

WHAT CRITERIA CAN BE ESTABLISHED FOR THE DEVELOPMENT OF A SUSTAINABLE SUPPLY CHAIN? — A CASE STUDY OF OUTSOURCING IN GREEN LOGISTICS PROCESSES

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Abstract

The utilization of renewable energy sources and the intensification of efforts aimed at reducing environmental burdens constitute fundamental prerequisites for the preservation of the Earth and its ecosystems. These considerations have become increasingly embedded at both societal and economic levels, leading to growing expectations within the business sector for the adoption of so-called “green technologies”, particularly in the context of logistics operations. Such technologies, process reconfigurations, and methodological innovations often require substantial capital investment, which not all firms are capable of undertaking. For these companies, outsourcing represents a viable strategic alternative. This study focuses on the outsourcing of green logistics activities. Its primary objective is to develop a comprehensive set of criteria that facilitates the selection of logistics service providers offering environmentally sustainable logistics solutions. The main contribution of the paper is a weighted scoring model that enables the objective comparison and ranking of green logistics service providers based on a predefined set of environmental and operational performance criteria. This approach support decision-makers in navigating complex outsourcing scenarios by enhancing transparency and rationality in the evaluation process.

Keywords: green supply chain management, green logistics, outsourcing, decision-support

1. Introduction

The rapid, dynamic and large-scaled development of the IT sector is a consequence of the modern age. This has accelerated and changed the world, impacting the business sector in the process. Factors that were previously absent from corporate management criteria have now become priorities for decision-makers. These include reducing environmental impact and adopting green technologies, enabling more and more organizations to take on social responsibility for building a sustainable economy.

The rise of globalization and the outsourcing of various corporate processes for cost efficiency reasons, primarily focusing on logistics activities, has given rise to a new industry: logistics services. This industry brings together companies that perform various logistics processes on behalf of client companies.

The use of green technologies is becoming an increasingly common expectation of partners, customers and society. However, not every company is capable of making the level of investment required to meet these demands. In such cases, outsourcing may be the solution.

This study aims to ensure that, should a company decide to outsource a logistics process, it selects a service provider that operates in accordance with sustainability principles. However, this significantly

complicates an already risky decision-making process, as demand for green technologies and environmental sustainability will become a fundamental criterion. Thus, the study aims to lay a groundwork for a decision-support model that uses a weighted scoring system to provide objective, quantifiable results.

2. Literature review

The transition toward environmentally sustainable logistics processes has become a critical for modern enterprises. One of the primary objectives in logistics is the reduction of emissions, particularly efforts aimed at minimizing greenhouse gas emission. In earlier decades, emission-related considerations were largely confined to transportation activities; however, since the 2000s and 2010s, these concerns have increasingly extended to manufacturing and warehousing processes as well. In many cases, environmentally responsible logistics operations are no longer optional but represent explicit expectations from customers and business partners. Such environmentally conscious logistics activities are commonly referred to as green logistics processes. The following literature review provides an overview of this concept.

2.1. The concept of green logistics

The concept of green logistics emerged as early as the mid-1990s, initially focusing primarily on reducing carbon dioxide emissions originating from transportation activities (Tetteh et al., 2024). As supply chains expanded in scale and complexity, and technological innovations accelerated from the 2000s onward, the field of green logistics gained significant momentum. This trend has been further amplified by the advancements associated with Industry 4.0 and Industry 5.0, which have intensified both academic and practical interest in the topic (Trinh et al., 2025). The growing emphasis on green logistics is largely driven by environmental challenges that became increasingly evident during the early 21st century. Logistics-related carbon dioxide emissions account for approximately 25-27% of global emissions (Adigüzel, 2024), with road transportation – dominated by internal combustion engine vehicles – being a major contributor.

It is therefore not coincidental that, during this period, several international organizations began prioritizing sustainability-related objectives. Frameworks such as ESG (Environmental, Social and Governance) and the SDG (Sustainable Development Goals), supported by organizations like the OECD, aim to promote sustainable economic growth – ensuring that present needs are met without compromising the ability of future generations to meet their own needs (Costea et al., 2025; Ma et al., 2026).

Technological advancements have played, and continue to play, a crucial role in reducing environmental impacts. Digital and smart technologies significantly enhance process optimization, including the mitigation of environmental externalities. The application of IoT sensors enables real-time data collection, which supports emission reduction in transportation, optimizes energy consumption, and enhances transparency across logistics systems and supply chains. These technologies are also widely applied in modern warehouse design, where they contribute to optimizing energy use (Li & Ma, 2022; Vudugula, 2025).

Furthermore, one of the key enablers of Industry 5.0, artificial intelligence (AI), contributes substantially to the development of green logistics processes. AI facilitates route optimization, thereby reducing fuel consumption in road transport. In addition, AI-driven demand forecasting improves accuracy, reducing the risk of overproduction and, consequently, unnecessary energy consumption (Šateikiene & Kovalevskaja, 2026). Real-time tracking systems and automated identification

technologies, such as RFID, help minimize stockouts and overproduction risks, further contributing to efficient resource utilization (Di Nardo et al., 2025; Šateikiene & Kovalevskaja, 2026).

Moreover, the digitalization and automation effects associated with the fourth industrial revolution – particularly through robotics – enhance energy efficiency in logistics operations. The integration of intelligent logistics systems, combined with the processing of large volumes of data, enables the efficient management of inbound logistics, warehousing, order picking, dispatching, outbound logistics, and transportation activities. In this context, the use of electric and alternative-fuel vehicles in transportation further reduces dependence on fossil fuels (Hou et al., 2021).

A growing body of research demonstrates that the implementation of green logistics practices can generate a competitive advantage for firms. Consumer preferences are increasingly oriented toward environmentally friendly products and services; consequently companies that adopt green practices in production or service provision may gain a stronger market position (Tetteh et al., 2024). In the academic literature, green logistics refers to logistics processes in which specific tools, systems, or practices aimed at reducing environmental impact are implemented. These practices can be most clearly illustrated by examining individual logistics activities.

Procurement is considered “green” when companies select suppliers that provide environmentally friendly raw materials or if the supplier itself applies sustainable practices within its operations (Li et al., 2021; Masudin et al., 2022; Štreimikienė et al., 2024).

In the case of production, green manufacturing is characterized by the use of environmentally friendly technologies and the reduction of production waste (Mirzaee et al., 2022; Altarazi, 2025). For instance, several automotive manufacturers have adopted renewable energy solutions, such as solar panels, to support their production and warehousing operations.

Transportation, as a critical function, is considered green when alternative-fuel vehicles are used, when intermodal transport solutions are incorporated into logistics planning, and when route optimization is applied to minimize both travel time and distance (Hou et al., 2021).

The European Union employs several interconnected regulatory and strategic frameworks that encompass climate targets, emission reduction obligations, reporting requirements, and operational standards (Morea et al., 2021; Tóth-Péter et al., 2023).

2.2. About the outsourcing

Companies have the option to outsource certain activities, driven either by cost-reduction objectives or by the lack of adequate technological capabilities required to meet customer expectations. In such cases, outsourcing can represent a viable strategic solution, as it eliminates the need for substantial capital investments. Instead, by selecting an appropriate service provider, firms can effectively address the underlying operational limitations. However, evaluating outsourcing opportunities constitutes a highly complex and multifaceted decision-making problem.

This study provides guidance for such decision context by developing a decision-support framework which, similarly to a structured checklist, facilitates the selection of the most suitable service provider in alignment with green logistics requirements.

The theoretical foundation of outsourcing logistics services is closely related to the 5PL model. According to this framework, as one progresses toward higher levels of logistics service provision, the service provider delivers increasingly comprehensive and sophisticated services. In other words, higher PL levels imply a greater degree of integration between the client and the service provider, as a wider range of more complex logistics activities are outsourced. Consequently, the level of coordination,

information sharing, and operational interdependence intensifies with each successive level (de Souza et al., 2025; McDonald & Nho, 2025).

3. Development of a weighted scoring model for service provider selection

In the scientific literature, several empirical studies have identified a wide range of relevant criteria concerning expectations toward green logistics service providers. During the review of the literature, environmental impacts and the issue of environmental sustainability understandably emerged on numerous occasions as fundamental criteria. In addition, cost and transportation can also be defined as key factors in economic performance (Ameknassi et al., 2016). In the case of green logistics, the issue of service quality is very important – with particular reference here to reverse logistics and its quality (Bajec & Tuljak-Suba, 2016; Vazifehdan & Darestani, 2018). For certain green logistics processes, adequate equipment and technology are essential. Thus, it can be concluded that technological infrastructure must also be part of the criteria system (Banasik et al., 2018; Nila & Roy, 2023). The nature of the partnership and the management of the cooperative relationship are of paramount importance in outsourcing decisions, so they can also be defined as criteria in this context (Vazifehdan & Darestani, 2018; Dang et al., 2025). Building on both practical insights and these scholarly contributions, the researcher developed the following criteria system for the proposed decision-support model (Figure 1).

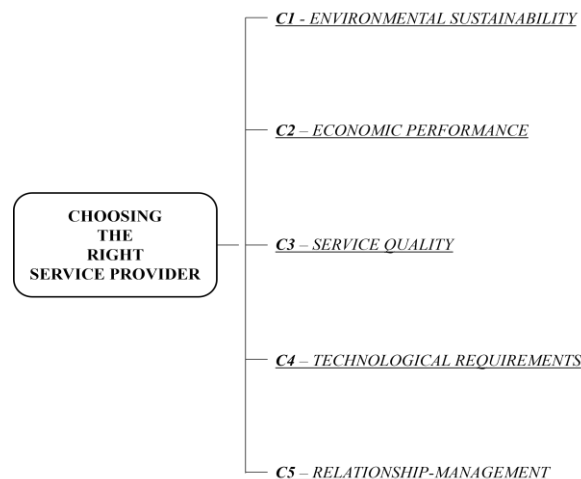


Figure 1. Developed criteria system (source: own construction)

In the figure, criteria are denoted by the letter C, while the two-level numbering structure enables the clear identification of sub-criteria associated with each main criterion. This hierarchical structure allows for the formulation of a more comprehensive and sophisticated requirement system toward prospective logistics service providers, thereby enhancing the overall quality and robustness of the decision-making process. Each sub-criterion category can be assigned a specific performance indicator, which facilitates the definition of minimum threshold requirements for candidate providers. Moreover, these indicators established and objective basis for comparison in the service provider selection process. The potential measurement indicators corresponding to each sub-criterion are summarized in Figure 2.

<u>C1 – ENVIRONMENTAL SUSTAINABILITY</u>	C1.1 – Green processes	→	MegaJoule / unit
	C1.2 – Existence of environmental certifications	→	ISO 14001
	C1.3 – Carbon dioxide emissions	→	gCO ₂ /ton-km
<u>C2 – ECONOMIC PERFORMANCE</u>	C2.1 – Logistics costs	→	Fix cost of warehousing
	C2.2 – Financial reliability	→	Price-fluctuations
	C2.3 – Market presence	→	Years of experience
<u>C3 – SERVICE QUALITY</u>	C3.1 – Quantitative and qualitative accuracy	→	On-time performance rate
	C3.2 – Rate of defective performance	→	Rejection-rate
	C3.3 – Customer satisfaction / References	→	Satisfaction-survey
<u>C4 – TECHNOLOGICAL REQUIREMENTS</u>	C4.1 – IT integration	→	EDI or API application
	C4.2 – Traceability and monitoring systems	→	Real-time tracking system
	C4.3 – Automation	→	Percentage of automated processes
<u>C5 – RELATIONSHIP-MANAGEMENT</u>	C5.1 – Relationship stability	→	Years of constant cooperation with partners
	C5.2 – Communication between partners	→	Reaction-time
	C5.3 – Willingness to share risks	→	Conditions of agreement

Figure 2. Potential measurement indicators of the criteria (source: own construction)

The first dimension encompasses criteria related to environmental sustainability. A fundamental requirement in this dimension is the application of green technologies. Within both warehousing and transportation activities, the proportion of alternative-fuel or low-emission vehicles and material handling equipment relative to the total fleet can be assessed, providing a clear indication of the extent to which a given service provider adopts environmentally friendly technologies. In addition, the presence of environmental certifications constitutes another critical factor, alongside the level of carbon dioxide emissions generated by the company's operational processes and activities.

The second dimension evaluates economic performance, including costs associated with logistics operations such as warehousing, inventory holding, and transportation. Complementing these cost-related factors, financial reliability reflects the operational viability of the firm, while market presence typically indicates a higher level of accumulated experience, which turn suggests greater financial stability and lower risk profile for the service provider. This dimension also includes fixed costs, such as those related to warehouse operations, warehouse maintenance, and human resources.

The third dimension focuses on logistics service quality, incorporating classical – originally supplier-oriented – evaluation criteria. These include delivery reliability in terms of timeliness and quality, the rate of defective or non-conforming deliveries, and customer satisfaction. The latter can be assessed bases on references, such as feedback from current and previous clients.

To ensure effective collaboration, and given the critical importance of green technology adoption in the selection process, the fourth dimension addresses technological capabilities. Specifically, it examines the level of IT integration, the traceability and transparency of the service provider's processes, and the degree of automation within environmentally sustainable technological operations.

The fifth and the final dimension focuses on partnership and relationship management. Key criteria include partnership stability – reflecting the prevalence of long-term collaboration – and the depth of integration between the service provider and its partners. Compliance with ESG principles is also incorporated within this dimension. The social pillar includes guidelines on cooperation with customers, supplier relationships, cooperation with public authorities, and engagement with local communities. This is important in the current situation because reducing emissions can only be achieved as a shared goal. In addition, the quality of communication channels is of fundamental importance, as seamless and

efficient communication between the client and the service provider reduces response times to potential changes or disruptions. Additionally, the willingness to share risks is determined by the contractual terms governing the collaboration.

In the next step, the weighting scheme is established (Figure 3).

<u>C1</u> <u>ENVIRONMENTAL SUSTAINABILITY</u>	30%
<u>C2</u> <u>ECONOMIC PERFORMANCE</u>	25%
<u>C3</u> <u>SERVICE QUALITY</u>	25%
<u>C4</u> <u>TECHNOLOGICAL REQUIREMENTS</u>	10%
<u>C5</u> <u>RELATIONSHIP-MANAGEMENT</u>	10%

Figure 3. Assigned weights (source: own construction)

Based on expert judgement, the environmental dimension receives the highest weight, as it fundamentally determines both the extent and the effectiveness of the service provider's efforts to reduce environmental impact. In essence, this dimension defines the very existence and authenticity of green logistics practices, serving as the primary determinant of whether a provider meets sustainability expectations.

Similarly, service quality is assigned a relatively high weight, as the implementation of green technologies and the client-provider relationship may entail additional costs, which must be justified by an adequate level of service performance.

By contrast, technological capabilities and relationship management factors are assigned lower weight. While these criteria are important in general service provider selection contexts, the primary objective in this case is to identify a provider that explicitly meets green logistics requirements, rather than optimizing across conventional selection dimensions alone.

4. An example of using the weighted scoring model

To illustrate the application of the weighed scoring model, the study presents a simplified case study.

In this example, the researcher outlines a decision-making scenario involving a Hungary-based organization operating in the fast-moving consumer goods (FMCG) sector. The company is a subsidiary of a multinational corporation and operated a nationwide distribution network. Within the management, a key issue has been identified in the form of high carbon dioxide emissions, primarily attributable to road freight transportation activities. In addition, cost containment has emerged as a critical managerial concern.

In response, the management decides to outsource its core logistics activities, corresponding to the third-party logistics level within the logistics service provider model. Three potential service providers are identified as prospective partners.

Service Provider #1 is a Hungary-based small and medium-sized enterprise, capable of offering lower service prices; however, it lacks advanced technological capabilities, particularly in relation to green technologies. Service Provider #2 is an internationally active logistics service provider with extensive experience and highly developed technological infrastructure, but it offers its services at a slightly higher price. Service Provider #3 is a start-up company that allocates significant resources to innovation, resulting in a high level of technological sophistication and the application of advanced environmentally sustainable – green – solutions. Nevertheless, it possesses limited market share and relatively low operational experience.

The developed criteria system is evaluated by the researcher using a five-point Likert scale, because it strikes a good balance between measurability, simplicity, and reliability. The final score is calculated by multiplying the scale values by the corresponding weights assigned to each criterion, thereby enabling the ranking of the service providers. The results of this evaluation are summarized in the following figure (Figure 4).

	<u>C1</u> <u>ENVIRONMENTAL</u> <u>SUSTAINABILITY</u> 30%	<u>C2</u> <u>ECONOMIC</u> <u>PERFORMANCE</u> 25%	<u>C3</u> <u>SERVICE</u> <u>QUALITY</u> 25%	<u>C4</u> <u>TECHNOLOGICAL</u> <u>REQUIREMENTS</u> 10%	<u>C5</u> <u>RELATIONSHIP-</u> <u>MANAGEMENT</u> 10%	<u>WEIGHTED</u> <u>SCORE</u>
<u>SERVICE</u> <u>PROVIDER #1</u>	3	3	3	2	2	<u>2.80</u>
<u>SERVICE</u> <u>PROVIDER #2</u>	4	4	5	5	4	<u>4.35</u>
<u>SERVICE</u> <u>PROVIDER #3</u>	5	2	3	5	4	<u>3.65</u>

Figure 4. The evaluation matrix of the green logistics service provider (source: own construction)

By applying the evaluation matrix, a ranking of green logistics service providers can be established. It is clearly evident from the numerical results that the first, smaller domestic company should not be selected, as it received a low overall score. This outcome is not coincidental: although the firm operates as a relatively stable small enterprise and is capable of offering more competitive pricing, it fails to meet the higher-weighted evaluation criteria. Most notably, it does not adequately comply with environmental sustainability requirements, which largely predetermines its unfavorable performance in the assessment. In parallel, its level of technological requirement does not reach the expected standard, particularly in relation to advanced and environmentally sustainable logistics solutions. Consequently, this logistics service provider can be unequivocally excluded from the selection process. Service Provider #2 achieved the highest overall score; therefore, the rational decision is to initiate cooperation with Service Provider #2. Although Service Provider #3 demonstrates a high level of innovation and employs advanced green technologies, it represents a substantial risk as a start-up enterprise. Its limited market presence, lack of extensive operational experience, and the high costs associated with market entry and innovation translate into higher service fees. In contrast, Service Provider #1 exhibits relatively underdeveloped

technological capabilities, particularly with respect to environmentally sustainable solutions, and thus fails to meet the highest-weighted evaluation criterion, which explains its lower overall score.

Accordingly, Service Provider #2 represents the optimal choice.

5. Summary and future research directions

The weighted scoring system demonstrated through the case study provides a quantifiable and objectively comparable decision-support framework, which can be applied effectively and efficiently when a firm opts to outsource its logistics activities. A defining characteristic of the 21st century business environment is the increasing emphasis placed on reducing the environmental impact of corporate operations. Consequently, it is a realistic expectation that, within outsourcing decisions, compliance with green logistics principles becomes a key selection criterion for logistics service providers. The proposed weighted scoring-based provider selection model offers an initial solution to this complex decision-making problem.

One drawback of the model is subjectivity. The determination of weights can be subjective. This can be avoided if the weights are established through a consensus decision made by a larger group using a group decision-making technique. Additionally, the trade-off effect must be managed, as very poor performance in one category can be offset by very good performance in another. Here, decision-maker preference and consistency are necessary for evaluating the situation. If KPIs are used to populate the individual categories, the model treats them as independent, which also creates the potential for bias. Regardless, the model developed here serves as a suitable starting point for selecting a green logistics partner.

As a direction for future research, the extension and validation of the model are proposed. Through a questionnaire-based empirical study, the research aims to assess corporate commitment to green logistics initiatives, as well as to gain deeper insights into the environmental performance of logistics service providers. This approach enables the alignment of demand- and supply-side perspectives and supports the subsequent validation of the proposed provider selection in a real-world business environment.

References

- [1] Adıgüzel, S. (2024). Green logistics: A bibliometric analysis of the concept scanned in Web of Science in the period 1980–2024. *European Journal of Studies in Management and Business*. <https://api.eurokd.com/Uploads/Article/1159/mbrq.2024.30.05.pdf>
- [2] Ameknassi, L., Aït-Kadi, D., Rezg, N. (2016). Integration of logistics outsourcing decisions in a green supply chain design: A stochastic multi-objective multi-period multi-product programming model. *International Journal of Production Economics*, 182, pp. 165–184. <https://doi.org/10.1016/j.ijpe.2016.08.031>
- [3] Altarazi, F. (2025). Evaluating the Impact of Lean and Green Practices on Operational Performance: A real data-driven simulation case study. <https://doi.org/10.48550/arXiv.2506.17354>
- [4] Bajec, P., & Tuljak-Suban, D. (2016). Identification of environmental criteria for selecting a logistics service provider: A step forward towards green supply chain management. In *Sustainable Supply Chain Management. InTech*. <https://doi.org/10.5772/62533>
- [5] Banasik, A., Bloemhof-Ruwaard, J.M., Kanellopoulos, A. (2018). Multi-criteria decision making approaches for green supply chains: a review. *Flexible Services and Manufacturing Journal*, 30, pp. 366–396. <https://doi.org/10.1007/s10696-016-9263-5>

- [6] Costea, I. D., Blidisel, R.-G., Hategan, C.-D., Imbrescu, C.-M. (2025). ESG-SDG Nexus: Research trends through descriptive and predictive bibliometrics. *Sustainability*, 17 (24). <https://doi.org/10.3390/su172411313>
- [7] Dang, V. L., Wan, S., Guo, J. (2025). Third-party logistics outsourcing: A review of two decades of advancing decision-making approaches with an up-to-date three-layer criteria framework integrating environmental, social, and governance metrics. *International Journal of Production Economics*, 284. <https://doi.org/10.1016/j.ijpe.2025.109615>
- [8] de Souza, N. L. S., Frazzon, E. M., de Oliveria, B. R. (2025). Evolution of logistics service providers: A study of 5 PL. *Industrial Engineering and Operations Management*, pp. 99–110. https://doi.org/10.1007/978-3-031-80785-5_8
- [9] Di Nardo, M., Gallab, M., Murino, T., Wu, J. (2025). Integrating sustainability and Industry 4.0: A framework for sustainable Logistics 4.0. *Circular Economy and Sustainability*, 5 (3), pp. 2157–2195. <https://doi.org/10.1007/s43615-024-00492-1>
- [10] Hou, L., Wang, C., & Yan, J. (2021). Electric vehicle charging scheduling in green logistics: challenges, approaches and opportunities. <https://doi.org/10.48550/arXiv.2103.07635>
- [11] Li, D.-P., Xie, L., Cheng, P.-F., Zhou, X.-H. (2021). Green supplier selection under cloud manufacturing environment: A hybrid MCDM model. *SAGE Open*, 11 (4). <https://doi.org/10.1177/21582440211057112>
- [12] Ma, H., Lu, S., Lee, C. K. M., Moktadir, M. D., Ren, J. (2026). A critical review of environmental, social, and governance (ESG) practices in the transportation sector: How does it contribute to SDGs? *Renewable and Sustainable Energy Reviews*, 229. <https://doi.org/10.1016/j.rser.2025.116654>
- [13] Masudin, I., Umamy, Z., Al-Imron, C. N., Restuputri, D. P. (2021). Green procurement implementation through supplier selection: A bibliometric review. *Cogent Engineering*, 9 (1). <https://doi.org/10.1080/23311916.2022.2119686>
- [14] McDonald, S., Ngo, M. D. K. (2025). Fifth-Party Logistics (5PL): Mastering digital supply chain ecosystems. *Level Up Your Logistics*, pp. 509–546. https://doi.org/10.1007/978-981-95-0533-3_13
- [15] Mirzaee, H., Samarghandi, H., Willoughby, K. (2022). A robust optimization model for green supplier selection and order allocation in a closed-loop supply chain considering cap-and-trade mechanism. *SSRN Electronic Journal*, <https://doi.org/10.2139/ssrn.4236015>
- [16] Morea, D., Fortunati, S., Martiniello, L. (2021). Circular economy and corporate social responsibility: Towards an integrated strategic approach in the multinational cosmetics industry. *Journal of Cleaner Production*, 315. <https://doi.org/10.1016/j.jclepro.2021.128232>
- [17] Nila, B., Roy, J. (2023). A new hybrid MCDM framework for third-party logistics provider selection under sustainability perspectives. *Expert Systems with Applications*, 234. <https://doi.org/10.1016/j.eswa.2023.121009>
- [18] Šateikiene, D., Kovalevskaja, J. (2026). The role of digitalization in implementing green logistics principles in warehousing operations: A case study. *World*, 7 (3). <https://doi.org/10.3390/world7030043>
- [19] Štreimikienė, D., Bathaei, A., Sreimikis, J. (2024). MCDM approaches for supplier selection in sustainable supply chain management. *Sustainability*, 16 (23). <https://doi.org/10.3390/su162310446>
- [20] Tetteh, F. K., Kwateng, K. O., & Mensah, J. (2024). Green logistics practices: A bibliometric and systematic methodological review and future research opportunities. *Journal of Cleaner Production*, 476. <https://doi.org/10.1016/j.jclepro.2024.143735>

- [21] Tóth-Péter, Á., de Oliveira, R. T., Mathews, S., Barner, L., Figueira, S. (2023). Industry 4.0 as an enabler in transitioning to circular business models: A systematic literature review. *Journal of Cleaner Production*, 393. <https://doi.org/10.1016/j.jclepro.2023.136284>
- [22] Trinh, P. T. X., et al. (2025). Green logistics and green supply chain management research: A bibliometric analysis based on Scopus database. *Journal of Science and Development Economics*. <https://doi.org/10.64632/jsde.37.2025.610>
- [23] Vazifehdan, M. N., Darestani, S. A. (2019). Green logistics outsourcing employing multi criteria decision making and quality function deployment in the petrolchemical industry. *The Asian Journal of Shipping and Logistics*, 35 (4), pp. 243–254. <https://doi.org/10.1016/j.ajsl.2019.12.011>
- [24] Vudugula, S. (2025). Sustainable smart supply chains: A review of green technologies and their impact on logistics. *American Journal of Scholarly Research and Innovation*, 4 (1). <https://doi.org/10.63125/1fehce37>