THE INFLUENCE OF GREEN SUPPLY CHAIN MANAGEMENT ON BUSINESS PERFORMANCE OF ELECTRONIC INDUSTRY IN THAILAND

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Abstract- This empirical study aims to explore the green supply chain management (GSCM) of the electronic industry in Thailand and analysis the relationship between GSCM implementation and business performance. 67 samples were collected from the firms, which joined in the Green Project ofMinistry of Industry. Multiple regression analysis is used to analyze the relationship between GSCM and business performance.The results of this researchhave shown that GSCM initiatives have strong positive impact on environmental and competitive performances. The results indicated that internal environmental management, green manufacturing, and green distribution have positively significant effect on environmental performance. Moreover,internal environmental management, cooperation with customers and green distribution have significant effect on competitive performance. However, green manufacturing and green distribution was found to have positively significant effect to economic and operational performance. This study have proofed that applying GSCM can improve business performance for electronic industry in Thailand.

Keywords- Business Performance, Electronic Industry, Green Industry, Green Supply chain Management.

I. INTRODUCTION

The electronic industry in Thailand pay increasing attention to environmental concerns in their manufacturing activities. With this environmental awareness, manufacturers need to improve their internal supply chain operation system by integrate with environmental management from upstream to downstream of their supply chain, which includes green purchasing, green manufacturing, green distribution, and reverse logistics.

The goal of environmentally friendly production is to take Thailand to a low-carbon society. In addition, the Ministry of Industry as the main department of industry development has strategically planned to support the development of the industry and the sustainable development. The Ministry of Industry launched the project of “Green Industry” in 2011, so as to encourage the industries in the Country to be more environmentally friendly, and more responsible to the society.

The green industry levels are divided into five levels. Firstly, "Green Commitment" is defined for the company who must define environmental policy and communicate environmental to all personal for acknowledgement. Secondly, "Green Activity" is for the company who implements environmental activities by planning the objective, target, procedure, responsible person and completed time frame. Thirdly, "Green System" is for the company who has a systematic environmental management including follow-up, assessment and revision. This stage aims to create continuous development as well as receiving a widely recognized award on environment and accreditations on a variety of environments. Fourthly, "Green Culture" is the company that cooperates of employee in all level organization to implement friendly environment in all aspects of business operations until it becomes a part of organization culture. Finally, "Green Network" is the extension throughout green demand chains by promotion business partners and allies entering into accredited green industry process. There are 2,675 entrepreneurs who join the green project and there are 81 electronic manufacturing companies [1].

However, the influence of green supply chain management (GSCM) and business performance in electronic industry in Thailand has not been investigated before. Therefore, this research focuses on GSCM practices and business performance of electronic industry in Thailand.

The value of this research is to provide the guideline for the manufacturers in Thailand who wish to start the GSCM practices for improving the business outcomes. Moreover, it aims to motivate the other industries for adopting the environmental concern in their supply chain management.

II. FRAMEWORK AND HYPOTHESISDEVELOPMENT

2.1. Green supply chain management (GSCM)

GSCM is the integration of environmental concept into the supply chain. Mains activities are

(1) Internal Environmental Management (X1) refers to activities involving the environmental policy, supporting GSCM from top management and mid-level

managers, environmental compliance, and ISO14001 certification [2].

(2) **Green Purchasing (X2)** refers to activities involving purchasing decision by environmental requirements for purchased item, environmental audit for suppliers' internal management [2].

(3) **Eco-Design (X3)** refers to design of products for reduce consumption of material/energy, design of products for reuse, recycle, recovery of material, and design of products to avoid or reduce use of hazardous products [3].

(4) **Green Manufacturing (X4)** refers to the production process scheme and route with low energy consumption, clean technology, selecting green products and reduce waste and pollution from production process.[4].

(5) **Cooperation with customers (X5)** refers to cooperation with customers for eco-design, cooperation with customers for cleaner production, and cooperation with customers for green packaging [2].

(6) **Green Distribution (X6)** refers to green transportation, determination ofsuitable location for distribution center or warehouse, recovery of company's end-of-life products [5].

(7) **Investment Recovery(X7)** refers to sale of scrap and used materials, sale of excess capital equipment [3].

2.2. Business performance

The outcomes are defined in this research into four categories as the results from adopting GSCM initiatives by manufacturing firms.

(1) **Economic performance (Y1)**is the financial benefits that reflect to the organization such as new market opportunities, increasing of product price, profit margin, sale, market share, customer satisfaction, decreasing of cost for energy consumption, increasing of investment, operation, and training cost [2].

(2) **Environmental performance (Y2)**is the effects of GSCM initiative from the beginning to the end of product life cycle such as reduction of wastes, reduction of hazardous materials, improvement of environmental compliance, using eco-labeling and partnership with green organizations and suppliers [3].

(3) **Operation performance (Y3)**is the benefit form the operation level of organization such as increasing amount of goods delivered on time, improving of capacity utilization, decreasing of inventory level, increasing product line [2].

(4) **Competitive performance (Y4)**is the intangible benefit from the organization adopting the environmental concern such as increasing amount of goods delivered on time, improving capacity utilization, decreasing inventory level, increasing product line **[5].**

2.3. Research Framework

GSCM implementation has been investigated in many literatures. It can be synthesized into seven activities. For this study we determined GSCM practices, which consist of internal environmental management, green purchasing, eco-design, green manufacturing, cooperation with customers, green distribution and investment recovery [2]-[5]. In addition, we found the contribution of GSCM to business performance which can divide into four categories such as economic performance, environmental performance, operational performance and competitive performance [2],[3],[5]. In this study, we examined the influence of GSCM on business performance. Respondents are selected form the Thai's electronic industry.

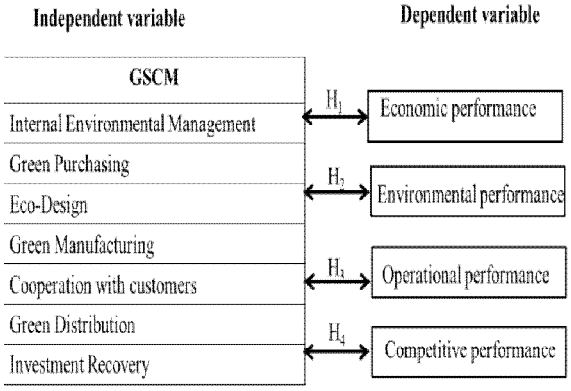


Fig.1. Research framework.

2.4. Hypothesis

The next section will detail the hypotheses, which are developed to be tested for this research.

2.4.1 GSCM and economic performance

Economic performance is the common driver for an organization that wishes to implement GSCM practices. Environmental operation is able to give more benefit to an organization such as: increasing market share, accessibility to the new market etc. PurbaRao and Diane Holt(2005) [5] studied the relationship between green supply chain and competitive advantage and economic performance in the South East Asia region. This research suggested that greening the supply chain leads to increasing competitiveness and economic performance. However, the electronic industry in Thailand has not been studied about the relationship of GSCM and economic performance before. Thus, it proposes in this research. We posit the first alternative hypothesis as follow.

Hypothesis 1: GSCM positively effects economic performance in electronic industries in Thailand.

2.4.2 GSCM and environmental performance

Qinghua Zhu et al.(2011) [3] showed that external GSCM practices such as supplier and customer collaboration can encourage the adoption of internal GSCM practices. Many researches have supported this idea. Many industries who have applied GSCM, found positive environmental outcome. For instance, Qinghua Zhu et al.(2005) [6] argued that Japanese manufacturers, implementing GSCM practice have made significant improvements for environmental and financial performances. Moreover, MuraliSambasivan et al.(2012) [7] investigated the impact of environmental pro activity on multiple performance outcomes of Malaysia firms by focusing on the environment indicators such as energy use, carbon footprint, and overall reduction in pollution. The finding of this research indicated that the environmental pro activity is positively related to operational performance, organization learning, stakeholder satisfaction, financial performance and environmental performance. However, for electronic industry in Thailand, there are a few researches studied GSCM in practices about environmental performance. So, we would like to test the second hypothesis as follow:

Hypothesis 2: GSCM positively affects environmental performance in electronic industries in Thailand.

2.4.3 GSCM and operational performance

The operational performance was used as the criteria to evaluate green supply chain strategies [7]**, [**8] , and **[**9]etc. These researches have studied and shown that GSCM has strong relationship with operation performance. Then, the operational performance has been used as a tool for environmental management in many industries[6].In 2007**,**Qinghua Zhu et al. [2]studied about GSCM implementation from four typical manufacturing industry sectors in China, which are power generating, chemical/petroleum, electrical/electronic and automobile. This research found that the electrical/electronic industry have higher level of GSCM implementation, which create higher operation outcome when it was compared to other industries. This evidence places to the third hypothesis for this research.

Hypothesis 3: GSCM positively affects operational performance in electronic industry in Thailand.

2.4.4GSCM and competitive performance

Tarig K. Eltayeb et al. (2011) [8] stated that competitive performance is the intangible outcomes of GSCM initiatives such as improving product image, enhancing image and goodwill of a firm for their stakeholders. According to PurbaRao and Diane Holt(2005) [5], there are a few researches who showed the relationship between the GSCM and competitive performance. Therefore, if we can confirm that GSCM has positive relationship with competitive performance, more industries will adopt the GSCM to their supply chain. The forth hypothesis becomes:

Hypothesis 4: GSCM positively affects competitive performance in electronic industry in Thailand.

III. RESEARCH METHODOLOGY

3.1. Data collection

To test the hypotheses, we selected the electronic manufacturing firms, who joined the Green Industry project [1].The population of this study consists of 81 electronic manufacturing firms. Sample data are 67.Questionnaires were analyzed through the SPSS statistical program and tested through multiple regression analysis. Respondents are senior or middle management, who responsible for environmental project. Survey data was gathered using 3 methods: mail survey, e-mail survey, and telephone survey. These procedures produced 100 percent repose rate.

3.2. Survey constructs

Based on previous students, a survey questionnaire was developed. Literature review is focused on the GSCM practices and business performance. Prior to data collection, the survey instrument was pre-tested for content validity to five experienced researchers and entrepreneurs. Then, the instrument was modified to enhance clarity and appropriateness of the measures, which intend to tab the construction.

3.3. Measurement development

The research was carried out based on stepwise multiple regression modeling, which allows to search and describe quantitatively complex relationships. It suits for one dependent variable which effected from two or more independent variables.

3.4. Reliability analysis

Prior to data collection, the survey instrument was pre-tested for reliability test for 30 samples. The cronbach's alpha coefficient of all items are between 0.713 and 0.970 [10]. Thus, reliability of the measurement of this study is acceptable.

Table 1and 2 present the means ($\bar{x}$), standard deviations (S.D.), and Cronbach's alphas (α) for GSCM variables and Business Performances. The results show that alphas range from 0.713 to 0.970[10]. These data indicates that all items have acceptable reliability.

Table1 :Descriptive statistics, alpha values on GSCM n = 30

Item	$\bar{x}$	S.D.	Alpha
X1	4.60	0.56	0.914
X2	3.86	0.83	0.758
X3	4.12	0.68	0.816
X4	4.23	0.68	0.713
X5	3.97	0.71	0.890
X6	4.25	0.83	0.714
X7	4.13	0.80	0.920

Notes: Mean/S.D. of items measured along a 5-point Likert scale for GSCM (1 =not considering it, 2=planning to consider it, 3=considering it currently, 4=initiate implementation and 5=implementing successfully**)**, n=30.

Table 2 : Descriptive statistics, alpha values on business performance n = 30

Item	$\bar{x}$	S.D.	Alpha
Y1	3.71	0.77	0.912
Y2	4.29	0.71	0.855
Y3	4.00	0.77	0.906
Y4	4.27	0.69	0.729

Notes: Mean/S.D. of items measured along a 5-point Likert scale for GSCM (1 =not at all, 2=a little bit, 3=to some degree, 4=relatively significant and 5=significant**)**, n=30.

Table 3: Means, standard deviations and correlations. n = 67

	$\bar{x}$	S.D.	X1	X2	X3	X4	X5	X6	X7	Y1	Y2	Y3	Y4
X1	4.56	0.46	1.00	0.56**	0.60**	0.55**	0.40**	0.71**	0.55**	0.45**	0.73**	0.61**	0.73**
X2	3.84	0.59		1.00	0.45**	0.63**	0.48**	0.61**	0.57**	0.37**	0.66**	0.62**	0.56**
X3	4.10	0.58			1.00	0.74**	0.60**	0.62**	0.40**	0.60**	0.71**	0.67**	0.67**
X4	4.19	0.52				1.00	0.67**	0.54**	0.38**	0.65**	0.75**	0.64**	0.59**
X5	3.96	0.62					1.00	0.54**	0.18	0.57**	0.59**	0.53**	0.59**
X6	4.22	0.62						1.00	0.40**	0.55**	0.73**	0.68**	0.74**
X7	4.11	0.74							1.00	0.19	0.42**	0.32**	0.30*
Y1	4.00	0.48								1.00	0.61**	0.60**	0.71**
Y2	4.26	0.52									1.00	0.82**	0.83**
Y3	3.98	0.65										1.00	0.86**
Y4	4.21	0.55											1.00

Note: p<0.10*, p<0.05**, p<0.01***, p<0.001.

IV. RESULTS

We use stepwise regression analysis to test the hypothesis and to analysis the relationship between GSCM practices and business performance. The regression results are reported in Table 3 and Table 4.From questionnaires of 67 sample data, we found that the average score of GSCM implementation including internal environmental management (X1)**,** green purchasing (X2), eco-design (X3), green manufacturing (X4), cooperation with customers (X5), green distribution (X6), and investment recovery (X7) range between3.84 and 4.56.Average score for business performance consists of economic performance (Y1), environmental performance (Y2), operational performance (Y3) and competitive performance (Y4). These performances average values range between3.98 and 4.26. The results can be used to conclude that these organizations in electronic industry have implemented GSCM in high level and their business performance is also in relatively high level. The correlation between green supply chain strategies are between 0.18-0.74.Green supply chain strategies relate to each other in the positive way with 0.01 significant level ($p < 0.01$), except strategy of cooperation with customer in environmental awareness.

Table 4: Results of hypotheses test and regression analysis.

Hypothesis	DV	IV	β	SE	t	p*	R^2(adj)
H_1	Y1	X4	.529	.094	5.248	.000	52.30%
		X6	.258	.079	2.952	.004	
H_2	Y2	X1	.281	.106	2.972	.004	73.00%
		X4	.434	.079	5.469	.000	
		X6	.294	.078	3.141	.003	
H_3	Y3	X4	.392	.121	4.015	.000	55.10%
		X6	.464	.102	4.746	.000	
H_4	Y4	X1	.398	.122	3.909	.000	66.00%
		X5	.260	.076	3.050	.003	
		X6	.317	.099	2.864	.006	

The four hypotheses were tested at the 95% level of significance (two – tail tests)using multiple linear regression analysis in the SPSS for Windows. Table 2 shows the results of the hypotheses tests and regression analyses.

All four alternate hypotheses were accepted (null hypotheses rejected) based on calculated p values which have values less than 0.01.

Hypothesis H_1states that GSCM by green manufacturing and green distribution improve economic performance. All the beta **(β)** for these variables are positive and statistically significant ($p < 0.01$).The adjusted coefficient of determination is 52.30%, indicated that 52.30% of economic performance is accounted by green manufacturing and green distribution.

Hypothesis H_2 states that GSCM by internal environmental management, green manufacturing, and green distribution improve environment

performance. All the beta **(β)** for these variables are positive and statistically significant ($p < 0.01$). The adjusted coefficient of determination is 73.00%, indicated that 73.00% of environment performance is accounted for by internal environmental management, green manufacturing, and green distribution.

Hypothesis H_3 states that GSCM by green manufacturing and green distribution improve operational performance. All the beta **(β)** for these variables are positive and statistically significant ($p < 0.01$). The adjusted coefficient of determination is 55.10%, indicated that 55.10% of operational performance is accounted for by green manufacturing and green distribution.

Hypothesis H_4 states that GSCM by internal environmental management, cooperation with customers, and green distribution improve competitive performance. All the beta **(β)** for these variables are positive and statistically significant ($p < 0.01$). The adjusted coefficient of determination is 66.00%, indicated that 66.00% of competitive performance is accounted for by internal environmental management, cooperation with customers, and green distribution.
However, the result of this research shows that the green purchasing, eco-design and investment recovery are not effects to business performance, which are different from other researches.

V. DISCUSSION

These results have several important implications for the electronic industries in Thailand in terms of understanding how to improve business performance.

Firstly, our study supports the literatures those found that GSCM plays an importance role in improving economic performance. According to reference Qinghua Zhu et al. (2005)[6] indicated that GSCM practices has positive relationship with an organization's economic performance. The results suggest that Chinese manufacturing enterprises adopted in the early stage of environmental practices and they have increased their environmental awareness due to regulatory, competitive and market pressures. In consequence, Chinese enterprises have to focus on GSCM practices to improve their environmental performance according to the opportunity for exporting their products to the foreign markets. Furthermore, PurbaRao and Diane Holt(2005) [5] argued that greening the supply chain would improve the economic performance such as sales, market share, and exploit new market opportunities, and profit margins.

Secondly, our study provides empirical support for finding in the literature that GSCM improve the firm environmental performance. Similar to Qinghua Zhu et al.(2007) [2], who studied GSCM initiatives of various manufacturing industrial sectors in China and investigated the relationship between GSCM initiatives and performance outcomes. The results showed that electronical /electronic industry has relatively higher levels of GSCM implementation and accomplish than the other manufacturer types. So, they have better performance outcomes. Due to the fact that electronical/electronic industry in China has been under pressure from their foreign customers to improve the environmental operations and compliance the environmental standard. Similarly, reference Weiqian Zhang et al.(2014)[11] studied the coating firmsin Shanghai as a case study, which have adopted Environmental Management System (EMS) for achieving a corporate's sustainable development. The results indicated that the environmental performance of EMS in the coating firms was satisfactory in 2008, and there was an evidently improvement in 2009, which form four aspects consist of thoroughly identifying environment factors, encouraging the development of advanced pollution control technologies, sustaining the improvement process of EMS after the initial adoption, and supporting the involvement of software applications.

Thirdly, our study supports the literature's findings on the role of GSCM in improving operational performance. According to Tarig K. Eltayeb et al. (2011) [8], the outcomes of green supply chain initiatives in eco-design and reverse logistics positively link to operational performance in cost reduction, quality, flexibility and delivery for a group of ISO 14001 certified firms in Malaysia. Which Similar to the study of Qinghua Zhu et al.(2012)[12], their work show that operational performance can be improved by eco-design. This research suggested that organization has to begin with the upstream environmental collaboration such as green purchasing and internal financial policies. The environmental collaboration motivate employees to find better options in cooperating with suppliers and thus improve operation performance.

Finally, we found that GSCM supports to increasing competitive performance. Tzu-Yun Chiouet al.(2011) [13] also found that environmental management and innovation are the most important indicators for the competitive advantage of the firms in the future. By focusing on green product and process innovation and green managerial innovation, firms will gain cost savings, increasing efficiency, increased productivity and better productivity and competitive advantage. Moreover, green innovation be able to barriers of other competitors and encourage the reputation of the firm. The study of Ali ÖzgürKaragülle (2012) [14] showed that logistics industry in Turkey increase the environmental awareness, because of the pressures from their customers who have increasing environmental concerns. Furthermore, organizations

begin to adopt environmental project to generate more business opportunities, by offering a new opportunity for companies to reduce costs, create value for customers, and manage limiting resource effectively.

The overall implication of the study can be shown in Fig. 2.

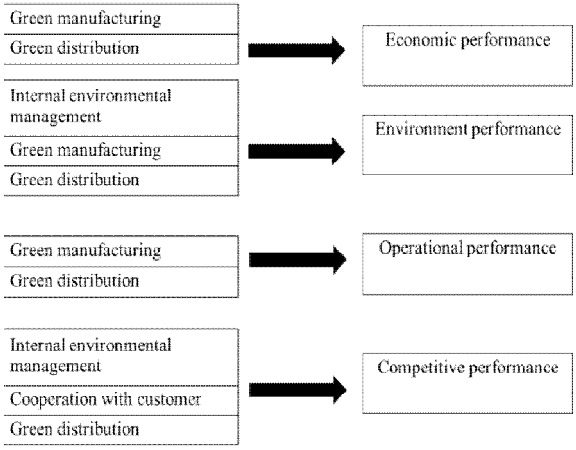


Fig.2. GSCM practices and business performance.

CONCLUSIONS

The purpose of this research was to gain the better understanding of adopting the GSCM to improve business performance in electronic industry in Thailand. Stepwise multiple regressions analysis was used as a tool to test the four hypotheses for this research. The variables used in this study cover all GSCM activities, which consist of internal environmental management, green purchasing, eco-design, green manufacturing, cooperation with customers, green distribution and investment recovery. Likewise, business performance composed of economic performance, environmental performance, operational performance and competitive performance. In this research, the results show that GSCM was positively correlated to four types of business performance. GSCM has strongly effects to environmental and competitive performance for Thailand electronic industry. The results provides us with managerial implications that many electronic manufacturing firms in Thailand have to increase their environmental practices due to the environmental regulations and market pressure to maintain the foreign market and to attain the competitive advantage. The result of this research can use to encourage the firms to implement GSCM because it can improve the firm performances.

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