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Determinants of the Intention of Green Innovation Implementation in the Logistics Industry: The Case of Logistics Service Providers in Vietnam

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ABSTRACT: The study identifies the factors relating to technology, organization and environment aspects influencing the intention of green innovation implementation in the logistics industry – the study with the logistics service providers (LSPs) in Vietnam. Out of the 182 questionnaires distributed in February 2021 to LSPs in Vietnam using mailing, 29 were excluded from analyses due to unsatisfactory responses, and 153 were used for statistical processing. Analysing through Smart-PLS tool, the study shows that the factors influencing the intention of green innovation implementation of LSPs (ranked descending order of importance) are organization encouragement, government's support, quality of human resources, accumulation technology, the explicitness of technology, and environmental uncertainty.

KEYWORDS: intention, green innovation, the green logistics industry, logistics service provider

I. INTRODUCTION

The concept of protecting the environment is increasingly concerned in recent years. Lots of governments have aimed to sustainably develop the economy by approving many regulations to preserve the environment (Taklo et al., 2020; Luo et al., 2023). The more economic achievements we get, the more direct impact on the environment causes climate change, global warming. Organizations in all sectors need to change new innovative ways to do their corporate social responsibility and companies have increasingly started to make significant efforts to establish green supply chain management initiatives (Kawai et al., 2018). Therefore, green innovation is regarded a crucial tool facilitating society, organizations to achieve environmental sustainability (Chu et al., 2019) and achieving economic performance (De Azevedo et al., 2019).

The logistics industry needs to quickly keep up with the green economy trend. In Vietnam, the logistics industry is believed to be a relatively new one. The Vietnamese logistics enterprises are still facing many challenges but have to well meet social and environmental issues. The logistics industry is facing up many problems: bad transportation infrastructure, air pollution, greenhouse gas emissions. Therefore, the LSPs in Vietnam should consider green innovation implementation as an important way of future sustainable development.

Hence, the paper answers the following research questions:

1. What is "green innovation"? Which elements affect the intention to implement green innovation in LSPs in Vietnam?
2. What is the important degree of each factor to the intention to adopt green innovation of LSPs in Vietnam?
3. Which solutions should the LSPs in Vietnam implement to keep up with green and sustainable development trends?

II. LITERATURE REVIEW AND CONCEPTUAL MODEL

A. Green logistics and innovation

Logistics and Green logistics

Logistics is defined to include integral activities such as transportation, storage, warehousing, material handling, order processing, inventory management…to save cost and bring satisfaction to customers (Karin, 2012). The development of logistics has an enormous impact on the environment in some ways because of the cost strategy and the expense of the environment. For example, when a company chooses to ship by air - the fastest mode of transportation, it means that the company will reduce the

costs of storage, but this transmits to the environment the amount of CO^2. Nowadays, due to the changing temperature of the earth, environmental matters have become important topics for the sustainable development of countries or companies. Thus, environmental matters have been taken into serious consideration in logistics systems: inbound logistics, outbound logistics, service contractors, material suppliers, distributors, end-users working together to reduce or eliminate the adverse impacts of their activities to environment (Chu et al., 2019). Moreover, LSPs' management is the outsourcing of logistics operations to a third party, to deliver products and services to customers more environmentally, LSPs need to address more efforts on the environmental issues (Wang et al., 2022).

"Green logistics" was first introduced in the late 1980s to illustrate the new model of a logistics system employing advanced facilities and technologies not only to reduces industries' negative environmental impacts, minimize damage to the environment during operation but also to increase companies' productivity. It enhances competitiveness through a process known as green differentiation (Chu et al., 2018). Scott (2011) describes green logistics in which activities in supply chain management of a company take into account environmental issues and integrate it into the supply chain to alter the environmental performance of suppliers and customers. The term logistics is related to green logistics in terms of cost, activities that are primarily motivated by environmental considerations. According to Su-Young, Woo-Sung, Gil-Am, and Seung-Gyun (2020) the term "green logistics" is supply chain management practices and strategies that aim to mitigate the environmental and energy issues of a freight distribution, which focuses on material handling, packaging, waste, and management transport. The eco-friendly logistics sector affects logistics functions and supply chains that include storage with resource savings, eco-friendly substitutes, transportation, delivery, recycling, a reduction of waste, and emissions.

In general, green logistics refers to all related partners in the logistics system, from inbound logistics to outbound logistics to consider how their actions affect the environment. Most activities are associated with managing the flows of goods, services, and information from origin to destination including transport, warehousing, other services such as labelling, customs clearance, forwarding, and packaging. It is expected that LSPs who coordinate all activities such as shipping, inland transportation, warehouse distribution, customs service…use of their supply chains in the most efficient way, minimize bad impacts towards the environment by taking innovative processes through green logistics.

Green innovation

Innovation is understood just as the use of new technical knowledge and administrative skill to offer a new product or service to customers. It is any practices new to organizations, including policies, projects, equipment, products, processes, and services (Chu et al., 2018).

"Green innovation" or "Eco-innovation" and can be defined as a process that honor the sustainability of nature. It helps to create new production and technologies with the purpose of reducing environmental risks, such as pollution and negative consequences of resource exploitation (Taklo et al., 2021). Furthermore, green innovation related to green products or processes like energy saving, pollution prevention, waste recycling, green product designing, or industry include consolidating shipments, disposing of waste responsibly, purchasing ecological products, reducing energy consumption, reducing solid/water waste and emissions, using cleaner transportation methods, and using recyclable packaging/containers (Chu et al., 2019). Green innovation is any green management practice that a 3PL provider engages in but had not previously. Examples include using fuel-efficient vehicles using environmentally friendly or recycled materials and adopting new environmental evaluation software among other endeavors (Chu et al., 2018)

A logistics company may adopt several green practices for responding to a variety of environmental issues at the same time.

B. Determinants of the intention to implement green innovation and conceptual model

Some articles have supposed the importance of the environment, some have introduced possible factors that may influence the adoption of environmental practices for companies (Taklo et al., 2021). There are not many studies about factors influencing the intention to implement green innovation of LSPs and no study for this theme has been carried out with LSPs in Vietnam.

Some studies about the determinants of adopting innovations showed that organizational success in terms of green innovation requires companies' knowledge about technology due to system characteristics and technological complexity (Dangelico, 2016), acceptation of corporate culture through exchange of knowledge, experience and skills among employees (Roy and Khastagir, 2016), demonstrating commitment by senior management (Burki and Dahlstrom, 2017), and practicing green corporate culture (Chu et al., 2019). Competitor pressure, customer's requirement along with employee behavior all had positive impacts on GI activities (Taklo et al., 2020). Nevertheless, implementation of these factors is facing some challenges such as inefficient government support or few environmental regulations into effect (Aguilera-Caracuel and Ortiz-de-Mandojana, 2013). Therefore,

the author group focus to investigate the intention to adopt green innovations from the following aspects: technology, organization, external environment

In terms of the technology aspect, Tsai and Ghoshal (1998) claim that an organization in which the knowledge can be intra-firm shared easily will have a higher innovative capability. That means the adoption of organizational innovation is influenced by the transferability of knowledge. It is easier to transfer or share technological knowledge with the higher explicitness. The study by Lin and Ho (2008) also shows that the explicitness of technology is one of the main factors. In addition to the explicitness of the technology, the cumulative nature of related knowledge will influence the adoption of technological innovations. An organization with rich experiences in the application or adoption of related technologies will have a higher ability in technological innovation (Lin & Ho, 2008). Luo et al. (2023) affirmed that the digital economy may take a vital part in improving green innovation. Thus, we propose the explicitness and accumulation of technology positively influence the adoption of green innovations.

In terms of the organizational aspects, cultures of organizations will drive the adoption of innovation (Chu et al., 2019). Internal factors such as the top management's leadership behavior, organizational encouragement for innovation, and their support to innovation may dramatically influence the development of organizational innovation (He and Jiang, 2019). The company's supports for employees using a particular technology will influence technical innovation. Due to providing incentives, ensuring the availability of financial, and technical resources for innovation (Lin, Ho, and Chiang, 2009). Cuerva et al. (2014), Lin and Ho (2008) posited that the quality of human cappital reinforces green innovative activities. In fact it exhibits a significant influence on the willingness to adopt green innovation. Lin, Ho, and Chiang (2009) claim that training and education help humans become more knowledgeable, apply green practices into their operation to protect the environment. Therefore, we propose that organizational encouragement and quality of human resources might influence the adoption of green innovations.

In terms of the external environmental aspect, the environmental factors in this study refer to the external environment in which a company conducts its business. Government support, government regulations are suggested by Huang et al. (2019). Government regulation can both encourage and discourage the adoption of green innovation. Ebrahimi and Mirbargkar (2017) also confirms that governmental support, environmental uncertainty such as consumer's pressure, rival's pressure (Zhang and Zhu, 2019) in green initiatives has a positive impact on the company's willingness to participate in the green supply chain because governments can provide financial incentives, pilot projects, and tax breaks to stimulate technological innovation for logistics companies. Thus, we expect that government support and environmental uncertainty have a positive influence on green practice adoption.

From the analysis of various literature mentioned above, this study proposes a conceptual model consisting of 6 factors on intention to adopt green innovation: Explicitness of technology, accumulation of technology, organization encouragement, quality of human resources, environmental uncertainty, and governmental support. The dependent factor is green innovations.

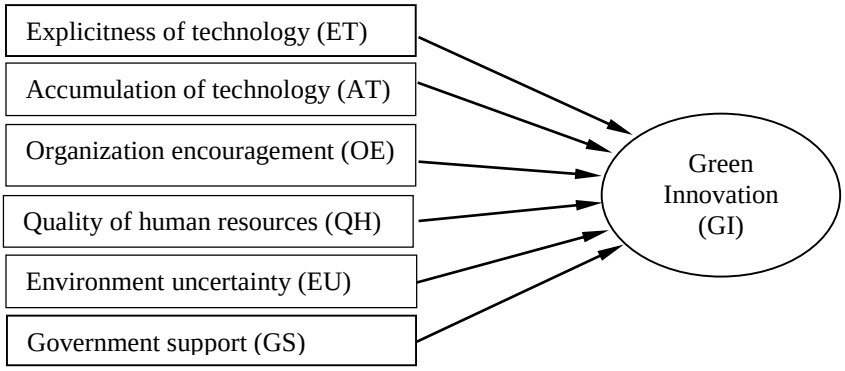

Fig. 1. The proposed conceptual model

- **The explicitness of technology (ET)**

The explicitness of technology relates to technological knowledge, learning capability of technology, and transferability or sharing of knowledge to others within a firm. It was measured according to the degrees that the technology can be transferred (Tsai and Ghoshal, 1998, Lin and Ho, 2008). The scale "ET" consists of 04 measurement items developed from the scale of Lin and Ho (2008).

The proposed hypothesis is:

H1: There is a positive relationship between Explicitness of technology and intention to adopt green innovation

in which

ET1: Books or other resources are available to apply in practice

ET2: Learning to apply from books is an easy way.

ET3: It does not take time to learn the practice

ET4: Understanding green practice is so easy

- **Accumulation of technology (AT)**

The accumulation of technology means the process of gradually increasing or getting more and more technology in terms of technical change and technological capability acquisition. Accumulation of technology was measured according to the degrees of fitness of related technologies a firm possessed (Lin and Ho, 2008).

The scale of "AT" consists of 03 measurement items as developed by Lin and Ho (2008). The developed hypothesis is:

H2: There is a positive relationship between the accumulation of technology and intention to adopt green innovation

in which

AT1: Using the related practices required lots of experiences

AT2: Much green knowledge in an organization have been executed

AT3: There is no difficulty in integrating the practice into the company's current system

- **Organization encouragement (OE)**

The organizational encouragements relate to the fact that management encourages risk-taking and new ideas about innovation, supports, and fairly evaluates new ideas, rewards and recognize creativity. It is relevant to companies' resource supports and leaders' attitudes towards green innovation. Encouragement from leaders may have affected to the implication of green innovation (Lin & Ho, 2010).

The scale "OE" consists of 04 measurement items measured according to Lin and Ho (2008, 2010). Hence, the proposed hypothesis is:

H3: There is a positive relationship between organization encouragement and intention to adopt green innovation

in which

OE1: Company's board of management motivates all employees to learn green information

OE2: Employees in the company get awarded from the leader

OE3: All staff in the company receive supports from the board of management to learn green logistics

OE4: Company's leaders help employees when they meet troubles

- **Quality of human resources (QH)**

The quality of human resources mentions the level of being trained, being educated about technology, and the sharing of ideas of staff in an organization. It is also the staff's innovation capabilities. The quality of the person working in a company may have affected the implication of green innovation (Lin & Ho, 2008). Base (2017) posits that a company with possession of human resources who are aware of environment, of green technology can generate the good environmental performance.

The scale "QH" consists of 04 measurement items developed from the studies of Scupola (2003); Lin and Ho (2008). The research proposes: of the company

H4: There is a positive relationship between the quality of human resource and intention to adopt green innovation

in which

QH1: Employees find it is easy to learn new technologies

QH2: Staffs in the company have a lot of ideas

QH3: Staffs' abilities learn how to use technology to think of solutions for trouble

QH4: Employee can share knowledge easily

- **Environment uncertainty (EU)**

The environmental uncertainty mentions the conditions happening to business which the board of management has to take action in compliance with the change of such conditions, such as customers' requirements, rivals' innovative abilities and environmental technology advance.

The scale "EU" consists of 4 measurement items adopted from the study by Zhu and Weyant (2003). The research proposes:

H5: There is a positive relationship between environmental uncertainty and intention to adopt green innovation

in which

EU1: The advance in new green logistics technologies is quickly

EU2: Competitors usually launch new logistics services

EU3: Customers' requirements become wider

EU4: Customers' requirement changes day by day

- **Governmental support (GS)**

Governmental support is defined as supports from the perspective of finance, technology, law, and human resources (Scupola, 2003). The government's law, regulation, tax incentives, tax breaks are all related to technology innovation. Governments through their regulation can both encourage and discourage the adoption of innovation.

The scale "GS" includes 04 measurement items developed from the scale of Scupola (2003); Lin and Ho (2008). So, the last hypothesis is:

H6: There is a positive relationship between government support and intention to adopt green innovation

in which

GS1: To develop green logistics practices always receive financial support from the government

GS2: Government usually encourage to provide logistics project for companies

GS3: Government give a hand in training green logistics' skills

GS4: Government launch the law relating to the logistics industry

- **Green Innovation (GI)**

The scale of green innovation includes 06 measurement items developed from the scale of Chu et al., (2019)

GI1: Waste disposal deriving from solid and hazardous;

GI2: Recycling materials

GI3: Reducing water and air pollution

GI4: Saving energy

GI5: Reducing consumption

GI6: Recycling used materials.

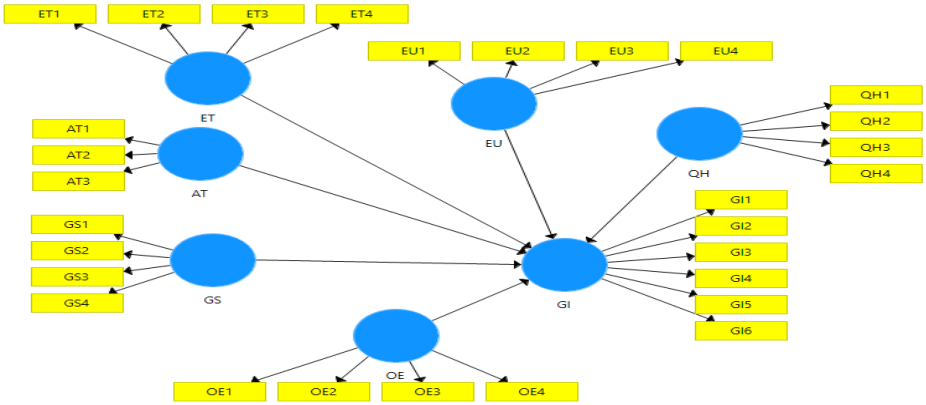

Fig. 2: The proposed conceptual model with the measurement items

III. RESEARCH METHODOLOGY

A. Measure of factors

The survey questionnaire is divided into 2 parts: Part 1 of measurement items measuring the factors, part 2 of the questions of the asked companies' size, capital and the number of employees. There are a total of 29 measurable items in the first part and using a five-point Likert scale (1: completely disagree, 5: completely agree) in which the explicitness of technology embraces 4, the accumulation of technology 3, the organizational encouragement 4, the quality of human resource 4, the environmental uncertainty 4, the governmental support 4, and 6 measurement items is for dependent factor - the intention of adopting green innovation.

B. Procedure and data collection

This study mainly uses qualitative methodology together with quantitative methodology.

The qualitative research methodology is performed with scholars, managers of LSPs. Since the measurement items were drawn from the literature in English, we carefully considered when translating into Vietnamese. Firstly, they are translated into Vietnamese by the first person. The Vietnamese version was then translated back into English by another logistics scholar. Next step, the translated English version was checked against the original English version to examine the discrepancy. In qualitative research, there is no requirement for a specific number of samples, but it depends on the saturation in the answers from asked people. Interviewing is conducted with 3 logistics scholars, 2 directors, and 3 managers of LSPs. After interviewing persons numbered 6 -8, all answers were saturated, there was no more change in answers from them. All agreed with the proposed factors

and measurement items of each factor. Based on the feedback from face-to-face discussions, we modified the wording in some questions to ensure that the measurement items were understandable and relevant to practices in Vietnam. Then, the finalized Vietnamese questionnaire for determinants of intention on adopting green innovations was given.

The quantitative research methodology is then used to evaluate the reliability of the measurement items of factors, test the suggested conceptual model, and the proposed hypotheses. Respondents are managers, deputy directors, directors of LSPs, and employees with more than 5-year experience of LSPs, which is clearly stated in the filter question in the questionnaire.

The questionnaire drafts were given to 30 respondents in the method of convenience sampling and snowball sampling through the online survey and they help to check how testers understand before the actual data collection, meeting the requirement about the number of samples for the preliminary quantitative survey (Stopher, 2012). The result of the preliminary quantitative survey shows that all measurement items meet the required standards to be used for an official survey.

The official questionnaires are released on both online surveys and offline surveys, also in the method of convenience sampling and snowball sampling. There are 182 questionnaires are collected and some of them are unusable. So, there are 153 acceptable responses in total to be used for the analysis. According to Hair, Hult, Ringle, and Sarstedt (2013), the minimum sample size should be 100 -150. The sample size must not be less than 5 times of measurement items. The study has 29 measurement items; therefore, a minimum sample size should be 5*29 = 145 and thus 153 responses are enough to conduct this study.

C. Statistical method

For this kind of research, SPSS or Smart PLS both are suitable. Finding that Smart PLS gives very attractive graphical outputs and more convenient, the author used Smart PLS version 3.0 tool. The two-stage approach was employed in PLS analysis, as proposed by Hair et al. (2013).

Stage one, the analysis of the measurement model evaluates reliability, convergent validity, and discriminant validity. In the step, factor loadings, composite reliability (CR), average variance extracted (AVE), cross-loadings are respectively analyzed. This step is to make sure of the reliability and validity of the measurement items before carrying out the structural model.

Stage two examines the structural model. First, examine the explanation level of factors for the model by a portion of variance explained. Next, check cross-validated redundancy and identify predictive relevance by blindfolding procedure. Then, the structural model is tested by nonparametric bootstrapping and only accept factors with sig value not above 0.05 from the analyzing result.

IV. RESULT

A. Measurement Model

Firstly, testing the reliability and convergent validity, discriminant validity of the constructs. Measuring internal reliability by Cronbach's alpha and Composite reliability (in CR column). The CR values of all factors are above 0.7. Thus, the reliability of each measurement item is satisfactory. In terms of convergent validity,the AVE of factors is all higher than 0.5, proving that degree of convergent validity is not violated, which means all factors are different.

Table 1. The Reliability and Convergent Validity, Discriminant Validity of the Constructs

Constructs	No. Items	Reliability		Convergent validity		Discriminant validity
		Cronbach's alpha	CR	Factor loadings	AVE	
Explicitness of technology (ET)	4	0.831	0.881	0.852 – 0.925	0.791	Not violated
Accumulation of technology (AT)	3	0.725	0.844	0.800 – 0.887	0.695	Not violated
Organization encouragement (OE)	4	0.837	0.884	0.716 – 0.871	0.665	Not violated
Quality of human resources (QH)	4	0.891	0.917	0.749 – 0.883	0.670	Not violated
Environment uncertainty (EU)	4	0.867	0.902	0.791 – 0.895	0.742	Not violated
Governmental support (GS)	4	0.880	0.915	0.770 – 0.856	0.663	Not violated

Green Innovations (GI)	6	0.801	0.871	0.731 – 0.824	0.611	Not violated

Next, testing discriminant validity of the constructs or the factors. Firstly, examning the cross-loadings of the factors. The result is that no loads higher on opposing factors. Secondly, examining the square root of AVE (Fornell and Larcker). The result is that the square root of each factor is higher than that of the construct in inter correlations with the other constructs. Diagonals **(in bold**) of table 2 below represent the square root of the AVE. Therefore, the model can confirm that the discriminant validity of all factors is not violated.

Table 2. Discriminant Validity Coefficients

	ET	AT	OE	QH	EU	GS	GI
ET	**0.813**						
AT	0.507	**0.806**					
OE	0.426	0.437	**0.840**				
QH	0.494	0.695	0.507	**0.864**			
EU	0.459	0.577	0.342	0.567	**0.784**		
GS	0.446	0.577	0.359	0.500	0.581	**0.797**	
GI	0.614	0.559	0.544	0.473	0.413	0.373	**0.778**

Diagonals **(in bold)** represent the square root of the AVE

B. Structural Model

After the results of the measurement model are satisfactory, there is a need to assess the structural model, check the model fit, and the proposed hypotheses.

Firstly, examine Multi-collinearity by collinearity statistics (VIF). VIF of all measurement items are less than 5, except for EU3. Therefore, there is an appearance of multi-collinearity on the proposed structural model and thus EU3 must be deleted from the model.

Secondly, examine the p-value and the relationships of factors in the structural model. The relationships of factors are shown by the Path coefficient. Nonparametric bootstrapping is run with 1000 replications to examine the structural model. The finding gives support for all 6 hypotheses (see Table 3) because all have a sig value < 0.05, so they are all statistically significant.

Table 3. Path Coefficient and Hypothesis Testing

	Path Coefficient	Significance Levels	P Values	Level of Effect
ET -> GI	0.133	P<0.05	0.041	Yes
AT -> GI	0.140	P<0.05	0.022	Yes
OE -> GI	0.284	P<0.05	0.001	Yes
QH -> GI	0.190	P<0.05	0.039	Yes
EU -> GI	0.114	P<0.05	0.035	Yes
GS -> GI	0.276	P<0.05	0.006	Yes

In sum, the analyzed results confirm the hypotheses suggested in the previous conceptual model (Figure 3). The results indicate that all six factors influence the adopting of green innovations of LSPs with the coefficients as below:

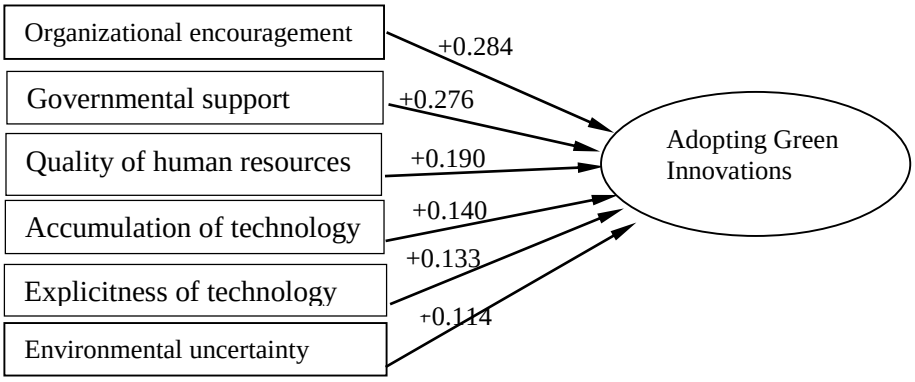

Figure 3. The adjusted conceptual model

Thirdly, examine R^2 and R^2 adjust. The finding indicates that all suggested factors can explain a 69.4% model of adopting green innovations. Other factors are influencing the adopting of green innovations of LSPs but have not yet found in this conceptual model.

Table 4. R^2 and R^2 adjust

	R^2	R^2 adjust
GI	0.722	0.694

V. CONCLUSION

In conclusion, all the proposed factors (ranked in descending order of importance) including the organization's encouragement, the governmental support, the quality of human resources, the accumulation of technology, the explicitness of technology, and environmental uncertainty have positive influences on the intention to adopt green innovation.

The results of this study have a similarity to those of previous researches. For examples the influence of the explicitness of technology is also supported by Tsai and Ghoshal (1998), Lin and Ho (2008); the influence of the accumulation of technology is affirmed by Li and Ho (2008); the influence of the organization encouragement is asserted by Li and Ho (2010); the influence of the quality of human resources is also declared by Li and Ho (2008, 2010); The governmental support is same as Scupola (2003), Environmental uncertainty is supported by Li and Ho (2008), Zhu and Weyant (2003)

From the discussion with the same surveyed participants in qualitative research, they all have agreed that the result of this study is suitable for today's practices in Vietnam. Thus, from the result of this study, the authors would like to propose some administrative suggestions to increase the adoption of Vietnam LSP's for green logistics.

To begin with, the research shows the organization's encouragement was the most influential. LSPs need to raise awareness of environmental protection. Organization encouragement, especially the board of management, can motivate the employees to make green innovation.

The logistics companies must encourage their employees to environmental activities. They should consider environmental issues as a part of their development strategies. In the short term, they need to invest in technology, vehicles and they have to accept the less profit. They need to consider long- term profit and balance three factors including environment, society, and economy. For example, they can save electricity usage by using solar energy or measure carbon footprint. Moreover, they need to support their employees so that environmental activities are popular in the company. To do that, they make some training about environmental-related knowledge and encourage the employees to learn green information. Besides, the accumulation of technology is a factor that affects the intention to do green innovation implementation. When they are interested in environmental activities, they will be ready to adopt green innovation.

Secondly, governmental support is the second most significant impact on the intention of green innovation implementation in the logistics industry. Governmental support provides motivation and guide to LSPs to make green innovation. The government provides financial incentives by subsidizing greener freight modes or reducing the duty for alternative fuels. For companies that use solar power or leading the way in green products, the government may offer a bank to decrease the interest rate to help businesses or apply fewer tariffs. Also, to encourage the logistics companies to catch up with the green and sustainable development trend, the government needs to approve more regulations relating to vehicle emissions, eco-green fuels and have a

transparent policy to encourage the LSPs. Through the logistics association, the government could give a hand in training the green logistics' skills and experiences.

Thirdly, logistics companies need to focus on the quality of the human resources factor. The results of this study showed the quality of human resources was the third significant impact on the intention of green innovation implementation in the logistics industry. High- quality human resources mean the employees can learn and apply new clean technologies in adopting green practices. The employees have lots of ideas and share knowledge easily. They also can solve the green troubles in logistics. Through headhunter companies, logistics companies will recruit experts which can provide new ideas in green implementation for companies. Besides, their current best staff can go abroad to update the tendency in green logistics innovation. Especially, companies have to make a good and friendly working environment so that the employees' trust leaders and colleagues, are ready to share knowledge.

Finally, LSPs have to care about the environmental uncertainty factor. Business environment concerns about many parties: the customers, the competitors. The customer's requirements change day by day and become wider. LSPs need to catch up with the requirements, minimize the cost as well as preserve the environment by establishing transparent service, and maximize logistics efficiency.

VI. LIMITATION

According to Spencer (2003), Lin and Ho (2009), company history and size might influence the adoption of technological innovation. Therefore, some researches in the future should test the different relationship between these key determinants and intention on adopting green innovations of LSPs according to company size, company capital, and the number of employees. Also, the 6 mentioned factors only account for 69.4% of the intention to adopt green innovations of LSPs in Vietnam, further research should consider more factors.

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