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Constructing performance measurement indicators to suggested corporate environmental responsibility framework

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ABSTRACT

Leading enterprises worldwide are proactively fulfilling environmental protection. This trend has elicited international attention. The corporate environmental responsibility (CER) framework was constructed based on the strategy these enterprises executed. This conceptual framework precisely determined current international advanced CER content. However, understanding the true intention of businesses that practice environmental management and protection through the CER framework is difficult, thereby making CER performance measurement indicators crucial. However, the lack of active CER performance measurement indicators resulted in the inability to reflect fully the effects of industry situation and business development on the living environment. Hence, this situation signals the urgency to construct CER performance measurement indicators that reflect fully industry situation and social needs. This study aims to address the deficiencies of CER performance measurement indicators in the academic circle, and construct a set of active CER performance measurement indicators that fully reflect the effects of industry situation and business development on the living environment. For this reason, this study employs content analysis method to establish CER performance measurement indicators based on the CER framework. This indicator provides an effective and applied CER performance measurement tool and offers the government with foresighted concepts of environmental protection.

1. Introduction

High economic development and growth are important national development policies of countries around the world. However, such a policy direction causes many countries to focus only on economic construction and development activities and neglect environmental sustainability. Chen et al. (2012) argue that although industrial parks create considerable economic benefits, these structures emit tremendous amounts of pollution and consume significant environmental resources. The environment has lost its original regulatory function because of excessive human pressure. These policies also have caused extreme weather phenomena and environmental disasters. Parmesan (2006) points out that climatic change will threaten global economic development and human living environment. Therefore, regardless of country or industry, corporate environmental performance must be scrutinized by international organizations and the public. Environmental protection is the best economic development strategy. Environmental protection and economic development aim to improve the quality of human life. Thus, economic development should regard environmental protection as its premise. According to the concept of sustainable development, economic development and environmental protection can be parallel and compatible. Sustainable development is an economic policy that seeks to guide society to make proper deployments for environmental protection, consumers, and investors (IAEA, 2005).

Reduction of environmental pollution and improved efficiency of energy utilization are critical; leading firms worldwide are actively fulfilling their environmental protection activities, while social responsibilities have become an international trend (Hsu et al., 2011; Wang et al., 2015). In addition, companies should adopt and implement a corporate social responsibility strategy as early as possible to prevent future negative publicities (Chen et al., 2016). The formulation of industry standards has become an industry competitive strategy that can create higher entry barriers for obtaining excess return and ensure competitive advantage. Environmental protection standards are vital to

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industry standards and are just and legal (Vastag et al., 1996). For example, the EU passed Waste Electrical and Electronic Equipment (WEEE), Restrictions on Hazardous Substances Directive (RoHS), and Directive of Eco-design Requirements of Energy-using Product (EuP) as formal laws in 2003. If electronic products exported to the EU fail to comply with these regulations, the products will be returned or the exporters will be subjected to heavy fines. Therefore, enterprises should completely integrate environmental protection into their competitive strategy rather than be limited to laws and regulations.

Reporting on non-financial information is becoming a continuing trend for most of the world's largest companies. Communication of social and environmental dimensions of the company plays a key role in the sustainable development of organizations, and therefore should be investigated in depth (Bonsón and Bednárová, 2015). In the 1990s, worldwide companies began to issue their social reports. The two main reasons that contribute to this trend can be identified easily. The first one is the increasing pressure from various stakeholders, and the other one is the fact that some companies have realized that reporting their social contribution can benefit them (Gao, 2011). One study applied content analysis to examine the Corporate Social Responsibility (CSR) reports of listed companies in Asian countries; this study reported that 79% of companies showed positive attitude toward undertaking social responsibilities (Gao, 2011). Jain and Winner (2016) propose an international perspective to CSR and sustainability (Sus) discussions by examining CSR/Sus reporting practices of the 200 largest state-owned and private companies in India; they show that while most companies share CSR/Sus information through their websites, they associate different levels of importance to this communication. An increasing number of studies are paying attention to this issue (Bonsón and Bednárová, 2015; Fortanier et al., 2011; Kennedy Nyahunzvi, 2013; Kiliç, 2016). However, CSR reports are written at the enterprise level and people encounter difficulty in understanding the true intention of businesses practicing environmental management and protection. Thus, CER performance measurement indicators are crucial. The World Economic Forum developed environmental performance indicators from the Global Reporting Initiative (GRI; www.globalreporting.org/Pages/default.aspx) and the Environmental Sustainability Index (ESI; www.yale.edu/esi). In Taiwan, the content of measurement reflects the perceptions of environmental groups instead of perceptions of firms. International indicators are not adjusted accordingly despite differences in economic development and directions among countries. A single foreign indicator may inaccurately measure the performance of a country. Therefore, according to the content of the CER framework, the present study establishes CER performance measurement indicators that fully reflect the effects of industry situation and business development on the living environment.

The CER framework developed by Yu and Chen (2014) was constructed based on the strategy that enterprises executed. This conceptual framework has precisely determined the current international advanced CER content that includes three primary dimensions and seven secondary dimensions. Nevertheless, understanding the true intention of businesses practicing environmental protection and management through the CER framework remains difficult (Yu et al., 2016). Therefore, the present study constructs a set of CER performance measurement indicators based on the CER framework developed by Yu and Chen (2014). Firms and the public could then develop an easy-to-use measurement tool to understand the true intention of businesses that practice environmental management and protection. The main contribution of this study is the construction of a set of CER performance measurement indicators that fully reflect the effects of the industry situation and business development on the living environment. Firms and the public are provided with an easy-to-use measurement tool than can help them understand the true intention of businesses that practice environmental management and protection.

The study aims to (1) address the deficiencies of CER performance measurement indicators in the academic circle; (2) construct a set of active CER performance measurement indicators that fully reflect the effects of industry situation and business development on the living environment; (3) provide businesses and the public with an easy-to-use CER performance measurement tool; and (4) provide government units with a prospective concept of environmental protection as a basic structure to normalize CER.

2. Literature review

2.1. Institutional perspectives on responsibility regulations

Institutional theory is used to explain why businesses undertake environmental management (King and Lenox, 2000; Sharma, 2000). According to institutional theory, no organization can be free from external environmental pressure. An organization that faces external pressure and fails to adjust properly will endanger its own survival (Selznick, 1949). Meyer and Rowan (1977), DiMaggio and Powell (1983) postulate that an organization is an open system, i.e., the environment is the external system of all organizations. Hence, an interactive "input–transform-output" relationship exists between the organization and external environment. External environmental factors include cultural, science and technology, educational, political, legal, natural resource, demographic features, social environment in the regular social environment and customer, supplier, competitor, socio-political, and technology factors in the special task environment. These factors affect the environment in various degrees and are the sources of momentum in system change and adjustment. Thus, institutional factors play an important external environmental factor (pressure) in this cycle.

Open system theory stresses that an organization is strongly influenced by the external environment. Institutional theory claims that humans and organizations are rational. Through faith and unified goals, an organization may survive and grow under such complicated systems and regulations. Therefore, an organization follows the steps of environmental regulation changes and makes proper adjustment to synchronize with the external environment. Institutional theory believes that when an organization faces external environmental pressure, the company must adjust its organizational structure or adopt necessary adjustment activities to meet environmental demand (Scott, 1987). The institutionalization process will induce the external environment to transfuse business with its own value and concepts when the relationship between corporations and the environment is viewed from the institutional theory perspective. When a firm faces environmental demand, the company is inclined to seek the legitimacy the institutional environment identifies. Therefore, business will make proper adjustments upon the demand of the institutional environment (Scott, 1992). Moreover, CER is generally considered part of CSR; thus, CER is defined as "the broad array of strategies and operating practices that a company develops in its efforts to deal with and create relationships with its numerous stakeholders and the natural environment (Surroca et al., 2010)."

People encounter difficulty in understanding the true intention of businesses that practice environmental management and protection. Kennedy Nyahunzvi (2013) suggests that future studies can examine actual CSR practices adopted by practical sector. According to Michelon et al. (2015), evidence suggests CSR reporting practices are symbolic rather than substantive. Thus, an easy-to-use measurement tool is crucial to understand the true intention of businesses that practice environmental management and protection.

2.2. Corporate environmental responsibility

Environmental management issues have attracted worldwide attention. The International Standard Organization (ISO) raised a series of environmental protection certificates (e.g., ISO 14001), and the United Nations Framework Convention on Climate Change (UNFCCC) continuously held conferences to solve the problem of global warming. Maxwell et al. (1997) believe that enterprises should adopt positive and active corporate environmental strategies. These strategies could generate

competitive advantages, such as cost reduction, quality improvement, enhancement of corporate image, and development of new markets. Chen (2008) argues that investment and development of green core competence is helpful for enterprises to improve their green innovation and image. Therefore, firms should focus on innovation performance of green product and production to obtain competitive advantage.

A study that applied content analysis to examine CSR reports of listed companies in China reported that 79% of companies showed a positive attitude toward undertaking social responsibilities (Gao, 2011). Moreover, CER is generally considered part of CSR. Sindhi and Kumar (2012) propose a CER framework to elucidate the underlying reasons for adopting CER as a strategy; they indicated that CER is accepted as a norm for sustainable organizations. Moreover, Lee (2012) emphasizes that CER should be regarded as the pivotal activity in implementing an environmentally oriented strategy in businesses. Yu and Chen (2014) further argue that a CER framework based on the current environmental actions of firms could reflect the environmental philosophy and green technology objectives of the firm; thus, this framework can be used to regulate CER and guide firms or governments in their efforts toward sustainable development.

2.3. Measure of CER performance

Vastag et al. (1996) argue that enterprises would adopt different environmental coping strategies when faced with different internal and external environmental risks. Chen et al. (2006) further emphasize that enterprises will choose different environmental management strategies when attention and attitudes of firms toward environmental protection are different. Slater and Angel (2000) divide environmental protection strategies into four categories according to the extent and strategic behaviors of enterprises to respond to environmental pressure. These four categories are (1) lazy strategy, which means that enterprises did not have any response; (2) response strategy, which means that enterprises conduct environmental management with a negative attitude and that enterprises want to spend as little as possible; (3) proactive strategy, which means that enterprises anticipate changes in the environment to adopt active and positive environmental strategies and regard environmental management as the key factor of their business; and (4) interaction strategy, which refers to the process of bringing relative environmental issues into strategic management and considering these measures in overall operations.

Performance is used to measure the resource use of enterprises, but environmental issues need to be discussed from a wider social perspective. Corporate environmental performance is an important dimension of organizational performance (Hart, 1995). Environmental performance measurement is a systematic process for measurement and assessment of corporate environmental performance. Firms must establish proper performance indicators to obtain objective and reliable data and consider opinions of internal and external stakeholders to transform organization management performance into useful information because enterprises measure environmental performance (Ku, 2000).

ISO 14031 indicates that environmental indicators shall cover two categories, namely, environmental condition indicators (ECIs) and environmental performance indicators (EPIs). EPIs can be divided into management performance indicators (MPIs) and operation performance indicators (OPIs). MPIs are used to evaluate management effectiveness and effectiveness of decisions and actions in improving environmental performance. The evaluation of MPIs covers implementation of policies and programs, fitness, financial performance, and public relations. OPIs are used to evaluate the environmental performance of organizations in operations, including materials, energies, devices and equipment, products, wastes, air pollution emission, wastewater discharge, and noise/radiation. Environmental condition indicators provide the surrounding environmental status, which can help organizations understand potential harm to the environment under its environmental consideration. Therefore, planning and implementation of environmental performance assessment would be helpful.

Callan and Thomas (1996) state that the environmental performance assessment principle provided by the Coalition for Environmental Responsible Economics can be divided into 10 principles: (1) minimize pollutants, (2) conserve energies, (3) reduce wastes, (4) save resources, (5) reduce risks, (6) bring harmless products to markets, (7) disaster compensation, (8) reveal potential risks, (9) obtain management commission, and (10) assessment process.

Previous empirical evidence provides mixed results on the relationship between corporate environmental performance and the level of environmental disclosures (Clarkson et al., 2008). Ingram and Frazier (1980) examine the association between the content of corporate environmental disclosure and corporate environmental performance. This study focuses on lack of corporate social responsibility disclosures in annual reports due to their voluntary nature. Regression results indicated lack of association between environmental disclosure and environmental performance. Bewley and Li (2000) examine factors associated with environmental disclosures in Canada from a voluntary disclosure theory perspective. This study finds that firms with more news media coverage of their environmental exposure, higher pollution propensity. This finding suggests that increased political exposure is likely to disclose general environmental information, which suggests a negative association between environmental disclosures and environmental performance. Al-Tuwaijri et al. (2004) explore the relations among environmental disclosure, environmental performance, and economic performance using a simultaneous equations approach. They find a positive association between environmental performance and environmental disclosure. For most large companies, reporting on non-financial information is a continuing trend. Communication of social and environmental dimensions of the company plays a key role in the sustainable development of organizations (Bonsón and Bednárová, 2015). In the 1990s, companies worldwide began to issue social reports because they realized that reporting their social contribution can benefit them. One study applied content analysis to examine the CSR reports of listed companies in Asian country and reported that 79% of companies showed a positive attitude toward undertaking social responsibilities (Gao, 2011). Jain and Winner (2016) propose an international perspective to CSR and sustainability (Sus) discussions by examining CSR/Sus reporting practices of the 200 largest state-owned and private companies in India; they show that most companies share CSR/Sus information through their websites, but they associate different levels of importance to this communication. An increasing number of studies are focusing on this issue (Bonsón and Bednárová, 2015; Fortanier et al., 2011; Kennedy Nyahunzvi, 2013; Kiliç, 2016).

3. Materials and methods

This study adopts the content analysis method of qualitative research to construct a set of CER performance measurement indicators. The proposed framework aims to reflect the effects of industry situation and business development according to the content of the CER framework developed by Yu and Chen (2014). Content analysis is used in the construction of the CER framework to analyze leading high-tech firms with international level in Taiwan. The relative environmental management activities in the CSR report is integrated with the relative information to develop a CER framework. Discussions with experts in related fields will be considered in constructing the set of CER performance measurement indicators.

3.1. Content analysis method

Content analysis is a set of inference techniques that objectively and systematically appraise precise messages (Holsti, 1969). As a research methodology, content analysis is a set of procedures that make effective inferences on communication. The inferred information considers the recipient and sender of the information, as well as the actual

information. The approach of inference varies according to the preference of researchers on either theoretical or empirical studies (Weber and Roeth, 1999). According to Wimmer and Dominick (1983), the purposes of using content analysis are as follows: (a) describing communication content, (b) hypothesizing characteristics of the appraised message, (c) comparing media content and the real world, (d) appraising the image of special groups, and (e) building the beginning of media effect research. Krippendorff (2004) points out that content analysis must address the following questions: *Which data are analyzed*? *How are they defined*? *What is the population from which they are drawn*? *What is the context relative to the data that are analyzed*? *What are the boundaries of the analysis*? *What is the target of the inferences*? Based on the content of the CER framework developed by Yu and Chen (2014), the present study will start discussions with experts in related fields to construct a set of CER performance measurement indicators.

Following Neuman (2003), Yu and Chen (2014) apply content analysis to examine environmental management action based on CSR reports. The procedure involved determining research focus, discussing and clarifying the process with experts, and thoroughly examining CSR reports. Yu and Chen (2014) selected and categorized data. The data selection process involved data screening, interpretation, categorization into charts, and naming and adjusting. These steps completed the first variable system (Company A). The same processes were performed to complete other variable systems (Companies B and C), which were finally represented as figures for systematic comparison and management.

Yu and Chen (2014) construct a CER framework using the environmental management action of Company A for data partition, attribute identification, and open coding. The CER framework of Company A was developed into a comprehensive CER framework by referring to the CER framework of Company A and using axis coding and CER concepts of Companies B and C. The coding name refers to the business environmental management tools proposed by Toth (2007).

3.2. CER framework

Fig. 1 shows the complete CER framework developed by Yu and Chen (2014). Letter A in the text box indicates that the item exists in the framework of Company A. The same notation applies for letters B and C. The thick box indicates the corporate environmental framework of Company A (the initial CER framework).

3.3. Case selection and data processing of CER framework

Yu and Chen (2014) use the CSR report formally published by leading technology firms (companies A, B, and C) with international levels; they also refer to Neuman (2003) to view the relative corporate management activities in the CSR report by adopting content analysis method.

To construct the initial CER framework, open coding method is used for data segmentation of the relative environmental management activities of Company A provided in the CSR report. This approach was also used to determine the nature of this company. Axis coding method is then used to construct the CER frameworks of Companies B and C. The CER frameworks of Companies B and C are used to modify and enhance the initial CER framework. Finally, the complete CER framework is constructed. The links of Company A, B, and C are as follows.

A http://www.tsmc.com/english/csr/csr_report.htm;
B http://www.umc.com/English/CSR/B.asp; and
C http://auo.com/?sn=171&lang=en-US

3.4. Constructing the performance measurement indicator of CER: steps and rationales

The steps in constructing the CER performance measurement indicators and the rationales for such actions are as follows.

Step 1 Positive CER performance measurement indicators are currently lacking. Therefore, the effects of industry situation, social needs, and business development cannot be measured correctly. Hi-tech companies pay more attention to green image than other general companies do because their production processes highly contaminate the living environment. Based on the content of the CER framework developed by Yu and Chen (2014), the present study aims to construct a set of CER performance measurement indicators by obtaining expert opinion.

Step 2 This study verifies the primary dimensions, secondary dimensions, tertiary dimensions, and component factors in the CER framework developed by Yu and Chen (2014). The CER framework includes three primary dimensions, namely, Green Social Capital, Green Strategy Transition, and Green Benefit Output. The CER framework covers seven secondary dimensions, seven tertiary dimensions, and 56 component factors.

Step 3 Data are preliminary arranged under the major dimensions of content analysis data while the CER framework is being developed. For example, Green Social Capital includes two secondary dimensions, namely, Green Certification and Industrial Support. Green Certification covers eight component factors, and Industrial Support includes two component factors.

Step 4 Data from content analysis are integrated after arranging the data under major dimensions. For example, Companies A and C have a component factor, i.e., Green building soft/hardware. Relative content analysis data are then integrated into the Green building soft/hardware of Companies A and C.

Component factor	Original contents
Green building soft/hardware	1. Domestic facilities obtain domestic green building certification. (Company A) 2. Domestic facilities obtain international green building certification. (Companies A and C) 3. Foreign facilities obtain international green building certification. (Companies A and C)

Note: Company A means Company A has conducted the process; Companies A and C mean both have conducted the process.

Step 5 The original contents of component factors are then amended to meet the formation and conditions of performance measurement systems. For example, the original content of Green building soft/hardware includes: (1) domestic plant obtained domestic green building certification; (2) domestic plant obtained international green building certification; and (3) foreign plant obtained international green building certification. However, a discussion with experts revealed that the main purpose is to determine whether the company obtained relative certifications for Green building soft/hardware. This idea does not necessarily follow that each company maintains plants at home and abroad. Therefore, after discussion with experts, this study amends the original content to: (1) domestic green building certification and (2) international green building certification.

Component factor	Amended contents
Green building soft/hardware	1. Domestic green building certification. 2. International green building certification.

Note: We no longer distinguish the tasks that each company has done due to the development the performance measurement system.

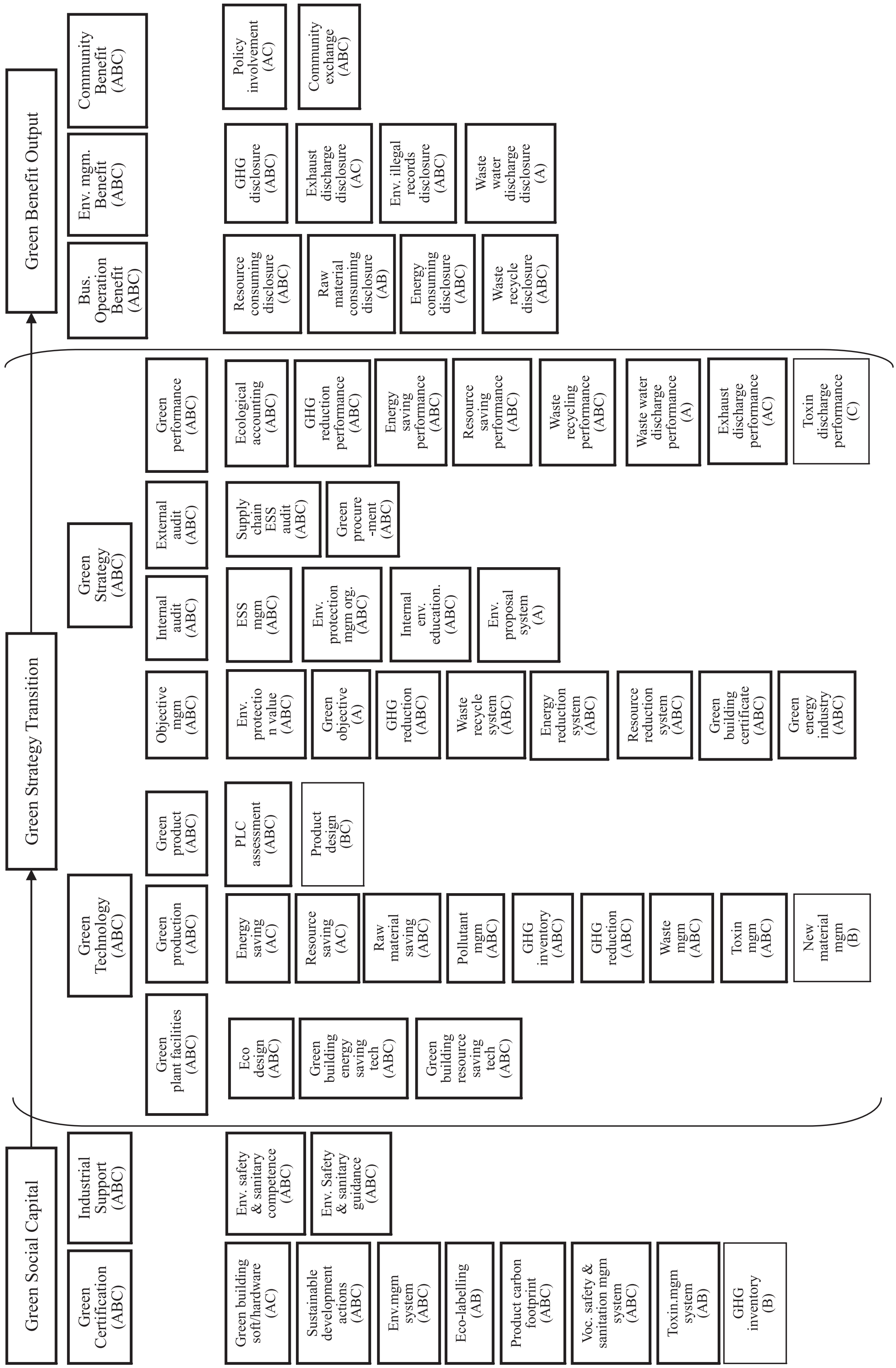

Fig. 1. CER framework.

Step 6 After amending the contents of component factors, the results are classified to their dimensions following the CER framework developed by Yu and Chen (2014). This step comprises the initial CER performance measurement indicator.

Step 7 After completing the initial CER performance measurement indicators, a discussion with experts in related fields will be conducted again. The content of the initial CER performance measurement indicator will be amended based on importance and the objectives the primary, secondary, and tertiary dimensions want to express in CER performance measurement indicators. After amendments are completed, CER performance measurement indicators are constructed.

The CER performance measurement indicators are constructed for the following reasons. In Taiwan, the content of measurement reflects the perceptions of environmental groups instead of perceptions of firms. International indicators are not adjusted accordingly despite differences in economic development and directions among countries. A single foreign indicator may inaccurately measure the performance of a country. Moreover, leading firms worldwide that are actively practicing environmental protection and bearing corporate social responsibility have become a trend (Gao, 2011). However, understanding the true intention of businesses practicing environmental management and protection is difficult. Thus, CER performance measurement indicators are crucial.

This study aims to construct a set of CER performance measurement indicators through expert opinions based on the content of the CER framework developed by Yu and Chen (2014). The constructed CER framework based on current environmental actions of firms can reflect the environmental philosophy and green technology objectives of firms. Thus, this framework can be used to regulate CER and guide firms or governments in their efforts toward sustainable development. The CER performance measurement indicators established in this study are developed based on the content of the CER framework developed by Yu and Chen (2014). Therefore, the indicators can motivate other firms and governmental units to achieve sustainable development and fully reflect the effects of industry situation and business development on the living environment.

3.5. Reliability and validity

This study adopts Cronbach's α value as a tool for reliability examination. According to Guielford (1965), a high Cronbach's α value indicates high internal consistency. If the α value is bigger than 0.70, then the reliability of measurement is fairly high. With the help of top managers of a hi-tech company in Taiwan, 32 questionnaires were randomly distributed to 32 hi-tech companies in Taiwan to verify the reliability of CER performance measurement indicators. Table 1 shows that Cronbach's α values are higher than 0.95, regardless of primary dimensions or secondary dimensions. Therefore, internal consistency of all dimensions is quite good.

Based on Waltz et al. (1991), the present study employs Content Validity Index (CVI) through expert identification method. The calculation method involves dividing the proper question number and the proper question number after being modified by the total question number. A CVI value higher than 0.8 indicates high expert validity.

Aiken (1985) emphasizes that the number of persons to be interviewed for expert validity can range from 9 to 15. Ten experts were chosen to judge expert validity. The research topics and specialties of these 10 experts include corporate social responsibility and social enterprise, green marketing and environment management, business administration, environmental cost and climate change analysis, green environmental management, sustainable technology, green innovation and new product innovation, and environmental management performance indicator. Table 2 shows expert validity. The mean CVI value of the 10 experts is higher than 0.97, which indicates high expert validity.

Table 1
Reliability of CER performance measurement indicators.

Primary dimensions	Secondary dimensions	Cronbach's α value of primary dimensions	Cronbach's α value of secondary dimensions
Green Social Capital	Green certification	0.975	0.961
	Industrial Support		0.98
Green Strategy Transition	Green Technology	0.989	0.98
	Green Strategy		0.982
Green Benefit Output	Business Operation Benefit	0.98	0.956
	Environmental Management Benefit		0.961
	Community Benefit		0.967

Table 2
Expert validity of CER performance measurement indicators.

Experts	Proper/proper after being modified question number	CVI value
Professor Hu	94/0	1
Associate Professor Yu	94/0	1
Associate Professor Hsu	82/12	1
Associate Professor Lee	65/9	0.78
Professor Chen	89/5	1
Adjunct Associate Professor Lin	76/18	1
Assistant Professor Ho	92/2	1
Professor Tsai	91/3	1
Instructor Liao	84/9	0.99
Associate Professor Liu	83/11	1
Mean		0.977

This study uses convergent and discriminant validity to measure construct validity. The assessment criteria of convergent validity includes (1) factor loading of each variable for measuring question items should be more than 0.5 (Bagozzi and Yi, 1988; Hair et al., 1998) and (2) composite reliability (CR) of each variable should be more than 0.6 (Bagozzi and Yi, 1988; Fornell and Larcker, 1981). Based on the data, the factor loading of each variable for measuring question items in this study is higher than 0.6 and the CR value of each variable is higher than 0.97. The results show that all variables in this study have convergent validity.

According to Fornell and Larcker (1981), if discriminant validity exists between variables, the average variance extracted (AVE) of each variable should be higher than 0.5; the explainable variation of the variable should be higher than the measurement error. The data show that the AVE values of the variables in this study are higher than 0.62, which indicates the existence of discriminant validity between variables. In summary, CER performance measurement indicators of this study have construct validity.

4. Results

4.1. CER performance measurement indicators

Tables 3 to 5 show the complete CER performance measurement indicators.

4.2. Discussion of results

Tables 3 to 5 show that the CER performance measurement indicators constructed in this study include three primary dimensions (Green Social Capital, Green Strategy Transition, and Green Benefit Output), seven secondary dimensions, seven tertiary dimensions, and 56 component factors. Green Social Capital includes Green Certification and Industrial Support; Green Strategy Transition includes green

Table 3
CER performance measurement indicators (Green Social Capital)

Primary dimension 1: Green Social Capital (includes: Green Certification, Industrial Support)	
GC1	Domestic green building certification.
GC2	International green building certification.
GC3	International environment management system certification.
GC4	Domestic occupational safety and environmental health management certification.
GC5	International occupational safety and environmental health management certification.
GC6	International toxic substances management system certification.
GC7	Domestic product carbon footprint certification.
GC8	International product carbon footprint certification.
GC9	Domestic greenhouse gas emissions inventory third party verification.
GC10	International greenhouse gas emissions inventory third party verification.
IS1	Company will lead upstream and downstream manufacturers to improve energy-saving and carbon-reducing performance of products.
IS2	Company has systematically promoted green management of supply chain.
IS3	Company will assist suppliers to analyze and find out projects executed for improving environmental protection, safety, and health (ESH) management performance (e.g., with the largest energy-saving effect, the latest energy-saving method, etc.), and suggest suppliers to be led in.
IS4	Company will improve ESH management capabilities of suppliers through regular audit and counseling to reduce the incidence of accidents.
IS5	For suppliers with weak ESH management, the company will assist them to improve ESH management performance through counseling.
IS6	Company will raise improvement suggestions and continuously trace its improvement performance against those suppliers failure to reach standards.

technology and green strategy. Green technology includes component factors like green plant facilities, green production, and green products. Green strategy includes four component factors like objective management, internal audit, external audit, and green benefit. Green Benefit Output includes three component factors: Business Operation Benefit, Environment Benefit, and Community Benefit.

4.3. Green Social Capital

The green certification system is an internal managerial tool, with a purpose of helping organizations materialize the environment objectives it sets and continuously improve its environmental practices to reach higher standards; i.e. green certification provides organizations orientation in practicing environmental management. This study found that the demands stemming from environmental pressure and economic development made environment friendly an innovated development direction. Only those that are certified can be considered true green organizations. The data analysis found that although Companies A, B, and C all practice green certification, each actually put their emphasis in different areas.

When a firm chooses its suppliers, it mainly assesses the suppliers' social responsibility competence (Hsu et al., 2011). Golicic et al. (2010), in their study on Fortune 500 enterprises, showed that there were already 22 well known firms began reducing their suppliers' natural environment impact. This study found Companies A, B, and C all have certain environmental safety and sanitation (ESS) technology competence and provide certain levels of guidance in their Industrial Support to their supply chain.

4.4. Green Strategy Transition

When a firm adopts green technology, it not only can take care of the waste material and pollutant issues but also lower its cost and enhance its quality (Hsiao et al., 2002). Also, green design has been valued in developed countries and become the major designing trend. The idea is to bring environmental concept into the development of product design, with green life cycle design as its core concept. In the development of green product, one can take the point of view of product life cycle and link its end with its start. All three companies implemented the concept of green design in their plant facilities and employed energy-saving and resource-saving technology in their buildings. Meanwhile, all three companies practiced green production; besides this, Company B out-practiced Companies A and C in new material management and Company C out-practiced Companies A and B in toxin management.

Winn and Roome (1993) thought corporate environmental management means the strategy, approach, procedure, and action a firm takes for the environmental, ecological, and social impacts it caused. This study found that all three case firms had almost identical objective management, with an exception that Company A had an extra item in green objective.

4.5. Green Benefit Output

Hutchinson (1992) mentioned that when a business proactively face the environment issues, it can enjoy potential benefits like enhancing corporate image and popularity, attracting more green consumers, receiving positive investment evaluation, lowering its costs through increasing production efficiency by means of recycling and pollution control, lowering expenses through energy conservation, avoiding excess insurance premium, enhancing relationships with the neighboring communities, and producing high value green products, etc. Maxwell et al. (1997) also thought that business should take proactive environmental strategies, because this can create advantages like lowering costs, improving quality, enhancing corporate image, and developing new markets, etc. This study found that in Business Operation Benefit, case firms A, B, and C had almost identical items, with an exception that Company C lacked information in raw material consuming disclosure. In environment benefit, only Company A met all GRI (Global Reporting Initiative) indicator requirements, with Company B fell short on releasing information on exhaust emission disclosure and waste water discharge disclosure, and Company C fell short on releasing information on waste water discharge disclosure. Finally, in community performance, all three case firms were identical, with an exception that Company B was not enthusiastic in policy involvement.

4.6. Summary

The CER performance measurement indicators established in this study reveal an interaction of 「input – transition – output」 among dimensions. The components of this interaction affect one another. In other words, Green Social Capital, which is invested by enterprises, will change to Green Benefit Output through Green Strategy Transition. Hence, enterprises should select Green Social Capital for early investment to ensure that the relative Green Benefit Output can be immediately obtained through Green Strategy Transition. Similarly, if enterprises aim to obtain the relative Green Benefit Output, investment of relative Green Social Capital is required before Green Strategy Transition.

Table 4
CER performance measurement indicators (Green Strategy Transition).

Primary dimension 2: Green Strategy Transition (includes: Green Technology, Green Strategy)	
GT1	The construction of buildings takes the relative green projects into account (e.g., resource recycling, enhancement of energy efficiency or reduction of environmental attack).
GT2	Company has considered subsequent harm to the living environment and resource waste as constructing buildings.
GT3	Company has introduced green concept as programming.
GT4	Company has led the relative energy-saving facilities in as constructing and designing.
GT5	Company adopts energy-efficient lighting.
GT6	Rainwater retention system is set on the top of building.
GT7	Water-saving fixtures are equipped with washing facilities.
GT8	Company has introduced energy-saving plan of machine in standby, maintenance, and shutdown.
GT9	Company has carried out electricity reductions of machine in production state.
GT10	Company has carried out water reductions of machine in production state.
GT11	Company has inventoried high-effective greenhouse gases treatment and prevention facilities.
GT12	Company continuously improves product packaging, transportation mode, and loading mode to reduce greenhouse gas emissions of packaging materials and transportation process.
GT13	Company has executed green logistics.
GT14	Company has established Hazardous Substance Management System (e.g., QC 080000).
GT15	Company has prepared substitutes for concerned hazardous substances according to international environmental protection trend and governmental regulations.
GT16	Company will regularly test the content of hazardous substances in its products through impartial third party lab.
GT17	Company possesses product life cycle assessment plan (to inspect energy, raw materials, and environmental pollutants in the whole process from the application and manufacturing of raw materials of suppliers to production and delivery).
GT18	Through product life cycle assessment, company will estimate greenhouse gas emissions of the main products from extraction and preparation of raw materials to production.
GT19	Based on product life cycle assessment results, company will continuously improve production process and reduce consumption of energy and resources.
GT20	Company will continuously develop and design products with low toxicity and low energy consumption.
GT21	Company has set up a complete database, which can be used to develop high-efficient and low electricity-consumption product design flow.
GT22	Company will integrate common environmental regulations and laws in the world for internal employees to lead into product design.
GS1	Company has set specific targets to reduce greenhouse gases emission.
GS2	Company will evaluate and use the substances with low greenhouse gases emission.
GS3	Company will continuously promote new action for reducing greenhouse gases emission.
GS4	Company has set specific targets about waste recovery.
GS5	Company will give priority to take recycling for waste treatment.
GS6	Company will continuously assess and introduce various technologies of waste treatment and recycling.
GS7	Company has set specific targets to save electricity.
GS8	Company has adopted the relevant energy-saving measures (e.g., low energy-consuming lamps, reducing line losses or energy-saving lighting in production area).
GS9	Company has set specific targets to save water.
GS10	Company has set a relative water management strategy.
GS11	Company has set a target of annual environmental protection, safety, and health (ESH) management system.
GS12	Annual internal audit of ESH management system is executed in all areas of company.
GS13	Annual internal audit result of ESH management system will be put into the key projects of ESH management in next year.
GS14	Company has established reward system for encouraging employees to raise environmental protection improvement plan.
GS15	The internal audit system can choose and praise better environmental improvement plans raised by employees.
GS16	Company will continuously promote environmental protection improvement plan.
GS17	Company will audit sustainable development and ESH management of the main domestic and foreign suppliers and assistant factories for raw materials.
GS18	After green audit, if suppliers do not meet the requirements, they will be listed in objects for counseling management.
GS19	Company will bring ESH management performance of suppliers in supplier assessment.
GS20	Green procurement company is promoting will ask suppliers of raw materials to provide statement, ensuring that their products do not contain substances harmful to the environment.
GS21	Company will promote green procurement, in order to ensure that products meet customer needs or international requirements for limit materials.
GS22	Company possesses green procurement standard procedure responsible for inspecting production process and raw materials of suppliers.
GS23	Company has set environmental accounting system.
GS24	Company has set environmental expenses related statistics.
GS25	Company has set environmental benefits related statistics.
GS26	Company has set statistics of greenhouse gas reduction effectiveness corresponded by energy-saving actions.
GS27	Company has set statistics of greenhouse gas reduction effectiveness corresponded by greenhouse gas prevention facilities.
GS28	Company has set statistics of annual greenhouse gas emission.
GS29	Company has set statistics of annual unit product electricity savings.
GS30	Company has set statistics of annual electricity savings.
GS31	Company has set statistics of energy reductions corresponded by energy-saving actions.
GS32	Company has set statistics of water savings corresponded by water-saving actions.
GS33	Company has set statistics of annual water savings.
GS34	Company has set statistics of annual natural gas savings.

5. Conclusion

One study applied content analysis to examine the CSR reports of listed companies in Asian country; this study reported that 79% of companies showed a positive attitude toward undertaking social responsibilities (Gao, 2011). Existing research are focusing on this issue (Bonsón and Bednárová, 2015; Fortanier et al., 2011; Jain and Winner, 2016; Kennedy Nyahunzvi, 2013; Kiliç, 2016). Given that CSR reports are written by enterprises, people who want to understand the true intention of businesses practicing environmental management and protection encounter difficulty in understanding the content of these reports. Thus, CER performance measurement indicators are crucial. Enterprises and the public need a simple and applied measurement tool when they endeavor to understand the proactive practices and true intention of enterprises that practice environmental management.

This study employs content analysis to construct a set of CER performance measurement indicators. These indicators aim to reflect fully the effects of industry situation and business development on the living environment based on the content of the CER framework developed by Yu and Chen (2014). The proposed CER performance measurement

Table 5
CER performance measurement indicators (Green Benefit Output).

Primary dimension 3: Green Benefit Output (includes: Business Operation Benefit, Environmental Management Benefit, Community Benefit)	
BOB1	Company has disclosed total water consumption.
BOB2	Company has disclosed total water consumption in production process.
BOB3	Company has disclosed energy consumption, usage, and distribution.
BOB4	Company has disclosed total electricity consumption in production process.
EMB1	Company has disclosed greenhouse gas emission and distribution.
EMB2	Company has disclosed greenhouse gas surveying range and execution mode.
EMB3	Company has disclosed the external surveying result of greenhouse gas.
EMB4	Company has disclosed the relative environmental compliance record.
EMB5	Company has disclosed major leakage events, penalties, and fines for environmental violations.
CB1	Company will participate into the public department or industry association to discuss and formulate the relative environmental regulations and laws.
CB2	Company will raise some suggestions about environmental regulations and laws for the public department or industry association.
CB3	Company will assist the public department or industry association to draw up reasonable and feasible environmental regulations and laws.
CB4	Company will raise timely and constructive suggestions for the formulation of the relative environmental regulations and laws by the public department.
CB5	Company will participate into community related environmental activities.
CB6	Company will participate in informal discussions held by environmental protection associations, which can be used as the reference for company to make subsequent decisions.
CB7	Company will participate in or sponsor related environmental protection projects conducted by nongovernmental units.

indicators are useful and can be applied as a CER performance measurement tool. Moreover, the tool offers the government with foresights in the concepts of environmental protection.

This study aims to address the deficiencies of CER performance measurement indicators in the academic circle and construct a set of active CER performance measurement indicators that fully reflect the effects of industry situation and business development on the living environment. The indicators provide businesses and the public with an easy-to-use CER performance measurement tool. These indicators also offer government units with a prospective concept of environmental protection as a basic structure to normalize CER.

5.1. Theoretical implications

The CER performance measurement indicators developed in this study reveal an interaction of 「input – transition – output」 among dimensions. The components of these dimensions affect one another. In other words, Green Social Capital (including Green Certification and Industrial Support), which is invested by enterprises, will change into Green Benefit Output (including Business Operation Benefit, Environmental Management Benefit, and Community Benefit) through Green Strategy Transition (including Green Technology and Green Strategy). Moreover, the CER performance measurement indicators established in this study are consistent with the viewpoints of Meyer and Rowan (1977) and DiMaggio and Powell (1983). These previous works determined that an organization is an open system, whereas the environment is the external system of all organizations. Accordingly, an 「input – transition – output」 interaction is formed between the organization and the external environment. The components of this interaction affect one another. All types of external environmental factors, including environment, technological environment, natural resources in a general social condition, as well as customer, supplier, competitor, and technical factors in a special task condition, may become the source of power for changing and adapting an organization system with different degrees of influence.

This study uses content analysis to construct a set of CER performance measurement indicators according to the content of the CER framework developed by Yu and Chen (2014). The construction of these measurement indicators addresses the deficiencies of the academic circle in CER performance measurement indicators and creates a full and systematic conclusion of corporate environmental reliability. Based on the establishment of CER performance measurement indicators, enterprises can realize that the relations exhibited relative to CER actions are 「input – transition – output」 interactions, which can affect one another.

5.2. Managerial implications

Environmental protection is a major global issue. Economic development is a goal that is eagerly pursued by countries and enterprises. An important management issue that challenges all countries and enterprises is achieving a win–win situation between economic development and environmental protection. In Taiwan, few enterprises will positively self-promote CER related regulations. However, international regulations and laws related to green products and environmental protection have been enacted across the world. For example, carbon footprint, carbon allowance allocation, water footprint, and green mark products are designed to monitor CER-related behaviors by using negative international regulations and laws. The promotion of CER based on the concept of institutional theory is a global activity that can be adopted in the future. For instance, enterprises that focus on economic development without considering environmental protection are deleted. Therefore, earlier formulation of environmental standards can be deemed as the survival means of an enterprise by responding to environmental pressure. Green innovation and technology can be used to obtain corporate competitive advantages and excess profits.

The CER performance measurement indicators established in this study reveal an interaction of 「input – transition – output」 among dimensions. The components of this interaction affect one another. In other words, Green Social Capital, which is invested by enterprises, will change into Green Benefit Output through Green Strategy Transition. Hence, enterprises should select Green Social Capital for early investment, such that the relative Green Benefit Output can be immediately obtained through Green Strategy Transition. Similarly, if enterprises aim to obtain the relative Green Benefit Output, the investment of relative Green Social Capital before the Green Strategy Transition is required.

This study constructs a set of CER performance measurement indicators through expert opinions and refers to the content of CER framework developed by Yu and Chen (2014). Thus, when enterprises and the public want to understand the proactive practice and the true intention of enterprises practicing environmental management, they can use a simple and applied measurement tool. The study also provides a useful reference for governments to create related green regulations and laws.

Once a company decides to address major issues, especially environmental responsibility and friendly policies related to corporate tenets and objectives, the company will systematically develop a feasible and fully functional strategic framework from its fundamental operation philosophy, operational objectives, organizational and strategic transition, or technology (from product design and raw material procurement, production equipment, design of facilities, and

assembling management). Therefore, the CER framework and CER performance measurement indicators built from the current environmental strategic actions of a case company can reflect environmental responsibility philosophy of the company and its green technology objectives, thereby making it an appropriate fundamental structure for regulating CER. CER performance measurement indicators can be used to help companies that aim to address environmental issues build an environmental management system. These indicators can also guide firms and governments toward sustainable development.

5.3. Limitations and suggestions for future research

This study constructs a set of CER performance measurement indicators through the content of CER framework developed by Yu and Chen (2014). As Yu and Chen (2014) focused on high-tech industries, future studies could investigate and compare the conditions of different industries.

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