activi-

ties of the enterprises, it is the performance of enterprise's green production behavior .

④Environment condition index, Environment condition index refers to the environmental effects of enterprises after the implementation of environmental management, mainly considering three aspects: energy-saving and emission reduction, ecological benefit and sustainable development.

⑤The environmental accounting index, mainly from the two aspects of environmental cost and income to measure.

Table 1. The index system

	Primary indicator	Grade two index
Environmental management index (A)	Environmental culture indicator (Social Responsibility) (A1)	Entrepreneur consciousness(A11)
		Enterprise environment concept(A12)
		Enterprise environment image(A13)
		External environment exchange(A14)
	Environmental strategy indicator (institutional strategy)(A2)	Environmental policy(A21)
		Environmental management system(A22)
		Environmental management system(A23)
		Environmental information platform(A24)
	Environmental production and management index (production and operation) (A3)	Green design(A31)
		Green purchase(A32)
		Green production(A33)
		Green Logistics(A34)
		Green sales(A35)
		Green recovery (A36)
	Environmental benefit index (environmental benefit) (A4)	Conserve energy,reduce emissions(A41)
		Ecological benefit(A42)
		Sustainable development (A43)
	Environmental accounting index (economic benefit) (A5)	Environmental cost(A51)
Environmental benefits (A52)		

3. Assessment Methods for Environmental Management of Heavy Polluting Enterprises

Competitive advantage model is a relatively objective and fair evaluation method, the basic principle is based on the idea of justice, the first step is the evaluation of individual agents, each individual that participates in the evaluation can select the most favorable index weight, then through the comparison with other individuals, the advantages of their own characteristics and their disadvantages compared to other individuals can be obtained, if the individual ranking in front that the individual has a comparative advantage, otherwise, the participating objects can feel a heartfelt admiration to more excellent competitors, if for each applicant, applicants with advantages are relatively concentrated, then benchmark object can be obtained in this group, which can be a good guide for the improvement and development direction of other participating objects. The second step is to evaluate the results obtained by the individual proxy evaluation, and get the fair evaluation rank [4-7].

3.1. The Establishment of the Evaluation Indicator Hierarchy

According to the evaluation index system established above, the factor levels of the indicators can be obtained.: Evaluation index A= (enterprise environmental management index comprehensive evaluation)

First class indicators A= (A2, A3, A4, A5, A1) = (environmental culture, environmental strategy, environmental management, environmental indicators, environmental accounting indicators)

Second class indicators A1= (A11, A13, A14, A12) = (entrepreneur awareness, corporate environmental philosophy, corporate environmental image, external environmental exchange)

A2= (A21, A22, A24, A23) = (environmental policy, policy, environmental management system, environmental management system, environmental information platform)

A3= (A31, A32, A33, A34, A35, A36) = (green design, green procurement, green production, green logistics, green sales, green recycling)

A4= (A42, A43, A41) = (energy saving, emission reduction, ecological benefits, sustainable development)

A5= (A52, A51) = (environmental cost, environmental gains)

(2) Individual proxy evaluation

If there are n objects in the evaluation, the ideal value of the j-th index is B_j^* , then, for each object x_i , we need to establish a group of the most favorable weight number ($w_{i1}, w_{i2}, w_{i3}, w_{i4}, w_{i5}$)

$$\begin{aligned} \min_w d_{ii}^2[B_{ij}, B_j^*] &= \sum_{j=1}^5 w_{ij}^2(x_i)[B_{ij} - B_j^*]^2 \\ \text{s.t.} \sum_{j=1}^5 w_{ij} &= 1 \\ w_{ij} &\geq 0, j = 1, 2, \dots, 5 \quad i = 1, 2, \dots, n \end{aligned} \tag{1}$$

Model (1) of the optimal solution is: ①when the index component value of a participating object I has reached the ideal value, the corresponding weight value of the index of the component that reaches the ideal value is 1, if there are more than two to achieve the ideal value, then averaging the index weights (the sum is 1) that reach the ideal value in the calculation process, and the corresponding weight value of the index that doesn't reach the ideal value is 0. ②When the index component value of participating object I does not reach the ideal value of the component, there are:

$$\begin{aligned} w_{ij} &= \frac{1}{(B_{ij} - B_j^*)^2 \sum_{j=1}^5 \frac{1}{(B_{ij} - B_j^*)^2}} \\ i &= 1, 2, \dots, n \\ j &= 1, 2, \dots, 5 \end{aligned} \tag{2}$$

By formula (2), we can get the optimal weights for each participating object and each individual uses their optimal weight to carry on the appraisal to the other participating objects, such as using the weight of the i-th participating object to evaluate the k-th object, getting the evaluation result for the k-th object:

$$\begin{aligned} d_{ik}^2[B_{kj}, B_j^*] &= \sum_{j=1}^5 w_{ij}^2(x_i)[B_{kj} - B_j^*]^2 \\ \text{s.t.} \sum_{j=1}^5 w_{ij} &= 1 \\ w_{ij} &\geq 0, j = 1, 2, \dots, 5 \\ i &= 1, 2, \dots, n \end{aligned} \tag{3}$$

d_{ik} represents from the individual advantage characteristic of the x_i -th object, to evaluate the difference between the object x_k and the ideal data value, difference is small on behalf of more advantage, calculating all participating objects and the obtained results were sorted in ascending order to evaluate and analyze.

(3) Democratic proxy evaluation

For each participating object I, finally n different comprehensive scores can be obtained, as ($d_{1i}, d_{2i}, \dots, d_{ni}$), the agent democratic evaluation model can synthesize the individual agent evaluation results of each participating object, to measure the arithmetic average of n groups of evaluation results of each participating object, that is the agent democratic evaluation results of the participating object, such as formula (4):

$$\begin{aligned} d_k &= \frac{1}{n} \sum_{i=1}^n d_{ik} = \frac{1}{n} \sum_{i=1}^n \sqrt{\sum_{j=1}^5 w_{ij}^2(x_i)[B_{kj} - B_j^*]^2} \\ i &= 1, 2, \dots, n \\ k &= 1, 2, \dots, n \\ j &= 1, 2, \dots, 5 \end{aligned} \tag{4}$$

In the formula (4), d_k represents for the agent democratic evaluation results of the participating objects, these results are sorted in ascending order, namely it would be better if the value is smaller .

4. Case Study

The paper takes iron and steel enterprises as an example for research, chooses five typical iron and steel enterprises, they are the Shanghai Baoshan Iron and Steel Group, Anshan Iron and Steel Group, Maanshan Iron and Steel Group, Taiyuan Iron and Steel Group, Wuhan Iron and Steel Group. According to the evaluation index system and evaluation model, the paper uses the method of the business environment related field experts, scholars and business professionals scoring to evaluate the environmental management evaluation index of five companies. This paper selects the 10 experts, academics and industry professionals to investigate and score the five iron and steel enterprises according to cultural environment index, environmental strategy index, environmental production and management index, environmental benefit index, environmental accounting index these five aspects, the index scores are obtained as shown in Table 2.

Table 1. Scoring Statistics

Judges Index	N0.1	N0.2	N0.3	N0.4	N0.5	N0.6	N0.7	N0.8	N0.9	N0.10
Environmental Culture Index(A1)	9	7	9	8	7	9	9	7	8	7
Environmental strategy index(A2)	9	8	8	7	8	8	9	8	7	8
Environmental production and management index(A3)	9	7	8	9	8	8	9	8	9	7
Environmental benefit index (A4)	8	9	9	8	7	9	8	7	8	9
Environmental accounting index (A5)	7	8	9	8	7	9	7	7	8	8

Comment: each full marks for 10 points, the total score is 50 points

The optimal weight matrix of (9,9,9,9,9,9,9,9) each person is as follows:

$$W = \begin{pmatrix} \frac{1}{4} & 0 & \frac{1}{4} & 0 & 0 & \frac{1}{4} & \frac{1}{4} & 0 & 0 & 0 \\ \frac{1}{2} & 0 & 0 & 0 & 0 & 0 & \frac{1}{2} & 0 & 0 & 0 \\ \frac{1}{4} & 0 & 0 & \frac{1}{4} & 0 & 0 & \frac{1}{4} & 0 & \frac{1}{4} & 0 \\ 0 & \frac{1}{4} & \frac{1}{4} & 0 & 0 & \frac{1}{4} & 0 & 0 & 0 & \frac{1}{4} \\ 0 & 0 & \frac{1}{2} & 0 & 0 & \frac{1}{2} & 0 & 0 & 0 & 0 \end{pmatrix} \quad (5)$$

According to the weight matrix, five individual agent evaluation scores of each participating object can be calculated, as follows:

$$D = \begin{pmatrix} 0 & 0 & 1 & 1 & 1 \\ 0.5 & 0 & 1.25 & 0 & 0 \\ 0.5 & 0 & 0 & 0.5 & 0.5 \\ 0.5 & 1 & 1 & 0 & 0.5 \\ 1 & 2 & 1 & 0.5 & 0 \end{pmatrix} \quad (6)$$

Through the above matrix we can see that cultural environment index (A1), environmental production and management index(A3),environmental condition index (A4) and environmental accounting index (A5) have their relative strengths, and the relative advantage of environmental strategy index(A2) is not obvious. And the environmental culture index (A1) and environmental production and management index (A3) have relatively more advantages. Through the agent democratic evaluation,we can get the comprehensive score of each contestant index, that is (0.6,0.75,0.3,0.6,0.9), it can be seen that environmental production and management index(A3) has the absolute advantage, and has a relative comparative advantage, so we think the environmental production index (A3) should be its relative major business environment index at the present stage of the enterprise, and gradually spread in the industry.

5. Conclusion

Implementing environmental management is the only way for enterprises to implement sustainable development, the core of enterprise’s strategy in the future is how to improve the level of green business of enterprises, enterprises must find their own road of sustainable development and green business model, plan for the future in terms of technology, methods and investment, which can not only win the benefit of the enterprise itself, but also get greatly improvement in the environment, eventually create a green, environmental protection, and efficient business model. At this stage, the environmental management of most enterprises still remains in the early stages, green culture, green system and business development direction are not mature enough. Therefore, this stage of the enterprise should focus on their own environmental management in the whole process of production, and thus gradually develop into the corporate culture and strategy, and realize the enterprise's comprehensive green development.

References

- [1] He Zhe. Enterprise environment management and enterprise competitive advantage [J]. Henan social science.2004,12 (3): 119-120.
- [2] Sun Minghua. Economic issues of environmental management.2004 (10): 28-30.
- [3] Cheng Yongming.The environmental management idea of Japanese enterprise and its practice [J]. modern Japanese economic.2010 (1): 40~45
- [4] Feng Hailong. The construction and application of basic competitive advantage model [J]. China industrial economy. 2003 (10)
- [5] Wang Qimin, Zhao Xinan, warm. A method for evaluating the competitive advantages and its application [J] Shenyang: 2008 (10) of the Journal of system management
- [6] Zhao Xi Nan Wang Qi.ZHU chun-hong.An objective Individuality Indentification Method on objective Limited[J].Systems Engineering-Theory Methodology Application 2006,15:459-466. [6]
- [7] Zhang Lili. Identification method for the competitive advantage and its application [D]. Northeastern University, 2010