

Environmental Effect Model of ISO 14001 on Small and Medium Sized Enterprises

Fauzy AMMARI¹ Takeshi NONOMURA² and Yuichiro WAKAHARA²

Abstract: ISO 14001 registration may become a necessary condition for all Small and Medium Sized Enterprises (SMEs) in future global competition. The SMEs play an important role in a real contribution to local and global environmental quality protection. However, applying ISO 14001 is not easy. The outputs, products, processes, and activities in the enterprises should be poured in term of demanding and require commitment and dedication of the ISO 14001 principal. The understanding of the environmental effects is one of the recognized components within the environmental management system. In doing so, to show the environmental effect performance, develop an evaluation model as a strategy to measure the environmental effect is absolutely required in long run of ISO 14001 applications. Thus, this paper is concerned with the preliminary mathematical model of evaluation tactics for measuring environmental effects of ISO14001. The aim being to identify approximately those effects where there is a positive environmental reason for management spirit. The relevant of evaluation performance can be used for understanding and improving present situation activities in these enterprises.

Keywords: ISO 14001, Environmental Effect, Small and Medium Sized Enterprises

1. INTRODUCTION

Small and medium sized enterprises (SMEs), it is defined as a firm with less than 500 employees, will likely be dramatically affected by the movement toward a formal global environmental management system, as they have been impacted by other manifestations of globalization, (Miles et al., 1999). As far as we know, ISO is a global federation of more than 130 national member bodies, created shortly after World War II to develop international manufacturing and communications standards. Regarding environmental management system, in September 1996, ISO published the first of the ISO 14000 series standards.

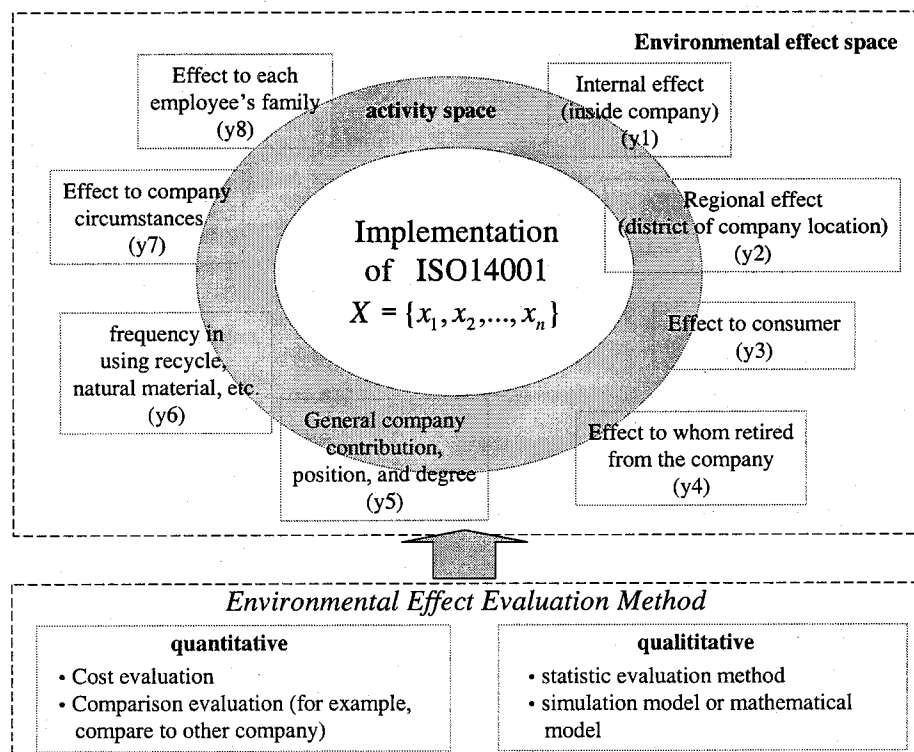


Figure 1. Some environmental effect, Interaction of vector X, and vector Y.

¹ Member of JSCE, Dr. Eng., Environment and Planning, Dainichi Consultant Inc. F-Ammari@dainichi-consul.co.jp

² Dainichi Consultant Inc., Yabuta Minami 3-1-21, Gifu-Shi 500-8384, Japan Tel:058-271-2506 Fax:058-276-6417, nonomura-T@dainichi-consul.co.jp, wakahara-yuichiro@dainichi-consul.co.jp, http://www.dainichi-consul.co.jp/

In response to stakeholder needs and environmental concern, many companies, however, are integrating aspects, such as those included in ISO 14000, into their business plans (Graff, 1997). Recently, ISO 14001 as a part in ISO 14000 is familiar as a tool to solve management system problem in SMEs. By December 1999, roughly 13,370 organizations in 75 countries were certified to the ISO 14001 EMS standard. It can be described generally that the benefit of environmental management system as follows:

(1) Assuring customers of commitment to demonstrable, (2) Environmental management, (3) Maintaining good public/community relations, (4) Satisfying investor criteria and improving access to capital, (5) Obtaining insurance at reasonable cost, (6) Enhancing image and market share, (7) Meeting vendor certification criteria, (8) Improving cost control, (9) Reducing incidents that result in liability, (10) Demonstrating reasonable care, (11) Conserving input materials and energy, (12) Facilitating the attainment of permits and authorizations, (13) Fostering development and sharing environmental solutions, (14) Improving industry-government relations, etc.

In this study, we attempt to develop a way based on mathematical simulation approach to evaluate environmental effects of the application of ISO 14001. The environmental effect is defined as the contribution of small and medium sized enterprises (SMEs) to reduce environmental load in their daily activity based on ISO 14001.

2. ANALYSIS

We assume that in the starting point, the environment quality was low when the ISO 14000 begins to improve the quality of environment. Thus, mathematically, the initial activities have been doing to lift up the value of environment quality. As shown in equation (1)-(3), the problem is how Y can be obtained from X. Here, logically, when the activity of improvement is high, the environmental effect is high. In other words, the control of using energy in each small and medium sized enterprises become improved, the contribution to environmental quality also improved. Vector X can be used to show the term of activities in each company. Same activities in all companies are given by same variable x.

$$\begin{aligned} y_1 &= F(X) = f(x_1, x_2, \dots, x_n) \\ y_2 &= F(X) = f(x_1, x_2, \dots, x_n) \\ &\vdots \\ y_m &= F(X) = f(x_1, x_2, \dots, x_n) \end{aligned} \quad \dots\dots\dots (1)$$

Where:

$$X = \{x_1, x_2, \dots, x_n\} \quad X \in R \quad \dots\dots\dots (2)$$

$$Y = \{y_1, y_2, \dots, y_m\} \quad Y \in R \quad \dots\dots\dots (3).$$

Actually, the problem is defined in multi variables, it brings some difficulties to determine type of function to show the phenomena of environmental effect.

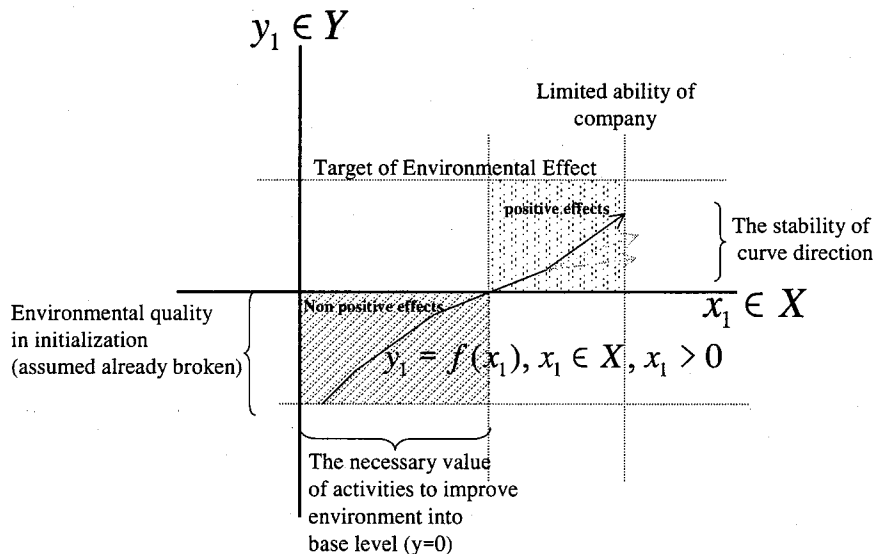


Figure 2. Environmental effect phenomena follows logarithmic function characteristic.

The phenomena mentioned above follows closely to logarithm function, see equation (4). Logarithmic functions were used extensively in computation, almost in the form of tables of logarithms to the base 10. For a positive number n , the logarithm of x (written $\log x$) is the power to which some number b must be raised to give n . here b is the base of the logarithm; i.e.

$$y = \log_b x, \quad \text{if } b^x = y \quad \dots\dots\dots (4).$$

Where $x \rightarrow 0 \Rightarrow y \rightarrow -\infty$
and b is positive constant.

To do the analysis, we describe some other functions and its characteristics roughly, see figure 2 and figure 3.

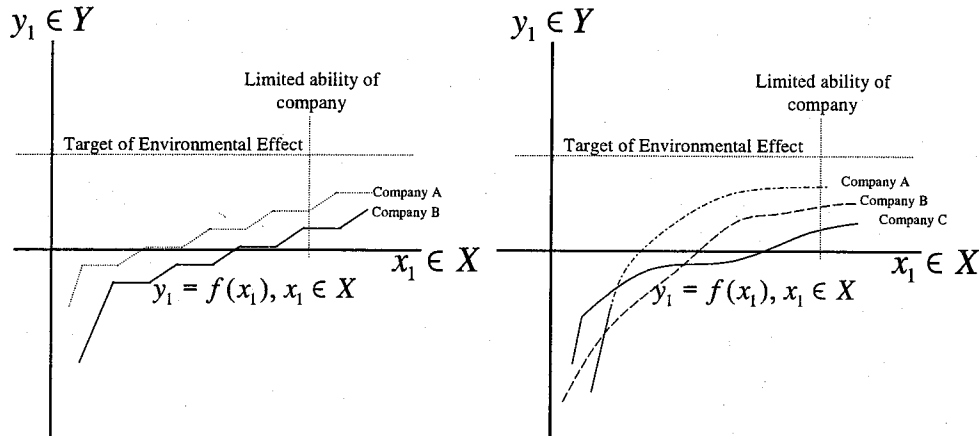


Figure 3. Other alternative curves in expressing the environmental effects.

3. NUMERICAL EXAMPLE

Actually, it is difficult to determine the environmental effect exactly, because it is depend on multi variables. However, generally, in small and medium sized enterprises, control of using copy papers can be used as an initial activity for practicing the element of ISO 14001. Some difficulties in control of using papers number are on the how many number was using for a type of work and where the papers will be putted after used, inside the company or bring out. Also, some difficulties come in backup the data of the number of reuse papers transferred from copied papers in each unit purchased. An easy way of controlling the fluctuation of papers number in a company is done on purchasing volume during a year work. Table 1 shows the three years data of virgin paper and recycle paper purchasing in each month.

Table 1. Purchased data of virgin paper (copy paper) and recycle paper at Dainichi Consultant.

Year 1998			Year 1999			Year 2000		
Months	virgin paper purchasing (sheet)	recycle paper purchasing (sheet)	Months	virgin paper purchasing (sheet)	recycle paper purchasing (sheet)	Months	virgin paper purchasing (sheet)	recycle paper purchasing (sheet)
4	384000		4	172,250	37,000	4	125,125	50,500
5	388750		5	111,000	35,000	5	129,250	52,500
6	447125		6	132,625	32,500	6	130,000	57,500
7	188500		7	145,375	24,500	7	107,250	48,000
8	125250		8	145,750	36,000	8	92,000	47,000
9	182500		9	129,125	28,500	9	135,250	58,000
10	202000	19125	10	211,625	49,500	10	134,000	54,000
11	165500	16125	11	151,000	34,000	11	146,750	65,000
12	155500	15500	12	167,750	34,000	12	111,000	48,000
1	128000	10500	1	145,750	42,000	1	161,125	70,000
2	169250	29000	2	135,250	92,000	2	148,750	64,500
3	203750	34500	3	181,500	65,500	3	151,000	67,500
total	2740125	124750	total	1829000	510500	total	1571500	682500

In this numerical example, we use purchasing data of papers in Dainichi consultant from 1998 until 2000. Copy paper (virgin paper) and recycle paper dominated the number of purchasing paper type. The type of paper data presented here is A4 paper size. The variable x works as a policy of an activity in handling paper using based on application of ISO 14001. The higher of x value means the higher of strictly policy implementation on the related activities. In this simple example, a variable y (environmental effect variable) depends on a variable x (in more closely real problem, a y depend on many x). A

logarithmic function is chose as an alternative to show the relation between x and y. The result of calculation after data calibrated is shown in figure 4. Positive effect ($y > 0$) found in the x value more than 148750 sheets purchasing of copy paper. The increasing of paper purchasing caused the bad environmental effect ($y < 0$, non positive effect). The curve shows that positive environmental effect going up slowly. In other words, to find a better environmental effect, it takes highly discipline of policy implementation. On the contrary, non-positive environmental effect (destruction effect) will be quickly occurred within low discipline of policy implementation.

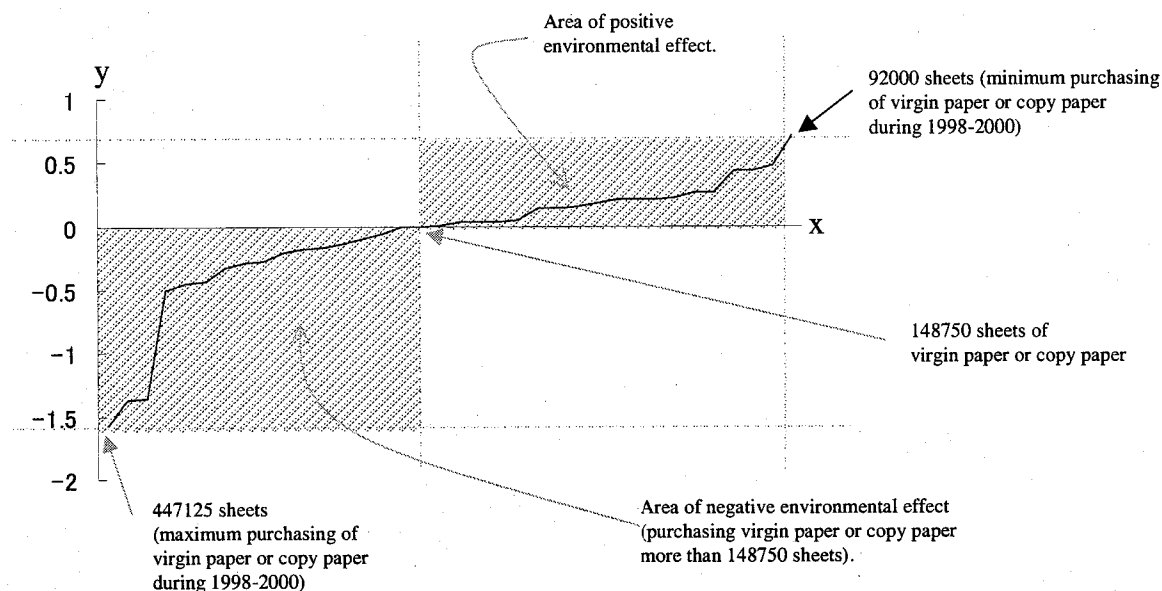


Figure 4. Calculation result shows the environmental effects.

4. CONCLUSION

The ISO 14001's research related to this problem is still rare, it can be concluded that this preliminary study can be used as a framework. To find the environmental effect caused by ISO 14001 activities in small and medium sized enterprises (SMEs) is difficult in class of measuring the effect quantity. The proposed procedure is mathematical simulation approach. It needs an analysis of existing data from some enterprises in many countries. The simple numerical example ($y=f(x)$) shows the possibility of the model application and the development. The future studies are mainly focus on finding the functions that can be expressed closely to the environmental effect phenomena in each case of effect. It requires a collection of databases of ISO 14001 applications from many small and medium sized enterprises.

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