

The Current Status of Greening Goods Transportation by Road in Hanoi City

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ABSTRACT: The research focuses on analyzing the current status of green transportation of goods by road in Hanoi city. The authors conducted primary data collection from two groups of respondents: transportation managers and road freight transport companies. The study surveyed 150 samples, and after data cleaning, 145 samples were used for analysis. Both qualitative and quantitative analysis methods were employed using SPSS software and Smart PLS SEM to examine the impact of measurement scales on the degree of green transportation of goods by road. The measurement scales included green transportation development policies, road infrastructure, green transport vehicles, green transportation information systems, and human resources. The analysis results indicated that all measurement scales had a positive impact on the green transportation of goods by road. Based on the research findings, the authors proposed several solutions to enhance green transportation of goods in Hanoi.

Keywords: transportation, greening transportation, road freight, and green logistics.

1. INTRODUCTION

Logistics plays a crucial role in connecting and promoting the socio-economic development of countries worldwide, contributing to enhancing the competitiveness of businesses in the national economy. According to the Vietnam Logistics Service Business Association (VLA), the logistics sector in Vietnam has been experiencing a growth rate of around 14%-16% in recent years, with an annual scale of approximately 40-42 billion USD. The logistics market in Vietnam includes about 3,000 domestic enterprises and around 25 leading global freight forwarding corporations operating in various forms.

However, practical experience has shown that logistics activities also give rise to significant environmental issues. The amount of carbon emissions into the environment is enormous due to the development of transport activities, along with noise pollution and other related consequences. That's why green logistics is an effective solution to address environmental issues in the global supply chain. Green logistics not only brings many benefits in terms of environmental protection (reducing CO₂ emissions, minimizing resource consumption, etc.), but it also helps save costs and optimize the supply chain, leading to strong stimulation of production and business activities.

Therefore, analyzing the current situation of road freight transport in Hanoi City is necessary to make specific adjustments and plans for immediate priorities as well as long-term benefits. This analysis aims to enhance the

efficiency of road freight transport in Hanoi City and promote the green transformation of road freight transport in the city.

2. RESEARCH METHODOLOGY

2.1. Data Collection Method

The research team utilized a questionnaire to assess the fundamental characteristics of the collected data by calculating statistical parameters such as the type of business, company scale, operating time, positions of survey participants, etc.

Table 1: Response Information

		Frequency (n)	Percentage (%)
Type of business entity	Sole proprietorship	56	38,6
	Limited Liability Company	21	14,5
	Foreign-invested enterprise	13	9,0
	State-owned enterprise	21	14,5
	Joint-stock company	24	16,6
	Joint venture	10	6,9
Business scale	Medium-sized enterprise	67	46,2
	Small-sized enterprise	58	40,0
	Micro-sized enterprise	9	6,2
	Large-sized enterprise	11	7,6
Operating time	1-4	32	22,1
	5-10	82	56,6
	11-20	26	17,9
	>20	5	3,4
Survey position	General Director	6	4,1
	Production Director	19	13,1
	R&D Department Head	24	16,6
	Operations Department Head	46	31,7
	Employee	50	34,5

Source: Survey data, analysis, 2023

2.2. Data Processing and Analysis Methods

The research topic of the authors focuses on evaluating the level of interest and response of transportation businesses to the greening of road transport activities. The authors also highlight the benefits of paying attention to the frequency of training, guidance, and training for employees to promote the greening of road freight transport in transportation units. In addition, the research investigates the assessment level of transportation businesses regarding the influence of factors on the greening of road transport. After collecting the survey questionnaires, the data was encoded, cleaned, and then entered into SPSS for reliability analysis. Subsequently, comprehensive tools, SMART PLS SEM 4, were used to assess factors including convergent validity, discriminant validity, reliability, and AVE to analyze and verify the collected data and the developed hypotheses.

3. RESEARCH RESULTS

3.1. Current Situation of Greening Freight Transport by Road in Hanoi City

3.1.1. Use of Emission Standard Vehicles and Improving Vehicle Quality

The compliance level with green freight transport regulations in Hanoi is low, accounting for 26.7%, with the lowest rate being 13.3% corresponding to high and very high compliance levels. This indicates that the level of concern and compliance by transport enterprises is currently not high. The majority of them are at a normal or low level, showing that the regulations and awareness of the population have not been high regarding environmental protection and sustainable development. Both the general public and businesses have not shown sufficient concern or implemented the specific regulations for greening road freight transport in Hanoi.

The biggest issue currently facing road freight transport is the high rate of empty return trucks, which significantly affects transport quality. According to the Logistics Report 2022, 39.0% of surveyed businesses stated that their proportion of empty return vehicles is less than 10%. Meanwhile, 40.3% of surveyed businesses reported a proportion of empty return vehicles ranging from 10% to 30%. Remarkably, 13% of businesses have a proportion of empty return vehicles above 50%. This will impact the energy consumption index calculated based on GDP, as running vehicles without return loads will increase environmental emissions without bringing any economic benefits. The main reasons for the high proportion of empty return vehicles are: insufficient cargo sources for two-way transport, changes in delivery schedules by customers, suboptimal transport routes, and failure to share transport resources with partners, among others.

3.1.2. Enhancing Fuel Efficiency and Using Green Fuels

Currently, the use of green fuels in road freight transport in Hanoi is considered an effective solution to improve efficiency and reduce CO₂ emissions into the environment compared to using diesel fuel. This is a significant driving force for proactive implementation of green transport policies in Hanoi as it receives substantial support from freight transport businesses.

Some businesses in Hanoi have invested in upgrading their vehicles by equipping them with advanced technologies to enhance fuel efficiency. These vehicles are often equipped with fuel-saving engines (combustion engines combined with electric motors), intelligent driver assistance systems (lane departure warning systems, driver inattention warning systems, blind spot warning systems, surveillance camera systems, etc.), fuel management systems (fuel sensors, remote management software systems), and other advanced technologies to reduce fuel consumption. However, a major challenge in upgrading transport vehicles to improve fuel efficiency is the initial cost. New vehicles and advanced technologies are usually more expensive, requiring businesses to have investment capabilities to replace their old vehicles. Ensuring financial resources and economic feasibility poses a challenge that businesses need to face. Therefore, most road freight transport businesses participating in the survey still show limited interest in the level of vehicle upgrades within their companies.

Although the use of green fuels in road freight transport in Hanoi brings many benefits such as increased efficiency and reduced CO₂ emissions, there are still many limitations. To promote the use of green fuels, significant investment and the development of fuel supply systems are needed, along with providing conditions and incentives for citizens and businesses to encourage the purchase and use of vehicles that use green fuels.

3.1.3. Use of transportation management software

Transportation management is always a challenge for logistics companies, and the use of transportation management software in their operations is essential to address this issue.

The effectiveness of transportation management software is a relatively difficult issue. Free software or software from foreign countries cannot solve problems related to Vietnamese traffic laws, which can create difficulties in transporting goods. For example, the software may not display the restricted hours for vehicles weighing over 15 tons, leading to drivers taking the wrong routes or occasionally getting lost due to inaccurate guidance from the software, which lacks practical considerations for Vietnam.

Therefore, allocating significant capital to invest in optimal transportation solutions is a challenging issue for businesses. About 23% of companies believe that these software solutions only optimize routes at a normal level due to several limitations, and they do not significantly enhance the efficiency of their operations. However, providing information is highly useful for businesses as they can capture basic data and share it with their drivers and customers, such as speed, GPS coordinates, and the distance traveled by the drivers. Additionally, 50% of companies stated that transportation management software meets the criteria for optimizing transport routes and providing information to the company, while 22% of companies reported that the software fully meets these criteria. This indicates that the application of information management software in the company's operational processes can greatly benefit various tasks and enhance the value of the services provided to customers.

3.2. Factors Influencing Greening of Road Freight Transportation

Building upon existing measurement theories and previous research by authors both domestically and internationally on green transportation, the research team proposes a model to study the factors that influence the greening of road freight transportation as follows:

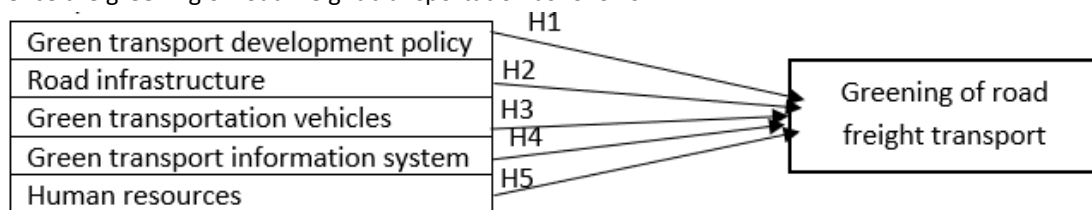


Figure 1. Research Model

3.2.1. Evaluation of reliability and validity

The reliability of the measurement scale was evaluated using two representative indices, namely CA and CR. CR and CA indicate the convergence of variables in the measurement scale into a single latent structure. Typically, to test the reliability of CA, if the result is above 0.7, it is considered acceptable. The analysis results show that all the factors meet the condition above 0.7. However, compared to CA, CR is considered a better measure of the homogeneity of reliability because it uses standard loadings of observed variables by Fornell and Larcker (1981). In this case, a CR value above 0.7 is considered satisfactory. In this research, all factors meet the requirements as presented in the table:

Table 2: Composite Reliability and Convergence

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
CS	0.916	0.936	0.936	0.745
HT	0.909	0.922	0.931	0.731
NL	0.938	0.993	0.954	0.839
PT	0.939	0.993	0.953	0.802
TT	0.892	0.903	0.924	0.753
XHVT	0.952	0.959	0.965	0.875

Source: Research Data Analysis Results by the Authors, 2023

According to the analysis results:

(1) Testing internal consistency reliability using Cronbach's Alpha and composite reliability (CR): The analysis of the measurement scale for the research concepts shows that all the measures have Cronbach's Alpha greater than 0.6 and composite reliability (CR) greater than 0.7. Therefore, all the measures achieve internal consistency reliability.

(2) Testing convergent validity: The analysis of the measurement scale shows that the highest extracted variance (AVE) is 0.875 and the lowest is 0.731, both exceeding 0.5. Thus, all the measures achieve convergent validity.

With the HTMT index, Henseler et al. (2015) suggest that if the value is below 0.9, discriminant validity is ensured. Meanwhile, Clark & Watson (1995) and Kline (2015) use a stricter threshold of 0.85. From Table 2, we observe that the correlation coefficients between policies, infrastructure, vehicles, information, and human resources, as indicated by the HTMT values, are all < 0.85, ensuring discriminant validity.

Table 3: Discriminant Results

	CS	HT	NL	PT	TT	XHVT
CS						
HT	0.105					
NL	0.138	0.346				
PT	0.068	0.237	0.087			
TT	0.399	0.053	0.105	0.078		
XHVT	0.419	0.236	0.162	0.200	0.356	

Source: Research Data Analysis Results by the Authors, 2023

3.2.2. Structural Model Results

Assessment of Impact Relationships

Table 4: Bootstrap Testing Results

	P values	Hypothesis
CS -> XHVT	0.000	Supported
HT -> XHVT	0.039	Supported
NL -> XHVT	0.049	Supported
PT -> XHVT	0.013	Supported
TT -> XHVT	0.007	Supported

Source: Research Data Analysis Results by the Authors, 2023

The level of impact of the 5 variables on greenization of road freight transportation, from strongest to weakest, is as follows: greenization development policy, green transportation information system, human resources, green transportation vehicles, and transportation infrastructure.

The explanatory power of the independent variables for the dependent variable (R-squared)

Table 5: Results of testing the explanatory power of independent variables for the dependent variable.

	R-square	R-square adjusted
XHVT	0.792	0.712

Source: Research Data Analysis Results by the Authors, 2023

We observe that the adjusted R-squared for greenization of transportation is 0.712, indicating that the independent variables explain 71.2% of the variation (variance) in greenization of transportation, while the remaining 28.8% is attributed to system errors and other factors outside the model.

3.3. Results Achieved and Limitations in Greening Road Freight Transport in Hanoi City

3.3.1. Results Achieved

This study focuses on evaluating the solutions implemented by road transport businesses in Hanoi, Vietnam, to minimize environmental pollution and enhance business efficiency. Addressing environmental pollution has become an important task for Vietnam due to commitments to reducing greenhouse gas emissions and addressing climate change-related issues. To achieve this goal, transport companies have implemented specific measures.

Firstly, they have invested in green transport vehicles, such as those meeting Euro 4 and Euro 5 emission standards, instead of using outdated and environmentally polluting vehicles. The use of these vehicles not only

reduces environmental pollution but also saves repair costs, improves fuel efficiency, and enhances reputation with customers.

Secondly, companies have adopted measures to increase fuel efficiency and use environmentally friendly fuels, such as biodiesel and ethanol, to minimize emissions. This requires training and educating drivers on fuel-saving driving techniques, speed adjustment, and vehicle maintenance to ensure optimal fuel efficiency.

Thirdly, companies have implemented management software in their operations. The application of management software helps improve competitiveness and enhance transportation services to better meet customer needs. Companies can leverage information technology to manage routes, optimize journeys, and monitor vehicle performance.

From implementing these solutions, the study found that road transport businesses in Hanoi have achieved a reduction in environmental pollution and improved business efficiency. The use of green transport vehicles and environmentally friendly fuels not only benefits the environment but also brings economic advantages and builds the reputation of the companies.

3.3.2. Limitations and Causes

The first challenge for businesses is the high investment costs required for greening transport operations. This is a significant challenge as it demands substantial capital investment to purchase new equipment and energy-saving vehicles. Procuring new equipment and vehicles necessitates a large amount of capital to renovate or replace outdated vehicles that do not meet energy-saving and environmental protection requirements.

The second issue is the ability to manage and assess effectiveness. Companies need a management and evaluation system for green transport activities to ensure the sustainability of their transportation services. However, managing and evaluating green transport activities can be challenging and requires meticulousness and expertise. The lack of supportive policies and incentives is also a limiting factor in greening transport efforts.

The third issue is the use of electronic transport information systems. These systems have not been universally standardized and integrated with other management systems. Deploying and synchronizing electronic transport information systems require collaboration among various stakeholders and investments in technology and finance for construction and maintenance. This creates cost pressures for businesses and necessitates support from local authorities and managers.

The final issue is the availability of high-quality human resources in the industry. Currently, there is a limited supply of high-quality human resources in the transportation sector. The training infrastructure for transportation workforce in Hanoi does not adequately meet the quality requirements for businesses. The shortage of reputable and quality training institutions in the transportation field contributes to this limitation.

3.4. Enhancing Green Freight Transport Solutions in Hanoi City

3.4.1. Policy Measures for Green Transport Development

Firstly, raising awareness and promoting customer understanding of environmental protection through the use of green transport services is crucial. When customers understand the benefits of using these services, it becomes a driving force for businesses to adopt greener practices in transport services.

Secondly, implementing the ISO 14000 environmental management system is an effective tool for transportation companies in Hanoi to green their operations and ensure sustainable environmental management.

Thirdly, issuing strategies and policies related to environmental safety for freight transportation activities in Hanoi is important to protect the environment and ensure the sustainable development of the transport sector.

Fourthly, encouraging the use of locally produced goods and services helps minimize the environmental impact of long-distance logistics and transportation. It also promotes the circular economy by leveraging the potential for product recovery, repair, and reuse.

Fifthly, attracting and providing attractive incentives for highly skilled domestic and foreign workforce specialized in green transport is necessary. To attract and retain high-quality human resources in the field of green transport in Hanoi, businesses need to have attractive incentive policies.

3.4.2. Road Infrastructure Solutions

Firstly, upgrading and expanding central road corridors is one of the important solutions to address traffic congestion in Hanoi. Some central road corridors need to be upgraded and expanded to 4 to 6 lanes for motor vehicles, such as Thang Long Avenue, a major arterial road connecting Noi Bai Airport and the city center.

Secondly, constructing parallel expressways to major national highways with high traffic volumes can expedite the completion of urban beltways and facilitate faster movement between different areas within the city, reducing congestion on main routes.

Thirdly, developing large-scale logistics centers with long-term vision is crucial. Two areas in Hanoi, namely Phu Xuyen district, are proposed for planning as major logistics centers. These areas can be well-connected with expressways, the north-south national highway, railways, and waterways to serve transshipment and distribution of goods between the northern and southern regions.

Fourthly, planning the construction of inland container depots along transportation corridors is important. These depots are considered places for gathering and transshipment of containerized goods, with functions similar to regular seaports.

Fifthly, planning the warehouse system. The existing warehouse system in Hanoi is still relatively outdated. Therefore, to meet the increasing demand for freight transport, investment and upgrades are needed.

3.4.3. Transport Vehicle Solutions

Firstly, investing in upgrading and improving transport vehicles towards greener options. Upgrading and improving the existing transport vehicle systems, replacing old trucks with new ones that have the capability to minimize emissions released into the environment.

Secondly, in Hanoi, transport vehicles can use environmentally friendly fuels.

Thirdly, improving the fuel efficiency of transport vehicles by using technologies such as ventilation systems, tires, and engines efficiently.

Fourthly, using cargo racks in road freight transport operations is also a green transport solution, helping to minimize negative impacts on the environment. Cargo racks optimize the use of space in transport vehicles, reducing the number of necessary trips for transporting goods.

Fifthly, developing an app to connect various transport vehicles.

3.4.4. Green Transport Information System Solutions

Firstly, promote the use of electronic transport information systems to replace documents and paperwork. The Vietnamese government has identified the use of electronic transport information systems as a solution to improve labor productivity, enhance transparency, and reduce processing time for documents and paperwork in businesses.

Secondly, simplify administrative procedures to accelerate the circulation speed.

Thirdly, expand cooperation and linkages among businesses within the city. Transport businesses in Hanoi can enhance their capacity and competitiveness by establishing close connections with businesses in warehousing, delivery, environment, aviation, etc., through industry associations.

Fourthly, utilize smart technologies to optimize routes. By using smart technologies to optimize routes, travel time and fuel consumption can be minimized.

Fifthly, the use of wireless communication technology and cloud services in road freight transport in Hanoi can help minimize traffic congestion and ensure continuity during transportation.

Sixthly, employ emerging technologies such as artificial intelligence (AI), the Internet of Things (IoT), and blockchain to address management issues and optimize the transport information system.

3.4.5. Workforce Solutions

Firstly, the management team of transport enterprises in Hanoi should consist of key personnel with high knowledge and experience in the field. S

Secondly, for operational staff, businesses in Hanoi should seek reputable training institutions to provide training and knowledge enhancement for employees involved in road freight transport.

Thirdly, for direct labor, training eco-friendly drivers is an important solution to minimize the negative impact of transport vehicles on the environment. Transport businesses should have policies to care for and train this core workforce.

Fourthly, intensify the training of high-quality workforce directly at training institutions.

4. CONCLUSION

Currently, greening transportation is not only a global trend to address environmental issues alongside economic development, but also a requirement and commitment to environmental regulations for the organizations that Vietnam participates in. Therefore, as the capital city, Hanoi needs to take the lead in developing green transportation to set the direction for the whole country. In this regard, the article has focused on addressing the following issues for the development of green road freight transport in Hanoi.

Summarizing the theory of road freight transport and greening of transportation. The authors propose a research model that inherits from previous studies and develops factors influencing the greening of transportation. Alongside the analysis of the current situation, the research team puts forward strategic solutions for the development of green road freight transport in Hanoi, including: (1) a group of solutions regarding green transport development policies, (2) a group of solutions regarding road transportation infrastructure, (3) a group of solutions regarding transportation vehicles, (4) a group of solutions regarding green transport information systems, and (5) a group of solutions regarding human resources.

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