Analyze the key factors promoting the development of green logistics: An empirical investigation in Vietnam

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Abstract:

The development of green logistics will surely help logistics or transport activities to become environmentally friendly. Hence, this study aims to analyze the key factors promoting the development of green logistics in Vietnam. Based on data collected from 437 logistics enterprises in the five centrally-governed cities of Vietnam, the study used data analysis methods containing descriptive statistics, Cronbach's Alpha test, exploratory factor analysis, and multiple linear regression to test the framework. The research results reveal that the factor of "politics" has the highest positive impact on developing green logistics whereas the factor "corporate" has the lowest positive impact on one. Our findings put forward several theoretical and practical implications for the Government, policy planners, and logistics enterprises to underline the crucial factors promoting the development of green logistics in Vietnam. There are solutions suggested to enhance the level of green logistics development in Vietnam in 2030.

Keywords: develop, green logistics, key factor, Vietnam

1. Introduction

The rapid development of the economy and climate change hurts the living environment of people across the globe. Logistics is vital to the economy and daily life of countries, but it is one of the cardinal factors of environmental pollution (Ibrahim et al., 2018). The logistics sector is facing increasingly stringent environmental requirements because the development of freight services has a terrible impact on traffic congestion, safety, and environmental pollution. Besides, demand for more sustainable logistics services is growing in other countries.

Liu and Shi (2007) stated that green logistics is very useful in promoting the industry's sustainable development adopted from the circular economy theory. Green logistics is a component of both symbiotic economies with environmental and adaptive economic growth, which plays a crucial role in the green economic development strategy of the country (Qu et al., 2017). The appearance of green logistics aims to apply new technologies and use clean fuels to reduce emissions and noise. Moreover, green logistics helps enterprises ensure long-term economic performance, limit the impact on the ecosystem, create breakthroughs in global environmental protection, and create the foundation for sustainable development.

In fact, the Vietnamese logistics sector is causing terrible environmental pollution by using fossil fuels. Additionally, Vietnam is one of the emerging economy, so the awareness of logistics enterprises about environmental risks is scant. Furthermore, the characteristics of logistics enterprises are small and medium-sized, so the application of green technology faces many difficulties. Therefore, the logistics sector of Vietnam is evaluated to be at a time when it is necessary to have a breakthrough for fast and sustainable growth.

The domestic study of Le (2013) analyzed the issues of green logistics. Besides, the work by Vuong (2017) looked at the base criteria for evaluating the development of green logistics at logistics enterprises in Vietnam. Although the above studies have discovered green logistics, the similarities do not come from the point of view related to analyzing the key factors promoting the development of green logistics. Thus, with the above situation and the research gap, this study aims to analyze the key factors encouraging the development of green logistics has theoretical and practical significance to help the Government, policy planners, and logistics enterprises understand the benefits of green logistics to the stable and sustainable development of the national economy as well as look for solutions to developing green logistics in Vietnam in the coming time.

2. Theoretical background and hypothesis

2.1. Theoretical background

2.1.1. Logistics

"Logistics is part of the supply chain management that plans, implements, and controls the performance, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption to meet customers' requirements" (Council of Logistics Management, 1988).

Doan (2010) defined logistics as optimizing location and time process, transporting and storing resources from the first point of the supply chain through production and distribution to the final consumer through economic activities.

Although there are different views, in this study, logistics is defined under the Vietnam Commercial Law 2005. Accordingly, logistics is a commercial activity in which traders organize one or more stages containing receiving goods, transporting, storing, customs clearance, making other documents, consulting customers, packing, marking, delivery, or other services related to the merchandise as agreed with the customer to receive the compensation.

2.1.2. Green logistics

Green logistics demonstrates the characteristics of the logistics system with the use of modern technologies and means to minimize the harm caused to the environment during the

operation process but still increase the use of resources in the system (Roger & Tibben-Lembke, 1998; Yanbo & Songxian, 2008).

Green logistics are activities related to the management process of the two-way flow of goods and information from the starting point to the endpoint in the supply chain to bring efficiency and minimize harm environment, as well as fully satisfied human needs. The green logistics aim is to transport and deliver goods, raw materials, and other physical resources at the lowest cost while providing the highest quality and minimizing the inverse impact on the environment during all processes (Carter & Rogers, 2008).

Ittmann (2011) put forward that green logistics are efforts to control how to minimize external factors and achieve a sustainable balance between the three main pillars: economic, social, and environmental. Green logistics is also described as supply chain management activities and implemented plans to minimize environmental and energy impacts of goods distribution, focusing on handling materials, waste management, packaging, and transportation (Rodrigue, Slack, & Claude, 2001).

In closing, green logistics focuses on combining the goal of protecting environmental resources into the system of common goals of the business and balancing the value chain to provide customers with core values. In simpler terms, it brings harmony between economic, social, and environmental benefits.

2.2. Hypothesis

In essence, green logistics is the coordination of traditional logistics and green technology. The study of Schmied (2010) indicated that four factors (company, customers, politics, and society) have a heavy impact on developing green logistics. In a research review by Evangelista, Santoro, and Thomas (2018), five crucial factors for developing green logistics are technology, financial and corporate, consumers, and government agencies. Motowidlak (2019) believed that the development of green logistics is influenced by two groups of external and internal factors. Internal factors related to organizational culture, quality of human resources, and corporate social responsibility. External factors related to customer expectations, stakeholder relations, legal pressure, and support from management agencies.

Based on the theoretical basis and empirical investigation of the authors, the key factors promoting the development of green logistics in Vietnam contains (1) politics, (2) cost-effectiveness, (3) green education, (4) green technology innovations, (5) competitors, (6) green infrastructure, (7) corporate, (8) customers.

Politics has a crucial impact on the development of green logistics (Schmied, 2010). Institutional, regulatory, and legal factors and Government support policies are the main driving force for the environmental efforts of logistics enterprises (Zhu, Sarkis, & Geng, 2005). Sudarto et al. (2016) pointed out that freight policies are significantly effective in the economic efficiency of green logistics. The heavy tax on carbon materials is beneficial for developing

green logistics (Klumpp, 2016). In addition, Government support policies are an effective model that positively impacts greening the logistics market process (Ren et al., 2019). Thus, the stability of politics and Government support policies will make logistics enterprises change their traditional thinking using old and outdated technologies and solutions to apply new technologies toward green development, protecting the environment and social community. It will create an advantage in the operation of the logistics sector. Therefore, the first hypothesis proposed in the study is:

H1: Politics has a positive impact on developing green logistics.

According to Isaksson, Johansson, and Fischer (2010), cost-effectiveness is one of the internal drivers affecting the green initiatives of logistics service providers. Cost-effectiveness is the efficiency between productivity compared to inputs. If the system with production costs per input unit is low, it will be more cost-effective than another system. Beškovnik and Jakomin (2010) stated that implementing green logistics is more cost-effective than traditional logistics. And so, cost-effectiveness is an essential factor in promoting green logistics development. The second hypothesis proposed in the study is:

H2: Cost-effectiveness has a positive impact on developing green logistics.

Green education will significantly enhance community attitudes and behavior toward green logistics (Chen, Dong, & Ren, 2017). Environmental or green education is a process that allows individuals to explore environmental problems and take action to protect the environment (EPA, 2020). As a result, individuals will increase their awareness of green logistics and acquire skills and abilities to make informed and responsible decisions after receiving green knowledge. Thus, green education is a crucial factor in promoting the development of green logistics. The third hypothesis proposed in the study is:

H3: Green education has a positive impact on developing green logistics.

The development of green logistics benefits significantly from green technological innovations (Ren et al., 2019). Technological innovations in green materials and clean energy reduce waste pollution and greenhouse gas emissions in logistics operations (Wang et al., 2018). Furthermore, the innovation of modern information technology significantly reduces redundant logistics activities, improves logistics performance, and promotes the development of green logistics. So, green technology innovations are a crucial factor influencing green logistics development. The fourth hypothesis proposed in the study is:

H4: Green technology innovations have a positive impact on developing green logistics.

Denisa and Zdenka (2015) carried out a study on 250 small and medium enterprises in Slovakia. And they confirmed that competitor is one of the stakeholders who directly affect the development of green logistics. Competitors can push enterprises to implement green logistics as a way for corporations to improve their competitiveness. Enterprises can also continuously

improve by measuring green criteria compared to competitors and adjusting their business operations (Sanchez-Rodrigues, 2006). Competition may intensify, especially with the emergence of new competitors due to trade deregulation, brand expansion, and globalization. Therefore, enterprises must offer a unique product, for instance, a green service that is different from the competitors. The fifth hypothesis proposed in the study is:

H5: Competitors have a positive impact on developing green logistics.

Green infrastructure is a solid foundation for developing green logistics in the country (Zhang et al., 2020). Building urban consolidation centers, intelligent transportation systems, shipment tracking systems, intelligent inventory routing planning systems, power lines, and packaging benchmarking systems will reduce carbon emissions and optimize the transport structure (Ahani, Arantes, & Melo, 2016). Hence, green infrastructure development significantly improves the efficiency of logistics operations and creates a revolution in the green logistics sector. The sixth hypothesis proposed in the study is:

H6: Green infrastructure has a positive impact on developing green logistics.

Logistics enterprises are the main actors in implementing any greening plan internally. If corporations are positive efforts in greening, they will implement green logistics development (Schmied, 2010). An empirical study by Hu and Hsu (2006) demonstrated that the most crucial factor for the success of green logistics is the support of business leadership. It shows that it is critical to have leadership support for green practices to be successfully adopted and implemented. Green logistics is a core approach to the business environment of enterprises to help improve the entire logistics system and promote a green society. Hence, corporate is the central factor for sustainable development approaches and is the direct object of green logistics. And so, the seventh hypothesis proposed in the study is:

H7: Corporate has a positive impact on developing green logistics.

The green demand of customers is a crucial factor in promoting the development of green logistics (Gu et al., 2015). With the environmental awareness of customers, the demand for green logistics in the market began to appear. In a green market, the benefit of logistics enterprises is from selling their products or services to customers in a green direction (Ottman, 1999). To meet the green demands of customers, enterprises involved in logistics activities must make changes to face threats that encourage green logistics development. On the contrary, if there is no green demand in the market, enterprises will not have the motivation to develop green logistics. So, the eighth hypothesis proposed in the study is:

H8: Customers have a positive impact on developing green logistics.

Thus, the conceptual model of this research can be illustrated as presented in Figure 1:

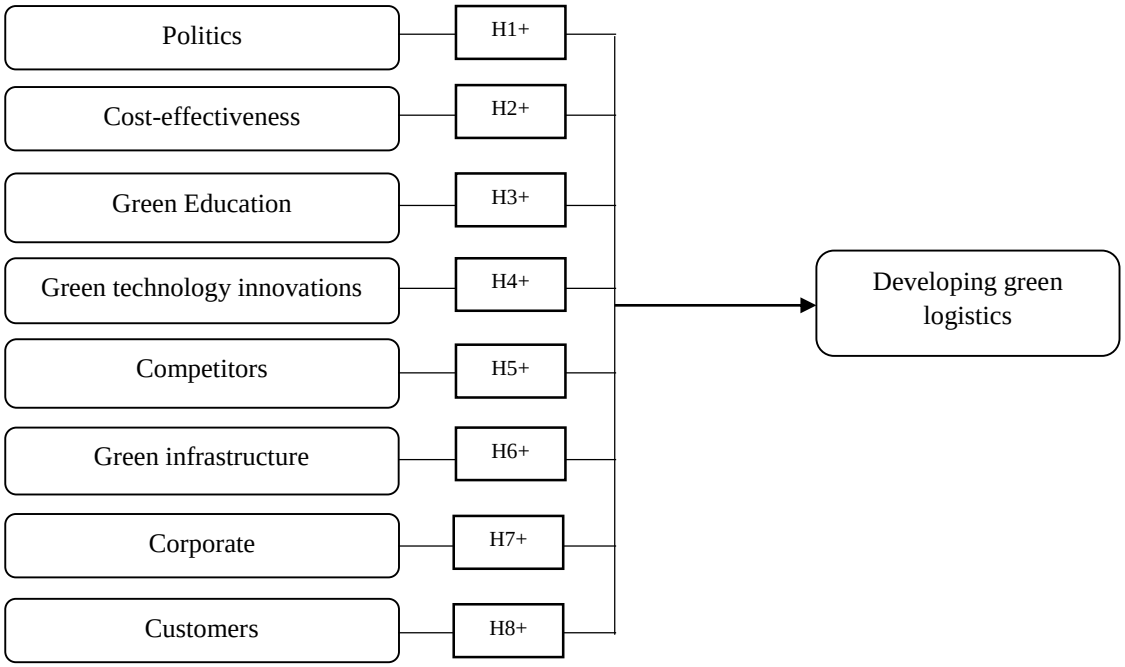

Figure 1: Research Model

Source: Proposed by the authors, 2022

The Multiple Linear Regression can be represented by the following matrix notation:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_8 X_8$$

Where:

Y (dependent variable): developing green logistics

X_i (independent variable): X_1 (Politics), X_2 (Cost-effectiveness), X_3 (Green education), X_4 (Green technology innovations), X_5 (Competitors), X_6 (Green infrastructure), X_7 (Corporate), X_8 (Customers)

The regression coefficient (β_k) with k = 0, 1, 2,…, 8.

3. Research methods

3.1. Scale design

The scale of factors in the proposed research model inherited from foreign studies is shown in Table 1:

Table 1: The scale of factors

No.	Construct	Sign	Adopted from
1	Politics	Pol	Li et al. (2021)
2	Cost-effectiveness	Cos	Self-developed
3	Green education	GE	Chen et al. (2017)

4	Green technology innovations	GTI	Ren et al. (2020)
5	Competitors	Com	Self-developed
6	Green infrastructure	GI	Zhang et al. (2020)
7	Corporate	Cor	Motowidlak (2019)
8	Customers	Cus	Motowidlak (2019)
9	Developing green logistics	DGL	Self-developed

Source: Summary and research of the authors, 2022

To ensure the content validity of the research scale, the authors carried out qualitative research through semi-structured in-depth interviews with the targeted sampling method. The study conducted in-depth interviews with ten experts divided into two groups. In which, group 1 includes five logistics experts, and group 2 contains five logistics business managers to receive comments on the content of factors in the proposed research model. The interview questions used are open-ended questions in the original scale to serve as a basis for developing the questionnaire. Since the COVID-19 pandemic, the in-depth interviews were executed online on MS Teams from January 15th to January 31st, 2022, and recorded in 20 minutes. The authors used Nvivo 11 software to store, encode and analyze qualitative data.

The results obtained through in-depth interviews are good, which is proven through 100% of the experts participating in the interview agree with the factors in the proposed research model. This study used a 5-point Likert scale (1 = very little motivating, 2 = little motivating, 3 = medium, 4 = motivating, 5 = very motivating)

3.2. Sample and Data collection

Vietnam Logistics Report in 2019 pointed out that five centrally-governed cities (Hanoi, Hai Phong, Da Nang, Ho Chi Minh City, and Can Tho) have the fastest growth rates and the highest logistics development advantages in the country. And so, this study selects a survey in 5 localities above. The total number of logistics enterprises operating at the research sites as of the end of 2019 is about 2,856 enterprises (Ministry of Industry and Trade, 2019). Therefore, the sample size will calculate by Slovin's (1984) formula (cited by Vo, 2010) as follows:

$$n = N : (1 + e^2N) = 2856 : (1 + 0.05^2 * 2856) = 350 \text{ (enterprises)}$$

Where:
- n: standard sample size
- N: overall scale
- e: errors allowed (0.05)

To avoid the low probability of a vote recovery, the authors will take the sample size of 475 observations (expect a sample loss of about 30%). This study used a convenient sampling method. The authors divided the survey equally among five cities as 475 : 5 = 95 enterprises per city. The authors divide equally among five cities to show a fair assessment of the

opportunities for green logistics development among those cities. The survey period is from March 1st to March 31st, 2022. The survey forms were sent in three ways: face-to-face meetings (23%), telephone interviews (32%), and email (45%).

After cleaning the data, the study collected 437 valid answer sheets with a return rate of 92%. Among 437 logistics enterprises participating in the survey, private enterprises accounted for 89.5%. The majority of enterprises with several employees from 51 to more than 100 people (64.5%) with operating time from five years to more than ten years accounted for 73.7% (see Figure 2). The characteristics of the survey sample are consistent with the situation of the logistics sector in Vietnam. The enterprise is small-sized with a limited number of employees, and operating time is not long compared to other countries.

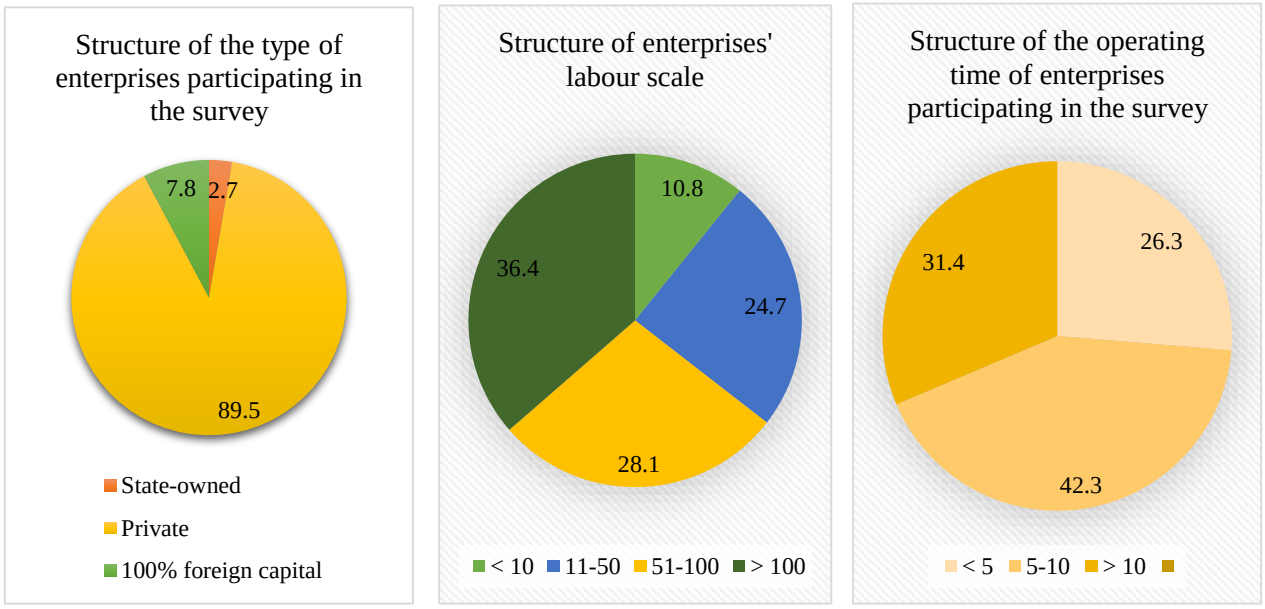

Figure 2: Sample characteristics

Source: Authors analyze, 2024

4. Findings and Discussion

4.1. Reliability and Validity test

The results of Cronbach's Alpha of the full measurement model indicated that the latent variable "Green infrastructure" has the lowest value of 0.785, while the latent variable "Green technology innovations" has the highest value of 0.835. Compared with standard 0.6, all observed items of the scale are internally consistent. The corrected item-total correlation coefficient is higher than 0.3. All scales achieve two reliability and discriminant validity. Hence, the scale is good and meets the reliable requirement for exploratory factor analysis (Nunnally & Bernstein, 1994).

The EFA of independent variables obtained results with the coefficient KMO = 0.808, Bartlett Test is statistically significant with Sig. = 0.000 (< 0.05), and eight factors were

extracted with Eigenvalue = 1.355, Sums of Squared Loadings = 81.03% (higher than 50%). And the above eight factors can explain about 81.03% of the data variation and 18.97% of the observed variables can not explain the data (Hair et al., 1998). Moreover, the results of EFA of a dependent variable have a factor loading higher than 0.5. The coefficient KMO = 0.612 (0.5 < KMO < 1) and Bartlett Test is statistically significant with Sig. = 0.000 (< 0.05), Eigenvalue = 2.321 (>1), Sums of Squared Loadings = 81.55% (higher than 50%).

On the whole, nine factors in the full measurement model were extracted to meet the requirement of convergent validity and discriminant validity (Hair et al., 2010).

4.2. The Multiple Linear Regression

The results of correlation analysis in Table 2 show that eight independent variables are correlated with the dependent variable. In which, the latent variable "Politics" has the highest correlation (r = 0.541), meanwhile the latent variable "Corporate" has the lowest correlation (r = 0.432) with the statistically significant at 99%. Thus, eight independent variables are qualified for the regression model to explain the dependent variable.

Table 2: The results of correlation analysis

Construct	**DGL**	**Pol**	**Cos**	**GE**	**GTI**	**Com**	**GI**	**Cor**	**Cus**
DGL	1								
Pol	0.541**	1							
Cos	0.520**	0.542**	1						
GE	0.511**	0.442**	0.443**	1					
GTI	0.540**	0.247**	0.590**	0.449**	1				
Com	0.487**	0.476**	0.421**	0.563**	0.466**	1			
GI	0.452**	0.452**	0.233**	0.214**	0.442**	0.426**	1		
Cor	0.432**	0.423**	0.324**	0.345**	0.421**	0.367**	0.423**	1	
Cus	0.523**	0.542**	0.421**	0.213**	0.355**	0.420**	0.231**	0.324**	1
**. Correlation is significant at the 0.01 level (2-tailed).									

Source: Authors analyze, 2024

The study carried out a regression analysis of 8 independent factors and a dependent variable by the Enter method. The analysis results showed the research model is consistent with the Sig. < 0.05. The R Square coefficient = 0.551 and the Adjusted R Square coefficient = 0.546 indicated that 54.6% of the data variation is explained by eight factors promoting the development of green logistics in Vietnam (see Table 3).

Table 3: Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.701[a]	0.551	0.546	0.33453	1.842
a. Predictors: (Constant), Pol, Cos, GE, GTI, Com, GI, Cor, Cus b. Dependent variable: DGL					

Source: Authors analyze, 2024

The results of ANOVA analysis and F-test with Sig. = 0.000 (< 0.05). The sum of squares of the regression (55.413) is higher than the sum of squares of the residuals (39.421), showing that the model explains most of the variance of the dependent variable. It means, the multiple linear regression is consistent with the research data. Thus, eight independent variables are related to the dependent variable (see Table 4).

Table 4: ANOVA test of the research model

ANOVA[a]						
Model		Sum of squares	df	Mean square	F	Sig.
1	Regression	55.413	8	9.213	56.421	0.000[b]
	Residual	39.421	429	0.246		
	Total	94.834	437			
a. Dependent variable: DGL b. Predictors: (Constant), Pol, Cos, GE, GTI, Com, GI, Cor, Cus						

Source: Authors analyze, 2024

The regression results in Table 5 indicated eight factors affecting the development of green logistics in Vietnam. In which, politics has the highest positive impact on developing green logistics with the standardised estimate of 0.481, followed by green technology innovations (β_4 = 0.421), customers (β_8 = 0.417), cost-effectiveness (β_2 = 0.387), green education (β_3 = 0.368), competitors (β_5 = 0.356), green infrastructure (β_6 = 0.333) and the lowest positive impact on one is corporate with a standardised estimate of 0.221. The results are similar to the studies of Schmied (2010), Evangelista, Santoro, and Thomas (2018), Motowidlak (2019). Consequently, hypotheses H1, H2, H3, H4, H5, H6, H7, and H8 are supported, and statistically significant coefficients are lower than 0.05. Additionally, the variance inflation factors (VIF) of the independent variables are lower than 10, so there is no

collinearity between them. The Multiple Linear Regression model is based on standardised coefficients as follows:

DGL = 0.481Pol + 0.387Cos + 0.368GE + 0.421GTI + 0.356Com + 0.333GI + 0.221Cor + 0.417Cus

Table 5: The results of regression analysis

Coefficients[a]								
Model		**Unstandardised Coefficients**		**Standardised Coefficients**	**t**	**Sig.**	**Collinearity Statistics**	
		B	**Std. Error**	**Beta**			**Tolerance**	**VIF**
1	(Constant)	0.414	0.129		3.199	0.002		
	Pol	0.069	0.027	0.481	2.534	0.012	0.693	1.442
	Cos	0.100	0.028	0.387	9.596	0.000	0.604	1.420
	GE	0.163	0.028	0.368	5.912	0.000	0.723	1.382
	GTI	0.169	0.030	0.421	5.671	0.000	0.722	1.385
	Com	0.275	0.030	0.356	3.280	0.000	0.790	1.449
	GI	0.105	0.027	0.333	2.811	0.005	0.677	1.447
	Cor	0.134	0.028	0.221	2.743	0.000	0.652	1.453
	Cus	0.127	0.027	0.417	3.125	0.000	0.711	1.423
a. Dependent variable: DGL								

Source: Authors analyze, 2024

In conclusion, the eight factors in the research model have a direct impact on developing green logistics in Vietnam. That is the highlight of this study and makes a difference from the studies of Le (2013), Vuong (2017). Since the previous did not discover the factors promoting the development of green logistics in Vietnam. Hence, this study could create a paradigm for future studies on discovering and analyzing factors affecting the development of green logistics. Furthermore, the regression results of this study pointed out a difference compared with the previous research results of Schmied (2010), Evangelista, Santoro, and Thomas (2018), and Motowidlak (2019). That is, it added two factors that contain the cost-effectiveness and competitors, which have an impact on promoting the development of green logistics in Vietnam.

5. Implications

This study provides some managerial implications for both theoretical and practice. For theoretical implication, by analysing the affecting factors, this research contributes to the body of the key factors promoting the development of green logistics in a country.

For practical implication, this is the first study exploring the key factors promoting the development of green logistics in Vietnam. Therefore, this study contributes to providing some useful information for the Government, policy planners, and logistics enterprises to promote the development of green logistics in Vietnam based on affecting factors.

The outcomes of the multiple linear regression model showed that politics, green technology innovations, and customers have the highest role in promoting the development of green logistics in Vietnam. So, significant implications focus on the three factors above are suggested as follows:

Firstly, politics has the highest impact on the development of green logistics. And so, the Government needs to perfect the legal framework, have preferential policies, and support mechanisms to encourage and create motivation for logistics enterprises to develop green logistics. Besides, the State should especially plan, invest in building infrastructure, logistics centers with technical means to protect the environment to effectively support the development of the logistics industry. Moreover, the State needs to focus on perfecting green logistics development planning in localities on the basis of experience exchange and implementation of general planning in bordering areas, master and detailed planning.

Secondly, logistics enterprises need to strengthen green technology innovations toward sustainable logistics development. Green technological innovations are a prerequisite for the development of green logistics. Logistics enterprises should link and cooperate to create the ability to improve capacity and invest in green technology systems to enhance business performance. At the same time, apply GPS technology to manage information and positioning in transportation. Furthermore, logistics enterprises need to strengthen the development of cold chain technology in approved place management to solve technical and equipment problems related to heat and cold preservation and energy saving for the approved place system. Additionally, logistics enterprises need to raise awareness among employees about the importance of green technology innovations for their health and the environment.

Finally, the Government should actively propagate the green concept to the public, trigger-off green education, and create a supportive social atmosphere that supports the development of green logistics. The above measures will create a positive impact on public attitudes toward green logistics development and further promote the formation of the green demand of consumers. Moreover, the local authorities can organize propaganda sessions on the role of green logistics to local people to raise their awareness.

6. Conclusion

This study brings significant results on the impact of factors on the development of green logistics in Vietnam. The data for the study were collected from a survey of 437 logistics enterprises in the five centrally-governed cities of Vietnam. The multiple linear regression analysis was carried out to look for the relationship between the constructs in the research model. The analysis results show that eight factors consisting of politics, cost-effectiveness,

green education, green technology innovations, competitors, green infrastructure, corporate, and customers have a positive impact on developing green logistics in Vietnam. The most important result of this study is to explore the degree of influence of key factors on the development of green logistics in Vietnam.

Although the study has achieved significant results, it is unavoidable that the sample size is limited because it was carried out in only five centrally-governed cities. Therefore, future research should raise the sample size or extend the survey scope.

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