
Bureaucratization of Environmental Management and Corporate Greening: An Empirical Analysis of Large Manufacturing Firms in Japan

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ABSTRACT

We have used qualitative comparative analysis (QCA) to empirically investigate relationships between the organizational structure of environmental management within large Japanese manufacturing firms and their corporate greening processes. Three dimensions of bureaucratization (i.e., formalization, centralization and professionalization) were chosen as the independent variables. Measures of corporate greening, such as integration of environmental responses into general management, introduction of green technologies and transformation of corporate culture, were chosen as the dependent variables. Our sample consists of 193 firms obtained in a survey conducted in 1997. We find that bureaucratization of environmental management generally has a positive relationship with corporate greening and that the presence of one or two of the three dimensions of bureaucratization may be sufficient for corporate greening to implement certain greening measures. The relationship between bureaucratization and ISO 14001 environmental management systems (ISO 14001 EMSs) and limitations of EMSs are also discussed. Copyright © 2005 John Wiley & Sons, Ltd and ERP Environment.

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Introduction

WHAT SHOULD MANAGERS DO TO PROMOTE CORPORATE GREENING? ACADEMIC LITERATURE concerning corporate environmental management provides valuable insights into this question but relatively few studies have been published on sufficiently concrete ideas based on which firms can formulate their action plans.

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Depending on the type of models that define their framework, literature on corporate environmental management can be divided into two categories: economic models and sociological models. The economic models assume that firms perform rational actions in order to maximize their objective functions such as profits or firms' values.¹ On the other hand, the sociological models assume that firms are firstly social groups that may not pursue profit maximization while the preconditions of their long-term existence make pursuit of survival a must. In several cases, studies employing sociological models segment a variety of firms into several stages to facilitate the differentiation of a firm's environmental progressiveness by assigning a stage to each company.²

Generally, neither type of study has focused on variables that corporate managers can manage in order to improve their firms' environmental management. Studies employing economic models usually choose variables that managers find difficult to change, such as firm size or industry sector. Studies employing sociological models often choose external variables such as social pressure or social norms.

In this study, we have chosen variables that are linked to firms' organizational structures in environmental management and that can also be changed at will when firms' managers desire to do so. Possible relationships between firms' environmental organizational structures and corporate greening are examined using the qualitative comparative analysis (QCA) technique. Certain characteristics of the QCA technique make it particularly suitable for identifying complex relationships such as those underlying firms' decisions on environmental management. In the empirical part of the paper we focus on examining the potential relationships between firms' organizational structure of environmental management and the role of ISO 14001 environmental management systems (ISO 14001 EMSs). As discussed below, there are certain theoretical reasons to believe that such relationships exist but no empirical studies exist on this topic yet.

This paper is organized as follows. The following section presents the method employed in this study, explains the variables chosen and provides the reasons we chose these variables. The next section reports the results obtained in the QCA and the relationships between organizational structure and ISO 14001 EMS. The fourth section discusses the results provided in the previous section. The fifth section concludes by reviewing the study and discussing its implications.

Method

The data used in this paper are based on a questionnaire survey conducted in May 1997.³ We distributed questionnaires concerning the respective firm's environmental responses to 600 manufacturing companies listed in the first section of the Tokyo Stock Exchange. The 600 companies were selected randomly from the sampling universe. By August 1997, 193 companies had responded (response rate 32%).

¹This type of literature includes work of DeCanio and Watkins (1998), Arora and Cason (1995, 1996) and Khanna and Dammon (1999).

²This type of literature includes work of Dodge (1997), Hart (1995), Winsemius and Guntram (2002) and Yamaji (2001).

³Although our survey was conducted 8 years ago, the insights gained in this paper are nevertheless still relevant. At the time of the data collection, a few large manufacturing firms in Japan had just started adopting environmental management tools such as ISO14001 EMSs, environmental accounting and environmental reporting. A number of large Japanese firms have since then implemented sophisticated environmental management tools, and thus we might not obtain similar results from these firms if an identical survey were conducted now. However, many Japanese firms, large and small, are still struggling in adopting environmental management practices. Furthermore, many SMEs in industrialized as well as developing countries outside Japan are yet to implement basic environmental management tools. For these companies, the results obtained in this study are relevant. Our data were originally collected for analysis using regression-type techniques. The current use of the QCA technique to analyze data of this type is new in the literature and will allow us to obtain new insights into firms' complex environmental management processes.

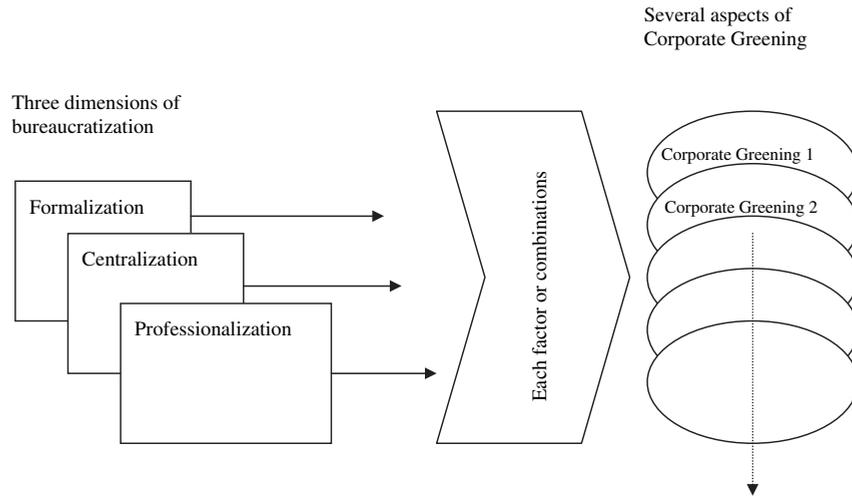


Figure 1. Model for analysis

Three variables concerning the organizational structure and seven indexes concerning corporate greening are identified from the survey responses. We use the QCA to empirically investigate the relationships between these three variables (independent variables) and seven indexes (dependent variables) (Figure 1).

The three variables concerning organizational structure represent the degree of a firm's bureaucratization. Three dimensions that correspond to these three variables are defined as follows.

- (1) *Formalization*. Rules and procedures are clearly defined and the need for compliance with these is emphasized.
- (2) *Centralization*. An organization's decision making is carried out by the upper management of the organization.
- (3) *Professionalization*. Division of labor in an organization is developed and the reinforcement of each special division is executed.

Max Weber emphasized the importance of bureaucracy in a modern society (Scott, 1998, pp. 42–49; Nonaka *et al.*, 1978). He claimed that the effectiveness of the bureaucracy makes it an essential component of modern organizations such as governments and firms. The word 'bureaucracy' carries a negative connotation, which is related to several potential shortcomings of the bureaucracy. In this paper, however, only the structural aspects of the bureaucracy are analyzed. In other words, the negative effects of the bureaucracy are ignored and only the neutral aspects of the bureaucracy are considered.

Three dimensions of bureaucratization (i.e., formalization, centralization and professionalization) are chosen as independent variables. Each of the three dimensions is measured by presenting the survey respondents with the following three statements.

- (1) *Formalization*. 'My organization has detailed written policies concerning the protection of the environment.'
- (2) *Centralization*. 'Several top-level managers in my organization are personally and actively involved in developing environmental protection policies and monitoring their implementation.'
- (3) *Professionalization*. 'The people in charge of environmental protection in my organization have sufficient authority.'

Next, respondents were asked to express their opinions regarding each of the statements by rating them on a 1–5 Likert-type scale (1 = do not agree at all, 2 = do not agree, 3 = neutral, 4 = agree, 5 = strongly agree).

We define the dependent variable, corporate greening, as the development of corporate management wherein the corporate members exhibit a concern for the natural environment. Since corporate greening is a complex and multi-faceted concept, we measure variables related to the concept with the seven statements provided below. On the basis of the responses to the following statements, we create variables with the same method as we used for the independent variables.

Corporate Greening 1 (comparison with other companies). Respondents were asked to consider the statement provided below and evaluate their firm's general performance compared with other firms:

'My organization's record with regard to environmental protection is significantly better than that of other organizations in our industrial sector'.

Corporate Greening 2 (corporate strategy). Nakamura *et al.* (2001) found that one of the important aspects of environmental responses by large manufacturing firms in Japan was to integrate environmental responses into the general management. Branzei *et al.* (2001) also found that, in Shanghai, China, as well as in Japan, the integration of environmental issues into general management was an important factor by which managers perceived their firms' corporate greening. Such integration is measured by the following statement:

'Environmental protection is an explicit component of my organization's strategic (long-term) plan'.

Corporate Greening 3 (decision making). Like the previous statement, the following statement gauges the extent to which managers consider environmental aspects when making managerial decisions:

'My organization's senior management has integrated environmental concerns into its decision-making process'.

Corporate Greening 4 (new technology). Corporate greening requires firms to learn new ways of doing things, i.e., to adopt a new technology, in a very broad sense. In fact, it is often claimed that new technologies are the ultimate solution to environmental problems (Kneese and Schultze, 1975). To measure the extent to which firms diligently pursue new technologies for environmental protection, the following statement is presented:

'In my organization, we are constantly seeking technological advancement in order to reduce our pollution levels'.

Corporate Greening 5 (sharing of ideas). Internal diffusion of new technologies for environmental protection would be enhanced if and only if members of a firm actively shared ideas on how to prevent pollution. The extent to which the members of a firm actively share such ideas is measured by the following statement:

'Ideas on pollution management are shared freely among the lower, middle, and upper levels within my organization'.

Corporate Greening 6 (necessity). Shrivastava (1995) emphasized that cultural change in a firm is a necessary condition for the transformation of the firm into a sustainable company. Recognizing the necessity of environmental protection would constitute a primary stage of cultural change. The following statement gauges to what extent such a cultural change has occurred in a firm:

‘Most people in my organization are extremely aware of the need to protect the environment and are well informed about our environmental policy’.

Corporate Greening 7 (culture). In the following statement, we inquire about cultural change in a more direct manner:

‘Environmental protection is an integral part of my organization’s culture’.

The method employed in this study, QCA, is a technique used to determine complex relationships between variables (Ragin, 1993; Kanomata *et al.*, 2001). These complex relationships include necessary and/or sufficient conditions, and combinations of those conditions. We expect complex relationships between the independent variables (the three dimensions of bureaucratization) and dependent variables (Corporate Greening indexes 1–7). Further, we choose the QCA to entangle the expected complex relationships.

The QCA can handle only binary variables, not multichotomous ones.⁴ In particular, the QCA analyzed binary variables, 0 (no)/1 (yes), using the Boolean logic. To use the data collected in the above-mentioned survey, we transform responses on a 1–5 scale as follows. Responses with a score of ‘1’ to ‘3’ are transformed into ‘0’ and responses with a score of ‘4’ and ‘5’ are transformed into ‘1’. Responses marked ‘do not know’ are transformed into ‘0’.

Results

We generate a truth table (Table 1), wherein Corporate Greening 1 (comparison with other companies) represents the dependent variable. In this table, ‘1’ indicates ‘present’ and ‘0’ indicates ‘absent’. For example, in line 1, all the numbers are ‘1’s. This implies that when all three bureaucratization factors, formalization, centralization and professionalization, are present, Corporate Greening 1 (comparison with other firms) is also present. However, as indicated in Table 1, of the 54 cases in line 1, Corporate Greening 1 is present in only 30 cases. In other words, line 1 has 24 contradictory cases. We resolve this type of contradiction by setting a cut-off value. We calculate ratios of ‘1’s in each line and also in the ‘total’ line. If the ratio of ‘1’s in a line is greater than that in the total line, ‘1’ is assigned to the line’s dependent variable. Otherwise, ‘0’ is assigned. In line 1, for example, Corporate Greening 1 is present in 30 out of 54 cases ($30/54 = 0.556$). In the total line, Corporate Greening 1 is present in 64 out of 193 cases ($64/193 = 0.332$). The ratio in line 1 is greater than that in the total line; therefore, ‘1’ is assigned to Corporate Greening 1 for line 1.

Table 1 provides a standard logic formula expressing relationships between the independent variables and dependent variable as follows:

$$\text{Corporate Greening 1 (comparison with other firms)} = FCP + FCp + FcP + fCp \quad (1)$$

⁴ Here, we talk about ‘crisp’ QCA. Fuzzy QCA and other techniques may be capable of handling multichotomous variables.

Line number	Independent variable 1	Independent variable 2	Independent variable 3	Number of cases		Dependent variable 1
	Formalization <i>F</i>	Centralization <i>C</i>	Professionalization <i>P</i>	Independent variables displaying this pattern	Presence of Corporate Greening 1	Corporate Greening 1 (comparison with other companies)
1	1	1	1	54	30	1
2	1	1	0	10	4	1
3	1	0	1	39	13	1
4	0	1	1	5	1	0
5	1	0	0	33	8	0
6	0	1	0	5	4	1
7	0	0	1	8	1	0
8	0	0	0	39	3	0
Total				193	64	

Table 1. Truth table with regard to Corporate Greening 1 (comparison with other companies)

where an uppercase character indicates the presence of each bureaucratization factor and a lowercase character indicates its absence; multiplications imply the logical AND; additions imply the logical OR. Formula (1) indicates that Corporate Greening 1 occurs when one of the following conditions is satisfied.

FCP. Formalization, centralization and professionalization are all present.

FCp. Both formalization and centralization are present. However, professionalization is absent.

FcP. Both formalization and professionalization are present. However, centralization is absent.

fCp. Centralization is present. However, formalization and professionalization are absent.

By simplifying Formula (1) based on the Boolean logic, we obtain the following summary formula:

$$\text{Corporate Greening 1 (comparison with other companies)} = FP + Cp \tag{2}$$

Using the same method by which we obtained Formula (2), we can obtain summary formulas for Corporate Greening 2–7 from Table 2, which is a truth table for all seven dependent variables (Corporate Greening 1–7):

$$\text{Corporate Greening 2 (corporate strategy)} = FP + C \tag{3}$$

$$\text{Corporate Greening 3 (decision making)} = FP + C \tag{4}$$

$$\text{Corporate Greening 4 (new technology)} = FP + Cp \tag{5}$$

$$\text{Corporate Greening 5 (sharing of ideas)} = CF + CP = C(F + P) \tag{6}$$

$$\text{Corporate Greening 6 (necessity)} = FC + FP + CP \tag{7}$$

$$\text{Corporate Greening 7 (culture)} = fCp + cP + FP \tag{8}$$

The ISO 14001 EMS is adopted by several firms in Japan as well as others around the world. In fact, the number of ISO 14001 certifications in Japan surpasses that of any other country. Table 3 provides

Corporate Greening	1	2	3	4	5	6	7
	Comparison with other companies	Corporate strategy	Decision making	New technology	Sharing of ideas	Necessity	Culture
<i>FCP</i>	1	1	1	1	1	1	1
<i>FCp</i>	1	1	1	1	1	1	0
<i>FcP</i>	1	1	1	1	0	1	1
<i>fCP</i>	0	1	1	0	1	1	0
<i>Fcp</i>	0	0	0	0	0	0	0
<i>fCp</i>	1	1	1	1	0	0	1
<i>fcP</i>	0	0	0	0	0	0	1
<i>fcP</i>	0	0	0	0	0	0	0

Table 2. Truth table with regard to Corporate Greening 1–7

	Formalization = 1	Centralization = 1	Professionalization = 1
With ISO 14001 certification: 61 firms	55 firms (90%)*	32 firms (52%)	44 firms (72%)
Without ISO 14001 certification: 132 firms	81 firms (61%)	42 firms (32%)	62 firms (47%)

Table 3. Relationships between ISO 14001 EMS certification and bureaucratization

*The percentages indicate the ratios of the companies with or without ISO 14001 certifications displaying the factors of bureaucratization.

the relationships between the ISO 14001 EMS certification and the three factors of bureaucratization measured in this study. Among the 193 companies analyzed above, 61 companies had obtained ISO 14001 EMS certifications while the other 132 companies had not. Table 3 indicates that ISO 14001-certified companies are more likely to bureaucratize with regard to all three aspects of bureaucratization.

Discussion

As indicated in Table 2, with regard to all seven corporate greening indexes, corporate greening occurs (= 1) when all three factors of bureaucratization of environmental management are present (= *FCP*). It appears that the bureaucratization of environmental management is an effective way to promote corporate greening.

A review of the summary formulas (2)–(8) indicates that all three factors of bureaucratization are not necessary and sufficient conditions for corporate greening. In other words, it is not true that Corporate Greening = *FCP*. In the cases of Corporate Greening 1 (comparison with other companies), 2 (corporate strategy), 3 (decision making) and 4 (new technology), i.e. when central aspects of corporate greening are concerned, a combination of formalization and professionalization (= *FP*) or centralization (= *C*) is generally a sufficient condition for corporate greening.

This finding suggests there exist two major ways of promoting corporate greening: (1) systematic organizational responses based on formalization and professionalization, and (2) strong leadership by the top management based on centralization.

The conditions required for Corporate Greening 5 (sharing of ideas) are rather different from those required for Corporate Greening 1, 2, 3 and 4. The necessary condition for this type of greening is cen-

tralization. Commitment by the top management is a necessary condition for sharing ideas concerning environmental protection technology among members of the organization. Corporate Greening 6 (necessity) requires at least two factors of bureaucratization as its sufficient conditions. Corporate Greening 7 (culture) has a complex summary formula. This may suggest that cultural change with respect to firms' environmental responses may involve complicated relationships with factors other than organizational structure.

The ISO 14001 EMS appears to be related to the bureaucratization of environmental management. This speculation is supported not only by the relationships between bureaucratization and ISO 14001 EMS shown in Table 3 but also by a reading of the ISO 14001 standard text. The ISO 14001 standard requires an organization to document a major portion of its environmental management and to report activities within the management system to the top management. The development of this kind of documentation and reporting corresponds to formalization and centralization of environmental management, respectively. In addition, ISO 14001 EMS requires internal and external auditors to audit the organization's environmental management system. The choice of such specialists represents professionalization of environmental management. In summary, ISO 14001 can be considered to be the bureaucratization of environmental management.

Conclusion

The analysis indicates that the bureaucratization of environmental management generally promotes corporate greening. The analysis is conducted on the basis of the data collected from 193 large manufacturing firms in Japan. The degree of bureaucratization of each firm's environmental management is measured with respect to three factors of bureaucratization, namely formalization, centralization and professionalization. Different aspects of corporate greening require different factors or different combinations of the factors of bureaucratization. When all three factors are present, all seven types of corporate greening seem to occur.

The positive relationship between bureaucratization of environmental management and corporate greening offers a prescription for corporate greening. When corporate greening of a firm appears to be stagnating, the manager should verify whether the factors of the bureaucratization of environmental management have been implemented properly, and he should ensure the implementation of the missing factors of bureaucratization.

The positive relationship between the ISO 14001 certification and bureaucratization elicits the view that implementing ISO 14001 EMS is the bureaucratization of environmental management. This view is also supported by the ISO 14001 standard text itself.

If one accepts this view, i.e. ISO 14001 EMS = bureaucratization, the contingency theory suggests that there will be both pitfalls and benefits of the bureaucratization of environmental management (Burns and Stalker, 1961; Stinchcombe, 1959). The theory claims that bureaucracy is suitable for stable situations and tasks, and it is unsuitable for unstable situations or tasks. If this concept is applied to environmental management, it is expected that ISO 14001 EMS will be suitable for stable situations or tasks such as situations where the production volume does not change considerably or continuous reduction of wastes is accomplished with minor changes. Otherwise, ISO 14001 EMS is not sufficiently appropriate.

Even though ISO 14001 as a tool of EMS is supposed to monitor the processes of a firm's business operations for environmental purposes, our results suggest that the types of process of firm business operations ISO 14001 can deal with might be limited to those that do not involve much change. In fact, the managers of a few Japanese firms claim that ISO 14001 EMS does not function well when a company introduces a new production system or adopts a fast-paced corporate management system (Nikkei

Strategic capability	Environmental driving force	Key resource	Competitive advantage
(1) Pollution prevention	Minimize emissions, effluents and waste	Continuous improvement	Lower costs
(2) Product stewardship	Minimize life-cycle cost of products	Stakeholder integration	Pre-empt competitors
(3) Sustainable development	Minimize the environmental burden of firm growth and development	Shared vision	Future position

Table 4. A stage model of environmental management
Source: adapted from Hart (1995).

Ecology, 2003). For example, when a factory of Canon Corporation introduced an innovative cell-production system, EMS appeared to be unfit for the situation where trial and errors are usual. Sony institutes EMS only at the plant level, not at the corporate level, because the corporate structural changes are too frequent to accommodate possible corresponding changes of EMS. Different anecdotal evidence of inappropriateness of formal EMS in certain situations concerns innovation.⁵ An environmental manager of a chemical product company claims that developing a new product utilizing recycled content requires a task-force team that is separated from EMS because it needs concentrated efforts by specialists. Another environmental manager of an electronic company says that the R&D department carries out technological development related to environmental protection, EMS has its role in standardizing the developed technology and R&D and EMS have different tasks.

In the Introduction, we refer to stage models of environmental management. For example, as shown in Table 4, Hart (1995) suggests that firms proceed from (1) the pollution prevention stage to (2) the product stewardship stage and finally to (3) the sustainable development stage. The ISO14001 EMS may be suitable for the initial stage, namely the pollution prevention stage; however, it may not be appropriate for the second stage because the key resource and competitive advantage for this stage are 'stakeholder integration' and 'preempt competitors'. These both require firms' ability to respond promptly to changes. In this manner, the findings in this paper can be related to literature on environmental management.

Finally, it is important to note the limitations of this study. Due to the nature of QCA, an analytical technique employed here, we could not conduct a statistical test to check the statistical certainty of the results. The measurement of variables relies on a manager's perception and lacks reliability to a certain extent. The results of this study are applicable to firms that are either in the early stages of environmental management or at stages similar to those of the survey respondents' firms at the time of our survey. It should be pointed out, however, that even though environmental management by firms is a global movement, the style of implementing environmental management may be significantly affected by country culture. For example, Japanese culture may play a significant role in shaping the environmental management practices of the respondents' firms in our survey. Our findings reported in this paper should be interpreted with this in mind.

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⁵These anecdotes were collected from interviews conducted in Japan in 2003.

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