

Determinants of the Level of Participation in Green Supply Chain Management: Case of Vietnamese Electronics Manufacturing Enterprises



Do Hoai Linh¹, Tran Duc Thanh², Do Thanh Tra³, Nguyen Thu Ha⁴, Vu Danh Tai⁵, Dao Thu Huong⁶

^{1,2,3,4,5,6}National Economics University, Vietnam

ABSTRACT: The study explores the main drivers that affecting the level of participation in green supply chain management of Vietnamese electronics manufacturing enterprises. The research team divided into two groups of factors, which are internal and external pressures. With primary data obtained from 544 electronics manufacturing enterprises in the Red River Delta and Southeast regions of Vietnam, the team applied two modeling software, SPSS 26.0 and AMOS 25.0. Combined with secondary data, the research team found that business type, size, environmental regulations, market pressures, and efficiency-oriented motivations all affect the level of management involvement. green supply chain. Since then, the research team has developed recommendations based on these groups of variables with the goal of promoting the participation of enterprises in the green supply chain management model.

KEYWORDS: Green supply chain, Green supply chain management, Electronics manufacturers, Supply chain management Vietnam.

I. INTRODUCTION

The current situation of e-waste in Vietnam is alarming, the world has also witnessed the shift of e-waste flow from developed countries to developing countries, including Vietnam, making Vietnam gradually become one of the largest "technological waste dumps". If we want to develop the industry in a reasonable and sustainable way, we need to apply a "green" strategy, a "green" program to change this situation. Therefore, it is urgent to build a roadmap to reduce and recycle e-waste in Vietnam, in which, the participation of enterprises in green supply chain management is one of the important links.

There have been study papers published on the use of green supply chains in Vietnam; however, most of these publications are either general studies of all domestic sectors or in-depth studies of the fast-moving consumer products industry, which is not even considering the electronics business. This research was carried out in the Red River Delta and Southeast regions of Vietnam, which are the country's highest concentration of electronic manufacturing businesses and where many of them use the eco-industrial model to sustainability and the implementation of green industrial construction standards. Stemming from the above reasons, the research team decided to choose the topic "Determinants of the Level of Participation in Green Supply Chain Management: Case of Vietnamese Electronics Manufacturing Enterprises".

II. LITERATURE REVIEW AND RESEARCH MODEL

A. Literature Review

1) Green supply chain management:

According to Samir K. Srivastava, green supply chain management can simply be understood as the introduction of "green" ideas into traditional supply chain operations. That way, it is possible to coordinate the level of environmental impact except before and after the product is used. Zhu and Sarkis offer a different angle of this concept, they say that green supply chain management is about bringing "green factors" into the relationship of production and consumption of three important links, that is, customers, suppliers and manufacturers. Viewing from a more macro perspective, green supply chain management is a "closed circle" and has no end point of materials and products from inside to outside the manufacturing enterprise (Simpson and Power, 2005).

2) Green supply chain management in the electronics manufacturing industry in Vietnam:

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Many studies have suggested that participating in the supply chain gives electronics manufacturers the opportunity to increase productivity, promote creativity - innovation and save costs (Stadtler, 2007; Nguyen Dinh Tai, 2013; Ngoc & Trang, 2011). According to the General Statistics Office, in the period 2016-2020, Vietnam's electronics industry has made a remarkable development when it was at the early stage in the electronics production chain. Foreign direct investment projects are increasing, many high-tech manufacturing facilities in Vietnam are invested and built by many big-name electronics firms in the world such as Samsung, LG, Foxconn. However, some other environmental aspects are still overlooked in the integration process, for example the frequency and extent of environmental costs incurred by enterprises are often not mentioned and considered in the accounting system and cost calculation. Therefore, according to the trend of developing a green economy in the world, the application of green supply chain management is considered a new approach of many businesses to develop activities in a sustainable way and to create new competitiveness for businesses.

To effectively manage green supply chains in electronics manufacturing enterprises, Rao (2002) divided green supply chain management activities into two parts: Internal and external environmental management.

Firstly, internal environmental management focuses on internal support and corporate commitment to green supply chain management, compliance with applicable regulations and environmental management system within the organization (Zhu and Sarkis, 2004). In the practice of internal management, managers need to be provided with complete and accurate information to support management activities. Information exchanged between department heads and environmental managers has strategic significance for the operation of the business. Supply chain management reports are shared to all levels of business management, helping managers in different departments have a more comprehensive and accurate view. In addition, the development and production of a green product requires cooperation from many different fields, typically design, engineering, R&D, marketing, etc., thus cross-functional teams are often formed, includes members from many different professions to solve problems and improvement projects in a certain time.

Secondly, external environmental management involves "greening" the suppliers so that they join the business in achieving environmental goals (Bowen et al., 2001; Rao, 2002; Hamner, 2006). Observational practice shows that suppliers often do not provide exclusivity to a single customer, and the relationships between the end-product manufacturers, the component suppliers, and the raw material suppliers is still fragmented, lack of sustainable connections (Ho Le Nghia, 2011). In addition, the localization rate of products in the electronics industry is still low, only about 20%, mainly plastic packaging and components; therefore, this easily causes material shortage or substandard conditions (Nguyen and Mai, 2020).

External environmental management also includes partnering with customers, achieving environmental requirements, restructuring investments and applying eco-design (Rao and Holt, 2005) or improving green products (Chen et al., 2006). It is important to note that the main customers of electronic business are usually parent companies - large foreign-invested corporations. With the increasing and unstable demands of customers, enterprises face many difficulties in planning production. Currently, most Vietnamese electronic manufacturing enterprises are just trading water in terms of manufacturing parts, assembling and processing electronic components, making it difficult for them to improve and design environmentally friendly products. However, manufacturers in the green supply chain can still create environmentally friendly products using renewable energy systems and new technological equipment, greening its production apparatus.

B. Research Models

1) Dependent variables:

Internal environmental management system is a specifically planned and directed management activity conducted by an organization with structure, functions, responsibilities and resources to prevent adversely affecting on the environment, while maintaining and promoting environmental protection activities.

Green purchasing or "eco purchasing" is an action towards reducing harmful material to the environment and human health through the procurement of services, environmentally friendly products.

Eco Design is defined by Sim Van der Ryn and Stuart Cowan (2007) as "any form of design that minimizes the devastating impact of the environment by integrating itself with life processes."

Reverse Logistics is defined by Rogers and Tibben-Lembke as "Reverse logistics is the process of planning, implementing, and controlling the efficient flow of raw materials, semi-finished products and related information from the view of reverse logistics with the purposes of value restoration or otherwise proper disposal".

Investment recovery is the activity of recovering the value of unused assets by identifying and reusing or disposing of surplus assets.

2) Independent variables:

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Environmental regulations include domestic environmental regulations, government environmental policies, and international environmental agreements.

Supplier pressure, including pressure on quality, design, and price of products, prompts electronic manufacturing enterprises to find a management tool that helps bring high profits while ensuring environmental safety.

Buyer pressure is reflected in increasing customer demand for ecological products, thus all organizations must ensure sustainability in all stages of their product lifecycle (Nguyen et al., 2014; Do et al., 2020; Do and Luu, 2019).

Competitive pressure is reflected in the efficiency of competitiveness and production scale, depending on the learning process and the dynamism of the market in which enterprises participate.

Competitive pressure, which reflects in the efficiency of competitiveness and production scale, depend on the learning process of enterprises and the dynamism of the market.

Community pressure is reflected in the green trend as last consumers become more and more aware of the environmental impact of electronics products. Therefore, electronics manufacturers need to offer more “green” products to meet customer expectations.

Social responsibility from electronic manufacturers to customers in particular or society in general is legally obligated to perform social responsibility.

Strategic drivers towards economic efficiency: Environmental protection activities can have a positive impact on the economic performance of a company. GSCM can cut raw material purchasing costs and energy consumption, reduce waste disposal and treatment costs, and avoid penalties in the event of an environmental accident (Zhu and Sarkis, 2004).

Strategic drivers towards environmental performance: Most businesses have a clear awareness of environmental management practices, green procurement, and eco-design to avoid the consumption of hazardous materials, have factors harmful to humans and the environment, reducing emissions and waste into the environment (Duong Van Bay, 2019).

The strategic drivers towards operational efficiency: This will help improve the position and reputation of the business, increase the opportunity to sell products to the market through the production and supply of high-quality products in a short time (Melnick et al.; Zhu et al., 2008).

3) Mediating variables:

Managers' commitment is reflected in the fact that the owner or manager will find all directions to promote the benefits for the entire enterprise, not stop at personal interests. Through the internal and external influences of the enterprise, managers together with functional departments will make decisions about participating in green supply chain management.

4) Controlled variables:

Type of business: For each type of business such as foreign-invested enterprises (FDI) or state-invested enterprises, the perception of investment in applying “green” initiatives will take place in different levels. For state-owned enterprises, according to Ms. Nguyen Thi Tram (2016), every year, state agencies will promulgate a system of regulations on environmental treatment and protection activities, so that the enterprises under their state ownership will pursue environmental goals more rigorously. As for FDI enterprises, according to Nakamura (2001), foreign owners will not be interested in contributing much to that social security, so the investment in environmental protection will be limited to compliance with social regulations.

Size of business is expressed in the total fixed assets and number of employees of the company, it represents a part of the potential emissions of the business because the equipment and plants are the sources of direct impact on the environment. However, if businesses are aware of their responsibility towards the environment, large-scale enterprises will often commit to green initiatives more voluntarily, as they have more resources, and activities of large firms are often more closely monitored (Bowen, 2002).

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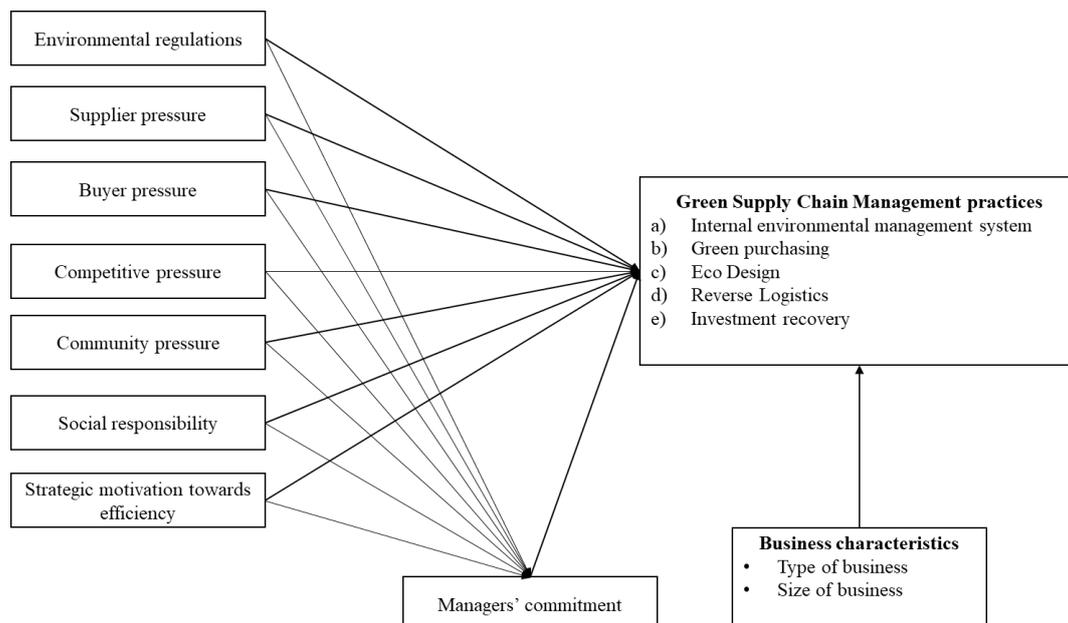


Figure 1. Research model of factors affecting the level of participation of electronic manufacturers in green supply chain management

III. METHODOLOGY

A. Qualitative research

To collect qualitative data, the team conducted a preliminary stage of document and information research, from which to make decisions and propose a research model that corresponds to the topic. From there, the research team adjusted the questionnaire appropriately.

In July 2021, the research team conducted in-depth interviews including an environmental expert and two senior employees of two electronic enterprises in the Red River Delta. The above subjects participated in interviews and discussions with the research team on the issue of building the complete scale, in which the authors adjusted, added, and removed variables used to measure the key drivers.

B. Quantitative research

The research team collect data from more than 500 survey answers related to the drivers affecting the participation in the green supply chain management of electronics manufacturing companies. Methods of analyzing the collected data include assessing the reliability of the scale by Cronbach's Alpha coefficient, testing the scale's value by exploratory factor analysis (EFA), assessing the suitability of research data with the theoretical model by confirmatory factor analysis (CFA). When the CFA analysis achieved good results, the authors analyzed the SEM and bootstrap linear structural models to determine the influence of each factor and test the hypothesis. Thereby, the group comes up with appropriate problem-solving strategies and recommendations.

C. Official scale

The authors developed a scale based on prior studies' theoretical models and qualitative research findings. Details of each observed variable of the scale are presented in Appendix 1.2 "The scale of factors affecting the level of participation of e-enterprises in green supply chain management".

IV. RESULT OF RESEARCH

A. Descriptive statistics of sample characteristics

The following are the results of the research survey: The research team sent survey questionnaires to 950 electronic manufacturing enterprises in the Red River Delta and Southeast regions such as Bac Ninh and Bac Giang, Ho Chi Minh City, etc., and obtained 544 standard results, which is larger than the minimum sample size of 365, thus it can be used as data, holding 57.2% of valid data. Regarding to the type of business, the survey showed that state-owned enterprises accounted for 2.6%, private enterprises accounted for 17.8% and FDI enterprises accounted for 79.6%. It is important to note that most of the surveyed enterprises are in the form of FDI enterprises.

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As for the size of business, statistics show that the number of enterprise employees under 100 accounted for 11.2%, from 100 to 500 accounted for 57.2%, those between 500 and 1000 accounted for 23.7%, from 1000 to 1500 accounted for 1.1%, 1500 to 2000 employees accounted for 1.3% and over 2000 people accounted for 5.5%. As a result, most businesses participating in the study are small and medium-sized, employing less than 1000 people.

B. Assess the reliability of the scale

The results of the overall Cronbach's Alpha reliability test of the variables are at a good level (greater than 0.7). As a result, the variables are proven to be trustworthy and compatible with the scale constructed.

Regarding the group of dependent variables, Cronbach's Alpha test reveals that all groups of observed variables are within the standard range with Corrected Item - Total Correlation greater than 0.3. However, three of the observed variables, HTQL2, MX5, and GVN4, had the lowest overall correlation coefficient in the group. After assessing the three observed factors' minor influence on the model and the improvement in the overall Cronbach's Alpha for the set of observed variables, the research team decided to eliminate these three observed variables.

For the group of independent variables, the majority of the observed variables attain the standard total correlation (higher than 0.3), except for the observed variable TNXH3. The research team excluded this observed variable because its total correlation coefficient only reaches 0.289, which is less than 0.3. Although the majority of the variables meet the total correlation requirement, the observed variables ALCT2 and HQHD5 show relatively poor results (lower than 0.4). Since the two variables indicated above have such a small impact on the overall model, the research team decided to eliminate them.

C. Scale value test through Exploratory Factor Analysis (EFA)

1) Scale value test in group of dependent variables:

EFA results show that, there are 2 factors extracted with a total variance explained of 68.150% (> 50%). The factors converge together on the same concept and form two new factors, shown in the following table:

Table I. Green Supply Chain Management Practices

| No | Symbol | Merge latent variable | Number of observed variables |
|----|--------|--------------------------|------------------------------|
| 1 | QLMT | Environmental Management | 10 |
| 2 | HSX | Post-production | 7 |

2) Scale value test in group of independent variables:

EFA results show that there are 6 factors converged with a total extraction variance of 71.607% (> 50%). The factors converge together on the same concept and form 6 representative drivers, shown in the following table:

Table II. Drivers Affecting The Level Of Participation In Green Supply Chain Management

| No | Symbol | Merge latent variable | Number of observed variables |
|----|--------|---|------------------------------|
| 1 | HQ | Strategic motivation towards efficiency | 12 |
| 2 | ALTT | Market pressure | 8 |
| 3 | NTXH | Social awareness | 5 |
| 4 | QDMT | Environmental regulations | 5 |
| 5 | NQL | Managers' commitment | 3 |
| 6 | ALCC | Supplier pressure | 3 |

D. Final research model and Research hypothesis

1) Final research model:

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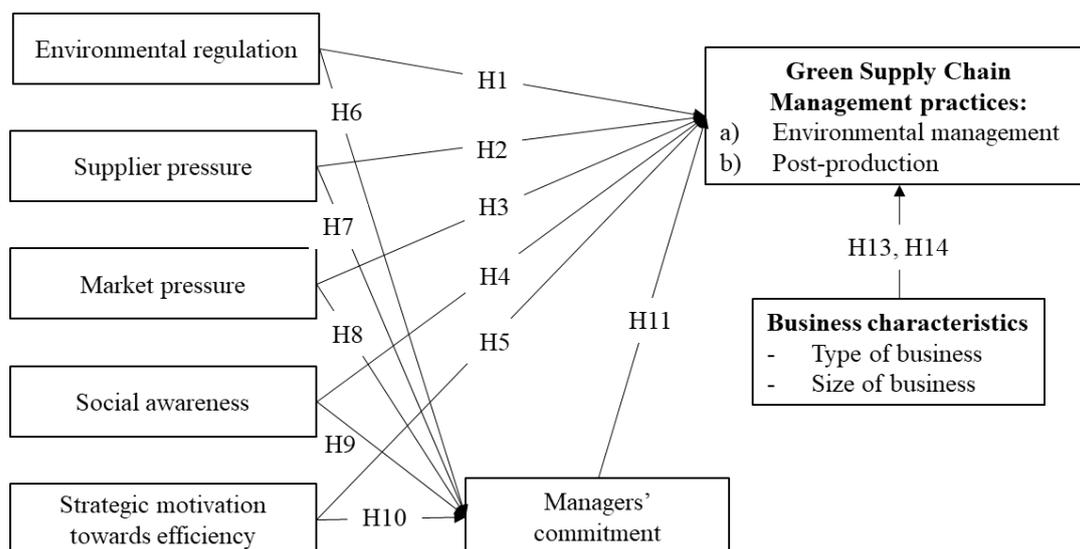


Figure 2. Final research model

2) Final research hypothesis:

Hypothetical group on external factors affecting green supply chain management

- Hypothesis H1: Environmental regulation has a positive influence on the participation of e-enterprises in (a) Environmental management, (b) Post-production.
- Hypothesis H2: Supplier pressure has a positive influence on the participation of e-enterprises in (a) Environmental management, (b) Post-production.
- Hypothesis H3: Market pressure has a positive influence on the participation of electronic enterprises in (a) Environmental management, (b) Post-production.
- Hypothesis H4: Social awareness has positive influence on the participation of e-enterprises in (a) Environmental management, (b) Post-production.

Hypothetical group on internal factors affecting green supply chain management

- Hypothesis H5: Strategic motivation towards efficiency has a positive influence on the participation of electronics enterprises in (a) Environmental management, (b) Post-production

Hypothetical group on mediating factors affecting green supply chain management

- Hypothesis H6: Environmental regulation has a positive effect on managers' commitment.
- Hypothesis H7: Supplier pressure has a positive effect on managers' commitment.
- Hypothesis H8: Market pressure has a positive effect on managers' commitment.
- Hypothesis H9: Social awareness has a positive effect on managers' commitment.
- Hypothesis H10: Strategic motivation towards efficiency has a positive effect on managers' commitment.
- Hypothesis H11: Managers' commitment positively affects the participation of e-enterprises in (a) Environmental management, (b) Post-production.
- Hypothesis H12.1: Environmental regulation can indirectly affect the participation of e-enterprises in (a) Environmental management, (b) Post-production in a positive manner through managers' commitment.
- Hypothesis H12.2: Supplier pressure can indirectly affect the participation of e-enterprises in (a) Environmental management, (b) Post-production in a positive manner through managers' commitment.
- Hypothesis H12.3: Market pressure can indirectly affect the participation of e-enterprises in (a) Environmental management, (b) Post-production in a positive manner through managers' commitment.
- Hypothesis H12.4: Social awareness can indirectly affect the participation of e-enterprises in (a) Environmental management, (b) Post-production in a positive manner through managers' commitment.
- Hypothesis H12.5: Strategic motivation towards efficiency can indirectly affect the participation of e-enterprises in (a) Environmental management, (b) Post-production in a positive manner through managers' commitment.

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Hypothetical group on the difference in green supply chain management according to electronics manufacturers characteristics

- Hypothesis H13: There are differences by type of business in terms of participation in (a) Environmental management, (b) Post-production.
- Hypothesis H14: There are difference by size of business in term of participation of enterprises in (a) Environmental Management, (b) Post-production.

E. Scale model fit test through Confirmatory Factor Analysis (CFA)

The CFA results for the critical model has 8 measured components: (i) Strategic driving force towards efficiency, (ii) Environmental management, (iii) Post-production, (iv) Market pressure, (v) Social awareness, (vi) Environmental regulation, (vii) Managers' commitment, (viii) Supplier pressure. The model fit index yielded good results such as CMIN/df = 2,906 (Chi-square/df \leq 5); GFI = 0.804 (Goodness of Fit Index \geq 0.8); CFI = 0.903 (Comparative Fit Index \geq 0.9); TLI = 0.894 (Tucker & Lewis Index \approx 0.9) and RMSEA = 0.059 (Root Mean Square Error Approximation \leq 0.08).

The results show that all observed variables in the factors are significant in the scale because Standardized Loading Estimates $>$ 0.5 and 8 measurement concepts all achieve a high level of confidence with Composite Reliability (CR) greater than 0.7. All Average Variance Extracted (AVE) values are greater than 0.5, which means that convergence validity is guaranteed. All Maximum Shared Variance (MSV) values are less than AVE, SQRTAVE (Square Root of AVE) values are greater than all of Inter-Construct Correlations. Therefore, the discriminant validity of the factors is guaranteed.

F. Structural Equation Modeling (SEM) analysis and hypothesis testing

1) Testing model fit:

The results of the analysis of the fit showed that CMIN/df = 2,997 (Chi-square/df \leq 5); GFI = 0.801 (Goodness of Fit Index \geq 0.8); CFI = 0.898 (Comparative Fit Index \approx 0.9); TLI = 0.889 (Tucker & Lewis Index \approx 0.9) and RMSEA = 0.061 (Root Mean Square Error Approximation \leq 0.08). Thus, the research model is considered to be suitable for the market data.

The results of hypothesis testing show that 8 research hypotheses are accepted with the direction of positive impact ($\beta > 0$). However, the estimated results also show that there are two variables with negative impacts on environmental management and post-production, which are supplier pressure and social awareness. Regarding indirect effects through the mediator Manager's commitment, the results show the value Sig. of all relationships are greater than 0.05 (significant level 5%). Therefore, there is no intermediate relationship from drivers to green supply chain management practices, thus rejecting hypothesis H12.

According to Levene and ANOVA test findings, all Sig. values of the control variables: type and size of business for the GSCM practices are less than 0.05. As a result, the H13 and H14 hypotheses are accepted.

Table III. Summary of official research results

| Hypothesis content | | Conclusion |
|--------------------|--|-----------------|
| Hypothesis H1 | H1a: Environmental regulation has a positive influence on environmental management | <i>Accepted</i> |
| | H1b: Environmental regulation has a positive influence on post-production | <i>Accepted</i> |
| Hypothesis H2 | H2a: Supplier pressure has a positive influence on environmental management | <i>Reversed</i> |
| Hypothesis H3 | H3a: Market pressure has a positive influence on environmental management | <i>Accepted</i> |
| | H3b: Post-production has a positive influence on market pressure | <i>Accepted</i> |
| Hypothesis H4 | H4b: Social awareness has a positive influence on post-production | <i>Reversed</i> |

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| | | |
|----------------|---|-----------------|
| Hypothesis H5 | H5a: The strategic drive towards efficiency has a positive influence on environmental management | <i>Accepted</i> |
| Hypothesis H7 | Supplier pressure has a positive effect on managers' commitment | <i>Accepted</i> |
| Hypothesis H8 | Market pressure has a positive effect on managers' commitment. | <i>Accepted</i> |
| Hypothesis H10 | Strategic motivation towards efficiency has a positive effect on managers' commitment. | <i>Accepted</i> |
| Hypothesis H13 | H13a: There are differences by type of business in terms of participation in environmental management | <i>Accepted</i> |
| | H13b: There are differences by type of business in terms of participation in post-production | <i>Accepted</i> |
| Hypothesis H14 | H14a: There are differences by size of business in terms of participation in environmental management | <i>Accepted</i> |
| | H14b: There are differences by size of business in terms of participation in post-production | <i>Accepted</i> |

V. CONCLUSION AND RECOMMENDATION

A. Conclusion

With the global trend of greening after witnessing the harmful effects of promoting a pure industry, making it green to the business itself is a step forward that helps not only each enterprise but the entire manufacturing industry in long-term and sustainable development. The green supply chain management model is one of the tools that fits that trend.

Firstly, the research team found that there is a difference in the level of participation in the green supply chain management in terms of two control variables that are Type and Size of business. For each type and size, manufacturers will participate in different levels depend on their own capabilities. Secondly, after testing, our group has found that the variable Supplier pressure will have a negative impact on Environmental management activities, while the group of Social awareness variables will have a negative impact on Post-production. This means that the more pressure from society and suppliers, the more we will straggle the participation of enterprises in the green supply chain management model. As for the group of variables Environmental regulations, Market pressure and Strategic motivation towards efficiency, there is an impact on environmental management and post-production, although there is a difference in the degree of influence. Therefore, the research team has made recommendations based on these groups of variables to promote participation in the green supply chain management model of enterprises.

B. Recommendation

1) For business:

Businesses need to simultaneously consider three aspects: economic development, the burden of finance on the environment, and social justice to create a balance between economic, environmental, and social benefits. The Vietnam Electronic Business Association (VEIA) should promote the role in mobilizing, propagating enterprises to apply environmentally friendly technologies and production processes, moreover, sharing and exchanging experiences in absorbing technology and international initiatives on green production should be considered. Additionally, improving technology level is a prerequisite for electronics manufacturers to participate and enhance their role in the global green supply chain. Lastly, with the limitations of scale and capital for green activities, enterprises themselves can take advantage of financial support as well as technology and management experience from the international community in the field of green business and green economy.

2) For the state:

Developing legal policies is one of the most important steps to create specific directions for big enterprises, most of which are FDI enterprises pouring capital in Vietnam, so that they have a direction and a green strategy to generate money. Furthermore, participating in a green supply chain management model will encourage the attraction of big electronic FDI enterprises that have

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implemented a green supply chain management model, allowing Vietnamese electronic manufacturing enterprises to participate in the parent company's supply chain as a factor, an important part in a whole chain, as in a production mold. Government should provide more green subsidies such as tax incentives, price support, loan support and direct subsidies, and because Vietnamese electronics manufacturing industry will get into a strong level of transition to the green economy. Lastly, governments should limit subsidies and spending in areas that deplete natural capital. Strengthening activities to promote propaganda for the consumption of green products by enterprises through separate programs and seminars as well.

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