

## The Impact of Information Technology in Improving Supply Chain Sustainability: A Case Study on Green Logistics in the Manufacturing Sector in Vietnam

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## Abstract

This study was conducted to examine the impact of information technology application on green logistics development in the manufacturing sector. Using qualitative research method, based on exploring the experiences of 14 logistics managers and information technology experts from 7 manufacturing companies in Hanoi city. The results of the study reveal valuable insights into the experiences of logistics managers and information technology specialists in exploring applied information technology systems; Collaboration between information technology and logistics teams; Practice data analysis and management; Technical challenges and future innovations in sustainable logistics. Based on the research results, a number of recommendations are made for businesses and policymakers to improve the sustainability of the supply chain, especially in the context of green logistics in Vietnam.

Keywords: Information technology, supply chain, logistics, green logistics, Vietnam.

## 1. Introduction

In today's rapidly evolving world, the intersection of information technology and sustainability has become an important area of research and innovation. The supply chain, as a central component of many industries, plays an important role in addressing environmental challenges (Pham, 2022). The term "green logistics" or similar terms such as "sustainable logistics"... is a subset of sustainable supply chain management, focusing on the application of environmentally friendly methods in transportation, warehousing and distribution to minimize environmental impact. In Vietnam, the concept of green logistics is still relatively new, so there is currently no unified and clear understanding. Vietnam Logistics Report 2022 (Ministry of Industry and Trade, 2022), introduced the concept of green logistics: "Green logistics is a logistics activity towards sustainable, friendly and environmental protection goals, minimizing negative impacts on the environment". Increased global awareness of environmental issues, such as climate change, resource depletion, and pollution, has prompted businesses and policymakers to seek more sustainable solutions. Therefore, the topic of green logistics or green logistics has attracted the attention of academics and practitioners. Capturing technology is key to achieving sustainable logistics operations, optimizing operations, and reducing the carbon footprint of the supply chain (Hung, 2023).

Many studies on the topic of green logistics have been carried out in both the world and Vietnam. Internationally, studies have focused on the application of information technology solutions, such as Internet of Things-enabled tracking systems, data analytics, and automation, to optimize supply chain processes and reduce environmental impact. In Vietnam, most of the previously published research mainly emphasizes challenges, obstacles or advantages when implementing green logistics strategies. Other studies have looked at the experience of green logistics development in countries and learned lessons for Vietnam. Meanwhile, research on the impact of information technology application on green logistics development in the manufacturing sector in Vietnam seems to be very limited (Hung, 2022).

Therefore, this study is conducted for the purpose of investigating the impact of information technology application on green logistics development in the manufacturing sector from the perspective of logistics managers and information technology experts. The research results are the basis for the author to make some recommendations to companies and policy makers to improve the sustainability of the supply chain, especially in the context of green logistics development.

## 2. Literature review

Li et al., (2017) investigates the impact of green information technology adoption on supply chain management practices and competitive advantage in Chinese manufacturing companies. Researchers collected data from a sample of manufacturing companies and analyzed the relationship between green information technology use, supply chain sustainability, and company performance. The findings suggest that the adoption of green information technology has a positive effect on sustainable supply chain management practices, leading to improved environmental performance and reduced costs. Moreover, companies that effectively integrate green information technology into their supply chain processes have gained a competitive advantage over their peers, demonstrating the importance of technology in achieving sustainability goals.

In addition, Mulyadi et al. (2021) systematically reviewed the literature, exploring the role of information technology in sustainable supply chain management practices in different industries and countries. The study reviewed and synthesized relevant articles published between 2010 and 2020. The findings indicate that information technology plays an important role in enhancing supply chain sustainability by improving visibility, traceability, and communication between supply chain partners. The adoption of IT solutions, such as IoT, big data analytics, and blockchain, promotes environmental responsibility and supports the achievement of sustainability goals. The study highlights the importance of technology-based solutions in driving sustainable supply chain operations.

In Vietnam, a number of studies related to the topic of logistics have been carried out. For example, Pham Thu Trang's research (2023), on the basis of secondary data from research papers and reports on green logistics in Vietnam, summarizes and presents some theoretical contents on green logistics, and at the same time makes some comments on the advantages and disadvantages of implementing green logistics activities in Vietnam. Research by Mai Le Loi (2018) has pointed out some opportunities and challenges for the logistics service industry in the context of international integration. Research shows that the incomplete development of logistics services, especially "door to door" package logistics services. At the same time, the study also points out a number of challenges in information technology and e-commerce, human resources, management policies and infrastructure, pointing out the causes of some shortcomings and solutions.

### 3. Research Method

This article uses qualitative research methods to explore the experiences and perspectives of logistics managers and information technology experts on the impact of information technology application on green logistics development in the manufacturing sector. The sample in this study was selected through intentional sampling, focusing on logistics managers and information technology specialists in manufacturing enterprises with at least three years of experience. The data was collected through semi-structured interviews with 14 logistics managers and information technology experts (including: 6 logistics managers and 8 information technology experts) of 7 manufacturing companies in Hanoi. The interviews were conducted between April 2023 and July 2023 on the basis of face-to-face and telephone interviews lasting from 30 minutes to 45 minutes each, the contents of which were recorded and transcribed for analysis. Data is analyzed using thematic analysis to identify key topics and samples emerging from interviews.

### 4. Research Results

Logistics managers and information technology specialists were asked a number of open questions about the impact of information technology application on green logistics development in the manufacturing sector at their companies, specific questions expressed in the Appendix.

The Impact of Information Technology on Supply Chain Sustainability: A Logistics Manager's Perspective

From the perspective of logistics managers, the research results show that sustainability in the company's supply chain activities is important, especially in the field of green logistics. Sustainability, for them, is more than simply complying with environmental regulations; it is a fundamental aspect of the corporate philosophy and strategic vision of companies. Logistics managers define sustainability as the responsible management of resources and operations to

minimize negative environmental impacts while maintaining economic viability and meeting the needs of customers and stakeholders.

According to some logistics managers, the company has implemented several key green logistics initiatives aimed at reducing its environmental impact and promoting sustainable practices throughout its supply chain. These initiatives cover different aspects of operations, from transportation to warehousing and the use of packaging in product packaging. One of the cornerstones of the green logistics strategy that companies use is roadmap optimization. Through the use of advanced route optimization software, companies carefully analyze delivery routes to ensure they are efficient, fuel-efficient, and environmentally friendly. By minimizing travel distances and optimizing the loading process, reducing fuel consumption and subsequently reducing greenhouse gas emissions. Another important initiative that companies have implemented is modal transformation. They are actively exploring opportunities to switch modes of transport from road to rail or sea, especially for long-distance shipments. This change in modalities not only helps companies achieve a significant reduction in their carbon footprint, but also supports more sustainable transportation options. Furthermore, logistics managers emphasize the energy efficiency of warehouses. Their warehouse is equipped with energy-efficient lighting, HVAC systems, and smart sensors. These technologies help the company optimize energy consumption by adjusting lighting and cooling systems based on temperature and power conditions, ensuring responsible use of resources. In the packaging sector, logistics managers are continually improving to minimize packaging materials and adopt environmentally friendly alternatives. By using sustainable packaging materials and packaging the right size, they have helped not only reduce waste but also reduce the environmental impact of shipments.

According to logistics managers, an integral part of companies' green logistics success lies in the seamless integration of information technology into their supply chain processes. Information technology plays a pivotal role in supporting green logistics initiatives. Logistics managers said their company has deployed various IT applications to optimize its logistics operations and enhance its sustainability efforts. For example, a Transportation Management System (TMS) is a key component of companies' green logistics strategy. TMS enables companies to optimize route planning, transportation consolidation, and real-time tracking. With this system, companies can ensure that their fleets operate at peak efficiency, reducing fuel consumption and emissions while maintaining on-time deliveries. Similarly, companies' warehouse management systems (WMS) play an important role in streamlining warehouse operations. By automating tasks, optimizing storage layouts, and guiding efficient picking and packaging processes, WMS reduces energy consumption and minimizes operational waste. Some logistics managers show that they also leverage the telematics and IoT devices installed in their vehicles to monitor fuel consumption, driver behavior, and vehicle maintenance. This data-driven approach allows them to identify opportunities to improve fuel efficiency and driver performance, further contributing to the company's sustainability goals. The adoption of business intelligence and data analytics tools has helped companies gain valuable insights into their supply chain performance. By analyzing supply chain data, companies can identify areas for improvement and make data-driven decisions to continuously strengthen their sustainability efforts.

However, some logistics managers believe that the integration of information technology brings many benefits, but their company has encountered some challenges in the process of applying and implementing information technology solutions for green logistics. One of the main challenges is the initial investment and associated costs to implement advanced information technology solutions. While the long-term benefits are clear, securing the required capital is quite a

challenge. In addition, integrating information technology systems with existing processes and legacy systems can be complex and time-consuming. Ensuring smooth integration and data flow remain a priority during implementation. In addition, protecting sensitive supply chain data and ensuring compliance with data privacy regulations is paramount when applying information technology solutions.

However, the majority of logistics managers believe that the advantages of using information technology to enhance the sustainability of the supply chain are significant. Efficiency is achieved through optimization based on information technology leading to reduced waste and resource consumption. Real-time visibility enabled by information technology applications allows them to quickly make data-driven decisions, leading to faster response times and improved overall supply chain performance. Furthermore, information technology applications provide them with the means to monitor and measure key sustainability indicators, such as carbon footprint, energy consumption, and waste generation. Armed with this data, companies can identify areas for improvement and implement targeted strategies to further reduce environmental impact.

The interview results also show that logistics managers believe that measuring the effectiveness of information technology-based green logistics activities in achieving sustainability goals is an ongoing process. They regularly track key performance indicators (KPIs) in line with their sustainability goals. These KPIs include carbon footprint, fuel efficiency, warehouse and transportation resource utilization rates, and customer satisfaction. By comparing benchmarks with these KPIs, they ensure that information technology-based green logistics operations are effective and aligned with broader sustainability goals.

In addition, logistics managers are convinced that information technology will continue to play a transformative role in promoting green logistics activities in Vietnam's manufacturing sector. Advances in technology such as artificial intelligence, machine learning, and big data analytics will bring further optimization. The integration of IoT and blockchain technology will further enhance supply chain transparency and traceability, driving sustainability efforts across the industry.

The impact of information technology in green logistics: The perspective of information technology experts

The interview results show that some experts said that, to support the company's green logistics initiatives, they have strategically integrated various information systems and technologies into the company's supply chain processes. These technologies play an important role in optimizing their operations, reducing their carbon footprint and improving their overall environmental performance. At the heart of most companies' green logistics strategy is the adoption of TMS. This advanced system allows them to plan and optimize transportation routes efficiently, taking into account factors such as fuel efficiency, vehicle capacity, and emissions. By minimizing mileage and optimizing congestion, TMSs help them reduce fuel consumption and greenhouse gas emissions, contributing to a greener supply chain. Besides, WMS of companies is another essential component of green logistics strategy of most companies. WMS streamlines warehouse operations, enabling companies to optimize storage layouts and inventory management. With a strategy to position products closer to shipping points, they reduce internal transportation and energy use in warehouses, further supporting the company's sustainability goals. In addition, to ensure real-time visibility and tracking of assets and shipments, the company uses a variety of tracking technologies, such as GPS and RFID (Radio Frequency Identification). These technologies allow the company to track the movement and condition of goods, ensure timely delivery, and minimize waste and delays. Moreover, companies' ability to analyze data and business intelligence enables them to harness the power of big data to make the right decisions regarding sustainability efforts. By analyzing large

amounts of supply chain data, including fuel consumption, transportation costs, and environmental metrics, they have gained valuable insights to optimize their operations and identify areas for improvement.

According to information technology experts, the successful integration of technology into green logistics processes depends heavily on effective cooperation between information technology and logistics teams. Regular communication, joint planning sessions, and a deep understanding of each other's roles are critical to ensuring that technology aligns with logistical requirements and sustainability goals. Companies' IT teams often work closely with logistics managers to understand their specific challenges and sustainability goals. By involving logistics professionals in the implementation and selection of IT solutions, they ensure that the technology aligns with operational needs and supports the organization's sustainability vision. In contrast, the logistics team provides valuable input on real-world challenges and industry best practices, guiding the information technology team to design and implement customized solutions tailored to the company's green logistics needs.

The results of interviews with information technology experts also show that data plays an important role, their data management and analysis methods are quite effective, ensuring complete and accurate tracking of data on sustainability and environmental impact of the company's logistics activities. They collect data from a variety of sources, including vehicle-installed telecommunications equipment, warehouse management systems, transportation management systems, and environmental monitoring systems. This data is then stored in a centralized data repository, where it undergoes standardized, cleaning procedures to ensure its accuracy and reliability. Data visualization tools allow them to create interactive dashboards that present key sustainability indicators and real-time environmental impact. These dashboards provide stakeholders with clear and actionable insights, facilitate data-driven decision making, and continually improve sustainable performance.

However, some information technology experts also note that, while applying information technology solutions to green logistics, they have faced a number of technical challenges and limitations. One of the main challenges is the integration of different IT systems and data sources. Information technology experts say they have overcome this challenge by implementing middleware and API solutions that enable seamless data exchange between different systems, ensuring smooth interoperability and reducing data silos. Besides, data security and privacy are the top concerns of IT professionals, especially when sharing sensitive environmental data with external partners. To address this, they have implemented effective data encryption, access controls, and compliance measures to protect information and ensure data integrity and security. In addition, the implementation of new information technology systems requires comprehensive training of the logistics team to familiarize them with new technologies. This has been accomplished through workshops, training sessions and ongoing support from their IT experts, ensuring a smooth transition and efficient use of new tools.

Information technology experts also stated that some specific innovations in information technology will play an important role in the future of green logistics in Vietnam as follows: (i) Artificial Intelligence and Machine Learning: These technologies will enhance predictive analytics, allowing them to forecast demand more accurately, optimize inventory levels and better allocate resources. Artificial intelligence and machine learning will also facilitate dynamic route optimization, considering real-time weather and traffic conditions, making transportation more fuel-efficient and environmentally friendly; (ii) Internet of Things (IoT): IoT devices will provide real-time environmental monitoring and condition monitoring capabilities during transportation and

warehousing. These devices will help them optimize temperature and humidity control, ensure product quality, and comply with sustainability standards; (iii) Blockchain technology: The decentralized and transparent nature of blockchain will enhance supply chain traceability and enable verification of sustainability claims. With blockchain, they can track the entire life cycle of products and materials, ensure responsible sourcing and ethical practices in the manufacturing sector.

## 5. Conclusion and recommendation

The study highlights the key role of information technology in enhancing supply chain sustainability, with a particular focus on green logistics in the manufacturing sector. The integration of advanced information systems and technologies allows manufacturing companies to optimize operations, reduce their environmental impact, and improve overall sustainable performance. Collaboration between IT and logistics teams is essential for successful implementation, ensuring the technology aligns with sustainability goals. Data management and analysis activities play an important role in tracking sustainability and environmental impact metrics, guiding data-driven decision-making for continuous improvement.

Based on the research results, some recommendations are made for companies and policy makers, specifically as follows:

(i) Investment in green information technology solutions: Manufacturing companies should prioritize investments in green information technology solutions, such as TMS, WMS, and IoT devices, to optimize transportation and warehousing. These technologies not only reduce environmental impact but also lead to cost savings and increased efficiency.

(ii) Collaboration and sharing of best practices: Encourage collaboration between IT and logistics teams to ensure successful integration of new technology-based green logistics approaches. Share best practices that will accelerate the adoption of sustainable solutions.

(iii) Set measurable sustainability goals: Establish clear and measurable sustainability goals aligned with industry best practices to guide companies in reducing carbon emissions, energy consumption, and waste generation.

(iv) Encourage green ICT adoption: Policymakers should provide incentives and funding for manufacturing companies to invest in green ICT solutions, accelerating the transformation of logistics activities.

(v) Sustainability reporting enforcement: Implementing mandatory sustainability reporting requirements for companies, enhancing transparency and accountability.

(vi) Research and development support: Invest in research and development initiatives focused on green logistics and sustainable technology to drive progress across the industry.

(vii) Provide training and skills development: Invest in training programs for information technology professionals and logistics managers to enhance their understanding of sustainable technologies and effectively integrate into logistics processes.

## References

1. Hung, P. H. (2022). Audit Service Quality And Loyalty To Audit Firms: Empirical Evidence From Vietnam. *Journal of Positive School Psychology*, 6(7), 5266-5281.
2. Hung, P. H. (2023). The Influence of Cultural, Legal and Institutional Factors on Auditors' Roles, Responsibilities and Perceptions of Audit Quality. *European Journal of Theoretical and Applied Sciences*, 1(5), 1131-1145.



3. Ministry of Industry and Trade (2022), Vietnam Logistics Report 2022, Industry and Trade Publishing House, Hanoi.
4. Elbanna, A., & El-Essawi, M. (2018). Green IT Practices and Their Impact on Supply Chain Performance: An Empirical Study. *International Journal of Information Management*, 43, 29-38. doi:10.1016/j.ijinfomgt.2018.06.019.
5. Li, J., Sun, Y., & Du, Y. (2017). The Impact of Green IT on Supply Chain Management and Competitive Advantage: An Empirical Study from China. *Sustainability*, 9(12), 2324. doi:10.3390/su9122324
6. Mai Le Loi (2018). Logistics situation in Vietnam, opportunities and challenges. *Journal of Finance*, 12(1), 125-136.
7. Mulyadi, A. A., Kusumo, M. A. S., & Siahaan, D. P. (2021). The Role of Information Technology in Sustainable Supply Chain Management: A Systematic Literature Review. *International Journal of Supply Chain Management*, 10(3), 32-40.
8. Pham Thu Trang (2023). Green logistics in Vietnam: opportunities and challenges. *Journal of Industry and Trade*, 10, 428-439.
9. Pham, H. H. (2022). Factors affecting the implementation of environmental management accounting in manufacturing enterprises: Evidence from Vietnam. *NeuroQuantology*, 20(12), 214.

## Appendix

### Logistics Manager Questionnaire

1. How does your company identify and prioritize sustainability in its supply chain activities, especially in green logistics?
  2. What are the key green logistics initiatives your company has implemented to reduce its environmental impact and promote sustainability?
  3. How has information technology been integrated into your company's green logistics initiatives? Can you provide specific examples of information technology applications used in your supply chain processes?
  4. What challenges have you faced in adopting and implementing information technology solutions for green logistics?
  5. In your opinion, what are the main benefits or advantages of using information technology in enhancing supply chain sustainability?
  6. How does your company measure the effectiveness of information technology-based green logistics activities in achieving sustainability goals?
  7. How do you see the role of information technology in the future in further promoting green logistics activities in Vietnam's manufacturing sector?
- Information Technology Specialist Questionnaire
1. What information systems or technologies are currently used to support green logistics initiatives in your company?
  2. How does the IT department collaborate with the logistics team to ensure successful integration of the technology into green logistics processes?
  3. Can you explain the data analysis and management methods used to monitor the sustainability and environmental impact metrics of logistics activities?
  4. Have you encountered any technical challenges or limitations in applying information technology solutions for green logistics and how have they been addressed?
  5. What specific innovations or advances in information technology do you anticipate will play an important role in the future of sustainable logistics in Vietnam?