Mechanism of Corporate Environmental Management: Empirical Study for Japanese and U.S. Companies

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Abstract

This article examines the environmental behavior of Japanese and U.S. manufacturing firms, and how the firm scale, industry type and external pressure relate to corporate environmental management. For the analysis of environmental management of firms, we used the data which was collected from the questionnaire survey conducted in 2007. The sample sizes of effective answer are 318 Japanese firms and 167 U.S. firms.

As for the practices of environmental management in Japan and the U.S., difference between firm sizes and industry type is more obvious in Japan than the U.S. In Japan, most of items show significantly higher average score in large scale firms. This means that large scale firms tend to perceive better in each of environmental practices implemented. In the U.S. firms, large firms tend to show higher average score but organizational initiatives like top management leadership and employee participation is higher in the medium and small sized firms. Pressure from community about environmental activity is significantly higher in small firms in Japan. On the other hand, pressures from government, community, and customers are all higher in the large firms in the U.S.

Economic benefit from environmental management is perceived to be stronger in large firms than in small and medium sized firms in both countries. From this result, we find that large firms significantly recognize the benefit positively in Japan and U.S. However, overall benefit compared to cost is not perceived significantly in Japan. Furthermore, small and large size firms recognize the benefit from environmental management over than environmental activity cost in U.S.

The major findings are summarized as follows. First, the corporate environmental management in Japan is being promoted by the external pressures, particular emphases are placed on the significant impacts of pressures from government and market. Secondly, it is found that the environmental activity and strategy are the path dependency of firm scale in Japan. On the other hand, the environmental management activity of U.S. firms is not affected by pressure from government, community and customer but by other factor.

1. Introduction

It has been 20 years since the broader discussion on sustainable development started. In 1987, the UN "World Commission on Environment and Development" report presented the fundamental principles of sustainable development (WCED 1987). During the Earth Summit (UNCED) in 1992, governments agreed with concepts of sustainable development, contained in the Agenda 21. In 1997, the Kyoto Protocol was signed to combat climate change and reduce greenhouse gas emissions.

With the development of this social and economic framework, firms gradually made efforts to reduce their environmental burden (Schmidheiny 1992, DeSimone and Popoff 1997). Environmental measures such as acquisition of ISO14001 certification, Green procurement, Life Cycle Assessment (LCA), Design for Environment (DfE), efforts in reducing CO_2 emissions and other activities, have been introduced. "Changing Course" by Schmidheiny (1992) advocates a paradigm shift in management wherein firms can enhance environmental behavior while increasing economic output. In 1991, Nihon Keidanren (Japan Federation of Economic Organizations) published the Keidanren Global Environment Charter. It mentioned that "Tackling with environmental problems is essential to one's own existence and activities." However, the promotion of environmental activities is a huge challenge.

To achieve a sustainable society, it is necessary to understand the organizational mechanisms in the simultaneous pursuit of economic and environmental performance, while formulating appropriate government policies. This article examines the environmental behavior of Japanese and the US manufacturing firms, and how the external factor relates to environmental management strategy.

2. Literature review

This section discusses previous research on the Cooperate environmental management. In terms of research focus, previous studies can be divided into three groups. The first group examines the relationship between environmental performance and external factor such as environmental regulations. Porter suggested that properly designed environmental regulations can encourage technological development, promote firms' environmental activities and can enhance environmental performance (Porter 1991, Porter and v.d.Linde 1995). Then, it is regarded that technological development and improvement in resource productivity can increase firms' competitive advantage and will enhance their overall economic performance. With regard to environmental regulations, policy decision such as environmental taxation is one of the main issues.

The second body of literature investigates the relationship between economic performance and environmental performance. Empirical studies have tried to assess whether a balanced relationship can exist between environmental and economic performance (Russo and Fouts 1997, Hart and Ahuja 1996, Wagner et al. 2002). Some researchers argue that there is no positive relationship between economic and environmental performance (Walley and Whitehead, 1994) or that it may occur only under specific condition (Rugman and Verbeke 1998, Palmer et al. 1995). Multiple regression analysis was used to

examine the relationship; research findings in the US (Hart and Afuja 1996, Konar and Cohen 1997, Al-Tuwaijiri et al. 2004), UK (Thomas 2001), Germany (Wagner et al. 2002) and Japan (Kimbara and Kaneko 2005, Nakao et al., 2007) were presented.

The third category of existing literature focuses on the environmental efforts and practices that can improve economic performance (Nerht 1998). For this purpose, it is useful to adopt a resource-based view to shed light on strategy and organizational capabilities that lead to enhanced performance, as it regards resources and capabilities as a basis of growth. Florida (1996) and Shrivastava (1995) discussed whether a proactive environmental strategy enhances economic performance. There is also evidence on whether total quality management and participatory management can increase environmental performance. Green supply chains and environmental management systems were also pointed out by Schaltegger and Synestvedt (2002).

In terms of performance, many studies have been done in the past decade to investigate the relationship between economy and environment, but most of researches have not explained the mechanism of the environmental management. Using the data from the survey in Japan and the US, we try to clarify the organizational mechanism between external factor and environmental behavior.

3. Data and model

The data was collected from the questionnaire survey conducted in 2007. In Japan, the questionnaires were sent by mail to 1,100 firms which are listed companies on the Tokyo stock exchange market during November and December in 2007 and collected 318 effective answers. In the US, we use telephone interview to 1000 firms during May to July, 2007. Effective answers were 167. We use these samples for analysis in this paper. Information was taken from the answers in the questionnaire, using a 5-point Likert scale[1].

To compare the questionnaire survey result by firm scale and type of industry, we separate the dataset as following. In firm scale grouping, we divide three groups which are “Small size”, “Medium size” and “large size”. Small size group is including firms whose employees are less than 299, medium size group is including firms whose employees are more than 300 and less than 999, large size group is including firms whose employees are more than 1000. The sample number of each group is Small(43), Medium(113) and Large(162) in Japanese firms, Small(52), Medium(23) and Large(92) in U.S. firms.

In type of industry grouping, we divide three groups which are “Daily commodity industry”, “Basic materials industry” and “Processing and assembly industry”.

[1] An exception of measurement is organizational indicator of environmental management system, (environment report, ISO 14001 certification, environmental accounting). The evaluation was made to describe the status of indicators whether it is in (i) implementing stage of formulation (=1), (ii) no plans to introduce or to formulate (=0).

This classification is based on the industrial statistic published by Ministry of Economy, Trade and Industry in Japan[2]. Table1 and Table2 show the sample number of each industry.

Table1. Number of Sample by type of industry in Japan.

Daily commodity (53)		Basic Material (113)		Processing and assembly (152)	
Food	26	Pulp, paper	6	Machinery	38
Beverage	4	Rubber	7	Computer and Electrical equipment	26
Textile Mills	9	Chemical	49	Telecommunications equipment	17
Wood	2	Coal, Oil	3	Electronic device	21
Furniture	3	Plastic	6	Transportation Equipment	41
Other industry	5	Ceramic	11	precision machine	9
Publish	4	Primary Metal	11		
		Non-ferrous Metal	11		
		Fabricated Metal	9		

Table2. Number of Sample by type of industry in U.S.

Daily commodity (31)		Basic Material (70)		Processing and assembly (66)	
Food	16	Coal, Oil	4	Machinery	14
Beverage	4	Chemical	52	Computer and Electrical equipment	38
Textile	5	Primary Metal	3	Electronic device	8
Publish	6	Fabricated Metal	6	Transportation Equipment	6
		Paper	5		

To clarify the relationship between external factor and environmental management factor (EMF), we apply the regression model as following. We apply the ten environmental management factors as dependent variable.

$$EMF = \beta_1 GOV + \beta_2 COM + \beta_3 CUS + \beta_4 EMP + \beta_5 Daily + \beta_6 Material + \beta_7 Processing + C \quad (1)$$

*EMP means number of employees, Daily, Material and Processing are dummy variable.

4. Result

4-1. Comparison by scale and type of industry

(1) Japanese firms result

Table3 and Table4 show the average score of the questionnaire survey result by scale and type of industry. In Table3 and Table4, we indicate each question by using sign such as GOV and COM[3]. We apply the Kruskal Wallis test to verify the significantly differences among the firms scale groups and type

[2] Daily commodity industry is including foodstuffs, Beverages/ feed/ tobacco, textiles, clothing/ other textile products, furniture/ furnishing, publishing/ printing. Basic material industry is including lumber /wood products, pulp/ paper/ paper processing, chemicals, petroleum and coal products, plastic products, rubber products, ceramics/ earthenware, iron and steel, non-ferrous metals, and metal products. Processing and assembly industry is including general machinery, electrical machinery, transportation machinery and precision machinery.

[3] Meaning of each sign is shown in the appendix.

of industry groups.

From Table3, most of items show significantly higher average score in large firms. This means that large firms tend to perceive better in each of environmental practices implemented.

Table3. Average score of questionnaire survey by type of scale and industry in Japan.

	All Sample	By firm scale					By type of industry				
		Small	Medium	Large	K-wallis test		Daily	Material	Processing	K-wallis test	
	N=318	N=43	N=113	N=162	P-value		N=53	N=113	N=152	P-value	
GOV	3.78	3.86	3.64	**3.86**	0.072	*	3.66	**3.96**	3.69	0.034	**
COM	3.62	**3.88**	3.46	3.65	0.022	**	3.40	**3.90**	3.48	0.000	***
CUS	4.03	3.81	4.05	**4.07**	0.323		3.58	4.03	**4.19**	0.000	***
LDS	4.35	4.35	4.19	**4.46**	0.010	***	4.30	**4.39**	4.33	0.590	
PAR	4.02	3.91	3.86	**4.16**	0.004	***	3.98	**4.04**	4.02	0.797	
VOI	3.89	3.83	**3.93**	3.88	0.773		3.86	**3.90**	3.89	0.800	
PRI	4.40	4.19	4.23	**4.57**	0.000	***	4.21	**4.50**	4.39	0.058	*
ISO	0.93	0.77	0.92	**0.99**	0.000	***	0.79	0.94	**0.98**	0.000	***
REP	0.65	0.35	0.52	**0.82**	0.000	***	0.57	0.65	**0.68**	0.266	
ACC	0.53	0.19	0.35	**0.75**	0.000	***	0.47	**0.56**	0.53	0.561	
PRO	4.53	4.26	4.38	**4.71**	0.000	***	4.44	**4.56**	4.55	0.390	
DSG	4.33	3.88	4.34	**4.44**	0.000	***	3.92	4.33	**4.46**	0.000	***
RCY	4.59	4.21	4.55	**4.72**	0.000	***	4.62	4.50	**4.65**	0.410	
WWAT	4.40	3.97	4.25	**4.61**	0.000	***	4.31	**4.48**	4.38	0.437	
WAIR	4.37	4.13	4.20	**4.54**	0.001	**	4.28	**4.46**	4.34	0.170	
CO2E	4.28	4.02	4.11	**4.48**	0.000	***	4.08	**4.35**	4.31	0.038	**
STA	4.44	4.47	4.35	**4.50**	0.145		**4.49**	4.42	4.44	0.967	
CLA	3.37	**3.53**	3.26	3.41	0.077	*	3.25	**3.40**	3.39	0.231	
SOL	3.93	3.95	3.81	**4.01**	0.273		3.87	3.83	**4.03**	0.138	
BEN	3.73	3.33	3.51	**3.98**	0.000	***	3.77	3.63	**3.78**	0.649	
OVER	2.91	**3.00**	2.88	2.91	0.677		**2.96**	2.90	2.90	0.912	

*, **, *** mean the 10%, 5%, 1% level significance, respectively.

We find Japanese firms recognize the pressure from market and consumers stronger than from government and community. Moreover, differences of cognition of external factor among type of industry are larger than among firm scale. Basic material industry recognizes pressure from government and community. Basic material industry is polluted industry in general, government, community and residence around the plant have interest their environmental activity and performance. On the other hand, processing and assembly industry recognize the pressure from market and consumer strongly. Because consumers can check the goods made by processing industry directly in the shop, and product consume the electricity and energy to work. So, consumers check the efficiency of product to minimize running cost. This background affects the answer to question about eco-design (DSG). Processing industry try to develop more eco-friendly design to get the market competitiveness. Most Japanese firms in this study

obtain ISO14001 certificate. The motivation of the obtain ISO14001 are to impress eco-friendly image to consumers, terms from parent company which try to make green supply chain, Bank set the low interest rate for firms which has ISO14001 certificate, one important condition to accept the order from government. Because of these advantages, Japanese firms have high motivation to obtain ISO14001 certificate. The progresses of environmental efforts in large firms are made in order of waste management and recycling (RCY), manufacturing process (PRO) and product development and design (DSG). On the other hand, small size firms recognize the environmental efforts on waste management and recycling are progressed than product development and design.

The reason in part of this is explained by such consideration as that waste disposal and recycling, which can be outsourced, allow the smaller firms to take immediate actions, while solving the individual technical problems is needed for the changes in product design change. With the development of infrastructures for realizing recycle-oriented society, the outsourcings of waste management and recycling is getting accessible, thereby the firms can easily address this issue.

With the increase in the size of firms, the environmental efforts are spreading over the business cycles in such a way that the environmental efforts on manufacturing process, waste management and recycling and product design are advanced in order. On the other hand, it also indicates that the smaller firms have possibility to be delayed or remain their efforts at the lower level.

(2) U.S. firms result

Next, we discuss the result of U.S. firms in Table4. We find U.S. firms recognize the pressure from government stronger than from community and market. This result is opposite to Japanese firms result. Regarding each firms size group, large firms tend to show higher average score but organizational initiatives like top management leadership and employee participation is higher in the medium sized firms in the U.S. firms. Meanwhile the result of Kruskal-Wallis test shows that we cannot say there are significant differences. Pressures from government, community and customers are higher in the large firms in U.S.

Table4. Average score of questionnaire survey by type of scale in US

	All Sample	By firm scale					By type of industry				
		Small	Mediu	Large	K-wallis test		Daily	Materia	Processin	K-wallis test	
	N=167	N=52	N=23	N=92	P-valu		N=31	N=70	N=66	P-valu	
GOV	3.95	3.92	3.83	**4.00**	0.601		**4.10**	3.99	3.85	0.456	
COM	3.68	3.54	3.70	**3.77**	0.381		3.58	**3.84**	3.57	0.203	
CUS	3.55	3.22	3.29	**3.77**	0.027	**	3.23	3.32	**3.91**	0.002	**
LDS	3.99	3.81	**4.09**	4.07	0.418		3.84	**4.10**	3.94	0.728	
PAR	3.91	3.98	**4.04**	3.84	0.386		3.81	**4.04**	3.82	0.310	
VOI	4.13	**4.22**	3.87	4.14	0.668		3.90	4.16	**4.20**	0.309	
PRI	3.90	3.78	3.65	**4.02**	0.166		3.77	3.90	**3.95**	0.580	

ISO	0.28	0.18	0.18	**0.36**	0.043	**	0.10	0.21	**0.43**	0.001	**
REP	0.35	0.31	0.27	**0.39**	0.472		0.23	**0.44**	0.31	0.106	
ACC	0.36	0.16	0.43	**0.45**	0.001	***	0.37	**0.38**	0.33	0.806	
PRO	2.77	2.16	**3.21**	2.99	0.000	***	2.70	2.64	**2.93**	0.353	
DSG	2.33	2.11	2.33	**2.44**	0.370		2.00	2.20	**2.57**	0.207	
RCY	4.29	3.91	4.27	**4.48**	0.001	***	4.27	4.15	**4.42**	0.377	
WWA	4.45	4.45	4.36	**4.47**	0.537		**4.58**	4.33	4.50	0.267	
WAIR	3.92	3.71	3.74	**4.09**	0.016	**	3.93	**3.96**	3.88	0.634	
CO2E	3.93	3.66	3.43	**4.21**	0.002	***	3.80	**4.06**	3.86	0.588	
STA	4.38	4.34	4.29	**4.42**	0.778		4.22	4.36	**4.50**	0.587	
CLA	3.51	3.25	**3.63**	3.58	0.319		3.55	3.22	**3.83**	0.041	**
SOL	4.34	4.31	4.26	**4.37**	0.816		**4.50**	4.28	4.33	0.458	
BEN	4.24	4.20	3.70	**4.40**	0.015	**	4.23	4.22	**4.28**	0.789	
OVER	4.36	4.41	4.04	**4.41**	0.045	**	**4.55**	4.26	4.38	0.232	

*, **, *** mean the 10%, 5%, 1% level significance, respectively.

(3) Comparison Japanese and U.S. firms result

As for the practices of environmental management in Japan and the US, difference between firm sizes is more obvious in Japan than the US. Regarding the cognitive of external pressure, Japanese firms recognize pressure form market strongly than government and community, however U.S. firms recognize pressure from government strongly than market and community. Furthermore, ratio of the obtaining ISO14001 certificate is very different between Japan and U.S. This big gap is caused by the company's incentive to obtain ISO14001 certificate. Economic benefit from environmental management (BEN) is perceived to be stronger in large firms than in small and medium sized firms in both countries. However, overall benefit (OVER) compared to cost is not perceived significantly in Japan. This result show that Japanese firms spend a lot of cost to environmental protection, then Japanese firms' score of overall benefit (OVER) is low even though economic benefit from environmental management (BEN) is high.

4-2. Relationship between external pressure and corporate management factor

Table5 and Table6 show the result of regression analysis in Japan and U.S. We set the ten models and explained variables in both country. We try to clarify the effect of external pressure into the firm's cognitive about environmental management factors.

From Table5, Pressure from market has positive and significant effect into the most of environmental management factors except reuse and recycling practices (RCY) in Japan. Therefore, Japanese firms tend to have strong environmental initiative and activity when they recognize pressure from market. Pressure from government also affects the many environmental management factors positively, but pressure from community does not affect to environmental factors strong. Accordingly, Japanese firms react more sensitively by the pressure form government and market than community. Number of employees has a significant and positive effect into the most of environmental management factors except VOI in Japan.

With regard to industrial dummy variable, dummy variable of daily commodity industry has negative effect into the eco-design (DSG), furthermore, dummy variable of basic material industry has negative effect into the reuse and recycle (RCY). In this analysis, dummy variable of processing and assembly industry is dropped in all models, therefore we can compare the score of each dummy variable as the processing and assembly is standard. Daily commodity industry produces the food and cloth which consumer eat and use every day. Thus, consumer tends to decide the preference to buy product in viewpoint of taste, security and design more than environmentally. This is the reason why daily commodity industry has some difficulty to treat eco-design proactively.

From Table6, we can find that there are not many independent variables which affect significantly compare the Japanese firms' cases. Therefore, the environmental management factors of U.S. firms are not decided by external factor but the other factor.

Table5. Result of the regression model in Japan

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8		Model 9		Model 10	
	LDS		PAR		VOI		PRI		PRO		DSG		RCY		WWAT		WAIR		CO2E	
GOV	0.115	**	0.137	**	0.225	***	0.152	***	0.144	***	0.059		0.202	***	0.136	**	0.019		0.075	
COM	0.116	**	0.094	*	-0.032		0.034		0.014		0.029		-0.028		0.079		0.105	*	0.049	
CUS	0.132	***	0.159	***	0.151	***	0.145	***	0.094	**	0.201	***	0.017		0.155	***	0.204	***	0.173	***
# of emp	0.000	**	0.000	***	0.000		0.000	***	0.000	***	0.000	**	0.000	**	0.000	*	0.000	**	0.000	***
Daily	0.085		0.108		0.054		-0.052		-0.023		-0.396	***	0.002		0.035		0.108		-0.069	
Material	0.018		0.012		-0.018		0.127		0.007		-0.113		-0.167	**	0.100		0.189	**	0.093	
Processing	dropped		dropped		dropped		dropped		dropped		dropped		dropped		dropped		dropped		dropped	
Intercept	2.904	***	2.447	***	2.544	***	3.043	***	3.522	***	3.259	***	3.878	***	2.915	***	2.967	***	3.040	***
R-square	0.161		0.182		0.115		0.170		0.150		0.169		0.097		0.138		0.148		0.155	

*, **, *** mean the 10%, 5%, 1% level significance, respectively.

Table6. Result of the regression model in U.S.

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8		Model 9		Model 10	
	LDS		PAR		VOI		PRI		PRO		DSG		RCY		WWAT		WAIR		CO2E	
GOV	0.062		0.041		0.146	**	0.058		0.022		-0.247	**	0.035		0.075		0.071		0.205	**
COM	0.164	**	0.021		0.119		0.135		0.268	**	0.358	**	-0.004		0.035		0.130	*	0.234	**
CUS	0.145	**	0.121	*	0.100		0.111		0.308	***	-0.033		0.195	***	-0.079		0.042		0.086	
# of emp	0.000		0.000		-0.000		0.000		0.000	*	0.000		0.000		0.000		0.000		0.000	**
Daily	-0.023		0.043		-0.300		-0.097		0.011		-0.493		-0.029		-0.021		0.055		-0.080	
Material	0.147		0.222		-0.144		-0.033		-0.150		-0.341		-0.211		-0.234	*	0.105		0.117	
Processing	Dropped		dropped		dropped		dropped		dropped		dropped		dropped		dropped		dropped		dropped	
Intercept	2.527	***	3.124	***	2.839	***	2.768	***	0.644		2.348	***	3.526	***	4.421	***	2.959	***	1.871	***
R-square	0.109		0.045		0.093		0.076		0.218		0.106		0.088		0.046		0.061		0.136	

*, **, *** mean the 10%, 5%, 1% level significance, respectively.

5. Conclusion

Based on the empirical analysis of the survey on the corporate environmental management for the firms in Japan and U.S., the major findings are summarized as follows.

First, the corporate environmental management in Japan is being promoted by the external pressures, particular emphases are placed on the significant impacts of pressures from government and market. Secondly, it is found that the environmental activity and strategy are the path dependency of firm scale in Japan.

The environmental management activity of U.S. firms is not affected by pressure from government, community and customer but by other factor.

Environmental regulation from government in Japan is not effective by itself, suggesting that the additional incentives should be given to the firms to increase the effectiveness of the regulation.

Further research needs to investigate the differences between environmental efforts of firms in developing countries as well as in developed countries. Moreover it is important to clarify the causality among firm's cognitive, financial performance and environmental performances such as toxic release and CO_2 emission. From such an analysis we could clarify the mechanism of corporate environmental management more in detail under the different situation and background.

Acknowledgment

We would like to thank David Eaton, Nishesh Mehta and Rachael Phillips for their assistance to conduct survey in U.S. This research funded by Grant-in-Aid for Scientific Research B(18330081) and Grant-in-Aid for Japan Society for the Promotion of Science Fellows.

References

Al-Tuwaijri, S.A., Christensen, T.E. and Hughes, K.E. (2004). "The relations among environmental disclosure, environmental performance, and economic performance: a simultaneous equations approach." *Accounting, Organizations and Society* 29: 447-471.

DeSimone, L.D. and Popoff, F. (1997), *Eco-Efficiency*, MIT Press.

Florida, R. (1996), "Lean and green: The move to environmentally conscious manufacturing," *California Management Review,* 39(1), 80-1065.

Hart, S.L. and Ahuja, G. (1996), "Does it pay to be green? An empirical examination of the relationship between emission reduction and firm performance," *Business Strategy and the Environment,* 5(1), 30-37.

Kimbara,T. and Kaneko, S. (2005), *Kankyo Keiei no Bunseki*, Hakuto Shobo.

Konar,S. and Cohen, M.A. (2001), "Does the market value environmental performance?" *The Review of Economics and Statistics* 83(2), 281-289.

Nakao,Y., Amano, A., Matsumura, K., Genba, K., and Nakano, M. (2007), "Relationship Between Environmental Performance and Financial Performance: an Empirical Analysis of Japanese Corporations," *Business Strategy and the Environment*, 16, 106-118.

Palmer K., Oates W. E. and Portney P. (1995), "The tightening environmental standards: The benefit-cost or the no-cost paradigm?" *Journal of Economic Perspectives* 9(4), 119-132.

Porter, M. (1991), "America's green strategy," *Scientific American*, April. p. 96.

Porter, M.E. and Linde, C.v.d. (1995), "Green and competitive: Ending the stalemate," *Harvard Business Review* September - October, 121-134.

Rugman, A.M. and Verbeke, A. (1998), "Corporate strategies and environmental regulations: An organizing framework," *Strategic Management Journal*, 19, 363-375.

Russo, M.V., and Fouts, P.A. (1997), "A resource-based perspective on corporate environmental performance and profitability," *Academy of Management Journal* 40(3), 534-559.

Schaltegger, S., and Synnestvedt, T. (2002), "The link between 'green' and economic success: environmental management as the crucial trigger between environmental and economic performance," *Journal of Environmental Management,* 65(4), 339-346.

Schmidheiny, S. (1992), *Changing course: A global business perspective on development and the environment,* The MIT Press.

Shrivastava. P. (1995): "Environmental technologies and competitive advantage," *Strategic Management Journal* 16, pp. 183-200.

Thomas, A. (2001), "Corporate environmental policy and abnormal stock price returns: An empirical investigation," *Business Strategy and the Environment* 10, 125-134.

Wagner, M. (2001), "A review of empirical studies concerning the relationship between environmental and economic performance what does the evidence tell us?" Center for Sustainability Management.

Walley, N. and Whitehead, B. (1994)," It's not easy being green," *Harvard Business Review* 72(3), 46-47.

World Commission on Environmental and Development (WCED) (1987), *Our Common Future: The Brundland Report on Environmental and Development*, Oxford University Press.

Appendix. Detail of the questionnaire survey

1=Strongly disagree, 3=Neither agree nor disagree, 5=Strongly agree, 2, 4 = interval

GOV: Government regulations and mandates require significant efforts to meet.

COM: The community's demand for environmental performance is strong.

CUS: Customers demand a product / service that are environmentally friendly.

LDS: Leadership on environmental issues by top management is strong.

PAR: Participant of employee to environmental issues is strong.

VOI: Person in charge of environmental issues has a strong voice in the organization.

PRI: Environmental impact is a priority when making business decisions.

PRO: Your company makes an effort to improve environmental performance in the manufacturing process.

DSG: Your company produces eco-friendly design products.

RCY: Your company implements reuse and recycling practices.

WWAT: The level of waste water treatment in your company is good.

WAIR: The level of air emissions reduction in your company is good

CO2E: Your company is active in reducing CO_2 emission.

STA: Your company's market base consists of stable, long-term customers.

CLA: Customers complain about you company's products and performance.
(In this study, we use inverse score of CLA, 1→5, 5→1)

SOL: Your company often cooperates with buyers to solve problems.

BEN: The company's efforts to improve environmental practices have had a positive effect on financial benefit.

OVER: Financial returns from environmental efforts outweigh costs of such efforts.

ISO: Your company has an environmental report or a sustainability report. Yes=1, No=0

REP: Your company has adopted environmental accounting. Yes=1, No=0

ACC: Your company has obtained ISO14001 certification. Yes=1, No=0