How does the Green Industry Policy Impact a Developing Country? A Case Study of the Electronic Products and Electrical Equipment Manufacturing Sector in Thailand

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ABSTRACT

Implementation of Green Industry (GI) strategy has long been recommended for industrial sectors to achieve sustainable production. Among various approaches, GI certification as a voluntary scheme has been implemented widely to promote the adoption of environmental-friendly practices for Thai industrial entrepreneurs. This research examined the progress and lessons learnt from existing schemes and identified the challenges of GI implementation and future improvement. The study particularly focused on small and medium-sized enterprises (SMEs) in the electronic products and electrical equipment manufacturing sector. A questionnaire-based survey was used to collect data, and the Mann-Whitney U Test was used to verify significant barriers and drivers among the samples. The results indicated that major common practices of SMEs are widely approved for fulfilling GI criteria, i.e., waste segregation and minimization, and energy saving, so as to comply with environmental law. While other environmental practices, such as greenhouse gas accounting, green labelling, and green supply chain management were limited in adoption. SMEs, both certified with GI and non-certified with GI, expressed the same opinion that all factors including financial, legal, social, personnel, technological and policies were barriers to GI adoption but significantly different from the economic factor. SMEs in both groups revealed the same opinion that incentive, expertise and technology were drivers of GI adoption but differ significantly from the financial support. Incentive-based instruments such as subsidies and voluntary schemes for green product certification are proposed as appropriate measures to encourage SMEs to adopt GI.

1. INTRODUCTION

The industry sectors are relevant to all Strategic Development Goals (SDG), specifically SDG 12 which strives to ensure sustainable consumption and production patterns. The industrial sector is the fundamental source of production which not only consumes resources to produce output, but also has a negative impact on the environment. However, industry does not require an ever-growing use of natural resources and can minimize the pollution by adopting green industry (UNIDO, 2018; Pedersen, 2018; Jones et al., 2018). The green industry concept is an important mechanism that will drive sustainable industrialisation, as the objective of green industry is sustainable production by considering the social and environmental aspects of business operations through the more efficient use of energy and raw materials, innovative practices, and applications of new green technologies (UNIDO, 2011; UNIDO, 2018). In the past decade, green initiatives, such as environmental management systems, eco-labelling, greening the supply chain, and corporate social responsibility (CSR) have been continuously promoted, which can contribute to the implementation of green industry (UNIDO, 2011; Lee, 2009; Potros and Enquist, 2007; Luan et al., 2016; Schoenherr and Talluri, 2013; Roy et al., 2013; Frey et al., 2013).

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Many European countries applied green industry strategy to rebalance their economy after the economic crisis in late 2005, and presently, advanced green strategy and circular economy have been adopted (Zamfir et al., 2017; Katz-Gerro and López Sintas, 2019). South Korea, Japan and China are exemplary Asian countries that have adopted green industry strategy into their national policy framework. South Korea transformed the traditional industries to green industries under the green growth policy framework in 2009 (Mathews, 2012; OECD, 2017). Environment and green innovation were identified as the key drivers for Japan's future growth (OECD, 2010). China has focused on resource efficiency and recirculation, green technology, and renewable energy in its 12th five-year plan (Peng and Sun, 2015). Environmental performance was under the influence of internal and external context. Internal context in terms of firms' capabilities, such as turnover (Zamfir et al., 2017), and cost saving (Triguero et al., 2013), has correlation with green process adoption. Ghazilla et al. (2015) revealed that innovation, technology, environmental knowledge, and finances are key drivers and also barriers for SMEs to adopt green manufacture practices. High cost, lack of awareness, lack of resources, and outdated machines are the barriers to sustainable production (Ghadge et al., 2017), whereas external factors from stakeholder involvement in government policy, regulation, and market need correlates with sustainable production (Ghadge et al., 2017). Not only customer and social requirements affected the decision-making of European SMEs to adopt eco-innovation (Kesidou and Demirel, 2012), but law also affected the adoption of eco-product or eco-organization (Triguero et al., 2013). Regulations, incentives, subsidies, market needs, and stakeholder involvement are the drivers of green manufacture practices (Ghazilla et al., 2015).

The Thai green industry strategy has been implemented over a decade in parallel with the international context (Figure 1). It was initially promoted in the industrial sector under the Green Industry project of the Ministry of Industry. The project is a certification awarded to entrepreneurs who operate businesses while complying with five levels of green development criteria (Table 1) (Ministry of Industry, 2017). The certification is a national voluntary scheme consisting of the process of application, audit, decision, and surveillance. The GI certificate is issued to the entrepreneurs with a three-year certification period. The total number of GI certified entrepreneurs from 2011 to 2018 was 31,290 (Ministry of Industry, 2018), which was approximately 23% of 138,038 registered factories (Ministry of Industry, 2016). The government has aimed to award the GI certificate to 2,000 entrepreneurs in 2021, which might increase up to 70,000 entrepreneurs in 2025 (Department of Industry Works, 2021).

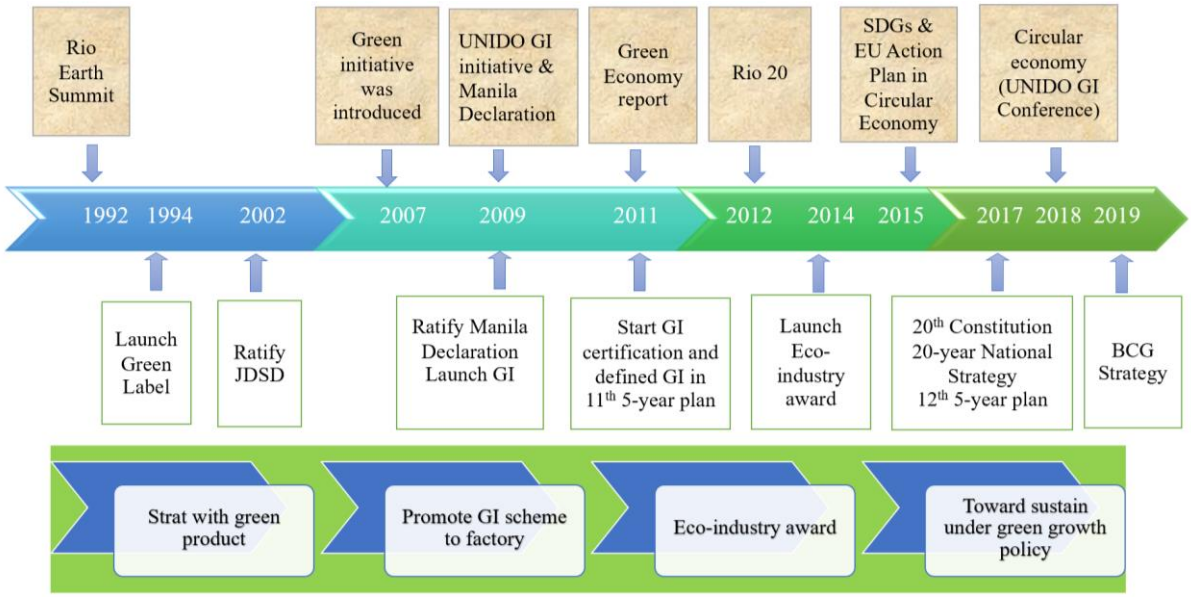

Figure 1. Green industry development in Thailand parallel with the international context (Remark: JDSD=Johannesburg declaration on sustainable development; BCG=Biology circular and green strategy)

Table 1. Five levels of Thai green industry criteria (Ministry of Industry, 2017)

Thai green industry	Criteria
Level 1: Green commitment	1. Organization must define environmental policy with the commitment related to environmental impact reduction or pollution prevention or sustainable resource use or climate change mitigation and adaptation or protection and restoration of natural environment. 2. Organization must communicate the environmental policy to all persons for acknowledgement.
Level 2: Green activity	1. Organization must define and communicate the environmental policy as defined in level 1. 2. Organization must prepare and implement environmental plan to comply with defined environmental policy, the environmental plan must consist of objective, target, procedure, responsible persons and completed time frames.
Level 3: Green system	Organization must establish, implement, maintain, continuous improvement the environmental management system which equal to ISO 14001.
Level 4: Green culture	1. Organization must have environmental management system as mentioned in level 3. 2. Organization must create organization culture in environment and implement it effectively by covering the criteria of standard of corporate social responsibility as ISO 26000. 3. Organization must prepare the environmental implementing report and communicate to the public.
Level 5: Green network	1. Organization must implement environmental management system and create organization culture with respect to green industry criteria of level 4 in all aspect. 2. Organization must implement promotion, creation, and interrelation of environmental activity with stakeholder throughout supply chain, community, and consumer by promote green industry implement to supply chain, encourage awareness and understanding in sustainable consumption to community and consumer. 3. Organization must prepare and distribute the report of promotion, creation and interrelation of environmental activity with stakeholders.

The level of GI achievement under the GI certification scheme could be reflected by the many number of certifications. However, factors supporting and hindering the success of the GI implementation in various industrial sectors have not yet been assessed, including the characteristics of the GI certified organization and its environmental policy and activities. In-depth analysis on this aspect should be carried out to clearly understand how to execute effective GI implementation policy. This information is a crucial input to develop the strategy to achieve sustainable production for industrial sectors. This paper investigates the status and outlook of GI development in Thailand focusing on SMEs in the electronic products and electrical equipment manufacturing sector. The main research questions were:

(1) What is the performance of SMEs in different GI levels?

(2) What are the barriers and drivers which impact SMEs capability to implement and improve according to GI criteria?

2. METHODOLOGY

SMEs have a vital role to play in the economy, employment, environmental protection and resource flows, as, globally, SMEs represent 90% of businesses and more than 50% of employment (World Bank, 2020). As of December 2020, Thai SMEs contribute to 9.05% of the total GDP (Office of Small and Medium Enterprises Promotion, 2020). Subsequently, Thai SMEs were the focus of this investigation to identify the lessons learned from GI implementation via the GI certified scheme. The electronic products and electrical equipment manufacturing sector (EE) was selected as a case study since this sector is one of the most promoted industrial sectors according to the National Industrial Development Plan 2012-2031. Moreover, it is also one of the top-rank exporters of Thailand. In February 2021, EE sector was known to have an export value of 317,877.2 million Baht and an import value of 134,265.3 million Baht (Ministry of Commerce, 2021). These export and import values accounts for 2.02% and 0.86% of the total GDP, respectively. There are more SMEs in EE sector, so they contribute significantly across the supply chain of this sector.

2.1 Questionnaire design

The questionnaire was developed based on the three pillars of sustainable concept and literature review relevant to green industry. The questions were designed in the context of social, economic and environmental factors (Annex A). The questionnaire for this study was divided into four main sections. The first section consisted of questions used to elicit demographic information concerning the SMEs, such as product category, employees, capital, and operation period. The second section consisted of statements

used to measure the GI performance such as certification status, environmental policies and activities. The third section consisted of questions used to measure the barrier of green industry implementation. The last sector included the items used to measure the factors that encourage the decision making to shift to GI. The questionnaire in the first and the second section was close-ended, while the questionnaire in the third and the last section was seven-point scale and five-point scale.

To confirm the validity of questions to acquire desirable data, the questionnaire was verified by a panel of experts comprised of seven professional representatives from academic, government and industrial backgrounds. The experts had more than five years of experience in green industry and environmental management system (EMS). The experts came from the Department of Industrial Works, the Office of Thai Industrial Standard Institute, the Office of National Standardization Council, the Office of the Permanent Secretary of the Ministry of Industry, The Federation of Thai Industries, EE SMEs and academia. The questionnaire was also tested in the preliminary piloting stage of the study, and its reliability was analyzed by Cronbach's Alpha analysis (Tavakol and Dennick, 2011; Yusup et al., 2015). The result is shown in the Table 2.

Table 2. Cronbach's Alpha of the validity of the questionnaire

Questionnaire	Number of items	Cronbach's Alpha	Remark
How important is each of factors for GI implementation in your organization?	7	0.894	Acceptable
What is the degree of these factors that encourages your organization to implement GI?	4	0.941	Acceptable

2.2 Sample

A list of prospective informants was obtained from the directory of registered SMEs database from the Office of Small and Medium Enterprises Promotion (OSMEP). SMEs in this study mean an enterprise with less than 200 employees according to the ministerial regulations of number of employments, and the fix asset value of small and medium enterprise, B.C. 2545 (Office of Small and Medium Enterprises Promotion, 2002). According to the OSMEP directory, 3,688 SMEs were registered in EE sector at the end of 2016 (Office of Small and Medium Enterprises Promotion, 2016). Yamane formula (Yamane, 1967) was then used to calculate the required sample size in this study:

$$n = \frac{N}{1+N(e)2}$$

Where; n is the sample size, N is the population size, and e is the level of precision. When this formula was applied to the 3,688 EE SMEs population, a sample size of 97 with an acceptable error of 10% was determined. From November 2017 to April 2018, a total of 1,300 questionnaires were mailed together with a cover letter to the EE SMEs. Responses of 179 valid questionnaires were obtained from sampling SMEs established in all regions of Thailand, a response rate of around 14%.

2.3 Statistical analysis method

The IBM SPSS software version 22 was applied for statistical analysis. The Mann-Whitney U test (Mann and Whitney, 1947) was used to verify the difference in key barriers and drivers between the two sampling groups, where one group of SMEs received a GI certificate, while the other group of SMEs did not receive a GI certificate (Yusup et al., 2015). This test is one of the most commonly used non-parametric statistical tests (Nachar, 2008). The assumptions of the test are:

(1) The two investigated groups must be randomly drawn from the target population.

(2) There is independence within groups and mutual independence between groups.

(3) The observations values are then of ordinal, relative or absolute scale type.

The Mann-Whitney U test initially implies the calculation of a U statistic for each group. The mathematical equations (Mann and Whitney, 1947) are defined by the following:

$$u_x = n_x n_y + ((n_x(n_x + 1))/2)) - R_x$$

$$u_y = n_x n_y + ((n_y(n_y + 1))/2)) - R_y$$

Where; n_x is the number of observations in the first group, n_y is the number of observations in the second group, R_x is the sum of the ranks assigned to

the first group and R_y is the sum of the ranks assigned to the second group.

Computing the Mann-Whithney U test using SPSS, the test results show the values of the ranks, the mean rank, the sum of ranks and the number of observations in the first table. In addition, SPSS automatically provides the tests results in the second table, i.e., the Mann-Whitney U, the Wilcoxon W and the Z results.

3. RESULTS AND DISCUSSION

3.1 The respondents' demographic profile

Most of the respondents in the survey were employed in management department, with 18% in the top management and 58% in environment and safety, quality control and production section (Figure 2). The remaining 24% were managers and staff from support departments, such as administration, human resources, and purchasing. Therefore, the data obtained from the questionnaire was reliable because more than 50% of respondents were the decision makers and part of the management personnel, who were well familiar with the organization's environmental performance.

Eighty five percent of the firms which responded to the questionnaire had been operating for more than ten years. The remaining 15% of firms had been operating for less than ten years. Fifty two percent of the firms that responded to the questionnaire had a capital less than 50 million Baht, while the rest had a capital of 51-200 million Baht (Figure 3).

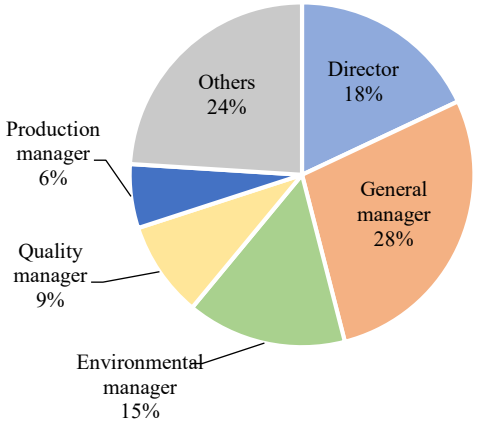

Figure 2. Profile of the respondents' position

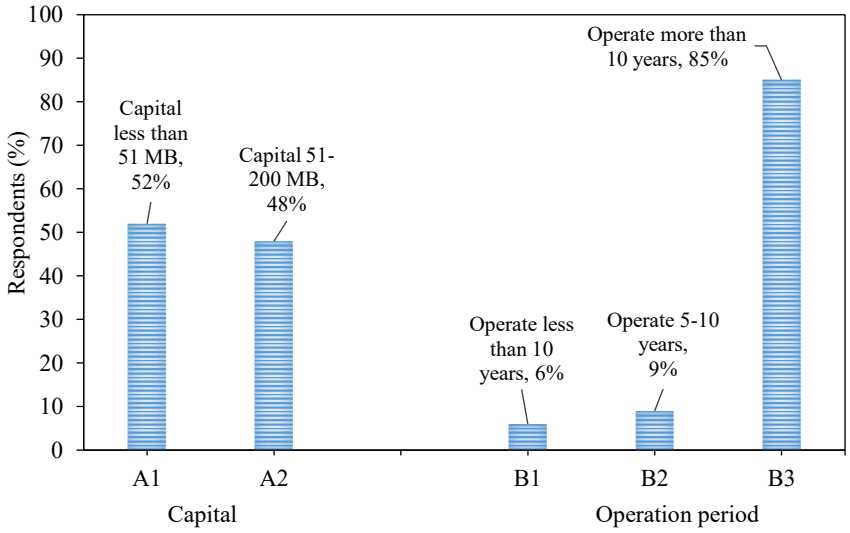

Figure 3. Profile of the capital and firm age of the respondents

3.2 GI Performance

GI performance is reflected by environmental policies and environmental practices adopted by SMEs. If environmental policies and practices contributed with international commitment and/or international standards, including required knowledge for implementation, it showed the performance rate of GI adoption by SMEs. Moreover, the level of GI certification can verify the GI performance.

3.2.1 GI certification

The survey results showed that majority of the SMEs in EE sector (68%) did not receive the GI certification, while 32% received the GI certification. The levels of these certifications were level 1: Green Commitment, level 2: Green Activity, level 3: Green System and level 4: Green Culture, as shown in Figure 4. The number of certified entrepreneurs was level 1 (12.50%), level 2 (15.62%), level 3 (65.63%) and level 4 (6.25%),

while none of the respondents received certification with GI level 5. It might be speculated that some importers of electronic products and electrical equipment have green procurement policy, then SMEs that had GI level 3 certification may have been impacted from their customers. Moreover, the GI level 3 certified by the Ministry of Industry is free of charge when compared to ISO 14001, which is certified by the certification body (CB). Thus, SMEs in the EE sector should rather adopt GI level 3 than ISO 14001 in order to manage environmental problems. This finding is different from SMEs in foreign countries that adopted a variety of advanced international standard, such as life cycle assessment (LCA), carbon footprint, eco-labelling, circular economy for environmentally friendly manner and sustainability (Jove- Llopis and Segarra- Blasco, 2018; Zamfir et al., 2017; Lefebvre et al., 2001; Jung, 2015; Wang and Chui, 2014).

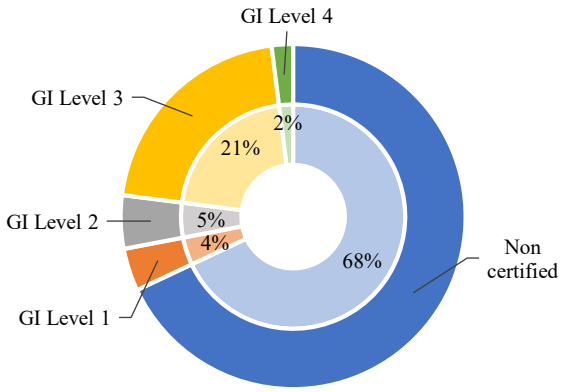

Figure 4. Profile of the green industry certification of the respondents

3.2.2 Environmental practices adoption

The environmental policy and practices for greening SMEs are presented in Figures 5 and 6. More than half of the respondents (52.5%) set environmental policies on the topic of environmental impact reduction or pollution prevention. Environmental policies on sustainable use of resources were set by 24.02% of the respondents. Furthermore, 9.5% and 8.9% of respondents set environmental policies on mitigation of climate change and the protection and restoration of natural resources, respectively, which was a very small number compared to the total sample size (Figure 5). It indicated that EE SMEs establish policy and target in order to comply with Thai environmental regulation, whose goal is to control the emissions at the end of pipe.

Figure 6 presented the data of environmental practices adopted by EE SMEs. The majority of SMEs implemented activities of energy saving (117), waste segregation (112), and minimization (110), while the environmental practices as green label certification, green supply chain management, and greenhouse gas quantification, were minority adoptions with 23, 23, and 22, respectively. It indicated that the majority of the environmental activities, such as energy saving, waste separation, and minimization are deployed with the policy of environmental impact reduction or pollution prevention, which is defined by a major part of SMEs. Whereas environmental practices, such as greenhouse gas quantification, eco labelling, green supply chain management, and product lifecycle assessment still

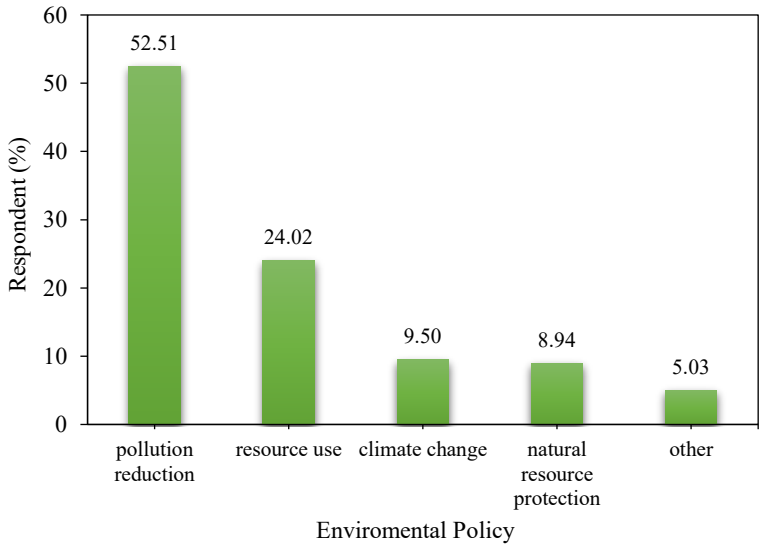

Figure 5. Issues of environmental policies on which SMEs focus

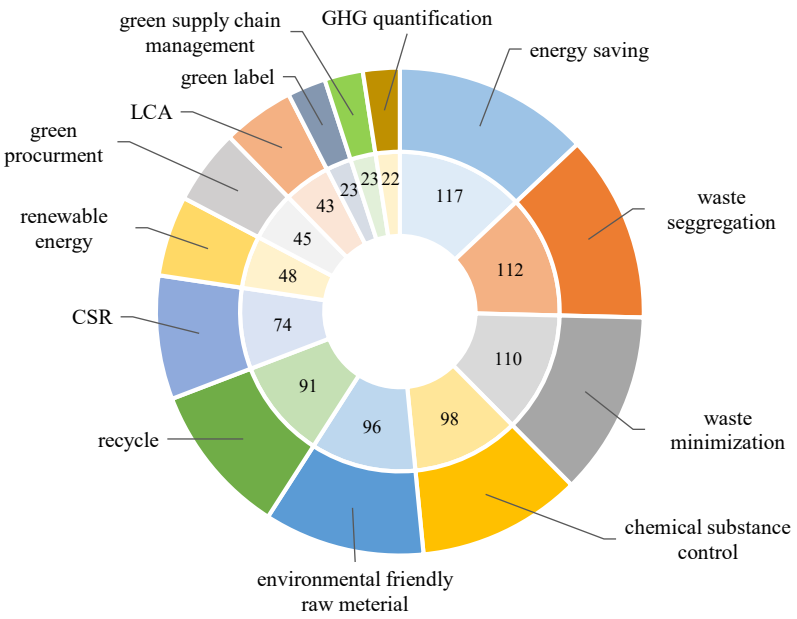

Figure 6. Environmental practices adopted by SMEs

only have minor application in SMEs. It seems that advanced GI development and implementation in SMEs has not been achieved yet. Even though Thailand announced Biology, Circular and Green strategy for a new business model to enhance circular economy and green industry in 2019, SMEs are still implementing environmental activities to comply with environmental regulations. It is in contradiction with other countries which have implemented a variety of advanced environmental practices for more than ten years. A comparative analysis in developed and developing economies indicated that the countries in Europe hold international leadership in sustainable consumption and production practices (Wang et al., 2019). SMEs in Belgium, Spain, France, Ireland, the Netherlands, Austria, Sweden, and Romania used renewable energy, redesigned product, and service to increase their environmental performances. SMEs in Italy and Poland minimized waste by recycling or circulating it (Zamfir et al., 2017). Spanish industrial SMEs have carried eco-innovation to reduce the environmental impact of unsustainable consumption and production (Kiefer et al., 2019) and implement circular economy as biodegradable material, environmentally efficient process, sustainable energy, eco innovation design product, industrial symbiosis, and environmental certifications (Prieto-Sandoval et al., 2018). In Asian countries, China transformed the traditional industry to green industry by adopting resource efficiency and recirculation, green technology and renewable energy (Chen et al., 2017). The new industry established in South Korea is the green industry which applies the climate technology, such as rechargeable battery, carbon capture and storage (CCS), smart-grid and sewage technology (Jung, 2015). Taiwan semiconductor manufacturers were promoted to adopt carbon footprint quantification, environmental management system and green labelling to transform to green supply chain (Wang and Chui, 2014). Malaysian government introduced green practice to construction entrepreneurs and SMEs. Malaysian green practice is similar to Thai GI criteria such as ISO/EMS, green technology, green procurement, green labelling, waste management (Bohari et al., 2015) recycling waste, complying with regulations and CSR (Ghazilla et al., 2015). SMEs in many other countries, especially across Europe, have applied environmental practices beyond their environmental pollution control. However, SMEs in Thailand have not made a big jump in applying environmental management tools to conduct business in an environmentally friendly manner.

3.3 Challenges of GI adoption in SMEs

Figure 7 showed the obstacles of GI adoption. SMEs were asked to score a number of different barriers on a scale of 1 (most important) to 7 (least important) to understand scale of impact. The result showed the rank scores of seven factors that could hinder SMEs to transition to green industry. Sixty SMEs agreed that financial (GI enhance cost reduction and competitivness) was the first priority issue. Moreover, 40 and 47 SMEs agreed that the second and third major obstacles were economic (Government

provide incentive to SMEs) and personnel (SMEs have competency personnel in environmental), respectively. The fourth major barrier was social (Interested parties require SMEs implement GI), which 33 SMEs agreed with. Whereas 63 SMEs agreed that the least important obstacle was the policy (SMEs completely establish environmentally friendly policy).

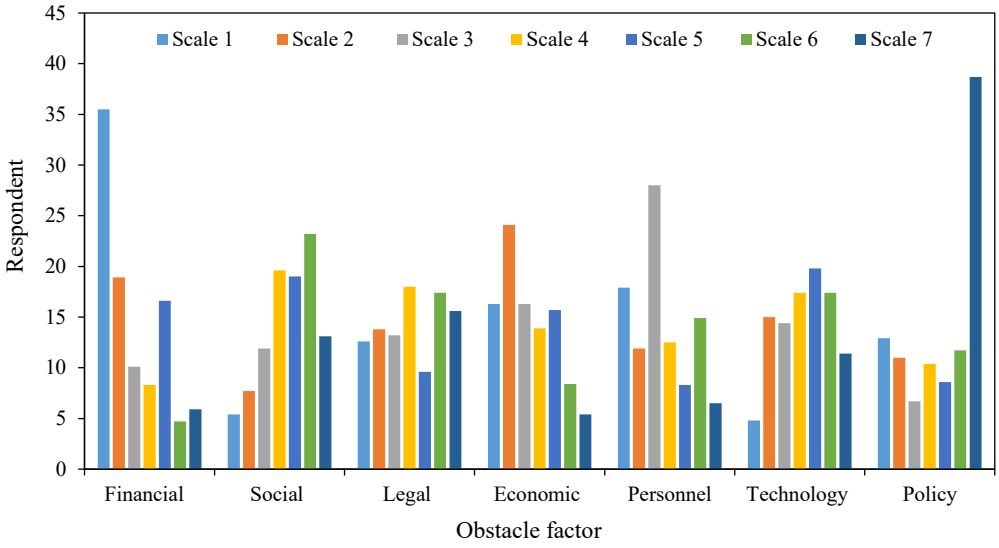

Figure 7. Important of perceived barriers to GI according to EE SMEs, on seven-point scale

The results of descriptive statistical analysis showed that SMEs with less capital than 50 million Baht received the GI certification less than SMEs with capital more than 50 million Baht. Approximately, one-third of SMEs that have the capital of less than 50 million Baht are certified GI, with GI 1 more common than other levels. While half of SMEs that have the capital higher than 50 million Baht are certified GI with GI 3 more common than other levels. Moreover, the majority (one-third) of SMEs having the capital of less than 50 million Baht expressed their opinion on the most important influence of finances to GI adoption, followed by personnel and technology (SMEs have capability of green technology).

It suggests that financial factor was the strongest challenges to SMEs adopting GI, which is a concept similar to the one found by Zamfir et al. (2017), Ormazabal et al. (2018), Stucki (2019), Caldera et al. (2019), and Woodard (2021). Moreover, this finding is consistent with the reports of UNIDO (2011), and the Office of Small and Medium Enterprises Promotion (2015), which stated that the economic problems such as financial and personnel force SMEs to focus more on business interests than environmentally friendly practices. The limit of human resources and budget could impact SMEs developing GI at a low level by setting and implementing environmental policies than creating green culture and green supply chains.

The Mann-Whitney U test was used to show the difference in the medians of the perception on the obstacles and drivers to GI adoption between two respective SMEs. The results are shown in Table 3 and Table 4.

Table 3 presented the results of the investigation of factors that impeded SMEs in being a GI. The ordinal data from the questionnaire (section 3) was analyzed by Mann-Whitney U test. The result showed that SMEs, both certified with GI and non-certified with GI, expressed the same opinion that all factors including financial, legal, economic, social, personnel, technological and policies were barriers to GI adoption. This finding is similar to Caldera et al. (2019), who revealed that the success of sustainable business practice was affected by SMEs' financial capability, expertise, regulation, and policy.

The economic factor was the obstacle that both groups of SMEs expressed their opinions significantly different. The mean sum of rank of economic factors in non-certified SMEs was more than certified SMEs. This implies that economic factor challenges non-certified SMEs in GI adoption more than certified SMEs. It may be caused by SMEs receiving GI certification to get more benefits and incentives from

the government. This finding is similar to Shrivastava and Tamvada (2019), who indicated that green products/services have a positive impact on firm performance. Therefore, it is highly recommended that the benefits of being GI should be recognized by SMEs' decision makers.

Table 3. The Mann-Whitney U test of the obstacles of greening SMEs

Obstacle	Mann-Whitney U (p-value) at level of significance (α=0.05)		Mean sum of rank order
	SMEs certified with GI	Non-certified	
Financial	Certified	0.495	Non-certified > Certified
	Non-certified	-	-
Social	Certified	0.3975	Non-certified > Certified
	Non-certified	-	-
Regulation	Certified	0.288	Non-certified > Certified
	Non-certified	-	-
Economic	Certified	0.0015*	Non-certified > Certified
	Non-certified	-	-
Personnel	Certified	0.437	Non-certified > Certified
	Non-certified	-	-
Technology	Certified	0.122	Non-certified > Certified
	Non-certified	-	-
Technology	Certified	0.248	Non-certified > Certified
	Non-certified	-	-

Remark: The definition of the obstacle - Financial, Social, Regulation, Economic, Personnel, Technology, Technology - referred to the questionnaire in the third section.

Table 4. The Mann-Whitney U test of the drivers to greening SMEs

Driver	Mann-Whitney U (p-value) at level of significance (α=0.05)		Mean sum of rank order
	SMEs certified with GI	Non-certified	
Financial	Certified	0.018*	Non-certified > Certified
	Non-certified	-	-
Incentive	Certified	0.0725	Non-certified > Certified
	Non-certified	-	-
Expertise	Certified	0.182	Non-certified > Certified
	Non-certified	-	-
Technology	Certified	0.161	Non-certified > Certified
	Non-certified	-	-

Remark: the definition of the driver - Financial, Incentive, Expertise, Technology - referred to the questionnaire in the fourth section.

Table 4 shows the result of Mann-Whitney U test on the drivers of GI (questionnaire section 4) comparing GI certified SMEs and non-certified SMEs. SMEs in both groups revealed the same opinion on the mechanism as incentivized, expert and technological. However, they expressed a different opinion with the finances ($p<0.05$) in which the mean sum of rank of non-certified SMEs was higher than certified SMEs. This implies that both groups of SMEs required finances, incentives, expertise and technology to improve their environmental practice toward advanced GI. This finding is similar to Kiefer et al. (2019), who indicated that internal financing resources and technology-push represent drivers to eco-innovation. Moreover, Shrivastava and Tamvada (2019) suggested that external financial support and green products/services adoption have significantly positive effects. Subsequently, subsidy mechanisms such as grants, funds, low-interest loans, moratoriums, tax exemptions, and fee exemptions should be provided to SMEs to enhance advanced GI adoption.

4. CONCLUSION

This study validated the GI performance in Thai EE SMEs which were successfully certified in GI level 1-level 3 more than GI Level 4 and Level 5. They mainly developed their organization to become a GI by implementing environmental policies and practices

in order to minimize environmental impact. EE SMEs currently implement rather simple environmental practices compared to those in large enterprises. The findings from Mann-Whitney U test on the importance of barriers and drivers to GI adopted by SMEs indicated that the median of opinion on economic factor and financial factor are significantly different between SMEs who are certified and non-certified with GI. However, Thai SMEs have significantly high potentials to contribute to sustainable production because they have commitment to transform to GI. Therefore, the incentive-based instruments as subsidies to SMEs is the first priority strategy by establishing a green industry fund for grant or loan to SMEs. Moreover, the regulation mechanism via product law and product tax in accordance with the voluntary agreement approach to green product certification is the second priority. Since the eligibility of the green product certification scheme requires that the manufacturers have to be a certified GI before they can manufacture certified green products, it can be supported by the enforcement of green product law and product tax.

This study focused on the EE sector in Thai SMEs, so further studies can focus on other industries, particularly S-curve industries of the national industrial plan, and form a comparison with this study. This study verified hypotheses with a questionnaire-based survey of only 179 responded questionnaires at the acceptable error of 10%, so this study is limited with sample size. Therefore, future studies should set an acceptable error of sampling with 5%. Furthermore, the statistical analysis of obstacles and drivers are to be refined and validated. The structural equation model (SEM) will be used in order to determine the level of importance for all barriers and drivers to shape a better framework to establish a more suitable strategy for enhancing SMEs adoption of the advance GI. Finally, this study hopes that the research results are beneficial to the policy maker in establishing the proper strategies to enhance the adoption of GI by Thai SMEs with an advance level of GI 4 and GI 5.

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