Social Performance Evaluation Study of Iron and Steel Enterprise A from Environmental Management Angle

Wei Wang [1, a], Hongchang Li [2, b], Jing Zhang [3 , c]

[1]University of Science and Technology LiaoNing, Anshan, 114000, China;

[2] University of Science and Technology LiaoNing, Anshan, 114000, China;

[3]State Grid Anshan Electric Power Supply Company, Anshan, 114000, China;

[a]wangwei8978@163.com,[b]aslhc@126.com,[c]58206630@qq.com

Abstract

Economic performance, environmental performance and social performance are the comprehensive conveyors of environmental management performance study of iron and steel enterprises, and of which social performance is the most crucial component. It is not only an overall indicator of social significance and contribution made during operations of iron and steel enterprises, but also an undertaker of responsibilities and obligations due. This thesis, selecting a typical iron and steel enterprise A as its subject, by using catastrophe progression method based on data from 6 years to evaluate social performance, is aiming at urging iron and steel enterprises to actively assume social responsibilities and shaping good images in this field and even to form a strong social force.

Keywords

Environmental Management, Iron and Steel Enterprises, Social Responsibilities.

1. Background Information of Iron and Steel Enterprise A

Iron and Steel Enterprise A, which was founded in the year of 1978 in Baoshan District, Shanghai, China, leaped into the most significant iron and steel enterprise with the highest technologies level in China. From 2012 on, Iron and Steel Enterprise A has always been engaged in implementing 2013-2018 Enterprise Development Strategy, carrying out environmental management during many product-manufacturing links, suck as procurement, producing, marketing, logistics and recycling. Iron and Steel Enterprise A, the initiator and practitioner the industrial chain of green iron and steel industry[1] , takes an active role in manufacturing beneficial measures for environmental protection, helping shape the distinctive environmental management practices. Hence, this current thesis chose this typical Iron and Steel Enterprise A as a research subject.

2. Construction of Evaluation Index System

2.1 Building of Index System

Social performance refers to the degree of social significance and social responsibilities after implementation of environmental management of iron and steel industries, covering social impacts and product liabilities. Social performance index is made on main basis of Social Responsibilities Report Guideline of Chinese Enterprises (CASS—CSR1.0) and the details are elaborated clearly on relevant evaluation indices of corporate social responsibilities as well as features of environmental management of Chinese iron and steel enterprises[2] . This current thesis adopts index system with reference for Table 2.1.

Table 2.1 Social Performance Index System

Main Objective	Grade-I Index	Grade-II Index
Social Performance A_0	Social Impact B_1	C_1 Social Contribution Rate
		C_2 Customer Satisfaction
		C_3 Employee Satisfaction
		C_4 Ratal
	Product Liability B_2	C_5 Development Rate of New Products
		C_6 Scientific Spendings
		C_7 Certified by ISO9000 or Not

2.2 Determination of Evaluation Methods

Catastrophe theory emerges on the combination of mathematical theory and catastrophe progression, which decomposes the multi-objective layers by the significance degree of indices step by step, leading to the formation of catastrophe function and by using normalization formula, the overall evaluation can be made and the overall catastrophe fuzzy membership function can be calculated. The advantage is that only relative significance of each index needs to be measured, so that this could be done in a scientific, reasonable and objective way[3].

The evaluation index system of this current thesis is a treelike structure in which index of each level corresponds to that of upper level and each of them is equipped with the only one and unique variable. In view of this, this current thesis makes an analysis from catastrophe models of Butterfly Catastrophe, Cusp Catastrophe and Swallowtail Catastrophe.

(1) Cusp Catastrophe Model: $f(x) = x^4 + ax^2 + bx$

Normalization Formula of Cusp Catastrophe Model:

$$x_a = a^{1/2}\ ,\ x_b = b^{1/3} \tag{1}$$

Relationship of two variables: the significance of variables is getting weakened counted from left to right and if this index can be decomposed into two sub-indexes, this can be taken as a cusp catastrophe system[3].

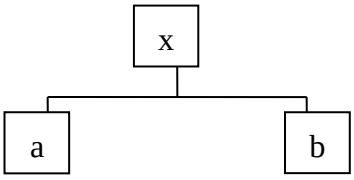

Fig 2.1 Variables Relationship Diagram of Cusp Catastrophe

(2) Swallowtail Catastrophe Model: $f(x) = x^5 + ax^3 + bx^2 + cx$

Normalization Formula of Swallowtail Catastrophe Model:

$$x_a = a^{1/2}\ ,\ x_b = b^{1/3}\ ,\ x_c = c^{1/4} \tag{2}$$

Relationship of two variables: the significance of variables is getting weakened counted from left to right. If this index can be decomposed into three sub-indexes, it can be taken as a swallowtail catastrophe system[3].

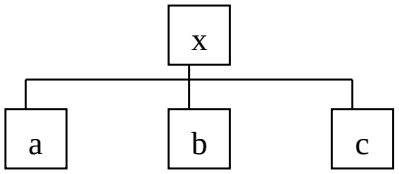

Fig2.2 Variable Relationship Diagram of Swallowtail Catastrophe

(3) Butterfly Catastrophe Model: $f(x) = x^6 + ax^4 + bx^3 + cx^2 + dx$

Normalization Formula of Butterfly Catastrophe Model:

$$x_a = a^{1/2},\ x_b = b^{1/3},\ x_c = c^{1/4},\ x_d = d^{1/5} \qquad (3)$$

Relationship of two variables: from left to right,the significance of variables is getting weakened counted.If this index can be decomposed into four sub-indexes, this can be taken as a butterfly catastrophe system[3].

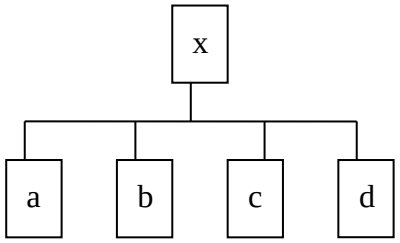

Fig2.3 Variable Relationship Diagram of Butterfly Catastrophe

3. Empirical Analysis

3.1 Data Collection and Analysis

3.1.1 Data Collection

Evaluation Index System covers quantitative indexes and qualitative indexes and the followings are assignment rules of index data: quantitative indexes are obtained through calculation of relevant statistics based on iron and steel enterprises, while qualitative indexes are obtained through questionnaires and expert consultations of interest-related parties. The value range of indices like “Certified by ISO14000 or Not” is: “Yes” is 1, while “No” is 0. Please refer to Table 3.1 for original data after initial conversion and processing.

Table 3.1 Table of Social Performance Evaluation Index of Iron and Steel Enterprise A from 2007 to 2012

Main Objective	Grade-I Index	Grade-II Index	Iron and Steel Enterprise A					
			2012	2011	2010	2009	2008	2007
Social Performance A_0	Social Impact B_1	C_1 Social Contribution Rate	0.331	0.327	0.321	0.314	0.304	0.298
		C_2Customer Satisfaction	92.63	90.8	90.1	92.48	92.57	92.17
		C_3Employee Satisfaction	99.78	99.76	99.79	99.75	99.7	99.59
		C_4 Ratal	82.3	79.5	74	71	156	58.9
	Product Liabilit B_2	C_5 Development Rate of New Products	0.726	0.692	0.531	0.429	0.417	0.386
		C_6 Scientific Spendings	56.82	53.46	50.98	23.38	27.19	16.8
		C_7 Certified by ISO9000 or Not	1	1	1	1	1	1

Data Source: Social Responsibilities Report of Iron and Steel Enterprise A from 2007 to 2012 [4]and Shares of Iron and Steel Enterprise A: Sustainable Development Report 2012[5].

3.1.2 Data Processing

Since discrepancies of properties and units lie in each index of evaluation index system, a direct comparison is not possible in each index. This current thesis processes relevant data in use of dimensionless methods with calculation formulas like Formula (4) and Formula (5) so as to facilitate study, converting all collected data into those data that can be made direct comparisons between [0,1] with.

$$\text{Positive Index: } V_{ij} = \frac{U_{ij} - U_{\min j}}{U_{\max j} - U_{\min j}} \quad (4)$$

$$\text{Negative Index: } V_{ij} = \frac{U_{\max j} - U_{ij}}{U_{\max j} - U_{\min j}} \quad (5)$$

Moreover, i=1, 2…, m (m is the index value); j=l, 2…, n (n is the index value). Please refer to Table 3.2 on the eventually processed data obtained from relevant data by using the above-mentioned formulas.

Table 3.2 Table of Social Performance Evaluation Index of Iron and Steel Enterprise A from 2007 to 2012 after Standardized Processing

Main Objective	Grade-I Index	Grade-II Index	Iron and Steel Enterprise A					
			2012	2011	2010	2009	2008	2007
Social Performance A_0	Social Impact B_1	C_1 Social Contribution Rate	1	0.879	0.697	0.485	0.182	0
		C_2 Customer Satisfaction	1	0.277	0	0.941	0.976	0.818
		C_3 Employee Satisfaction	0.95	0.85	1	0.8	0.55	0
		C_4 Ratal	0.241	0.212	0.156	0.125	1	0

	Product Liability B_2	C_5 Development Rate of New Products	1	0.9	0.426	0.126	0.091	0
		C_6 Scientific Spendings	1	0.916	0.85	0.164	0.26	0
		C_7 Certified by ISO9000 or Not	1	1	1	1	1	1

3.2 Evaluation Process

Take all evaluation indices of Iron and Steel Enterprise A in 2012 as an example, the calculation steps and results are shown as below:

(1) Grade-I Index

① C1, C2, C3 and C4 constitute butterfly catastrophe model, belonging to the complementary model and on basis of Formula (3), we can have:

$$x_a = x_{c1}^{1/2} = 1^{1/2} = 1$$

$$x_b = x_{c2}^{1/3} = 1^{1/3} = 1$$

$$x_c = x_{c3}^{1/4} = 0.95^{1/4} = 0.99$$

$$x_d = x_{c4}^{1/5} = 0.241^{1/5} = 0.75$$

On basis of calculation rules of means in complementary model, $x_{B1} = (x_{c1}^{1/2} + x_{c2}^{1/3} + x_{c3}^{1/4} + x_{c4}^{1/5}) / 4 = 0.94$

② C5, C6 and C7 constitute swallowtail catastrophe model, belonging to the complementary model and on basis of Formula (2), we can have:

$$x_{B2} = (x_{c5}^{1/2} + x_{c6}^{1/3} + x_{c7}^{1/4}) / 3$$

$$= (1^{1/2} + 1^{1/3} + 1^{1/4}) / 3$$

$$= (1+1+1) / 3$$

$$= 1$$

(2) Grade-II Index

① B1 and B2 constitute cusp catastrophe model, belonging to the complementary model and on basis of Formula (1), we can have:

$$x_{A0} = (x_{B1}^{1/2} + x_{B2}^{1/3}) / 2 = (0.97^{1/2} + 1^{1/3}) / 2 = 0.99$$

In the same way, the scores of each index of Iron and Steel Enterprise A from 2007 to 2011 can be calculated and please refer to Table 3.3 for their results.

Table 3.3 Environmental Management Performance Evaluation Results of Iron and Steel Enterprise A from 2007 to 2012

Year / Index	2012	2011	2010	2009	2008	2007
Social Impact B_1	0.94	0.82	0.63	0.82	0.82	0.24
Product Liability B_2	1	0.97	0.87	0.63	0.65	0.33
Social Performance A_0	0.99	0.95	0.87	0.89	0.89	0.59
Social Performance Rankings	1	2	3	4	5	6

3.3 Result Analysis

Analyzed from evaluation results, social performance of Iron and Steel Enterprise A is on the rise with each passing year, which explains that this enterprise pays growing attention to social responsibilities and corporate images besides conducting environmental management with peak point occurred in the year of 2012 and lowest 2007. Judged from a single index of social impact, social contribution rate is rising in a gradual way, which means increasing social involvement and more social responsibilities are taken from enterprise's side. However, little fluctuation occurred in customer satisfaction, employee satisfaction and ratal, whose are indicators that employee welfare should be improved and profit making capacity should be strengthened. From the angle of product liability, that Iron and Steel Enterprise A has passed the quality certification of ISO9000 since 2007 and increasing R&D spendings of new products proves more focus have been shifted towards scientific and technological level, product quality, development of new products, elimination of backward equipment and technologies as well as energy saving measures. Iron and steel enterprises should coordinate these following three aspects, i.e. economic gains, environmental protection and social benefits and only by achieving a well-coordinated and orderly development that the environmental management of iron and steel enterprises can be enhanced in real essence.

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