
A Study on the Effect of Applying Information Technology to Environmental Management on Firm Competitiveness

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Abstract

Countries in the world are enhancing the concerns about environmental protection issues so that cross-international ecological environmental protection has become a primary agenda in the 21st century. A lot of countries have optimistically expected the achievement of economic development together with environmental protection; unfortunately, the natural ecological environment seems not to afford the highly economic use. No matter how good the products of a high-tech business, the damage of the production process or use process on the environmental ecology would be a key factor in the selection of orders. Nevertheless, in face of such a green impact, the attitudes and coping methods would greatly affect the future transformation and the enhancement of competitiveness of high-tech industry. Aiming at high-tech industry in Taiwan, total 320 copies of questionnaire are distributed, and 254 valid copies are retrieved, with the retrieval rate 79%. The research results summarize significantly positive effects of 1. information technology on environmental management, 2. environmental management on firm competitiveness, and 3. information technology on firm competitiveness. According to the results, suggestions are proposed in this study, expecting to establish the integrated structure management with environmental protection and optimal quality in the product production or service process of high-tech industry as the required advantage and condition for future market competition.

Keywords: information technology, environmental management, firm competitiveness

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INTRODUCTION

Global economic activity in past years is approaching liberalization that high-tech industry would encounter different degrees of competition pressure. Various countries are enhancing the concerns about environmental protection issues that cross-international ecological environmental protection has become an important agenda in the 21st century. The natural environment is the basis for human survival and economic development. Resources for the activity in human society are acquired from the natural environment that the ecological system has to continuously operate, keep the regeneration ability and the materials in the loop ecosphere, degenerate pollution resulted from human activity, and provide environmental conditions on which human activity rely. Nonetheless, the implicit contribution of the

regeneration loop function of the natural environment to human society has been ignored for long so that the market prices of such natural resources do not properly reflect the social and environmental costs. The pursuit of unlimited resource use for economic growth would endanger the natural environment and human society that it is necessary to change traditional industrial production and product consumption concepts in order to save resources and protect the environment.

A lot of countries have optimistically expected the achievement of economic development together with environmental protection. However, the natural ecological environment seems not to afford the highly economic use. The thinking of environment has gradually formed new social cognition and social norms. Especially, global environmental problems of

ozone layer damage, greenhouse effect, acid rain, tropical rain forest destroy, and desertification have caused great damage on the natural ecology and resulted in the huge loss of economy in human society. People start to realize that merely the sustainability and stability of resources in the environmental ecology could the sustainable development of economy be achieved. Environmental protection therefore becomes a basic condition in future trade activity. No matter how good the products of a high-tech business, the damage in the production process or use process on the environmental ecology would be a key factor in the selection of business orders. Nevertheless, in face of such a green impact, the attitudes and coping methods of high-tech industry would result in great effects on the future transformation and the promotion of competitiveness. Aiming at the effect of applying information technology to environmental management on firm competitiveness, this study expects to establish the integrated structure management with environmental protection and optimal quality in the product production or service process of high-tech industry as the necessary advantage and condition for promoting the market competition.

LITERATURE REVIEW

Information Technology

Chan et al. (2016) stated that the development of information technology was merely few decades, while it deeply changed human lifestyles. The human society changed from industrial society into information society (Saeidi et al. 2015). In face of the business environment with domestic and international competition and changing customer needs, speed became an essential competitive weapon. Dangelico et al. (2017) regarded information technology as the set of non-human resources, playing the roles of storage, processing, and communication; such resources composed a system which could execute tasks, including hardware components to consist the information system structure and system software to integrate various functions. Abdul-Rashid et al. (2017) pointed out the technical viewpoint of information technology as computers, telecommunication, and automatic technology as well as the viewpoint of business activity as development and use activity. An organization had to invest in actual activity when attempting to utilize such technologies for benefits. Yu and Ramanathan (2016) regard it as the general name of various technologies for management and information processing, mainly applied to computer science and telecommunication technology for designing,

developing, installing, and practicing information systems and application software. Burki and Dahlstrom (2017) mentioned that the application of information technology contained computer hardware and software, network and communication technology, and application software development tools. Lozano (2015) indicated that, since the popularity of computers and Internet, people generally used computers for producing, processing, exchanging, and spreading various types of information (e.g. books, commercial files, newspaper, records, films, TV programs, voice, graphs, and images).

Environmental Management

Lu et al. (2016) stated that enterprises constantly pursued the economic growth and the enhancement of competitiveness but ignored the environmental cost for long; along with rising environmental awareness and the fear of deterioration of environment of the public, the environmental protection units in the world had to enhance the standard of environmental protection regulations in correspondent to the international trend and the pressure from domestic public sentiment, expecting to enhance corporate performance on environmental improvement with strict regulations and maintain the environmental space on which people relied. Danilecki et al. (2017) mentioned that enterprises also discovered the correlation between economic development and environmental protection and transferred the passive end-of-pipe treatment to the management of environmental protection strategy and source reduction. According to the reduction of environmental risks, Abdelzaher and Newburry (2016) divided environmental management of an organization into five stages; meanwhile, the environmental management content could reflect the environmental management attitudes of an enterprise, from the earliest indifference to environmental management, unnecessary for any preparation for environmental risk prevention, to listing environmental management as the priority with the involvement of sufficient resources and high-level supervisor and the integration of environmental management and business. Zhang and Yang (2016) indicated that the environmental protection measures and development strategies of an enterprise mainly went through the high-level supervisors' support, commitment, and decision-making and were spread to all employees for agreement in order to actually discuss the environmental problems of the organization and further draft policies, organizational programs, records, self-evaluation, and external confirmation in order to achieve the objective

of a green business. Tan et al. (2015) proposed that the environmental protection performance of an enterprise would be hardly changed when the high-level supervisors did not support the environmental protection strategies. Bae (2017) considered that the high-level commitment, establishment of item groups, education & training, selection of advisers, and quality documentation would affect environmental management performance.

Firm Competitiveness

Chen et al. (2016) referred the competitiveness of business management to high quality and low costs; in a long term, productivity was the best measuring method; and, competitiveness was the relative efficiency, i.e. productivity or production growth rate. Competitiveness contained three levels of meanings, including business, industrial, and national competitiveness. Ahmadi and Bouri (2017) mentioned that, in the process of a company competing with businesses in the industry, the cultivation of unique resources to form relative competitive advantage could have the products outperform those of competitors on prices or quality to further present better sales amount and market share, promote the overall profitability, show better competitiveness, and make innovation to enhance the operation of competitiveness and service management. Delmas and Pekovic (2015) indicated that competitiveness, in spite of the different meanings in various levels, presented the same competitive essence; competitiveness in any levels would stress on the persistent advantage, which was a long-term concept, accumulated through long-time effort, experience, and technology for the establishment and maintenance (Campos and Vazquez-Brust, 2016). Mathiyazhagan et al. (2015) revealed that an enterprise, based on competitive advantage, should accumulate the internal and external resources to further create competitive advantage which could not be learned or acquired by competitors.

Research Hypothesis

Chen et al. (2015) considered that, in the future economic and environmental development process, the role of environmental protection would be more important for an enterprise; merely the improvement of business management could have the society step into the field of environmental protection. In the electronic wave, the acceleration of internal information delivery became a key of a company in the acquisition of competitive advantage, as electronic processes could enhance the efficiency of internal environmental management key processes and effectively shorten the

time for information delivery (Dangelico et al. 2017). Alt et al. (2015) indicated that the effective management of environmental data was a difficult challenge for environmental managers. Factors in such a challenge lied in diverse data sources and varieties, changing characteristics of data with time and location, numerous data storage mechanisms and locations, and different staff with distinct data processing and reports to result in large frustration on internal relevant departments. Lu and Liu (2018) stated that some business managers gradually realized the effective storage and trace of environmental data for the best utilization; an enterprise could not simply store and file data, but had to manage information for improving the environmental management strategies. The following hypothesis is therefore proposed in this study.

H1: Information technology presents significantly positive effects on environmental management.

Zhang and Yang (2016) mentioned that firm competitiveness strategies of cost reduction and product segmentation could be applied to the environmental issues to acquire competitive advantage. Hallam and Contreras (2016) indicated that the consideration of environment could result in economic benefits for an enterprise; for instance, efficiently using materials in the production process could reduce costs, and the image of a green business could enhance the market share. Lu et al. (2016) proposed that future environmental issues were no longer the accessories of business development, but the skeleton of business management. For this reason, the real meaning of sustainable development for an enterprise was not simply inhibiting the economic growth by protecting the environment and resources; on the contrary, it contained more positive meanings to create larger economic benefits and promote firm competitiveness with the performance on environmental improvement. Przychodzen and Przychodzen (2015) also regarded four strategies of environmental management to reduce damage and enhance competitive advantage, including clean technology, resource efficiency, green consumption, and corporate social responsibility. Accordingly, the following hypothesis is proposed in this study.

H2: Environmental management shows remarkably positive effects on firm competitiveness.

Yang et al. (2015) pointed out the urgency of an enterprise, in face of rapidly changing economic environment, applying information technology and

enhancing the information technology ability to cope with the changing future. The role of information technology was changing; it started as the tool to generate business effectiveness and eventually became a resource for enterprises creating competitive advantage (Chen et al. 2016). Lewis (2017) stated that information technology (covering data transmission, computer hardware, software, data, artificial intelligence, and office & factory automation) created endless business opportunities for enterprises and changed the competition of an enterprise. Yu et al. (2017) indicated that information could reduce costs and increase differentiation to create competitive advantage as well as change competition coverage to create competitive advantage. Rozar et al. (2015) mentioned that, in face of rapidly changing market environment, it was primary for an enterprise applying information technology, enhancing and accelerating the R&D of new products, and establishing corporate competitive advantage to acquire the maximal rewards. The following hypothesis is further proposed in this study

H3: Information technology reveals notably positive effects on firm competitiveness.

RESEARCH METHOD DESIGN

Measurement of Variable

Information technology

Referring to Lu and Liu (2018), the commonly agreed dimensions, including 1. communication skills, 2. sharing ability, 3. handling ability, and 4. decision support ability, are used for measuring the information application of enterprises in this study.

Environmental management

Referring to Dai et al. (2017), dimensions of 1. environmental cost, 2. high-level supervisor support, 3. environmental benefits, 4. environmental responsibility, and 5. education & training are used in this study for measuring the practice of environmental management of an enterprise.

Firm competitiveness

Referring to Yu et al. (2017), the dimensions to measure firm competitiveness are described as below.

1. Competition potential: cost competitiveness, productivity, price competitiveness, and technical indicator.
2. Management process: involvement in international business activity.

Table 1. Confirmatory factor

research dimension	overall fit	analysis result
information technology	X ² =0(P<0.001); DF=0; GFI=1.00; CFI=1.00	excellent overall model fit
environmental management	X ² =0(P<0.001); DF=0; GFI=1.00; CFI=1.00	excellent overall model fit
firm competitiveness	X ² =0(P<0.001); DF=0; GFI=1.00; CFI=1.00	excellent overall model fit

Table 2. Correlation analysis

research dimension	α	information technology	environmental management	firm competitiveness
information technology	0.86			
environmental management	0.82	0.31**		
firm competitiveness	0.88	0.28**	0.26**	

3. Competition performance: export market share, trade balance, export growth rate, and profit rate.

Research Object

Aiming at high-tech industry in Taiwan, total 320 copies of questionnaire are distributed, and 254 valid copies are retrieved, with the retrieval rate 79%.

Test of Reliability and Validity Analysis

The reliability of the research dimensions in this study achieve above 0.7, showing high reliability of such research dimensions. The construct validity of the research scale is analyzed with confirmatory factor analysis. From **Table 1**, the research scale presents good convergent validity and construct validity.

ANALYSIS RESULT

Correlation Analysis

From **Table 2**, information technology, environmental management, and firm competitiveness show significant correlations. Such a result reveals the possibility of multicollinearity among research dimensions. A researcher could solve such a problem with nested model analysis. The remarkable correlation among research dimensions also reveals the correspondence with the research hypotheses.

Discussion of Overall Model

Regarding overall model fit, **Table 3**, the overall model fit standards $\chi^2/DF=1.466$, smaller than the standard 3, and RMR=0.007, showing proper χ^2/DF and RMR results. Furthermore, chi-square value is sensitive to sample size that it is not suitable for directly judging the fit. However, the overall model fit standards GFI=0.977 and AGFI=0.914 are higher than the standard 0.9 (the closer GFI and AGFI to 1 showing the better fit) that the model presents better fit indices.

Table 3. Overall linear structural model analysis result

overall fit	X2/Df	1.383
	GFI	0.977
	AGFI	0.914
	RMR	0.007

Note: * stands for $p < 0.05$, ** for $p < 0.01$, *** for $p < 0.001$

Table 4. Nested model analysis

Model	χ^2	$\Delta\chi^2$	GFI	CFI	RMSEA
Theoretical model	243.17		0.977	0.986	0.07
Model 1: hypothesis test	248.33	5.16*	0.977	0.986	0.07
Model 2: hypothesis test	255.71	7.38*	0.977	0.986	0.07
Model 3: hypothesis test	261.93	6.22*	0.977	0.986	0.07

Table 5. Hypothesis test

research hypothesis	correlation	empirical result	P	result
H1	+	0.352	0.00	supported
H2	+	0.304	0.00	supported
H3	+	0.337	0.00	supported

Discussion of Research Hypothesis

With nested model, chi-square test is used for the research hypotheses as each nested model appears one degree of freedom; when the difference in chi-square value between the nested model and the theoretical model reaches the significance, the path coefficient being set 0 is significant. The research results reveal the significance of the model. The nested model analysis results are shown in **Table 4** and the hypothesis test is shown in **Table 5**.

CONCLUSION

According to the research results, the practice of environmental management and the application of information technology could actually perfect high-tech industry and reinforce the competitiveness. In the 21st century, environmental problems are the major dilemmas for enterprises. In face of strict regulations, worsening environment, and decreasing resources, the practice of environmental management to reduce pollution and save resources is necessary for high-tech businesses moving towards the sustainable development; otherwise, they might be eliminated by successive environmental problems and could not encounter international competition. A high-tech business therefore should be well prepared to organize internal environmental data, apply the convenience of information technology to deal with complicated environmental data, and transform environmental data into useful information for the reference of decision-

makers to develop the advantage of information technology on environmental management. In order to improve the benefits of environmental management to acquire tangible benefits in the material purchase, product manufacturing process, and design process, e.g. purchasing materials with better environmental protection for products which might generate toxicity, improving product process, and even recycling used products, a high-tech business could present different competitive advantage from others. It is why environmental management is the pressure for high-tech industry. However, the application of technology innovation and the promotion of productivity could transform crises into chances and further into business opportunities to achieve the objective of sustainable development.

SUGGESTION

By organizing the research results and findings, the following practical suggestions aiming at such results are proposed in this study.

1. Due to complicated environmental problems and few responsible staff for environmental management in a high-tech business, information technology is required as the auxiliary tool for transforming environmental management data into useful information, which is changed into knowledge for high-tech industry. It is the spirit of knowledge management to assist high-tech businesses in enhancing the competitive advantage in the market.
2. A high-tech business should introduce new environmental protection knowledge or management tools to conform to the environmental protection requirements through the promotion of technology. Combing environmental management with information technology in the environmental information system aims to establish an enterprise with future competitiveness. The earlier a high-tech business practicing environmental information systems and drafting policies for the execution would earlier reduce the risk induced by environmental protection problems.
3. The relevant government units are suggested to evaluate the environmental cost standard with the environmental costs for various programs. With budgeting systems to present the environmental costs and the consumption among various programs, decision-makers of high-tech businesses could clearly understand the use of environmental costs and make correct judgment.

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