

USE OF SMART TECHNOLOGIES IN THE DEVELOPMENT OF GREEN LOGISTICS

Jurgita Paužuolienė, Ieva Kaveckė
Higher Education Institution / Klaipėdos valstybinė kolegija
j.pauzuoliene@kvk.lt, i.kavecke@kvk.lt

INTRODUCTION

Logistics plays a key role in driving economic operations and fostering global commerce by facilitating the seamless movement of goods across nations. In its essence, logistics encompasses various activities: cargo transportation, warehousing, packaging, loading and unloading, handling, and efficient good management. The advent of digital and emerging technologies is catalyzing a paradigm shift in the logistics sector towards a "smart" framework, enhancing operational optimization and freight efficiency. Through cutting-edge communication technologies and digital solutions, logistics operations can now access real-time data on the whereabouts of transport vehicles, containers, and distribution points. Implemented trackers and RFID tags enable swift identification and booking of items, while real-time analytics offer insights for congestion avoidance and resource-efficient strategies. This evolution towards smart logistics holds the promise of reducing energy consumption, curbing carbon emissions, and minimizing waste, thus aligning with sustainability goals. By centralizing information and streamlining delivery processes, smart technologies also contribute to shorter delivery times and reduced costs.

The problematic question is: What smart technologies do logistics companies use to contribute to the development of green logistics?

The aim of the research: To investigate the use of smart technologies by logistics companies in the development of green logistics.

Methods. Analysis of scientific literature, synthesis, quantitative research - questionnaire survey.

RESEARCH METHODS

Analysis of scientific literature, synthesis, quantitative research - questionnaire survey.

Methodology. A quantitative research method was applied—a questionnaire survey. The questionnaire, prepared for companies, consisted of three questions aimed at determining: how companies use smart technologies; the visible benefits of smart technologies in the development of green logistics; and the planned implementation of smart technologies in the future. Companies were selected based on the following criteria: operating in the field of logistics and conducting sustainability/social responsibility/green logistics activities. The organizations chosen for the study operate within the Klaipėda region. The survey participants were managers and specialists who are familiar with the organization's activities and the smart technologies used by the organization. Each company was personally contacted and asked to participate. The majority (53%) of the participants were from large organizations with more than 250 employees, while 33% were from small and medium-sized enterprises with between 51 and 250 employees. Additionally, one specialist each represented small and very small companies. Most companies have a clear sustainable development strategy, prepare social responsibility reports, and contribute to the implementation of green logistics.

RESEARCH RESULTS

The results of the survey indicate that the majority of companies incorporate smart real-time cargo tracking technologies into their operations, enabling customers to track their cargo in real time. Specifically, 13 (87%) of the surveyed companies utilize these technologies. Moreover, 10 (67%) companies employ intelligent technologies for document digitization, while 8 (53%) utilize route planning or optimal route selection programs. Additionally, 7 (47%) companies each utilize intelligent vehicle technologies for driver safety and cargo condition monitoring, as well as data analysis and predictive modelling technologies for demand forecasting and cargo flow management. Some companies (27%) in the manufacturing sector leverage smart technologies to automate production processes, resulting in shortened production cycles, as reported by 4 (27%) companies. Furthermore, 4 (27%) companies utilize artificial intelligence in customer service. A portion of the surveyed companies (27%) also apply intelligent technologies for driver behaviour analysis, aiding in monitoring and analysing economical driving indicators. Moreover, one company (7%) incorporates advanced warehousing technologies into its operations, including robots for order collection and/or packing, replacing human labour.

The companies that participated in the survey provided their insights on the benefits of advanced technologies employed in their operations towards the development of green logistics. In summary, it is evident that all companies unanimously agree that advanced technologies contribute to the advancement of green logistics in various capacities. Representatives from the participating companies concur that the utilization of advanced technologies impacts the financial performance of companies by facilitating savings across multiple areas.

Specifically, 10 companies (71%) agree that intelligent technology aids in reducing total operating costs facilitates emissions reduction through route optimization and decreased fuel consumption, and enhances resource efficiency, such as through the utilization of advanced warehousing technology, thereby streamlining warehouse operations and minimizing errors. 50% of companies recognize that advanced technologies can ensure driver safety, enhance energy efficiency, and optimize inventory levels. The companies that participated in the study were asked what smart technologies they plan to implement in the future that would help develop green logistics. The summarized results are presented in Table 1.

Table 1. Smart technologies are planned to be implemented

No	Smart technologies are planned to be implemented
1.	Use smart and new means of transport for cargo transportation that ensure lower or zero environmental pollution
	Electric trucks
	Gas-powered trucks
	Hydrogen-powered trucks Methanol fueled vehicles
2.	Renewable energy
	Solar panels that are used on trucks semi-trailers Solar panels used on warehouse roofs
3.	Technologies for digitization of information/documents
	Computer systems/robots that allow processing of various information electronically Electoral document archives for archiving digital documents.
4.	Artificial intelligence
	For customer service To analyze the data

CONCLUSIONS

The study revealed a high adoption rate of advanced technologies in the logistics sector, particularly in smart real-time cargo tracking, document digitization, and route optimization programs. Nearly half of the surveyed companies have also integrated intelligent vehicle technologies and data analysis and predictive modeling systems to enhance safety, efficiency, and cargo flow management. A smaller proportion of companies have implemented advanced technologies for manufacturing automation and customer service using artificial intelligence. Companies have acknowledged that these technologies not only aid in cost reduction and operational optimization but also contribute positively to the advancement of green logistics by reducing emissions and promoting resource efficiency.

This study underscores the significance of advanced technology in the logistics sector for driving innovation, sustainability, and competitive advantage. However, it is imperative to carefully evaluate several aspects before making decisions. Firstly, the financial aspect is crucial, as the implementation of advanced technologies often entails substantial investments. Secondly, maintenance and support costs must be taken into account to ensure system performance and reliability. Thirdly, applicability is essential to ensure that newly introduced technologies are beneficial and effective within the company's existing operating environment. Nevertheless, there is no doubt that the benefits of implementing advanced technologies are substantial for the advancement of green logistics.