Analysis of Construction Green Logistics in Urban Cities

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Abstract. The promotion and application of green logistics has gradually become a common consensus in modern society. This paper comprehensively discusses various aspects and evaluation methods related to the implementation and impact of construction green logistics in urban cities. Based on the research of some notable cases in Chongqing, several common green logistics strategies were summarized and listed in the paper, and the construction materials carbon emission o with the factors of logistics were calculated based on local samples, and the construction materials were classified by Activity Based Classification (ABC) method. In order to create an enabling environment and promote sustainability in the construction sector, policy approaches and initiatives which can facilitate and incentivize the adoption of construction green logistics practices were proposed. These actions will support public authorities and private initiatives in decisions about the efficiency and economic feasibility of construction green logistics. And some further studies were discussed in this paper.

Keywords: Construction green logistics, Sustainable logistics practices, Evaluation methods, Policy recommendations.

1 Introduction

The rapid growth of urbanization process in China has raised concerns about environmental issues, and researches on green logistics has also been introduced into the construction industry to reduce its impact on the environment [1][2][6]. The green logistics is influenced by several internal and external factors, which could affect the efficiency of green logistics in the construction industry [3]. In order to quantify the impact of various factors on the effectiveness of green logistics, the application quantity of main construction materials products and corresponding carbon emission were calculated. Based on the conclusions of the cases, several practice recommendations were proposed to facilitate and incentivize the construction green logistics.

2 Factors Influencing Construction Green Logistics

Construction green logistics in urban cities are influenced by various factors that shape the efficiency, sustainability, and overall effectiveness of the logistics operations within

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the construction industry [3][7]. These factors can be broadly categorized into internal and external factors. Internal factors refer to the characteristics and practices within the construction industry itself, while external factors result from the broader socio-economic and environmental context in which the industry operates. Understanding these factors is crucial for effectively implementing and promoting construction green logistics in urban cities.

2.1 Internal Factors

The internal factors which influence the construction green logistics mainly are construction methods / techniques, supply chain integration, resource management, and logistics planning / design.

The choice of construction methods and techniques strongly influences the logistics operations and their environmental impact. Innovative construction methods like modular construction, prefabrication, and off-site construction can minimize transportation needs and reduce waste generation. By embracing these methods, construction projects can achieve higher resource efficiency and reduce carbon emissions, ultimately contributing to greener logistics practices.

The level of integration within the construction supply chain greatly affects logistics efficiency. Seamless collaboration and coordination among different stakeholders, such as suppliers, contractors, and subcontractors, can help optimize material procurement, storage, and transportation processes. Efficient supply chain integration reduces unnecessary movement of goods, eliminates delays, and minimizes resource wastage, thereby enhancing the green performance of construction logistics.

Effective resource management practices play a key role in determining the sustainability of construction logistics. Efficient handling, utilization, and conservation of resources, including construction materials, energy, and water, can significantly reduce environmental impacts. Implementing strategies such as waste reduction, recycling, and reuse, as well as adopting energy-efficient technologies, contribute to greener logistics operations and enhance the overall sustainability of the construction industry.

Logistics planning and design decisions profoundly influence the overall performance of construction green logistics. The optimal layout and design of construction sites, warehouses, and transportation routes can streamline material flow, minimize travel distances, and reduce congestion, leading to improved logistics efficiency and reduced environmental burdens. The integration of advanced technologies, such as GPS tracking systems and real-time data analysis, can further enhance logistics planning and decision-making processes.

2.2 External factors

Government regulations and policies play a pivotal role in shaping the green logistics practices in construction industry. Meanwhile, the engagement and awareness of stakeholders, including government agencies, industry associations, construction companies, and the general public, significantly influence the promotion and implementation of construction green logistics.

Technological advancements, such as digitalization, automation, and the Internet of Things (IoT), offer immense opportunities for improving construction green logistics. Advanced technologies enable real-time monitoring, efficient inventory management, predictive analytics, and optimized routing, leading to enhanced logistics efficiency and reduced environmental impact. Moreover, evolution in consumer preferences and increasing market demand for sustainable products and practices are driving construction companies to adopt green logistics. The need to comply with green building certification requirements, such as Leadership in Energy and Environmental Design (LEED) or Green Building Evaluation Label, also motivates construction companies to adopt greener logistics practices

3 Evaluation Methods for Construction Green Logistics

In order to promote sustainability and assess the effectiveness of construction green logistics in urban cities, it is crucial to utilize appropriate evaluation methods. These methods enable stakeholders to measure the outcomes and impacts of green logistics practices, thereby facilitating strategic decision-making processes [8-10].

The evaluation methods used to assess construction green logistics mainly include Key Performance Indicators (KPIs), Life Cycle Assessment (LCA), sustainability indices, and stakeholder surveys/interviews. By employing these methods, stakeholders can measure the environmental, social, and economic impacts of construction green logistics initiatives, thus identifying areas for improvement and promoting sustainable practices in the construction industry.

Above all these methods, KPIs play a vital role in evaluating the efficiency and effectiveness of construction green logistics. KPIs serve as quantifiable measures that reflect the progress and achievements of green logistics practices. Some common KPIs used in practice include carbon emissions, energy consumption, waste generation, delivery time, cost efficiency, etc.

4 Case studies on Implementation of Green Logistics

As a typical urban city in the southwest China, Chongqing is chosen to delve into several cases which are implemented of construction green logistics from several local construction companies and their stakeholders, such as Longfor, Vanke, New Open, Jinke, Dongyuan, etc.

4.1 Typical Green Construction Projects in Chongqing

Several notable cases of green construction project in downtown Chongqing aim to minimize environmental impact throughout the construction processes and ensure the projects' long-term sustainability. Various common green logistics strategies were employed to achieve these goals in all these cases.

Firstly, construction materials were carefully selected, taking into account their recyclability and potential for waste reduction, and a comprehensive waste management system was implemented. Secondly, all these transportation logistics were optimized by coordinating delivery schedules and employing fuel-efficient vehicles. Furthermore, the project embraced innovative construction techniques that enhanced energy efficiency. All the cases show that the functional implementation of these green logistics strategies resulted in a sustainable and environmentally friendly outcome.

4.2 Impact on Integrated Supply Chain Management

As we studied the logistics in these cases, the result shows out that the implementation of integrated supply chain management enhances the overall efficiency and sustainability of the construction logistics process. By adopting just-in-time delivery strategies and digital technologies, the project team collaborated closely with suppliers and contractors to optimize material flows and minimize resource waste. Furthermore, innovative packaging solutions were proved to reduce material waste.

4.3 Carbon Emission of Construction Materials with Factor of Logistics

Based on the production and application characteristics of construction materials products, combined with logistics factors, we select materials with high usage and high carbon emissions in production and manufacturing in construction projects to form a core construction materials list. Four typical cases from residential, official, commercial/business, and industrial projects in Chongqing were chosen as samples for investigation. By calculating the application quantity of main construction materials products and the corresponding carbon emission intensity of building materials products in four sample projects, a comprehensive analysis is conducted to obtain a list of core construction materials with high usage and carbon emissions in construction projects, and their carbon emission distribution is calculated, as shown in Table 1.

Table 1. Construction Materials Carbon Emission Ratio.

Ranking	Types of Construction Materials	Proportion of Carbon Emissions	Activity Based Classification
1	Concrete & Prefabricated Components	33.76%	A
2	Steel & Steel Components	31.19%	A
3	Cement	7.63%	A
4	Mortar	5.94%	B
5	Blocks	5.85%	B
6	Adhesive	4.41%	B
7	Wire and Welding Materials	3.27%	B
8	Plastics for Construction	3.02%	B
9	Wood	2.91%	C
10	Glass, Ceramics, Insulation/Waterproofing Materials, and Others	2.02%	C

The results in Table 1 indicate that concrete, steel, and cement, take up over 70% of the carbon emissions of the whole main construction materials. According to the ABC

classification method, these three types of materials are classified as Class A building materials.

5 Recommendation for Construction Green logistics

As we studied the cases of construction green logistics in Chongqing, there are still many areas need further improvement. Based on the effective operations and exposed deficiencies [4][5], several recommendations can be made for construction green logistics in urban cites. These recommendations aim to create a supportive regulatory environment, incentivize sustainable practices, and encourage collaboration among stakeholders. The following recommendations are proposed:

5.1 Set up a Classified Regulatory Framework

To ensure the effective implementation of construction green logistics practices, it is vital to establish a comprehensive regulatory framework. The government should develop specific regulations and guidelines that address the unique challenges and opportunities. These regulations should focus on reducing emissions, improving energy efficiency, and promoting sustainable transportation practices. By introducing clear guidelines and standards, construction companies will have a better understanding of the requirements and expectations for adopting green logistics practices.

And base on the analysis of the carbon emissions of the whole main construction materials, there are fewer categories of Class A materials, but their carbon emissions are higher, so the more rigorous monitor and control measures should be taken. And materials in Class B are in the middle categories and have high carbon emissions, which should be moderately controlled. There are many categories of Class C materials, but their carbon emissions are low, which can be easily controlled.

5.2 Encourage Collaboration among Stakeholders

Promoting construction green logistics requires collaboration among various stakeholders, including construction companies, suppliers, logistics providers, and government agencies. The government should facilitate the formation of partnerships and platforms for knowledge sharing and collaboration. This could be achieved through the establishment of industry associations, organizing regular workshops, and creating online platforms to share best practices and success stories. By fostering collaboration, stakeholders can learn from each other's experiences and work together to address common challenges.

5.3 Provide Multiple Incentives and Support

To encourage construction companies to adopt green logistics practices, the government should provide financial incentives and support. This could include tax incentives,

grants, subsidies, and low-interest loans for companies investing in eco-friendly technologies and infrastructure. Financial support can help offset the initial costs associated with adopting green logistics practices and make them more economically viable for construction companies. Additionally, the government can collaborate with financial institutions to develop special financing programs tailored specifically for green logistics initiatives.

Moreover, raising awareness among construction companies and workers about the benefits of green logistics is crucial for driving adoption. The government should invest in educational campaigns and training programs to familiarize stakeholders with sustainable practices, technologies, and techniques. These programs can include seminars, workshops, and online training modules to educate construction professionals about the environmental and economic advantages of green logistics. By enhancing awareness and providing training, the government can facilitate a shift in mindset towards embracing sustainability.

6 Summary

Based on research of notable cases in Chongqing, this paper comprehensively discusses various aspects and evaluation methods related to the implementation and impact of construction green logistics in urban cities. Promoting construction green logistics in urban cities requires a multi-faceted approach that combines regulatory measures, financial incentives, stakeholder collaboration, awareness campaigns, and research and development efforts. By implementing these recommendations, a favorable environment for the adoption of sustainable logistics practices can be established.

References

1. Sakis J, Meade LM, Talluri S., E-logistics and the natural environment, Supply Chain Management, 2004, 9(3/4), pp.303-312.
2. Mollenkopf DA, Closs D., The hidden value in reverse logistics, Supply Chain Management Review, 2005, 9(5), pp.34-43.
3. Karaman, A. S., Kilic, M., and Uyar, Green Logistics Performance and Sustainability Reporting Practices of the Logistics Sector: The Moderating Effect of Corporate Governance, Journal of Cleaner Production, 2020, pp.258.
4. Reddy K. N., Kumar A., Choudhary A., et al., Multi-period green reverse logistics network design: An improved Benders-decomposition-based heuristic approach, European Journal of Operational Research, 2022, pp.303.
5. B. Liu, S. Z. Wang, Z. X. Xie, J. Zhao and M. Li, Ship recognition and tracking system for intelligent ship based on deep learning framework, TransNav the International Journal on Marine Navigation and Safety of Sea Transportation, 2019, 13(4), pp.699-705.
6. Al-Minhas U., Ndubisi N. O., Barrane F. Z., Corporate environmental management: A review and integration of green human resource management and green logistics, Management of Environmental Quality An International Journal, 2020, ahead-of-print.
7. Brito M., Dekker R., A framework for reverse logistics, Berlin, Springer, 2004, pp3-27.

8. P. Sureeyatanapas, P. Poophiukhok and S. Pathumnakul, Green initiatives for logistics service providers: An investigation of antecedent factors and the contributions to corporate goals, J. Cleaner Prod., 2018, 191, pp.1-14.
9. Xiaoyan W, Qiang D., Cheng L., et al., Exploration in carbon emission reduction effect of low-carbon practices in prefabricated building supply chain, Journal of Cleaner Production, 2022, 368.
10. Tawfik Alqadami, A., Abdullah Zawawi, N. A. W., Rahmawati, Y., Alaloul, W., and Faisal Alshalif, A., Key Success Factors of Implementing Green Procurement in Public Construction Projects in Malaysia. IOP Conf. Ser. Earth Environ. Sci., 2020, 498.