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# Effects of the Internal and External Factors of Small and Mediumsized Corporations on Green Management Performances through the Establishment and Utilization of Information Systems and Building Relationships for Information and Knowledge

Hyung-Shik Jung

*Chosun University*, [hsjung@chosun.ac.kr](mailto:hsjung@chosun.ac.kr)

Youngshim Kim

*Chosun University*, [Kys4779@chosun.ac.kr](mailto:Kys4779@chosun.ac.kr)

Jin A An

*Chosun University*, [thundertoy@hanmail.net](mailto:thundertoy@hanmail.net)

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# Effects of the Internal and External Factors of Small and Medium-sized Corporations on Green Management Performances through the Establishment and Utilization of Information Systems and Building Relationships for Information and Knowledge

**Jung, Hyung-Shik**  
Chosun University  
hsjung@chosun.ac.kr

**Kim, Youngshim**  
Chosun University  
Kys4779@chosun.ac.kr

**An, Jin A**  
Chosun University  
thundertoy@hanmail.net

## ABSTRACT

The current research was intended to examine the effects of internal and external factors of small and medium-sized corporations (SMC) on green management performances through the establishment and utilization of Information Technology (IT) and building external relations. The results of the study showed that of the corporate internal factors, the interest levels of CEOs concerning the environment did not significantly affect the establishment and utilization of information systems that required large expenses and investments in technological core competencies. Of the corporate external factors, the intensity of competition within the industry was shown to have a significant effect on building relationships for information and knowledge, but not on the establishment and utilization of information systems. On the other hand, government regulations on the environment had significant effects both on the establishment and utilization of information systems and on building relationships for information and knowledge. The establishment and utilization of information systems had significant effects on building relationships for information and knowledge, but not on green management performances. However, building relationships for information and knowledge showed significant effects on green management performances, suggesting the importance of building relationships for information and knowledge with external parties.

## Keywords

Environmental management, Information technology resource, Intensity of competition, CEO commitment, Government regulation of environment, Information systems, IT establishment and utilization, Building relationships for information and knowledge, Green management performance

## INTRODUCTION

In November, 2010, the Korean government reported its objective to reduce greenhouse gas emission 30% by 2020.(Korean Economy, 2010). This implies the presumed rise in corporate investment in eco-friendly products in response to the rising consumer interests in green consumptions. Recent external corporate environments have also been inclined to rapidly adopt and adapt to the proliferating demands for environment-friendliness, indicating more active measures taken for environmental management activities. Environmental management refers to a management activity that pursues both economic profits and environmental sustainability by improving environmental performances throughout the entire chains of corporate activities (Haden, Pane, Oyler, and Humphreys, 2009). However, SMCs, unlike large corporations, have faced difficulties with voluntary establishment of environmental management systems, development of eco-friendly products, and research and supporting activities for environmental perceptions and risks managements, due to the lack of owned resources and competencies.

Previous studies have mainly focused on examining large corporations rather than on SMCs (Lee, 2009; Melville, 2010; Seidel et al., 2011). This tendency can be explained due to the disputes regarding the feasibility of SMCs' product innovation

through technology development that is required to produce eco-friendly products. Due to such disagreements, more topics have been studied regarding the influences of government policies or interest parties, the adoption of strategies for environmental innovation, and the relationship between the role of innovation and actual performances for SMCs' environmental managements (Devashish et al., 2003; Melville, 2010). However, this study primarily examines whether SMCs commit to the improvement of green management performances through green management activities by focusing on the utilization of internal resources or building relationships for information and knowledge through externally associated parties in order to overcome the limitations of internal supplies. Therefore, the current study attempts to identify and distinguish the predicted significant internal and external factors that would influence SMCs' green managements, through the establishment and utilization of information systems and building relationships for information and knowledge.

First, the level of interests of CEO in green management could viably be considered as a corporate internal factor. Unlike larger corporations, SMCs could drastically differ in their strategic directions depending on the CEO's principles and values that are necessarily accompanied by the company's core competencies, financial resources, and capabilities. This is mainly due to the crucial decision-making power CEOs are entitled to SMCs. Moreover, the government policy responding to overseas environmental regulations also denotes the priorities placed on information supply over funding or technology development support. Previous studies on IT and green management have focused primarily on technology aspects and its relevance to performances. However, the relationship for the combining IT and green management and the actual green management performances remains much unexplored (Devashish et al., 2003; Schmidt et al., 2010; Selnes and Sallis, 2003). The current research intends to explore the internal and external influencing factors on green management performances of SMCs, and further discover which factors enhance the utilization of information systems and stimulate external relations. Because of the necessary incorporation of core competencies and financial capabilities for SMCs, a company's strategic direction could differ according to the perspectives or values CEOs hold on the environment. Additionally, information technology resource ownerships are considered as core competencies for SMCs. In general, due to the lacking resources and poor financial structure of SMCs, IT-related resources are considered as good opportunities to gain a competitive edge. Therefore, it is common for a company to invest in the maximization of the company's assets through resource distribution and system integrations. However, in comparison to large corporations, SMCs severely lack information and technology establishment capacities, leading to the necessity of technology and knowledge transfer through external joint technology establishment or sector collaboration. The henceforth research related with information technology resource has focused on the direct relationship between strategy and performances on a resource criteria perspective (Dao, Ian, and Jerry, 2011; Sanders, 2007). Therefore, this study attempts to examine more specifically whether internal factors lead to the invigoration of information systems in terms of integration and flexibility of internal resources in SMCs, or if not whether the factors lead to the strengthened external relations.

Meanwhile, corporate external factors tend to have significant impacts on SMCs in various aspects. Strategy employments differ according to the degree of internal competition in the industry SMCs are affiliated to. The more intense the competitive factor, the more efforts companies put to handle the competition more actively by setting up their own technology development systems or changing the corporate systems to become more flexible. Conversely, less intensity in competition reduces the incentives to promptly respond to market demands. Thus, this study intends to investigate whether the degree of competition within an industry actually fortifies the establishment and utilization of IT and external relations.

According to Steger(1993), responses to environmental pressures on companies depend on the market opportunities companies could seize through environmental preservation activities and environmental risks involved as a result of corporate activities. Governmental regulations could also influence corporate environmental engagements. Governmental regulations, by encouraging corporate innovation and pressuring corporate direction towards environmental preservation, tend to catalyze the improvement on corporate performance through environmental activities (Shrivastava, 1995c). That is, environmental regulations by the government impose pressures on corporate innovation and environmental activities, leading to corporate vigilance to filter out inefficient internal resource usages and discover potential technological innovations, providing insights into the paramount role of regulations that stimulate environmentally friendly activities and commitments. Therefore, under the continuous enforcement of environmental regulations corporations would become more environmentally active e.g., establishing environmental criteria and benchmarks to conform to and sustain the company's market position. It has been demonstrated through practice that, the stronger imposition and enforcement of environmental regulations, the more corporate initiative taken, including eco-friendly technology innovational activities, establishments of environmental planning, pollutant reduction activities, and inclined projected directions towards environment related regulation. This can be further interpreted that the higher the intensity of environmental regulations, the more initiatives corporations take through more active and strategic dispositions. Then, the question is whether the external pressures imposed on corporations have a stronger effect than internal pressures on the building of internal activities for environmental management, reinforcing external relations. How effectively companies coordinate the given internal and external resources and environment and accumulate networking management through collaborations and partnerships are crucial determinants of a company's sustainable growth through eco-friendly endeavors (Aoki, 1990).

This study intends to examine whether internal and external factors lead to reinforcing corporate internal information systems, or if they lead to a more active involvement in green management performances through joint research, product development, and building relations through collaboration among sectors. This study presumes that more lacking resources of SMCs would propel corporations to establish stronger external relations to compensate for drawbacks. On the contrary, should corporations hold sufficient resource and competencies, they would be more inclined to reinforce corporate internal activities in order to promptly and flexibly respond to external environmental changes. Additionally, this study intends to uncover the relative influence corporate internal and external factors have on the internal activities and external relations, further examining the main factors companies ought to focus on to implement and properly execute corporate green management.

## THEORETICAL BACKGROUND

### 1. Corporate internal factors, establishment and utilization of information system, and building relationships for information and knowledge.

#### 1.1 Interest levels of CEOs in Environments

As corporate CEOs hold key decision making powers, including establishing corporate missions as well as future goals and leading the company to particular projected directions, they also hold authorities to change corporate strategies. Therefore, the business objectives and projected directions for internal industrial level heavily depend on the interest levels of CEOs. Unlike large corporations, SMCs tend to have smaller worker scales with limited resources, making it difficult to distribute and designate human capitals on activities that digress from routine business activities, including environmental management and concerns. Therefore, SMCs hold a disadvantaged infrastructure to accumulate and implement internal expertise regarding environmental management and concerns (Korean Environmental Policy Research Institution, 2006). Jaworski and Kohil(1993) stated that the more innovative the disposition of a CEO, the more responsive attitude one displays regarding external changes, hence demonstrating a strong future-oriented market position. Therefore, the more committed attitudes CEOs show on green management, the more adept and systemized the corporate internal communication infrastructure would be or the more advanced in the establishment and utilization of intranet the company would become, fostering innovative ideas through information sharing. The biological industry sector, the current study's research subject, requires certain level of knowledge and expertise of CEOs, because it focuses on product output considering both environment and health. Thus, this study presumes that the establishment and utilization of the corporate internal information technology system would significantly depend on the values and interest levels of the CEOs. Amidst the rapidly changing environment, the higher environmental interests CEOs show, the more effort one would invest in overcoming the limitations on resources and establish a strong mutual and collaborative relationship with associate groups that closely relate to the firm's industry sector. In other words, it is hypothesized that SMCs would progressively try establishing intimate external relations in order to effectively transfer expertise, knowledge and technology resources by being affiliating to organizations or signing MOU contracts with local governmental bodies and research institutions. Accordingly, we hypothesized the following:

*H1a : Higher commitment levels of CEOs, would lead to increased establishment and utilization of corporate internal information system.*

*H1b : Higher commitment levels of CEOs would lead to the heightened establishment and utilization of relationships between information and knowledge.*

#### 1.2 Corporate Information Technology Resource

The resource based theory defines resources as the assets, capabilities, organizational operational systems, corporate core competencies, information, and knowledge operated by a firm, encompassing all degrees of material, human capital, and organizational levels. A company's competitiveness is not strictly defined by the resources the firm owns, but by the competency of their utilization through the combination of such resources (Eisenhardt and Mrtin, 2000). In order to reinforce leadership in technology innovation of SMCs, it is imperative to foster inimitable resources, and further create a unique business combination by successfully collaborating and integrating resources on a feasible ground on a small and medium-sized level (Holm and Pedersen, 2000; Frost et al. 2002). Thereby, corporate internal information technology resources could not only compensate for the insufficient resources of SMCs, but also create a competitive advantage leading to a more effective management of controllable system establishment.

Additionally, leadership in technology innovation for SMCs could also be influenced through external relations (Andersson et al, 2001; Porter, 1990). Among external networks, representative networking associates include: 1) local consumers who purchase products or services from SMCs, 2) local suppliers that provide parts or services to SMCs, and 3) competing

corporations such as multinational corporations that compete against local SMCs and other local firms. Porter(1990) stated that the differences between a company and its external networking factors, including local product markets, local component markets, local intensity in competition, and local regulations, are shown in the discrepancies in firm competitiveness. The supply of ideas regarding new products from local raw material suppliers or local governmental regulation or incentives could improve the quality of product and manufacturing. Furthermore, local consumers could also provide valuable feedback to contribute to developing new core competency. Through such means, possession of information technology resources in SMCs will put more emphasis on generating a synergy effect through efficient utilization of owned resources or through strong external relations. Accordingly, we hypothesized the following:

*H2a : Greater information technology resources would lead to more active establishment and utilization of the corporate internal information system.*

*H2b : Greater information technology resources would lead to more active building relationships for information and knowledge.*

2. Corporate external factors, establishment and utilization of information systems, and building relationships for information and knowledge

### 2.1 Corporate Intensity of competition in the industry

Perceived threat in competition among intra-industrial enterprises helps a firm precisely identify the forthcoming most precarious competition threat factor to that specific company (Delmas and Toffel, 2004). Competition intensity in the industry indicates the scope or degree of competition among firms within the same industry, in order to satisfy the consumer's demand and expectations on eco-friendliness. A firm would have to decide whether to focus on the maximization of seizing market opportunities and strengthening competencies while minimizing its weaknesses, or offsetting their weakening factors through external resources. Firms would eventually decide upon the strategy to extend the company's potential strengthening factors. This is because as industrial competition becomes ever-intense, competitive edge is hard to be secured or maintained only by relying upon corporate internal resources. Thus, acquisition of technology and knowledge by establishing mutual knowledge sharing through collaborations with external associations would reinforce the sustainability of the company. Therefore, as competitions become more heightened within the industry SMCs would not only establish and utilize the internal information system but also attempt to establish joint collaborations in order to promptly respond to the rapidly changing environment by strengthening the information and mutual knowledge ties between inter and intra-industrial enterprises. Accordingly, we hypothesized the following:

*H3a : Heightened competition in the industry would lead to more active establishment and utilization of the corporate internal information system.*

*H3b : Heightened competition in the industry would lead to more active building relationships for information and knowledge.*

### 2.2 Government regulation of the environment

Government regulation on the environment refers to an environmental authority establishing criteria in relation to environmental issues and enforcing the established criteria on corporations, taking the most representative forms of coercive measures on firms regarding environmental concerns (Del Rio Gonzalez, 2005). The primary interests of the authority's concerns lie in protecting the society from industrial risks or hazard occurring in the advent of environmental damages. Environmental regulations demand corporations to take an active, voluntary, and innovative stance in environmentally friendly activities, catalyzing the strengthening of competitiveness, implemented both politically and legislatively. This approach further stresses corporate innovation towards environmentally oriented direction, resulting in positive corporate performances (Shrivastava, 1995c). Therefore, through continuous reinforcement of environmental regulation, firms are more compelled to establish corporate environmental standards in order to sustain its market position as well as conforming to the governmental regulations, consequentially taking a more active position in developing a corporate internal system to execute eco-friendly activities. Heightened enforcement of environmental regulation in practice would mean more active involvement of corporate environment-related technology innovation activities, environment planning establishments, pollutant reduction activities, and inclined directions towards environment-related regulation. This highlights corporate capabilities to take more vigorous position in response to more heavily enforced environmental regulations.

Direct environmental regulations refer to utilizing final regulation equipment to confine a firm's aftermath pollutant emission as well as waste water, explicitly specifying regulations on the displacement and formation of pollutants, technical methods for pollutant disposal, and management of pollution prevention facilities. Such forms of regulations may also inhibit certain innovative methods companies could possibly take at the expense of certain level of risks (Potter and Van der Linde, 1995). Additionally, the predictability of regulations also stimulates corporations to incorporate the firm's strategy to be more

aligned with the active engagement in environmental management. The main reason for this is the reassurance implied regarding the necessities of consistent corporate environmental investments (Lyon, and Maxwell, 2008). This is also due to the risks corporations carry in tarnishing their public image on morality through the firm’s environment mismanagement on strategy employments or exacerbating corporate management by damaging relationships with interest parties (Hoffman, 2001). Unlike large corporations, SMCs lack in financial investment and competencies in capacity, inevitably putting more emphasis not only on corporate internal system establishment and utilization, but also on external relations. Accordingly, we hypothesized the following:

*H4a : Heightened governmental regulations on environment would lead to more active establishment and utilization of the corporate internal information system.*

*H4b : Heightened governmental regulations on environment would lead to more active building relationships for information and knowledge.*

3. Establishment and Utilization of Information Systems, Building Relationships for Information and Knowledge, and Green Management Performance

A firm with objectives to the optimization in environmental management and strengthened competitiveness commits to building networks with governmental institutions and suppliers, even establishing strategic partnerships with competing enterprises (Hemel, 1997). In other words, building relationships allow the long term communication among collaborative partners. Based on such long-term communication, firms attempt to strategically attain new knowledge from partners by taking corporate internal learning and accumulation procedures (Zander, 1991). Such efforts will further contribute to promoting the firm’s green management activities. That is, the establishment and utilization of the corporate internal information system will enable the firm to create an inimitable resource combination serving as the corporate key competitive advantage, compelling the firm to search for organizational improvements and adaptation, ultimately improving the quality in product, service, and consumer demand. Moreover, green management performance reflects a firm’s voluntary dedication to focus on future environmental management activities and taking initiatives to strengthen the company’s core competencies. Such voluntary forms of objectives followed by efforts to strengthen core competencies have been shown to bring significant growth on sales, cost reductions, and effects on competitive advantage in market position (Kotabe and Swan, 1995). Thus, a firm’s utilization of IT and building of relationships would lead to the enhancement of green management performance. Accordingly, we hypothesized the following:

*H5a : More active establishment and utilization of the corporate internal information system would lead to more active building relationships for information and knowledge.*

*H5b : More active establishment and utilization of the corporate internal information system will lead to the greater enhancement of green management performances.*

*H6 : More active building of relationships for information and knowledge will lead to the greater enhancement of green management performances.*

**RESEARCH METHODOLOGY**

1. Research Design

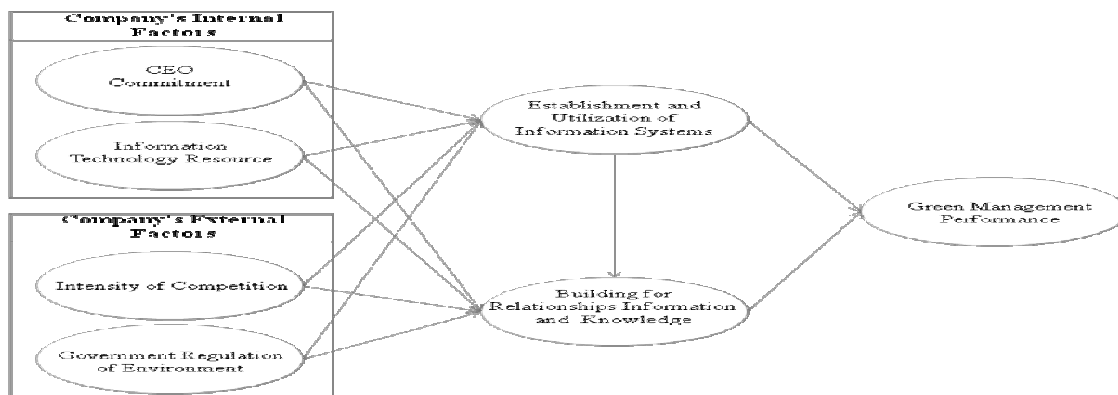


Figure 1. Research Model

Figure 1 shows the research model to test the hypotheses. The current study attempted to identify and distinguish the effects of internal and external factors of SMCs on the green management performances, and examine the factors that improve the utilization of information systems and building relationships for information and knowledge.

## 2. Sample of the Study and Data Collection

The current study bases its analysis measurement on industrial sectors that had relatively close environmental association, specifically surveying managers in environmentally related corporations. Examining enterprises as the research analysis measurement unit, this research targeted on directors, CEOs, and managers who held a general holistic view or executed corporate environmental administrative as well as managing decisions, selecting one participant per company. Firm selections were made through the report on corporation lists provided by the Regional Bioindustry Foundation. Total data of 178 companies located in the southern regions in Korea were incorporated in the final analysis.

## 3. Sample Characteristics

The founding dates of respondent corporations included: 9 firms were established between 1967 and 1980 (5.1%), 12 between 1982 and 1990 (6.7%), 76 between 1991 and 2000 (42.7%), and 81 in 2001 or after (45.5%). Numerical scale of employment included: 100 firms with less than 10 workers (56.1%), 47 firms from 11 to 30 workers (26.4%), 18 firms from 31 to 50 workers (10.1%), and 10 firms with 51 or above (7.4%). The total asset distribution included: 16 firms that owned approximately from \$18,000 to \$90,000 (12.4%), 60 firms from \$90,000 to \$900,000 (46.5%), 28 firms from \$900,000 to \$2,700,000 (21.7%), 14 firms from \$2,700,000 to \$4,500,000 (10.9%), and 11 firms that owned \$4,500,000 or above (8.5%). Total sales distribution included: 14 firms that earned approximately \$90,000 or below (9.7%), 53 firms from \$90,000 to \$900,000 (36.8%), 33 firms from \$900,000 to \$2,700,000 (22.9%), 13 firms from \$2,700,000 to 4,500,000 (9.0%), 15 firms from \$4,500,000 to \$9,000,000 (10.4%), and 16 firms that earned \$9,000,000 or above (11.1%). Total of 132 male respondents (74.2%), and 46 female respondents (25.8%) participated in the study. Age distribution included 17 respondents aged from 28 to 29 (9.6%), 47 respondents from 30 to 39 (26.4%), 56 respondents from 40 to 49 (31.5%), and 58 respondents 50 or above (32.5%). Distribution in position include: 46 CEOs (25.8%), 26 directors (14.6%), 94 managers and assistance managers (52.8%), and 12 Division Heads and Team Leaders (7.8%).

*(Exchange rate calculation based on \$1 = 1,100 WON)*

## 4. Measurement of Variables

The variables were properly modified for the study. A 5-point Likert-type scale was used to measure the variables, 5 being "Strongly Agree" and 1 being "Strongly Disagree." Measurements on the interest levels of CEOs, considered as primary internal factors, were examined based on three criteria: degree of value recognition regarding green management and subsequent policy promulgated and implemented towards green management; progressiveness in achieving objectives and benchmarks; and awareness of market trends regarding green management. Applying Spanos and Lioukas (2001)'s research index on corporate information technology resources, the study's measurements were based on three criteria: the degree of information technology system establishment, green management-related technology establishment system establishment and utilization, measured in comparison to the firm's competing enterprise; Transaction Processing System (TPS), and Electronic Payment System (EPS). The intensity of competition within the industry and government regulation on environment were measured through Delmas and Toffel (2004)'s criterion. First and foremost, the intensity of competition within the industry was based on four criteria; heightened competition for differentiation through environmental management activities within the industry; overall intensive competition on environment related matters; and increased levels of competing enterprises within the industry. The government regulation on environment was based on three criteria; overall strictness; restrictions on sales through environmental regulations; and consequences followed after violation on environmental regulations

The measurement on system establishment and utilization was based on the definition delineated by Welch and Pandey(2007), referring to corporate internal business related system establishment and the effective and productive utilization of composing members of organization. Thus, measurement units were based on four criteria; strengthened degree of the organization by utilizing information technology; utilization of information systems by members of the organization; utilization on information technology on new product establishment; extended scope of chance on new product establishment utilizing information technology.

Measurements on the building relationships for information and knowledge were based on Cui, Griffith, and Cavusgil(2005)'s four criteria; performance on academic and collaborative research; building networks with industrial associates regarding information and knowledge relations; strengthening relations with other overseas corporations; and technology establishment funding received from governmental and associate institutions.

Measurements regarding green management performances were derived from Selnes and Sallis(2003) and Matsuno, Nentzer, and Ozsomer(2002)'s research method, basing on three criteria; increased level of sales on eco-friendly products and efficient

usage of environmental energy; environment related certifications and rewards received in relation to comparative enterprises within the industry; high performance scores received regarding measurements of pollutants, pollution level, and violation on environmental regulation.

## DATA ANALYSIS

### 1. Validity and Reliability Test

Confirmatory factor analysis was conducted to guarantee the validity and reliability of variable. The result showed the follow indexes  $\chi^2=249.15$   $df=131$  ( $p=.00$ ),  $GFI=.91$ ,  $AGFI=.89$ ,  $NFI=.93$ ,  $CFI=.95$ ,  $RMSEA=.07$ , implying that all variable had convergent and discriminant validity (Brown and Cudeck, 1993). Testing reliability with Cronbach's coefficients, all the coefficients were within the range of .741~.935. Showing the reliability of the construct variables. In addition, representativeness of the constructs was verified from the composite reliabilities ranging .820~.936 which were higher than the commonly accepted level of .7 (Fornell and Lacker, 1981).

Variables	Items	Standard Factor Loading	Measurement error	t-value	Cronbach's $\alpha$	Composite Reliability
CEO Commitment	CEO1	.96	.09	16.93***	.896	.909
	CEO2	.96	.08	17.08***		
	CEO3	.70	.51	10.61***		
Information Technology Resource	ITR1	.90	.19	15.16***	.935	.936
	ITR2	.93	.14	15.97***		
	ITR3	.91	.18	15.40***		
Intensity of Competition	ICI1	.77	.41	11.21***	.855	.866
	ICI2	.97	.06	14.98***		
Government Regulation of Environment	GROE1	.96	.08	15.81***	.924	.925
	GROE2	.90	.20	14.28***		
Establishment and Utilization of Information Systems	ISU1	.83	.31	17.81***	.741	.831
	ISU2	.80	.36	11.86***		
	ISU3	.73	.46	10.75***		
Network Building for Information and Knowledge	NBKN1	.66	.57	9.30***	.807	.820
	NBKN2	.74	.45	10.89***		
	NBKN3	.92	.16	14.55***		
Green Management Performance	GMP1	.84	.29	13.27***	.865	.872
	GMP2	.73	.47	10.83***		
	GMP3	.92	.15	15.15***		
Fit Index	$\chi^2=249.15$ $df=131$ ( $p=.00$ ), $GFI=.91$ , $AGFI=.89$ , $NFI=.93$ , $CFI=.95$ , $RMSEA=.07$					

\* Estimated values are statistically significant at the level of 0.001

Table 1. Result of Confirmatory Factor Analyses

### 2. Results of Discriminant Validity Analysis

Discriminant validity was assessed with the analysis of correlation matrix ( $\Phi$ matrix) that checks the measured difference as among the theoretical different constructs. The results are value of "1" [calculated with correlation  $\pm$  ( $2 \times$  standard error)] out of range correlative coefficient among all the variables. Other method of testing discriminant validity was employed with average variance extract (AVE). The AVE's value was .607~.861, establishing the reliability at an acceptable level (Fornell and Robinson, 1983).

### 3. Results of Hypotheses Testing

The analysis of the goodness of fit indexes of the research model showed  $\chi^2=274.64$ ,  $df=135$  ( $p=.000$ ),  $GFI=.89$ ,  $AGFI=.86$ ,  $NFI=.92$ ,  $CFI=.95$ ,  $RMSEA=.07$  suggesting the superiority of the research model. The results of the analysis of causal relationships among the variables are shown in <Table 2>.



Hypothesis	Path	Coefficient	t-value	Result
H1a	CEO Commitment → Establishment and Utilization of Information Systems	.07	.77 <sup>n/s</sup>	Not Supported
H1b	CEO Commitment → Network Building for Information and Knowledge	.31	3.18 <sup>**</sup>	Supported
H2a	Information Technology Resource → Establishment and Utilization of Information Systems	.24	2.97 <sup>**</sup>	Supported
H2b	Information Technology Resource → Network Building for Information and Knowledge	.17	2.15 <sup>*</sup>	Supported
H3a	Intensity of Competition → Establishment and Utilization of Information Systems	.06	.78 <sup>n/s</sup>	Not Supported
H3b	Intensity of Competition → Network Building for Information and Knowledge	.49	5.29 <sup>***</sup>	Supported
H4a	Government Regulation of environment → Establishment and Utilization of Information Systems	.36	4.12 <sup>***</sup>	Supported
H4b	Government Regulation of environment → Network Building for Information and Knowledge	.14	1.64 <sup>+</sup>	Supported
H5a	Establishment and Utilization of Information Systems → Network Building for Knowledge and Information	.22	3.44 <sup>***</sup>	Supported
H5b	Establishment and Utilization of Information Systems → Green Management Performance	.08	1.20 <sup>n/s</sup>	Not Supported
H6	Network Building for Information and Knowledge → Green Management Performance	.52	5.70 <sup>***</sup>	Supported
Fit Index		$\chi^2=274.64$ $df=135$ ( $p=.000$ ) GFI=.89 AGFI=.86 NFI=.92 CFI=.95 RMSEA=.07		

1. +:  $p < .1$ , \*:  $p < .05$ , \*\*\*:  $p < .001$  2. Not Supported

Table 2. Results of Analyses on the Research Model

First, while the interest levels of CEOs did not show significant effects on the utilization of information systems, thus not supporting hypothesis 1a, the interest levels had significant effects on building relationship for information and knowledge, thus supporting hypothesis 1b. Second, corporate information technology resources had positive effects on both establishment and utilization of information systems and building relationships for information and knowledge, supporting both hypotheses 2a and 2b.

Third, competition intensity within the industry, considered as corporate external factor, did not have significant effects on the establishment and utilization of information systems, thus not supporting hypothesis 3a. However, the external factor showed significant impact on building relationships for information and knowledge, supporting hypothesis 3b. Fourth, government environmental regulation appeared to have significant impact on both the establishment and utilization of information systems, and building relationships for information and knowledge through associate enterprises and institutions, supporting both hypotheses 4a and 4b. Fifth, establishment of information systems showed significant effects on building SMCs information and knowledge through associate enterprises and institutions, supporting hypothesis 5a, while not showing a significant impact on green management performances, not supporting hypothesis 5b. Lastly, building relationships for information and knowledge through associate enterprises and institutions showed positive effects on green management performances, supporting hypothesis 6.

**CONCLUSION AND IMPLICATIONS**

1. Summary of Findings and Implications

The summary of findings in this study and their implications are as follows:

First, the interest levels of CEOs, considered as corporate internal factor, did not have significant effects on the utilization on information systems, while the interest levels showed significant effects on the building between information and knowledge. This indicates that increasing interest levels of CEOs not only stimulate information exchange with associating corporations and industries but also knowledge acquisition through building relationships as one of the contributing factors to promptly respond to the change in management environment, rather than kindling the establishment of corporate internal information systems. The results provide further insight into the necessity for government and

associate institutions that work with SMCs to encourage CEOs' interests in environmental issues through a wide variety of programs, including consulting and education, both directly and indirectly leading to the improvements of green management performances. Corporate information technology resources showed positive effects both on the establishment and utilization of information systems and on building relationships for information and knowledge, which seems due to the increased ease in the establishment and utilization of information systems within the company. Additionally, the more information technology resources company owns, the more adept the firm would become in responding to corporate environmental changes, encouraging building relationships for information and knowledge through associate enterprises and institutions. Second, competition intensity within the industry, considered as corporate external factor, did not show a significant effect on the establishment and utilization of information systems whereas it showed a significant effect on building relationships for information and knowledge through associate enterprises and institutions. Such results suggest that despite their passive position taken regarding the establishment and utilization of information systems even if the intensity of competition was increasing within the industry SMCs have shown to take more active measurements in building relationships for information and knowledge through various routes. This commitment could be explained by the direct impact on the enterprises sustainability as industrial competition intensifies. On the other hand, the external factor of competition intensity within the industry was formed to be directly related to the corporate survival, leading to building relationships through various routes, including collaborative research and funding for technology establishment. Third, government regulation on the environment showed significant effects on both the establishment and utilization of information systems and building relationships for information and knowledge. This seems because the more intensified government environmental regulations become the more efforts firms put on the establishment and utilization of the internal information system, parallel to the more active building of external relationships. It can be further explained as the government's simultaneous commitments to regulation enforcement as well as corporate supporting policies. Fourth, establishment of information systems had a significant effect on building relationships for information and knowledge through associate enterprises and institutions although it did not affect green management performances. The results reveal that while the establishment and utilization of the corporate internal information system could only serve as the company's enhanced competitiveness, not directly contributing to the performance levels, it could strengthen the building of relationships for information and knowledge with associated institutions and enterprises. Lastly, building relationships for information and knowledge through associate enterprises and institutions showed a significant impact on green management performances. This suggests that the efforts to strengthen external relations for SMC green management performances contribute to overcoming the limitations of internal sources, further leading to the enhanced performance levels. Therefore, industry-university-institute collaborative programs are shown to be of paramount importance in successfully improving SMC green management performances.

## 2. Limitation and implications for future studies

The hypothesis on the causal relationship related to the acquisition of market knowledge was not supported in this study.

First, this study attempted to explain the process of corporate internal and external factors, utilizing information systems, and contributing to the building of external relations in green management execution. However, the study includes limitations in that the interest levels of CEOs and information technology included in the study were adopted on a limited basis. Therefore, caution should be exercised in generalizing research results.

Future research should encompass more diverse variables that may affect information technology on green management performances, promoting a broader research base on information systems and green management. Secondly, the study exclusively focused on SMCs regarding environmental concerns. However, as the government's strategy for green establishment industry, unlike general industrial groups, renewable energy industrial groups could promote awareness and build core competencies through environment management activities. In addition, in comparison to pure manufacturing enterprises, IT industrial groups could promote unique value awareness in environment management activities in terms of product manufacturing and disposal procedures. Therefore, it is crucial to consider the fortification of core competencies for green management through specifically categorized and distinguished studies of industrial groups. Third, the results of the study do not show the impact of the establishment and utilization of information systems on green management performances. It seems because the limited competencies participating corporations held, of which 56.1% employed less than 10 workers, instead of displaying systematic relations. Future research should continue efforts to collect adequate participating companies in order to appropriately explore the green management performances of SMCs.

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