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Critical Factors and Their Correlation Affecting Green Industry Performance: Evidences from Small and Medium Enterprises

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Abstract

Large companies have achieved excellent progress toward green production while small and medium enterprises (SMEs) showed limited progress. This research aims to investigate key factors affect different stages of enhancing green industry implementation particularly in SMEs. This study conducted a systematic analysis to offer recommendations to unlock the inhibitors of the green industry. The electronic products and electrical equipment manufacturing industry in Thailand was chosen as a case study. Questionnaire is the main approach to collect primary data from SMEs. The structural equation model is developed to examine correlation and the degree of influencing factors. The model indicated that the latent factors' influence on the decision-making of SMEs in applying the green industry reflected by the influence of eighteen observable variables and it suggests that the external contexts from stakeholder have a greater influence on the decision-making than the internal context as organizational resources and capabilities. Whereas the level of certification conform with green industry criteria has minor correlation with the decision-making of SMEs. Innovative policy strategy is recommended to create synergy between incentive-based instruments in term of product charges or product tax, subsidies and voluntary measure as product certification are recommended tools to enhance green industry adoption by SMEs.

Keywords: Green industry; Small and medium enterprises; SMEs; Structural equation model; SEM; Electronic product

Introduction

Over the past two decades, global environmental concerns have led to several green initiatives – green industry (GI), sustainable industry, industry ecology and circular economy initiatives – to lessen environmental burdens caused by industrial growth and enhance sustainable development. Since 2015, at least 2 UN sustainable development goals (SDGs) focus on sustainable industrial growth, i.e. SDGs#9 focus on indus-

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try innovation and infrastructure and SDGs#12 responsible consumption and production. The GI principles are the key mechanisms supporting industrial sectors in achieving these SDGs. Complying with the GI concept helps reducing the ecological footprint by improving environmental performance of the industry [1]. The GI comprises two components: (i) continuous improvement in environmental performance and (ii) development to produce environmentally friendly products and services [2].

Many countries have implemented policies to promote the GI for sustainable growth. South Korea, Japan, and China are exemplary Asian countries that have adopted GI strategy into their national policy framework. South Korea transformed the traditional industries to green industries depend on the green growth policy framework [3–4]. Environment and green innovation were identified as the key drivers for Japan's future growth [5]. China has focused on resource efficiency and recirculation, green technology, and renewable energy in its 12th five-year plan [6]. Small and medium enterprises (SMEs) in European Union, Belgium, Spain, France, Ireland, The Netherlands, Austria, Sweden, and Romania, used renewable energy, redesigned product and service to minimize the use of materials or the use of recycled materials to increase their environmental performances [7]. SMEs from Italy and Poland minimized waste by recycling, reusing, or circulate it to another company [8]. About 28% of SMEs in Australia were familiar with clean industry practices [9].

Since 2009, the government of Asian country as well as Thailand ratified the Manila Declaration on Green Industry [10]. They declared to "establish policies, regulatory and institutional frameworks, which are conductive to shifting towards resource-efficiency and low-carbon industries, consistent with the sustainability business principle, and to will intensify the efforts towards the achievement of the measures" e.g., cleaner production, resource-efficiency, low-carbon industries, eco-friendly product and process, green innovation [11]. After Thai Government ratified this declaration, the Ministry of Industry launched Thai GI initiative [12] (Figure 1) in 2011, to promote environmentally and socially responsible industry. As if, the voluntary scheme of GI Certification was set up under the GI project. It aims to certify enterprises that successfully develop their organization in compliance with GI criteria (Figure 1) categorized into five levels as Green commitment, Green activity, Green system, Green culture, and Green network. The benefit of GI certification provided to the certified entrepreneurs were incentives such as annual fee waiver, soft loan, indulgent verification, certification fee, consultants, and authorisation of GI mark [12].

In 2017, around 30,400 Thai entrepreneurs obtained the GI certification [13]. Interestingly, large conglomerates or public corporates are able to achieve the GI certificate of Level 4 (Green culture) and Level 5 (Green network), while a small number of SMEs could achieve GI certification with the level 1 (Green commitment), Level 2 (Green activity) and Level 3 (Green system). The reason is that economic issues may force SMEs focus on business cost-saving more than environmental quality aspects [14]. The limit of human resources and budget could impact GI adoption by SMEs. Therefore, they are unable to put high priority on improving environmental performance. This is similar to the case study in Canada found that large industries in Canada pay more attention to environmental performance than small ones [15]. However, Ministry of Industry [13] reported that the entrepreneurs who have received the GI Level 5 certification, they also achieved higher sustainability ranking and got more profit. Then GI certification is useful for SMEs in terms of creating a corporate good reputation, being environmentally friendly and socially responsible, which can increase competitiveness.

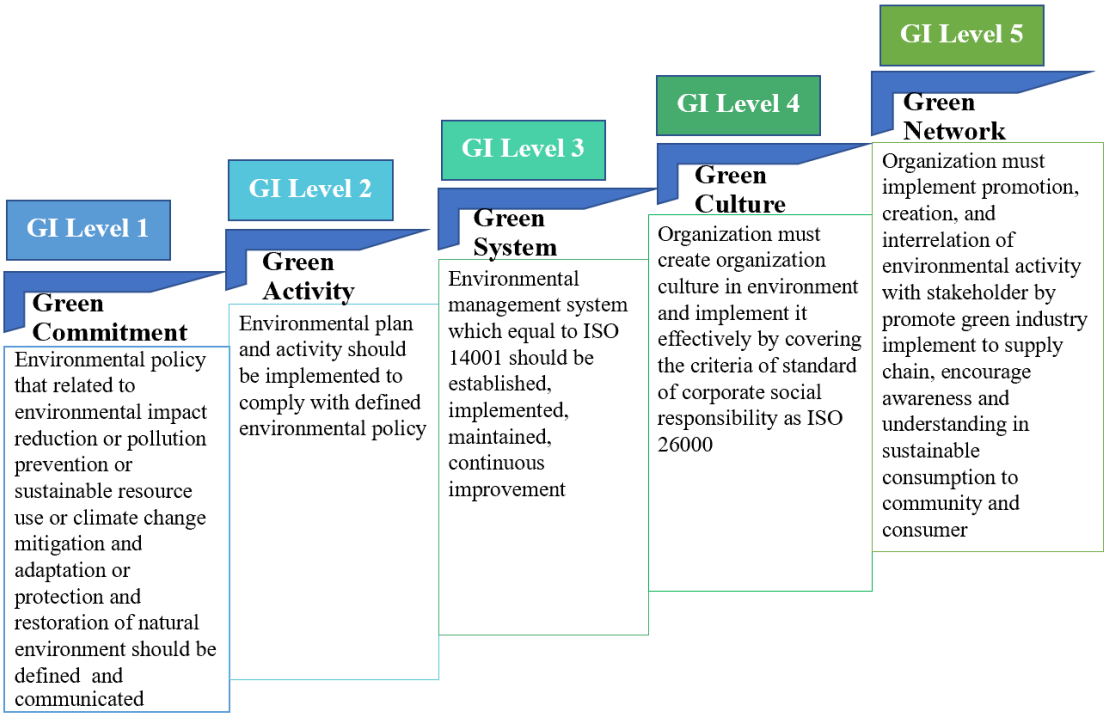

Figure 1 A 5-level of GI criteria of Thailand.

Drivers and barriers of sustainable industry

Global environmental concerns have raised the demand for the industry to ensure more environmentally friendly practices to protect the ecological system well-being. Firms have encountered several challenges from both internal and external contexts in managing their environmental sustainability performance as a part of their business strategy. The internal and external context that can affect, either positively or negatively, the way the organization manages its environmental responsibilities [16]. Internal context can be facilitated by considering issues arising within firm under its control whether they are tangible or intangible. Financial capital, physical capital, human capital, innovation, is both the tangible. The intangible is such as experience, knowledge, judgment, culture. Whereas, the external context are the outside elements that influence a business performance and operation. They are often part of social, economic and political environment.

Ghazilla et al. [17] revealed that innovation, technology, environmental knowledge, and finances are key drivers and also barriers for SMEs to adopt green manufacture practices. Whereas regulations, incentives, subsidies, market needs, and stakeholder involvement are the drivers of green manufacture practices. High cost, lack of awareness, lack of resources are the barriers to sustainable production. While government policy, regulation, and market need have correlation with sustainable production [18]. Not only customer and social requirements affected the decision-making of European SMEs to adopt eco-innovation [19], but law also affected the adoption of eco-organization [20]. Moreover, market opportunity has a significant positive effect on corporate environmental responsibility [21]. The specific organization resources (e.g. physical, financial, and experiential) and specific organization capabilities positively influenced the adoption of environmental practices by small firms [22]. The adoption of environmental practices is influenced by the degree of firms adopt advanced technology [23]. Furthermore, cost savings are the drivers of eco-innovation of products and process [24], while technological and managerial capabilities are more effective in

driving the adoption of cleaner technologies [25]. Market requirements, regulation and state support function as a push for a firm's green strategy [26]. Similarly, environmental legislation and financial support encourage firms to actively undertake greening processes [27].

Structural equation model in green industry

A structural equation model (SEM) is a collection of tools used to analyze the connections between various concepts in cases where these connections are relevant either in expanding our general knowledge or for problem-solving [28]. SEM is one of the techniques of choice for researchers across disciplines [29]. Moreover, it is used to study the influence of factors to verify theories in a variety of research areas of green initiatives. Durdyev et al. [30] stated that sustainable industry in Malaysia related to government, cost, knowledge, manpower, client, and market. Clear and effective legislative process as well as economic incentives will lead to effective implement sustainable industry. Hussey and Eagan [31] revealed that SEM can be useful in validating environmental performance model for SMEs as well as indicating that leadership, planning, information, and analysis improve environmental performance, while customer and market environmental requirements provided the influence on environmental performance. Aragon-Correa et al. [32] used SEM to verify the relationship of environmental strategy and performance in SMEs. The results found that SMEs adopt a range of environmental strategy from reactive regulatory compliance and environmental leadership. Leonidou et al. [22] revealed that internal company factor in term of organization resources and capabilities help SMEs to formulate green business strategy and the setup of green business strategy was affected by the condition of high regulation intensity, high market dynamism, high public concern, and high competitive. Interestingly SEM can involve quantitative forecasting studying the relationship between various variables in multiple regression analyses. It helps in forecasting or comparing the relationship between variables according to more than one factor by completing the analysis at the same time. This study, therefore, employed SEM in order to examine the relationship between different variables and the decision of SMEs in going green.

Study framework

Existing research has indicated that several factors influence the implementation of green initiatives. The previous studies on Thai GI revealed the lesson learn of large-scale entrepreneurs in the agricultural, petrochemical and cement industry, but SME has not yet been studied on the opportunities and obstacles of GI implementing. Even though SMEs are driving the economy with strengths in terms of agility, which account for 41.1% of the GDP and 27.4% of the total export value of the country [33]. This research examines both internal and external contexts that could have influenced SMEs' decision making on the GI implementation. The factors found from the review of the existing researches and the discussion with the practitioners were determined and categorized as the internal and external factors in accordance with the Resource-based theory [34], Stakeholder theory and Porter's competitive strategy [35–36]. Then nineteen observed variables were designed to verify in the study framework (Figure 2). The detail of nineteen observed variable were presented in Table 1 with the key survey question for investigation as well as key reference studies.

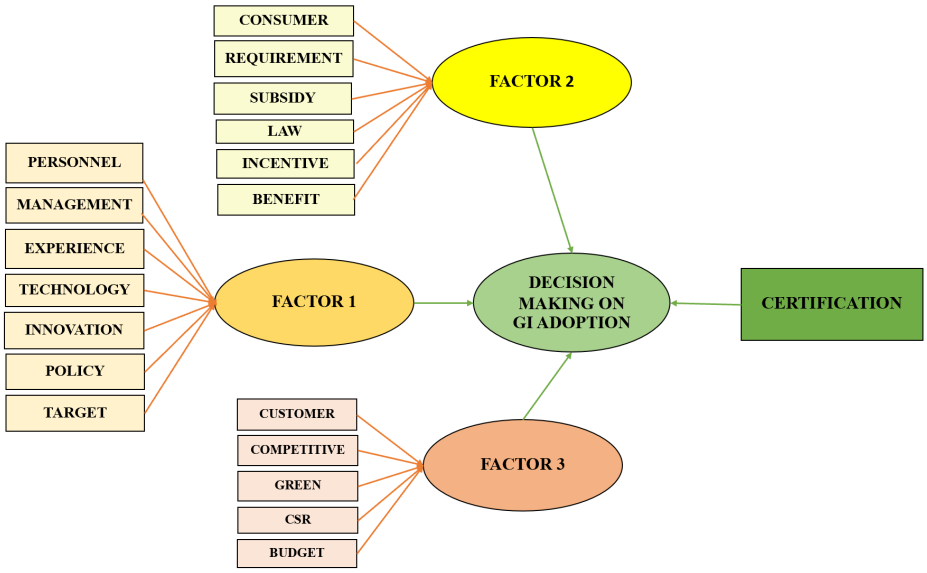

Figure 2 A study framework.

Table 1 Observed variables

Variables	Survey questions	Key references
Internal factors		
Policy	SMEs have an environmentally friendly policy	Originate from this study
Target	SMEs aim to be certified for environmental standards such as ISO 14001	Originate from this study
Management	Top management supports environmental activities	[31]
Personnel	SMEs have environmental experts	[22], [30]
Experience	SMEs have personnel with specific experience under various environmental standards such as ISO 14001	Originate from this study
Technology	SMEs have the requisite technological tools for environmental operations	[17], [23], [25]
Innovation	SMEs implement innovation that supports green development	[17]
Budget	SMEs have enough budget for green industry implementation	[17], [22]
Benefit	Business benefits such as increasing profit, reducing costs and increasing customer base	[24], [30]
External factors		
Law	Stringent environmental and legal measures	[17], [18], [20], [27], [30], [32]
Requirement	The green industry is defined as regulations or trade agreement	[18], [26]
Incentive	The government provides benefits	[17], [26], [30]
Subsidy	The government provides subsidies	[17], [26], [27], [30]
Customer	Customers force SMEs to become a green industry	[18], [19], [31]
Consumer	Consumers and stakeholders have a greater need for green industries	[17], [19]
Competitive	Competitors move towards becoming a green industry	Originate from this study
Green	SMEs need to create market opportunities by focusing on green issues	Originate from this study
CSR	SMEs need to conduct business according to the concept of social responsibility	Originate from this study
Certification	The level of GI certification of SMEs	Originate from this study

Materials and methods

A questionnaire-based survey was used to collect the primary data from the sample of SMEs in the electronic products and electrical equipment manufacturing industrial sector. This was followed by a statistical analysis of SEM whereby the GI uptake variables were analyzed to determine correlations of the decision-making to implement the green criteria.

1) Questionnaire design

The questionnaire for this study was developed into three sections. The first section comprised a set of questions used to elicit demographic information concerning the firm, such as product, number of employees, capital and operation period. The second section consisted of a set of questions used to collect information on the firms' GI implementation. The last section comprised eighteen statements to measure the factors affecting SMEs' decision to go green. The questions are drawn from case studies, academic literature and discussion with practitioners. All the items were close-ended, comprising statements designed to evaluate the participants' level of agreement concerning the effect of the factors. These factors were ranked using a 5-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neither agree or disagree, 4 = agree and 5 = strongly agree). A 5-point scale was selected to provide a neutral perspective. Further, the set of questionnaire was verified and its validity was confirmed by a panel of experts comprising academic, governmental and industrial professionals. The reliability of the questionnaire was analyzed using Cronbach's alpha analysis. Additionally, the questionnaire was tested in the pilot stage of the study. The pre-test questionnaire-based survey was conducted with 25 SMEs in order to validate the clearly of questions, which then used for the final questionnaire.

2) Sample size

SMEs from electronic products and electrical equipment manufacturing industrial sector was designed as case study, because it is an important industrial sector in Thailand not only this industry is in the top exporters of Thailand, but also the top 4th rank in Asian market and the top 13th rank in global market. It is one of the promoted industrial sectors according to the National Industrial Development Plan 2012–2031. In addition, this industrial sector has significant inputs from SMEs across the supply chain. The sampling procedure ensured that every firm is a separate entity and that they are not affiliated with each other. The size was limited to 200 or fewer employees in order to focus on SMEs [37].

A list of prospective informants was obtained from the directory of registered SMEs database from Office of Small and Medium Enterprises Promotion (OSMEP). A total of 3,688 SMEs were registered in electronic products and electrical equipment manufacturing industrial sector at the end of 2016 [33]. Yamane formula [38] was then used to calculate the requires sample size.

$$n = N / (1+N (e)^2)$$

Where n = sample size, N = population size, and e = level of precision. When the 3,688 SMEs population was applied, the sample at 360 with an acceptable error of 5% was obtained. The survey was conducted and contact total of 360 target firms from November 2017-April 2018. The results are high response rate of 179 completed and useable questionnaires (49.7%). were obtained from sampling SMEs established in all regions of Thailand.

3) Analytical methods

IBM SPSS AMOS software version 22 was used to develop the SEM in order to demonstrate the relation path and correlation level of variables on the SMEs' decision to implement the GI concept.

Results and discussion

1) The respondents' demographic profile

Most of the respondents in the survey were management personnel, with 18.44% from top management and 57.54% being managers engaged in environment and safety, R&D and production sections (Figure 3). The information obtained from the questionnaire was reliable because a majority of the respondents were decision-makers who contribute their organization's performance and GI. Most of the firms (about 84.39%) that responded to the questionnaires had been operating for more than 10 years, while the remaining firms (about 15.61%) had been operating for less than 10 years. Further, 52.05% of the firms that responded to the questionnaire had a capital of less than 50 million Baht, while 47.95% of firms had capital in the range of 51–200 million Baht.

The firms that responded to the questionnaire were manufacturers in the sector of electronic products and electrical equipment industrial (ISIC 26 ISIC 27), whose main products were electric motors, generators, transformers and electricity distribution and control apparatus (ISIC 271) (Figure 4). These industrial products are distributed in the domestic and international markets, which must comply market requirements regarding the quality and environment. 67.60% of the respondents did not receive the GI certification, while 32.40% of the respondents did so for Level 1 (Green commitment), Level 2 (Green activity), Level 3 (Green system) and Level 4 (Green culture) (Figure 5). The lack of certification may be due to internal factors as SMEs do not have the readiness of internal resources in terms of personnel, budget and technology.

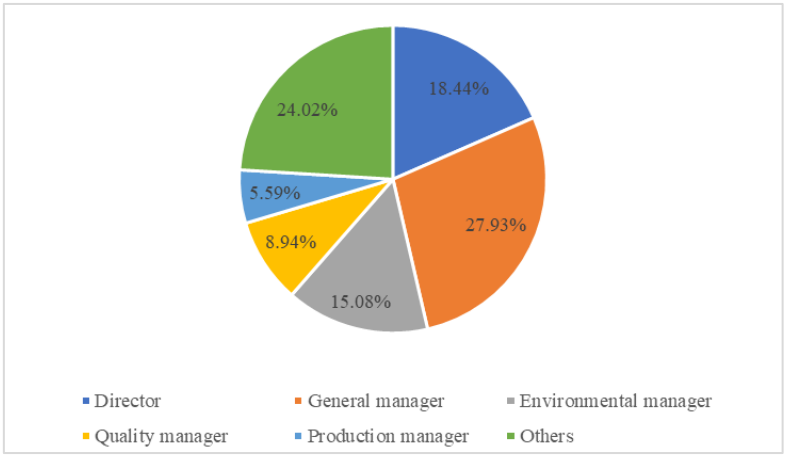

Figure 3 A profile of the respondents' position.

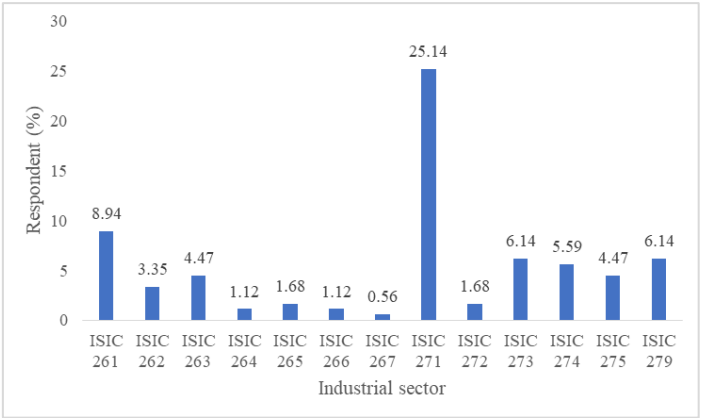

Figure 4 A profile of the industry sector of the respondents.

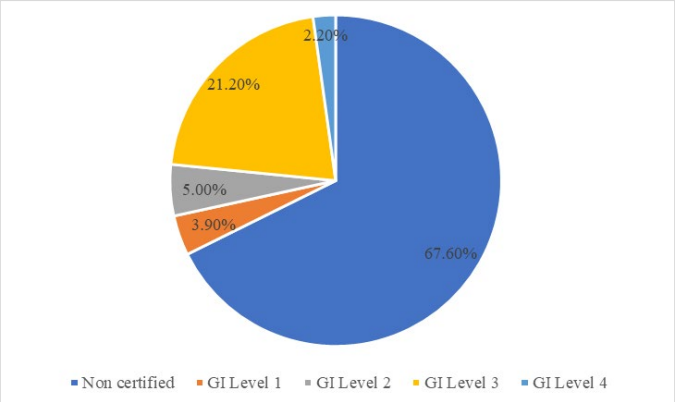

Figure 5 A profile of the GI certification of the respondents.

2) Reliability and validity

The data used in the path analysis by SEM was derived from the nineteen observed variables from the questionnaire. The questions' reliability and validity were assessed through Cronbach's alpha coefficient. The results showed that Cronbach's alpha coefficients for all the factors affecting the decision of SMEs to go green were greater than 0.9, indicating the overall reliability of the questionnaire (Supplementary Material (SM) 1).

The study employed a confirmatory factor analysis to test construct validity. Common factors were calculated using varimax rotation. To ascertain whether the relativity among the items was suitable to use in factor analysis, it was tested using the method of Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and the Bartlett sphericity test. The value of KMO was 0.856, which is higher than 0.7. The value of the chi-square in the Bartlett sphericity test was 1822.739, which is significant at a level less than 0.001. These tests confirm that factor analysis is a useful method. The rotated factor loading matrix is reported in SM 2. SM 3 depicts the initial eigenvalues and percentage of the variance from the correlation matrices and the eighteen observed variables. There were three factors with eigenvalues exceeding 1, and their cumulative percentage reached 60.074. These three factor groups had a total variation of 60.074% of the eighteen observed variables. This indicates that these three factor groups (Factor 1, Factor 2, Factor 3, as shown in Figure 6) reflect the bulk of information derived from the raw data.

The validity of SEM can be demonstrated with the absolute fit indices and incremental fit indices. The absolute fit indices are Chi-square (X^2), root mean square error of approximation, root mean square residual (RMR), standardize root mean square residual (SRMR) and the incremental fit indices are normed-fit index (NFI), Tucker-Lewis index (TLI)/non-normed-fit index (NNFI) and comparative fit index (CFI) [29]. Fit indices and their acceptable thresholds are shown in SM 4.

The maximum likelihood procedure was used to estimate the model. The result from SEM analysis is shown in Figure 6. The goodness-of-fit of the competition model is CMIN (Chi-square = 139.715; p-value = 0.075), CMIN/DF (Chi-square/df = 1.194), normal fit index (NFI = 0.927), relative fit index (RFI = 0.894), comparative fit index (CFI = 0.987), root mean square error of approximation (RMSEA = 0.033; p-value = 0.925). These indicators help confirm that the developed model is acceptable [29].

3) Factors affecting the success of green industry development

According to Figure 6, the measurement model employed a confirmatory factor analysis

validate eighteen observed variables were reflected three underlying latent variables (Factor 1, Factor 2, Factor 3), while there is a correlation among reflexive indicators (observed variables) for the same latent variable [28] and the effect of latent variables (Factor 1, Factor 2, Factor 3) on latent variables (Decision). Whereas, the observed variables (Certification) could reflect underlying latent variables (Decision) with a low certain amount of correlation is 0.01. The reason is that the rule of GI scheme encourage SMEs adopt GI by stepping at GI Level 1 to GI Level 5.

Each variable shows different value of factor loading that reflects the influence of each observable variables on latent variables (Factor 1, Factor 2, Factor 3). The Factor 1 was comprised of seven observed variables with its' factor loading including personnel (0.83), management (0.78), experience (0.77), technology (0.74), innovation (0.66), policy (0.65), and target (0.54), respecttively. As though all observed variables are organizational resources and capabilities. The Factor 2 was contributed six observed variables and the factor loading of each variable as following: requirement (0.72), consumer (0.71), subsidy (0.68), law (0.63), incentive (0.61), and benefit (0.61). It appears that the majority of observed variables are external contexts from stakeholder. The Factor 3 was comprised five observed variables and factor loading of each variable including customer (0.84), competitive (0.82), green (0.57), CSR (0.54), and budget (0.49), respectively. It seems that the observed variables are organizational resources and capabilities and external contexts.

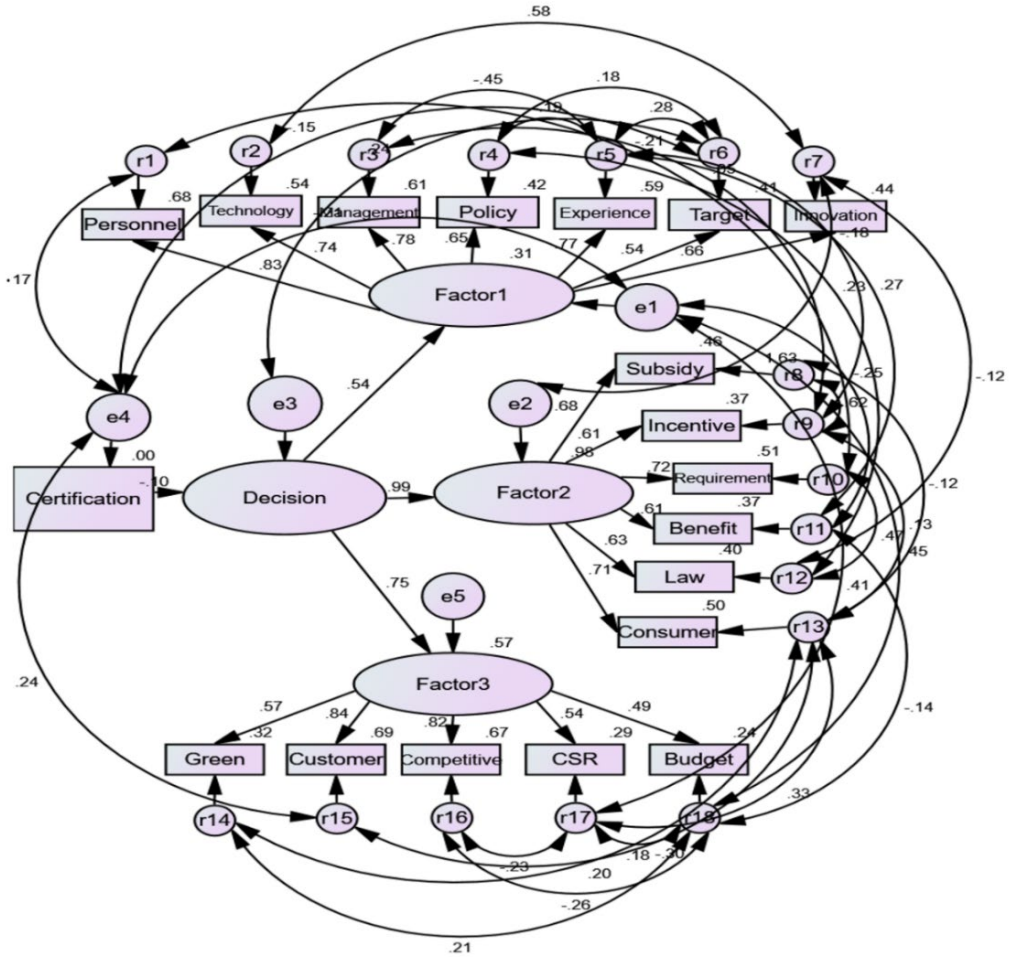

Figure 6 SEM of the factors that affect SMEs decision to become green industry.

The effect of Factor 1, Factor 2, and Factor 3 on decision were reflected by the standardized regression weights 0.54, 0.99 and 0.75, respectively. The Factor 2 (0.99) is the most significantly influence while the Factor 3 (0.75) were the second highest influence and the Factor 1 (0.54) had the least influence. It suggests that, Factor 2 (external contexts from stakeholder) has a larger influence on the decision. This finding is in harmony with Ghadge et al. [18] urged that market requirements and environmental regulation influence environmental management practices, and Hussey and Eagan [31] revealed that customer and market environmental requirements provided the influence on environmental performance. While Factor 1 (organizational resources and capabilities) has a smaller influence on the decision. This finding supports the OSMEP study [14] indicated that financial and personnel are obstacles to the business operations of Thai SMEs. As well as, Leonidou et al. [22] revealed that internal company factor (organization resources and capabilities) help SMEs to formulate green business strategy, and Durdyev et al. [30] found that organizational resources such as personnel, experience, and technology contribute to SMEs' decisions to follow the efficiently resources utilization.

Due to the difference reflexive value of observed variables for the same latent variable, the observed variables can be prioritized on strategy determination to enhance the decision making of SMEs to adopt GI. It is especially interesting that SEM show six observed variables reflexive Factor 2 has the greater contribution to Decision (standardized regression weight = 0.99). Therefore, the reflexive value of six observed variables are determined to establish the strategy, according to the Porter hypothesis [35], the demand for the green initiative can result from environmental regulations, as well as competitive forces based on Porter's competitive strategy [36] and stakeholders driving factors for the improvement of environmental performance [18]. Then the economic-base instrument is recommended strategies for enhance SMEs adopt GI, especially product charge or product tax could be suitable tools. The reason is that, the difference tax rate of electronic products and electrical equipment could be set up, and in this context the electronic products and electrical equipment produced from GI SMEs will determined with low tax rate than the same one produced from non-GI SMEs. The low tax rate could trigger the consumer need and then trigger the GI adoption by SMEs. As though the product charge or product tax can raise revenues to government and can administrative simple. [39]. This tool is similar with the environmental taxation in China, involved a two-rate tax system which lower rates are imposed on emissions below an official standard and higher rates are imposed on all emissions over that standard [39]. Moreover, Durdyev et al. [30] stated that economic incentives will lead to effective implement sustainable industry.

SEM showed five observed variables, reflexive Factor 3 has the contribution to a decision with the standardized regression weight = 0.75. Then the reflexive value of five observed variables are determined to establish the strategy, according to the stakeholder involvement could be the driving factors for the improvement of environmental performance [18]. As well as customer requirements, social requirements [19] and business opportunity [21] has a significant effect on corporate environmental responsibility. Then the voluntary measure as product certification is recommended tools for enhance GI adoption. Depend on the strategy of Bioeconomy, Circular Economy, and Green economy (BCG) of Thailand, the green procurement and sustainable procurement policy could be announced with the supporting measure of the certification of the electronic products and electrical equipment produced from GI SMEs. If the green procurement and sustainable procurement policy was implemented, the demand of certified product could help increase

by the customer as well as market competitive and enhance SMEs to become a GI. Moreover, the mechanism of product certification conforms with the international principal of conformity and can facilitate to international trading.

SEM show seven observed variables reflexive Factor 1 has the minor contribution to decision with the standardized regression weight = 0.54. Then the reflexive value of seven observed variables are determined to establish the strategy, according to the Resource-based View Theory [34], stated that an organization will be successful in business competition as a result of implementing strategy formulation based on internal resources owned by the organization. The incentive-based instruments as subsidies are recommended tools for enhance GI adoption. The reason is that the government could subsidies not only tangible resource but also intangible resource for enhancement capabilities of internal resource of SMEs. SMEs will be successful with green business strategy if they have adequate and appropriate organizational resources [22]. Moreover, subsidy is politically popular and the advantage of encourage pollution reduction and encourage innovation [39].

Conclusions

This research revealed that the relationship between four latent variables and nineteen observed variables based on both internal and external context by confirmatory factor analysis. The SEM confirmed that Factor 2 reflect by six observed variables majority are external context from stakeholder, could have a larger influence on the decision than Factor 3, reflect by five observed variables and Factor 1, reflect by seven observed variables, majority are organizational resources and capabilities and external context. In short, the model says that the latent factors' effect (Factor 1, Factor 2, Factor 3) on the decision-making of SMEs in applying the GI (decision) reflected by the influence of eighteen observable variables. While, the observed variables (certification) could reflect underlying latent variables (decision) with a low certain amount of correlation.

The relationship and the contribution of the variables demonstrated by SEM can lead to the determination and customization of policy guidelines appropriate for promoting the GI concept in SMEs due to the variables factor having the greatest influence on their decisions. The strong demands for environmentally friendly industry from the stakeholder, it will become a reasonable driving force for SMEs to adopt GI practice. In Thailand, incentive-based instruments in term of product charges or product tax and subsidies as well as voluntary measure as product certification should be promoted to empower and transform SMEs to be environmentally friendly firms. The economic-based instruments could have more advantages. Whereas the legal mechanism e.g., law, permit, registration, directive based on Factory Act enforced for long time with uneffective legislative process. Then the combination of economic mechanisms with voluntary measure as well as environmental education and awareness raising will help encouraging the implementation of green SMEs in Thailand and potentially in other countries as well. Future research can be directed at exploring more information regarding the most suitable economic-based instrument to promote green SMEs.

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