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# The impact of green learning orientation on proactive environmental innovation capability and firm performance

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Previous studies have devoted significant attention to exploring the impact of organizational learning on innovation capability and performance. However, few studies have investigated the specific outcomes concerning green innovation or environmental management. This study attempts to fill the existing research gap by proposing a novel construct - green learning orientation - and providing a research framework to explore the impact of green learning orientation on proactive environmental innovation capability and firm performance. This study uses a questionnaire survey to assess electrical and electronics manufacturers in Taiwan. The results show the following: (1) green learning orientation is positively associated with proactive environmental innovation capability, (2) green learning orientation is positively associated with firm performance, and (3) proactive environmental innovation capability is positively associated with firm performance. Thus, companies that are pioneers in green learning have the ability to enhance their innovation capability in terms of processes, products, and services and increase their performance. Additionally, proactive environmental innovation capability is also an important source of performance.

**Key words:** green learning orientation, proactive environmental innovation capability, firm performance.

## INTRODUCTION

In recent years, business ethics, corporate social responsibility, environmental management, and green innovation have become critical issues for companies in many industries (Lee, 2009; Cruz and Pedrozo, 2009). The increasing rise of environmental consciousness in consumers, the trends of strict international environmental regulations, and the rapid changes in industrial technologies have had a significant impact on companies (Chen et al., 2006). To survive and grow in highly competitive environments, a company must be able to respond to these competitive challenges by developing into a learning organization or an innovative firm (Kline and Saunders, 1993; Senge, 1990; Robinson and Stern, 1997; Kelley, 2001). Green issues and environmental concerns are crucial considerations for many companies.

Organizational learning, which is a type of knowledge-

based resource capability, has become more important in the rapidly changing and fiercely competitive business world (Carrillo and Gaimon, 2004). In other words, the processes of organizational learning involve key components that support knowledge productivity processes, which include searching for information and assimilating, developing, and creating new knowledge of products, processes, and services (Verdonschot, 2005). Several studies have concluded that learning is associated with the development of new knowledge, which is crucial for a firm's innovation capability and performance (Cohen and Levinthal, 1990; Hurley and Hult, 1998; Lopez et al., 2005).

In addition, many studies have investigated the positive relationship between innovation capability and performance (Hurley and Hult, 1998; Pitt and Clarke, 1999; Loof and Heshmati, 2002). In this context, organizational learning is related to innovation capability and performance, and knowledge-based innovation may be a source of performance.

Previous studies have devoted significant attention to

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exploring the impact of organizational learning on innovation capability and performance. However, few studies have investigated the specific outcomes concerning green innovation or environmental management. Thus, the following research questions were addressed in this study. Can an organization benefit by obtaining green knowledge? Can the accumulation of such useful knowledge further enhance an organization's capability to innovate? Do such environmental innovation efforts enhance firm performance? How can these efforts be more functional?

The aim of this study is to understand the effect of organizational learning on environmental innovation capability and firm performance. Furthermore, this study proposes a novel construct - green learning orientation - to fill the existing gap in the existing literature regarding organizational learning.

## LITERATURE REVIEW

### Organizational learning

Organizational learning is a process in which members of an organization act as learning agents for the organization by responding to changes in both the internal and external environments of the organization. The members accomplish this by detecting and correcting errors in the extant organizational knowledge and by embedding the results of their inquiry in private images and shared maps of their organization (Argyris, 1996). When the learning process is embedded among the members of an organization, a learning orientation is established and organizational learning occurs (Argyris, 1996). Some researchers have adopted a strategic perspective of organizational learning by focusing on the learning orientation of an organization. From a strategic perspective, organizational learning can be viewed as a principal means of achieving strategic renewal and harmonizing continuity and change at the organizational level (Senge, 1990; Crossan et al., 1999).

Learning orientation is an organization-wide activity in which knowledge is created and used to enhance competitive advantages. These activities include the obtaining and sharing of information about customer needs, market changes, and competitor actions, as well as the development of new technologies to create new products that are superior to competitors' products (Hurley and Hult, 1998; Moorman and Miner, 1998; Calantone et al., 2002). Therefore, learning orientation influences the degree to which an organization is satisfied with its knowledge base and, thus, the degree to which proactive learning occurs. In this regard, learning orientation affects the information that a company considers, interprets, evaluates, and eventually accepts or rejects (Argyris, 1996; Sinkula et al., 1997).

In a strictly regulated and rapidly changing business environment, learning at a rate slower than the rate of

environmental change is indicative of learning deficiencies that can erode the market position of a company. Therefore, organizations must be able to learn at a rate that at a minimum remains current with environmental changes if they are to develop and maintain core competencies with market value (Sinkula et al., 1997). Facing strict international regulations, environmental protection conventions, and rising consumer environmentalism, a commitment to the natural environment has become a strategic issue in today's competitive business environment.

Therefore, the generation of social and environmental awareness among employees and organizational attitudes that encourage such awareness is very critical for an organization (Sharma, 2000; Bansal and Roth, 2000; Ramus and Steger, 2000; Anderson and Bateman, 2000; Bansal, 2003; Reverdy, 2005).

Researchers have concluded that organizational learning is associated with the development of new knowledge, which is crucial for a firm's innovation capability and performance. Some researchers have focused on the commitment to learning, shared vision, and open-mindedness in organizations, while other researchers have emphasized interactions with other firms, institutions, and customers (Hurley and Hult, 1998; Calantone et al., 2002; Capello, 2002; Capello and Faggian, 2005). Although previous researchers have devoted considerable attention to the learning orientation, there has been no research regarding the learning orientation specific to green innovation or environmental management. Therefore, this study aimed to fill this existing research gap by proposing a novel construct – green learning orientation – to explore the positive relationship between proactive environmental innovation capability and firm performance. Based on the above review, this study assumed two perspectives on organizational learning: the individual level and the organizational level. The individual level occurs within an organization, and the organizational level occurs between different organizations. Additionally, the purpose of organizational learning depends on the strategic intent of each organization. To meet environmental regulations and satisfy customer needs, it is assumed that an organization should focus on obtaining green or environmental knowledge. Therefore, in this study, green learning orientation is defined as the inter-organizational and intra-organizational sharing of green knowledge and the creation of green innovation or environmental management.

### The positive effect of green learning orientation on proactive environmental innovation capability

Innovation is involved in the acquisition, dissemination, and use of new knowledge (Verona, 1996). Therefore, innovation enables the generation, acceptance, and implementation of new ideas, processes, products, or

services (Thompson, 1965). Accordingly, innovation refers to new newly initiated products or services, newly introduced ideas, overall technical renovations, and adaptability to change. Innovation can be the result or outcome of organizational learning (Cohen and Levinthal, 1990; Hurley and Hult, 1998). The processes of organizational learning involve key components that support knowledge productivity processes, which include searching for information and assimilating, developing, and creating new knowledge related to products, processes, and services (Verdonschot, 2005). Hence, a learning orientation represents the degree to which proactive learning occurs in an organization (Sinkula et al., 1997). Organizations with a strong learning orientation proactively expand their capacity and renew themselves (Vowles, 1993).

Furthermore, Cohen and Levinthal (1990) argued that the ability of a firm to recognize, assimilate, and apply the value of new external information is critical to its innovative capability. Meeus et al. (2001) elaborated on this argument by stating that organizational learning is a critical constituent of the process of innovation.

Many studies and theories have suggested that learning is an antecedent to innovation (Cohen and Levinthal, 1990; Hurley and Hult, 1998), and many scholars have stressed the importance of learning orientation to enhancing innovation capability (Damanpour, 1991; Cahill, 1996; Yeung et al., 2007).

To overcome environmental pressures, the communication of information and exchange of knowledge based on environmentally friendly requirements are critical success factors for environmental innovation and management. To survive in such conditions, the development of individual and organizational capability with regard to knowledge obtainment, application, sharing and creation are necessary.

In this study, proactive environmental innovation capability is defined as innovation capability regarding processes, products, and services related to environmental protection and consciousness that stays ahead of competitors and exceeds the requirements of environmental laws. Therefore, the following hypotheses are proposed:

H<sub>1</sub>: Green learning orientation is positively associated with proactive environmental innovation capability.

H<sub>1a</sub>: Intra-organizational green knowledge sharing and creation is positively associated with proactive environmental innovation capability.

H<sub>1b</sub>: Inter-organizational green knowledge sharing and creation is positively associated with proactive environmental innovation capability.

#### **The positive effect of green learning orientation on firm performance**

The ability of companies to achieve and sustain a

competitive edge depends on their success in managing intangible assets such as human skills, knowledge bases, or other strengths with products or services that their competitors cannot provide (Kaplan and Norton, 1992). Various scholars have long acknowledged the importance of learning orientation to overall firm performance (Slater and Narver, 1995). The literature also emphasizes the importance of organizational learning for a company's survival and effective organizational performance (Decarolis and Deeds, 1999). Bontis et al. (2002) demonstrated that organizational learning at all levels has a positive impact on business performance. Similarly, Lopez et al. (2005) pointed out that organizational learning positively contributes to a company's financial performance and innovation. Undeniably, knowledge acquisition, sharing, application, and creation contribute significantly to the performance of any organization. Given today's society and its increasing awareness of environmental protection, incorporating environmental concepts in organizational policies and decision-making processes may be create excellent business opportunities for organizations. Therefore, the following hypotheses are proposed:

H<sub>2</sub>: Green learning orientation is positively associated with firm performance.

H<sub>2a</sub>: Intra-organizational green knowledge sharing and creation is positively associated with firm performance.

H<sub>2b</sub>: Inter-organizational green knowledge sharing and creation is positively associated with firm performance.

#### **The positive effect of proactive environmental innovation capability on firm performance**

Innovation capability is the most important determinant of firm performance (Mone et al., 1998). Furthermore, an increasing number of studies have ascertained that innovativeness is a key to achieving a superior organizational performance (Hurley and Hult, 1998; Pitt and Clarke, 1999). The failure to promote innovative projects and activities negatively affects productivity and organizational performance. Therefore, a positive link exists between innovation and organizational performance and between the various elements of innovation (for example, innovations in design, speed, or flexibility) and organizational performance (Loof and Heshmati, 2002). Some authors have suggested that environmental management may be a tool that helps organizations to improve their competitiveness (Ambec and Lanoie, 2008; Hart, 1995; Porter and Van der Linde, 1995). The corporations that are pioneers in green innovation and environmental management enjoy a first mover advantage; this advantage allows them to demand higher prices for green products, improve their corporate images, develop new markets, and increase firm performance (Hart, 1995; Peattie, 1992; Chen et al., 2006). Hence, positive environmental innovations are necessary elements for organizations

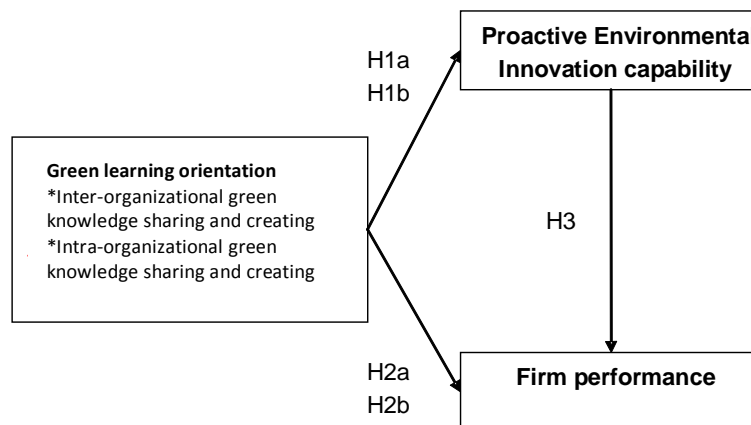


Figure 1. Research framework.

because they can improve both environmental and financial performance (Huang and Shih, 2008). Additionally, the proactive adoption of an environmental innovation strategy can efficiently reduce environmental pollutions and improve a company's environmental image and performance (Claver et al., 2007). Therefore, the following hypothesis is proposed:

H<sub>3</sub>: Proactive environmental innovation capability is positively associated with firm performance.

## METHODOLOGY

Based on the above discussions, the relationships between green learning orientation, proactive environmental innovation capability, and firm performance were tested. The research framework of this study was shown in Figure 1. To analyze the above relationships, a questionnaire-based survey was used to test the hypotheses. Relevant previous studies were referred to for the design of the questionnaires, which were used to assess electrical and electronics manufacturers in Taiwan.

### Data collection and samples

The unit of analysis in this study was at the business level. The research subjects in this study were electrical and electronics manufacturers in Taiwan. There are several major reasons for focusing on Taiwanese electrical and electronic manufacturers. First, electrical and electronics manufacturing is a major industry in Taiwan. Second, the export value of electrical and electronic goods is estimated to account for approximately half of the total Taiwanese annual export value. Third, under strictly international environmental regulations particularly in America, Europe, and other developed countries, Taiwanese manufacturers must follow environmental trends and meet international environmental requirements.

The samples were randomly selected from the "Business Directory of Taiwan." The questionnaire respondents were CEOs or top managers in the departments of manufacturing, R and D, marketing, or environmental protection. To increase the survey response rate, this study telephoned the respondents that were

selected, explained the objective of this survey, and confirmed respondents' contact information prior to mailing out questionnaires. The respondents were asked to return the completed questionnaires within two weeks via postal mail.

The questionnaire items in this study were adopted from relevant past studies. Prior to mailing them to the respondents, the questionnaires were mailed to 20 scholars and experts who were asked to refine and modify questionnaire items as needed. Comments and suggestions from these respondents were used to improve the readability of the questionnaire. In total, 800 questionnaires were mailed, and 238 valid questionnaires were received; the effective response rate was 29.75%.

### Definitions and measurements of variables

The questionnaire included three parts. The first part assessed green learning orientation, the second part assessed proactive environmental innovation capability, and the third part assessed firm performance. The questionnaire items were measured on a five-point Likert scale where 1=strongly disagree and 5=strongly agree. The definitions and measurements of the variables were defined as follows.

#### Green learning orientation

This study referred to the definitions provided by Bansal and Roth (2000), Bansal (2003), Hurley and Hult (1998), Capello and Faggian (2005), Calantone et al. (2002), and Tsai (2001), and defined green learning orientation as the inter-organizational and intra-organizational sharing of green knowledge and the creation of green innovation or environmental management. The measurement of intra-organizational green knowledge sharing and creation included four items: (1) all employees and top managers agree that learning ability is the key to competitive advantage and guaranteed organizational survival, (2) all employees and top managers are committed to the goals and visions of this organization and are also willing to critically evaluate operational routines and accept new knowledge, (3) our organizational structure facilitates the sharing and creation of green knowledge, and (4) our top managers encourage the sharing and creation of green knowledge. The measurement of inter-organizational green knowledge sharing and creation also included four items: (1) our company frequently interacts with both upstream and downstream partners, (2) our

**Table 1.** descriptive statistics.

Constructs	Mean	Standard Deviation	Min.	Max.
Inter-organizational green knowledge sharing and creation	3.733	0.5725	2.00	5.00
Intra-organizational green knowledge sharing and creation	3.7553	0.5219	1.00	5.00
Proactive environmental innovation capability	4.000	0.6233	2.00	5.00
Firm performance	3.6779	0.6393	2.00	5.00

**Table 2.** Cronbach's  $\alpha$  coefficient of the constructs.

Constructs	Number of items	Cronbach's $\alpha$	Remark
Inter-organizational green knowledge sharing and creation	4	0.815	Acceptable
Intra-organizational green knowledge sharing and creation	4	0.724	Acceptable
Proactive environmental innovation capability	5	0.942	Acceptable
Firm performance	3	0.772	Acceptable

company frequently interacts with other companies in this industry (3) our company frequently interacts with government institutions, and (4) our company frequently interacts with academic and research institutions.

#### Proactive environmental innovation capability

This study referred to the definitions provided by Ramus and Steger (2000), Rivera (2002), Hurt et al. (1977), Hollenstein (1996), and Hurt and Teigen (1977), and defined proactive environmental innovation capability as innovation capability in the processes, products, and services related to environmental protection and consciousness that were aid a company in staying ahead of the competitors and exceeding environmental legal requirements. The measurement of proactive environmental innovation capability included five items: (1) our company frequently experiments with new green ideas, (2) our company seeks more environmental ways to do things, (3) our company is creative with green efforts regarding management and operational processes, (4) our company is often the first to market new green products and services, and (5) the environmental requirements associated with our processes, products, and services are often more rigorous than those of our competitors and go beyond environmental regulations.

#### Firm performance

This study referred to studies conducted by Delaney and Huselid (1996) and Richard (2000), and adopted sales, profitability, and market share as indicators of firm performance. The measurement of firm performance included three items: (1) the sales growth of our company is greater than that of our competitors, (2) the profitability of our company is better than that of our competitors, and (3) the market share of our company is better than that of our competitors.

## RESULTS

Table 1 shows the descriptive statistics for each construct. Construct reliability was analyzed with Cronbach's  $\alpha$  coefficient. Cronbach's  $\alpha$  coefficient of each construct is shown in Table 2. The results show that Cronbach's  $\alpha$  coefficient of inter-organizational green knowledge

sharing and creation is 0.815; that of intra-organizational green knowledge sharing and creation is 0.724; that of proactive environmental innovation capability is 0.942; and that of firm performance is 0.772. Generally, the minimum requirement for Cronbach's  $\alpha$  coefficient should be greater than 0.7 (Hair et al., 1998). Cronbach's  $\alpha$  coefficient of each construct was greater than 0.7; the finding indicates that the measurements were acceptable regarding reliability.

Furthermore, the questionnaire items in this study were adopted from past research work. Prior to mailing them to the respondents, the questionnaires were mailed to 20 scholars and experts, who were asked to refine and modify questionnaire items. The comments and suggestions from these respondents were used to improve the readability of this questionnaire. Therefore, the measurements in this study were acceptable in terms of content validity.

Table 3 shows the results of the factor analysis in this study. Each construct can be classified into only one factor in this study. The correlation matrix for the constructs is shown in Table 4. Both inter-organizational and intra-organizational green knowledge sharing and creation were positively and significantly correlated with proactive environmental innovation capability and firm performance. Additionally, proactive environmental innovation capability was positively and significantly correlated with firm performance.

#### Regression analysis results

Table 5 displays the regression analysis of the relationship between green learning orientation and proactive environmental innovation capability. With regard to the relationship between inter-organizational green knowledge sharing and creating and proactive environmental innovation capability, the empirical results show that inter-organizational green knowledge sharing

**Table 3.** Factor analysis of this study.

Constructs	Number of item	Number of factor	Accumulation percentage of explained variance (%)
Inter-organizational green knowledge sharing and creation	4	1	64.429
Intra-organizational green knowledge sharing and creation	4	1	55.852
Proactive environmental innovation capability	5	1	81.144
Firm performance	3	1	68.859

**Table 4.** Correlation coefficient between the constructs.

	(A)	(B)	(C)	(D)
(A) Inter-organizational green knowledge sharing and creation				
(B) Intra-organizational green knowledge sharing and creation	0.677**			
(C) Proactive environmental innovation capability	0.431**	0.528**		
(D) Firm performance	0.483**	0.562**	0.473**	

Note: \*  $p < 0.05$ , \*\*  $p < 0.01$

**Table 5.** Regression analysis of the relationship between green learning orientation and proactive environmental innovation capability.

<b>Dependent variable: Proactive environmental innovation capability</b>	
<b>Independent variable</b>	
Inter-organizational green knowledge sharing and creation	0.436**
Intra-organizational green knowledge sharing and creation	0.136*
R <sup>2</sup>	0.289
Adjusted R <sup>2</sup>	0.284
VIF	1.847
F	47.677**

Note: \*  $p < 0.05$ , \*\*  $p < 0.01$

and creation was positively associated with proactive environmental innovation capability. Therefore, H<sub>1a</sub> was supported in this study. With regard to the relationship between intra-organizational green knowledge sharing and creation and proactive environmental innovation capability, the empirical results show that intra-organizational green knowledge sharing and creation was positively associated with proactive environmental innovation capability. Therefore, H<sub>1b</sub> was also supported in this study. The VIF value of the regression model was 1.847, which is below 10. Therefore, there was no multicollinearity in this regression model (Hair et al., 1998). The results indicate that greater efforts regarding green

knowledge education lead to stronger environmental innovation capability. Thus, promoting a green learning orientation would result in a great advantage for companies with regard to innovation.

Table 6 shows the regression analysis of the relationship between green learning orientation and firm performance. As far as the relationship between inter-organizational green knowledge sharing and creation and firm performance was concerned, the empirical results show that inter-organizational green knowledge sharing and creation was positively associated with firm performance. Therefore, H<sub>2a</sub> was supported in this study. As far as the relationship between intra-organizational

**Table 6.** Regression analysis of the relationship between green learning orientation and firm performance.

<b>Dependent variable: Firm performance</b>	
<b>Independent variable</b>	
Inter-organizational green knowledge sharing and creation	0.189**
Intra-organizational green knowledge sharing and creation	0.433**
R <sup>2</sup>	0.335
Adjusted R <sup>2</sup>	0.329
VIF	1.847
F	59.118**

\* p &lt; 0.05, \*\* p &lt; 0.01

**Table 7.** Regression analysis of the relationship between proactive environmental innovation capability and firm performance.

<b>Dependent variable: Firm performance</b>	
<b>Independent variable</b>	
Proactive environmental innovation capability	0.473**
R <sup>2</sup>	0.224
Adjusted R <sup>2</sup>	0.220
VIF	1.000
F	68.005**

\* p &lt; 0.05, \*\* p &lt; 0.01

green knowledge sharing and creation and firm performance, the empirical results show that intra-organizational green knowledge sharing and creation was positively associated with firm performance. Therefore, H<sub>2b</sub> was supported in this study. The VIF value of the regression model was 1.847, which is below 10. Therefore, there was no multi-collinearity in this regression model. The results indicate that greater efforts to obtain green knowledge lead to enhance firm performance. Thus, promoting a green learning orientation would greatly benefit companies.

Table 7 shows the regression analysis of the relationship between proactive environmental innovation capability and firm performance. The empirical results showed that proactive environmental innovation capability had a positive effect on firm performance. Therefore, H<sub>3</sub> was supported in this study. The VIF value of the regression model was 1.000, which is below 10. Therefore, there was no multi-collinearity in this regression model. Thus, in addition to enhancing their innovation capability regarding processes, products, and services, pioneering companies in the green market are able to increase their overall performance.

## DISCUSSION

The strategic issue of corporate environmentalism and green management emerged in the 1990s and has

become an internationally popular slogan in the 2000s. Debates relating to corporate social responsibility and green management are becoming important subjects of the management literature in this century. Companies are confronted with environmental issues in their decisions, not only to take into account ethics and social values that need to be promoted, but also to ensure sustainable economic success. Although prior researchers have widely discussed the relevant issues of learning orientation, no study to date has explored the learning orientation specific to green innovation or environmental management. To fill this existing research gap, this study proposed a novel construct - green learning orientation - and developed a research framework to further discuss the effect of green learning orientation on proactive environmental innovation capability and firm performance.

First, this study revealed that both intra-organizational and inter-organizational green knowledge sharing and creation had positive effects on proactive environmental innovation capability. Therefore, H<sub>1a</sub> and H<sub>1b</sub> were supported by the study results. This finding was consistent with the literature (Cohen and Levinthal, 1990; Hurley and Hult, 1998; Yeung et al., 2007). Hence, companies that endeavor to encourage intra-organizational and inter-organizational green knowledge sharing and creation can enhance their environmental innovation capabilities. Second, this study revealed that both intra-organizational and inter-organizational green knowledge sharing and creating had positive effects on firm

performance. Therefore, H<sub>2a</sub> and H<sub>2b</sub> were supported in this study. Several studies have suggested that organizational learning with regard to knowledge acquisition, sharing, application, and creation can contribute to business performance (Bontis et al., 2002; Lopez et al., 2005). Hence, the finding of this study agreed with those studies. Third, this study revealed that proactive environmental innovation capability was positively related to firm performance. Therefore, H<sub>3</sub> was supported in this study. This finding also provided support for recent studies (Claver et al., 2007; Huang and Shih, 2008). To increase firm performance, companies must ensure that green concepts, ideas, and creativities are embodied in their processes, products, and services. Thus, companies can benefit from engaging in green innovation or environmental management practices.

### THEORETICAL CONTRIBUTIONS AND MANAGERIAL IMPLICATIONS

The main theoretical contribution of this study was the proposal of a novel construct – green learning orientation – and the successful verification of the effect of green learning orientation on proactive environmental innovation capability and firm performance. Additionally, this study considered inter-organizational and intra-organizational learning collectively. The developed research framework and empirical evidence from this study can provide useful references for further studies to investigate the relevant literature regarding learning orientation, innovation, and performance. In addition, there are four managerial implications. First, a company's competitive advantage is built on a full understanding of its environment, including its competitors' actions, customers' needs, future trends, and emerging technologies. Therefore, managers should encourage employees to use company time to pursue knowledge that is outside the scope of their work. Through cross-functional integration, employees can share existing knowledge and develop new knowledge and skills.

Second, knowledge creativity and innovation capability can be viewed as organizational resources. Therefore, managers should establish an efficient mechanism to reserve these assets and effectively use them to enhance performance and gain competitive advantages. Third, proactive environmental innovation requires a high level of technical and management skills in employees. To foster proactive environmental innovation, it is important to introduce training programs aimed at increasing employees' environmental awareness and courses specifically addressing the development of new technical and managerial competencies. Therefore, managers should establish clearly independent teams or departments to manage environmental initiatives efficiently and build highly formalized processes, systems, and structures to promote the efficient sharing and generating of knowledge both internally and externally. Fourth, some

employees in the organizations viewed learning as an extra burden on their current roles. It is important for employees and top management to understand why an organization must acquire green knowledge and adopt green management and innovations. Therefore, managers should be able to realize this negative organizational climate and respond by introducing training and education programs to promote green knowledge and providing extra incentives to encourage employees to attend these programs.

### LIMITATIONS AND FUTURE STUDIES

There are some limitations in this study. Because the questionnaire survey was used to verify the stated hypotheses, this study can only provide cross-sectional data and is unable to provide any longitudinal data. Therefore, through the use of a two-stage longitudinal survey, future studies may better assess the development of such knowledge sharing and creation in different stages. Furthermore, this study focused on electrical and electronics manufacturers in Taiwan. Therefore, further studies can focus on other industries in other countries, and compare their results with this study. Finally, these results that may prove constructive to researchers, managers, and institutions, this study may be a helpful reference for future studies as well.

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