

An Investigation of the Environmentally Sustainable Urban Supply Chain and the Latest Developments in Transportation Solutions for E-Commerce

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Abstract: *The proliferation of e-commerce has led to an increase in urban freight traffic, resulting in undesirable consequences such as noise, pollution, congestion, habitat loss, and emissions. Efforts are being made to make urban last-mile (LM) deliveries more environmentally friendly. However, there is a lack of integration between current research trends and solutions in the relevant literature. This report identifies patterns and research gaps in the field of environmentally friendly last-mile deliveries in the urban e-commerce industry by conducting a literature review using the Systematic Review and Meta-Analysis (SRL) methodology. Similarly, the online business market presents its flow study findings and strategies that enhance its ecological sustainability. The conclusions provide a precise and comprehensive summary of the study on environmentally friendly last-mile e-commerce deliveries in cities. They identify areas of research that need further investigation and highlight current and emerging research interests worldwide. The areas of momentum research, ICT and innovative solutions, customer behavior, and performance evaluation appear to have received insufficient attention in terms of study and analysis. Essentially, it is a comprehensive source of information and guidelines regarding the latest advancements in the solution for last-mile e-commerce deliveries in urban areas. This resource can assist local governments, freight operators, and other stakeholders in enhancing the sustainability of their last-mile integrated operations.*

Keywords: environmental conservation, e-commerce, environment, last-mile shipping, metropolitan delivery, green final mile, systematic literature review

I. INTRODUCTION

As per the United Nations, about 55% of the global population presently resides in urban areas, and this percentage is projected to increase to 68% by the year 2050. In Europe, the proportion of the people residing in urban regions is considerably higher than the global average of 74.5%. The relationship between urbanization and trade is evident. The growing urban population, particularly those with high incomes, has led to a surge in the need for housing, services, and goods. The expansion of retail commerce, primarily in conventional physical stores but increasingly in virtual stores as well, has been propelled by the consumer's need for merchandise. Products can be acquired from any location in the digital realm, and following their global shipment, they are ultimately delivered to the end consumer, usually residing in urban areas. In 1992, the National Science Foundation removed its restriction on the commercial utilization of the internet, leading to the significant growth of e-commerce in 1993. The most challenging aspect of this progression, known as last-mile delivery, appears to be the one with the highest costs, inefficiencies, and environmental impact. Since then, internet usage has experienced a worldwide increase. The global percentage is projected to be 63.2% in 2020, with Europe accounting for 87.2%.

The infrastructure is improving, particularly in terms of connection speed and access to broadband internet. The popularity of e-commerce has increased due to advancements in smartphone capability. Streamlining the checkout and payment process, as well as improving delivery efficiency, are especially important in response to the changing shopping patterns and the increasing revenue generated from online commerce. E-commerce sales experienced an almost threefold growth from 2014 to 2019. The proportion of online sales in the United States has increased from 5.1% in 2007 to 21% of all retail purchases. By the year 2030, there will be a significant 78% rise in the need for last-mile delivery services, leading to a corresponding 36% increase in the quantity of delivery trucks across 100 cities globally. Furthermore, the COVID-19 epidemic facilitated the exponential expansion of e-commerce. Online shopping, like any human activity, has environmental consequences, particularly in urban areas where most people reside. Logistics services, including last-mile deliveries of online shopping, are a significant cause of increased emissions. A third increase is expected. Furthermore, it is expected that the congestion caused by last-mile deliveries will rise by 21% by the year 2030.

Hyperbolic discounting, which refers to the tendency to prioritize smaller incentives that persist longer above larger benefits that also last longer, appears to be a cognitive trait that could have detrimental outcomes, despite its historical role in human survival. The environment suffers significant damage due to the allure of convenience, effortless online shopping, and a high frequency of product returns. Many individuals tend to overlook the potential long-term consequences of their activities, particularly in relation to the environment. Nevertheless, certain studies indicate that online shopping may have a more positive impact on the environment compared to traditional shopping, particularly for non-food items. This is mostly due to the reduction in CO₂ emissions resulting from home delivery. Undoubtedly, the rise in last-mile delivery resulting from the growth of the e-commerce industry has an adverse effect on the environment. Although there is increasing interest in studying last-mile logistics, there has been a lack of applied research specifically focused on reducing the environmental impact of e-commerce last-mile delivery. Consequently, the e-commerce industry necessitates environmentally friendly solutions for the final leg of delivery.

Based on the examination of relevant literature, it has been shown that there is a lack of coherence in how current trends and solutions for ecologically sustainable last-mile deliveries are presented in the city-based e-commerce sector. Consequently, the understanding of the most crucial research topics and ecologically sustainable solutions for urban last-mile e-commerce delivery is hindered. The previous contributions primarily emphasize the conceptual framework or the engineering management perspective, neglecting the issues pertaining to environmental regulations. The majority of these articles focus on cost reduction rather than environmental conservation. The sole review that examines the ecological impacts of e-commerce encompasses the body of work until 2014. Subsequently, a multitude of research have been conducted on ecologically sustainable last-mile delivery, so creating fresh prospects for environmentally conscious deliveries. Furthermore, there has been no assessment of the ecological consequences of e-commerce last-mile deliveries that are only limited to urban regions. The objective of this article is to evaluate the current state of research on environmentally friendly last-mile delivery in metropolitan regions of the e-commerce sector. Additionally, it aims to identify patterns and places where further study is needed, using the SRL technique.

II. LITERATURE REVIEW

The concept of sustainable development has garnered significant interest from researchers, members of society, and politicians. The UN Brundtland Commission, responsible for formulating the main idea, described sustainable development as "development that satisfies the requirements of the current generation without jeopardizing the capacity of future generations to fulfill their own needs." The goal of the commission's founding was to tackle the increasing worry regarding the rapid deterioration of the human environment and natural resources, as well as the resulting ramifications for economic and social development. All definitions of sustainable development emphasize the importance of integrating the three core components: social fairness, economic expansion, and environmental protection. These components are often referred to as the three pillars of sustainable development. Environmental issues play a crucial role in defining sustainable development and are sometimes referred to as environmental sustainability. This is a reply to concerning reports regarding the condition of the natural environment on a global scale. The word emphasizes the conservation of limited natural resources and the maintenance of environmental health. This principle ensures that human activities do not cause any damage to the planet's land, air, or water resources. It recognizes that

human activities can cause substantial adverse impacts on the environment, including ozone depletion, greenhouse gas emissions, waste generation, biodiversity loss, and pollution. The challenges related to addressing environmental externalities and promoting environmentally conscious practices have garnered considerable focus in the quest to create more sustainable cities. This attention often revolves around logistical operations, particularly in the context of green logistics and e-commerce market last-mile deliveries.

City logistics encompasses the transportation of goods for the final leg of delivery. Urban areas predominantly rely on road freight transport as the primary form of transportation, which is also accompanied by the most significant negative environmental impacts during the delivery process. Last-mile delivery in urban areas is responsible for increased traffic, congestion, noise, and air pollution. It also exposes the divergent interests of players involved in city logistics, such as corporate entities (logistics operators, haulage and shipping corporations), public organizations, non-governmental organizations (NGOs), and the general public. While the motivations of private corporations are clear, those of public authorities or the broader public are less apparent. Despite studies showing that customers have a significant preference for home delivery, it seems that e-commerce customers have only recently started to acknowledge the environmental consequences of last-mile e-commerce deliveries. The quickest delivery option is highly favored. Nevertheless, there is an observable pattern that suggests that certain customers will opt for an ecologically conscious delivery option when provided with information.

The key factors that impact the environment and organization are stakeholder pressure, environmental regulations, company size, industrial sector, geographical location, internationalization, position in the value chain, strategic attitude, managerial attitudes and motivations, manager characteristics, and human resources. Studies on the determinants that drive businesses to adopt more ecologically sustainable practices often incorporate these aspects. The objective of this study is to perform a systematic assessment of scientific literature on environmentally friendly last-mile delivery in urban e-commerce markets. This study outlines areas of research that have not yet been explored in this particular sector and provides an overview of the current directions that research is taking. The bibliographic study was conducted using the VOSviewer software. The research encompasses English conference papers that have been published in peer-reviewed journals from two databases: Scopus and the Web of Science. These databases offer a vast amount of research on the challenges related to green last-mile delivery that impact the urban e-commerce sector. To effectively analyze, cluster, and map the abundance of papers and publications from various sources worldwide, a meticulously planned strategy is essential. In this regard, the approach proposed by Tran-field was employed to obtain a comprehensive overview.

Analysis and Guidance for Subsequent Research

1: This approach has been extensively employed in the field of social sciences. Despite being a form of collaborative solution, the author argues that crowd shipping is important enough to be considered as a distinct trend in future study on advancing environmentally-friendly e-commerce delivery. Crowd shipping, which refers to the utilization of crowdsourced individuals for last-mile deliveries in the context of e-commerce, has gained attention in recent years. Although the first academic articles on this topic were published in 2017, they have already received significant recognition and are frequently referenced. The concept of crowdsourcing is examined in scientific literature, specifically in relation to public transportation passengers, private automobile owners, bike owners, and neighbours. Additionally, business professionals also employ crowdsourcing strategies.

2. Customer behavior, both in online and physical retail settings, has been a topic of scientific inquiry for several years. Recent developments have focused on modeling customer behavior to encourage other parties to adopt sustainable techniques for last-mile e-commerce deliveries. The behavior of end-users can greatly influence the selection of an environmentally responsible distribution channel, which in turn can either contribute to or reduce environmental pressures. The present study investigates this behavior from an economic perspective, without taking into account environmental considerations. Exploring methods to enhance customers' knowledge of purchasing and delivery choices seems to be a potential field for further investigation, given the concerning status of the environment. This involves integrating the delivery organization with marketing and psychology.

3. The utilization of Information and Communication Technology (ICT) and intelligent solutions for the secure and cost-effective delivery of items purchased online is emerging as a recommended area of research. Evangelista

discovered a lack of studies on how ICT tools might assist in promoting environmentally friendly actions by third-party logistics providers (3PLs). The implementation of ICT and smart solutions in urban last-mile deliveries seems to be in its early stages.

4. Insufficient attention is given to the subject of utilizing ICT techniques to enhance the environmental sustainability of urban LM e-commerce delivery. The Internet of Things, big data, and sensors integrated into infrastructure and cars facilitate immediate monitoring of various aspects, such as fuel consumption, wear and tear of components and spare parts, product temperature, driver working time, and pollution. Thus, by implementing enhanced route planning, fleet management, and traffic control, as well as utilizing information and communication technology (ICT) in decision support systems, energy-saving technologies, and big data analysis, it is possible to greatly enhance the sustainability of last-mile (LM) e-commerce deliveries and minimize negative environmental impacts. In order to enhance the environmental sustainability of LM e-commerce delivery in metropolitan regions, it is imperative to explore these potential options. Consequently, the author suggests conducting further investigation in this field.

5. The evaluation of performance is becoming increasingly difficult due to the expanding range of methods and techniques available for delivering online-purchased items to clients in urban areas, as well as the constraints posed by economic, social, and environmental factors. Previous assessments have emphasized the importance of creating performance assessment measures for third-party logistic service providers. Similarly, a limited number of studies also examine the topic of environmentally sustainable urban last-mile e-commerce deliveries.

6. The analysis revealed a substantial number of research publications focused on green vehicles, such as bicycles, electric vehicles, and public transit. It also indicated a growing interest among scholars in this field. The environmental friendliness and cost-effectiveness of electric vehicles are still subjects of controversy. Alternative possibilities are being considered, such as employing bicycles for the purpose of delivering services or utilizing public transportation to move goods. To summarize, the primary focus of research lies on optimizing last-mile delivery, with green cars being the subsequent area of interest. The transition towards stakeholder management is apparent, as prior submissions have indicated. Extensive research has been conducted on stakeholder collaboration, leading to numerous publications. The examination of alternative distribution locations is the subsequent crucial field of investigation. The assessment has identified the issue of access constraints as the next subject of inquiry. Furthermore, there is a comparable amount of interest shown in crowd logistics, customer behavior, and performance evaluation.

III. CONCLUSION

The author aims to advance literature studies by doing empirical research on green last-mile delivery in the e-commerce business, specifically focusing on customer behavior trends. The field of information and communication technology (ICT) and intelligent solutions has the lowest number of published works. Additionally, it would be intriguing to examine the challenges faced by rural last-mile delivery in the e-commerce industry and compare them to those encountered in urban areas. It has the potential to uncover common concerns across all areas and how they are resolved. Finally, it is important to identify a few limitations. Despite making every conceivable effort to ensure a comprehensive review, it is likely that certain papers may have been inadvertently omitted. The arrangement of the keywords and the constituents of the search term may also serve as a constraint. Although researchers examined the selection of keywords, it is likely that the search overlooked certain relevant contributions due to the structure of the search phrase and the utilization of search operators. Furthermore, the search was limited to collecting papers and research articles published in English in academic journals. Consequently, works that could have been pertinent in different languages may have been disregarded. Another notable constraint is that several publications in the analyzed set did not exclusively focus on e-commerce deliveries. This was done to ensure the inclusion of the widest range of papers on the environmental effects of last-mile e-commerce delivery in metropolitan settings. However, they were included in the examined set as long as LMe-commerce was included. Notwithstanding these restrictions, the author firmly believes that the essay offers a precise depiction of the research on the influence of environmentally friendly last-mile deliveries on the urban e-commerce sector. Consequently, the findings of the analysis are considered definitive.

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