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## The Benefits and Challenges of Last-Mile Delivery: A Review

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### Abstract

*Last-mile delivery, the final step in the logistics process where goods are transported from a distribution centre to the end customer, plays a pivotal role in the e-commerce and retail industries. This phase significantly influences customer satisfaction and operational efficiency. This study explores the critical aspects of last-mile delivery, highlighting its impact on the supply chain and the evolving strategies to mitigate associated challenges. The research follows a literature review-based methodology, aimed at synthesizing existing knowledge on the benefits and challenges of last-mile delivery. This qualitative approach involves systematic identification, evaluation, and synthesis of relevant literature to provide a comprehensive understanding of the topic. The findings of the study suggest that the benefits of last-mile delivery include enhanced customer convenience, faster delivery times, and the potential for increased brand loyalty. However, it also presents numerous challenges such as high operational costs, logistical complexities in urban areas, and environmental concerns. Balancing the advantages and difficulties requires innovative solutions like the use of advanced technologies, optimized routing algorithms, and sustainable delivery methods.*

**Key Words:** Customer satisfaction, E - commerce, Last-mile delivery, Logistics, Operational efficiency, Urban logistics, Environmental impact

### 1. Introduction

Last-mile delivery, the final leg of the supply chain journey where goods are transported from a transportation hub to the end customer, has gained significant attention in the logistics and supply chain sectors. This stage is critical because it directly affects customer satisfaction and operational efficiency. The surge in e-commerce and consumer demand for faster delivery times has made last-mile delivery more prominent and challenging than ever before. Last-mile delivery, the final step of the delivery process from a distribution centre or facility to the end user, has become a focal point in the logistics and supply chain industry. With the rise of e-commerce and the increasing demand for fast and reliable shipping, the importance of efficient last-mile delivery cannot be overstated. This crucial phase of delivery plays a significant role in customer satisfaction and retention, impacting a company's reputation and bottom line. However, while last-mile delivery offers several benefits such as enhanced customer service and competitive differentiation, it also presents substantial challenges. These challenges include high operational costs, logistical complexities, and environmental concerns. Understanding the benefits and challenges of last-mile delivery is essential for businesses aiming to optimize their delivery processes and meet the evolving expectations of consumers.

### 1.2. Processes Involved in Last-Mile Delivery

#### ➤ Order Processing

Once an order is placed online, it is processed at the retailer's warehouse. The order details are verified, and items are picked, packed, and labelled for shipping.

➤ **Transportation to Local Distribution Centre**

The packaged order is transported from the central warehouse to a local distribution centre or a hub closer to the delivery destination. This step is essential for reducing delivery times and managing inventory efficiently.

➤ **Route Planning and Optimization**

Advanced algorithms and software are used to plan the most efficient delivery routes. Factors like traffic conditions, delivery windows, and vehicle capacity are considered to minimize delivery times and costs.

➤ **Sorting and Loading**

At the local distribution centre, packages are sorted according to delivery routes. They are then loaded onto delivery vehicles, which could range from trucks and vans to bicycles and electric scooters, depending on the delivery area.

➤ **Final Delivery**

The delivery personnel transport the packages to the customers' addresses. This step may include additional services like in-home delivery, delivery to lockers, or curb side pickup.

➤ **Proof of Delivery**

Once the package is delivered, proof of delivery is collected, which may include a signature, photo confirmation, or a GPS timestamp. This ensures accountability and provides confirmation to the sender and receiver.

### 1.3. Research Objectives

- To identify key factors in last-mile delivery that significantly impact customer satisfaction.
- To assess how delivery speed, reliability, flexibility, and communication influence customer loyalty and retention.
- To study the logistical hurdles faced in urban and rural areas, such as traffic congestion, delivery density, and infrastructural limitations.
- To highlight the effectiveness of different logistical strategies in overcoming these challenges.

## 2. Review of Various Literatures

The literature evaluation for this work was meticulously curated to offer a thorough grasp of the benefits and challenges of effective last-mile delivery services. A methodical strategy was used to identify relevant papers and research that provide important insights into this issue. The selection procedure included examining academic databases, such as MEC e-Library and Google Scholar, for terms relating to last-mile delivery, customer satisfaction, cost-effectiveness, and environmental sustainability.

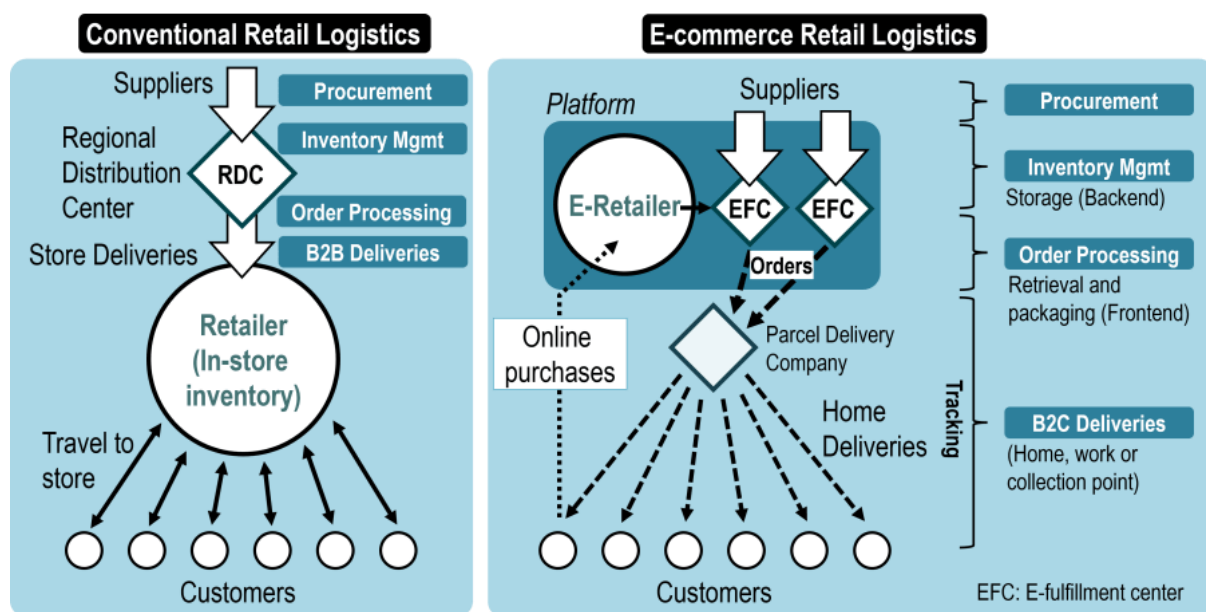
The articles were chosen based on their relevance to the study aim and research objectives, as well as their legitimacy and academic rigour. Peer-reviewed publications and trustworthy sources were prioritised to ensure the accuracy and trustworthiness of the material offered in the literature review. Furthermore, studies with empirical data and case studies were preferred since they provided real-world examples of the benefits of effective last-mile delivery services.

The literature review is organised to emphasise major themes and conclusions from the selected publications, resulting in a thorough overview of the current state of knowledge in this topic. This study attempts to fill gaps in the literature and provide new insights to our understanding of effective last-mile delivery services by synthesising and analysing current information.

## 2.1 The Importance of Last-Mile Delivery

Last-mile delivery, or the final stage of the supply chain process in which items are transferred from a distribution centre to the end customer's location, is critical to customer happiness and corporate success (Bates et al., 2018). It is the customer's final encounter with a company, thus their experience at this point can have a significant influence on their view of the total service. E-commerce has an influence on logistics, notably in the business-to-consumer market.

In a traditional retail supply chain, customers must purchase their items at the retailer's location. They are adopting the "last mile" of freight distribution by going to the store and returning with their own purchases. However, the development of e-commerce has challenged the old approach. E-commerce allows people to make purchases online and have them delivered to their door (Rodrigue, 2024). This shift in consumer behaviour has created an increased need for quick and dependable last-mile delivery services, making a great impact on last mile-logistics. In order to meet this newly created high standards of customer expectations, logistics solutions providers companies must focus on last-mile delivery quality and efficiency.



*Figure Error! No text of specified style in document..1: Difference Between Conventional and E-Commerce Retail Logistics (Rodrigue, 2024)*

## 2.2 The Benefits of Efficient Last-Mile Delivery Services

Efficient last-mile delivery services play an important part in corporate success, delivering a range of benefits that favourably affect customer satisfaction, cost-effectiveness, inventory management, and market reach.

**a. Increased customer satisfaction:** Timely and consistent delivery are critical to guaranteeing client satisfaction. According to a McKinsey & Company survey, 25% of customers are prepared to pay a large premium for same-day or quick delivery (Joerss et al., 2016) and a study by Capgemini Research Institute states that 55% of customers will switch to retailers or brands that offer faster deliveries (Jacobs et al., 2019). These statistics are on the rise given the continuous advancement of e-commerce over the years. Efficient last-mile delivery ensures that items reach clients in a timely way, resulting in a great customer experience (Datta, 2018). This can lead to repeat purchases, favourable feedback, and improved consumer loyalty.

**b. Cost reduction or cost effectiveness:** Efficient last-mile delivery helps organisations cut expenses in a variety of ways. One of the primary methods is to optimise delivery routes. Businesses can use route optimisation software to lower fuel consumption and labour expenses connected with delivery (Datta, 2018).

Furthermore, effective last-mile delivery can help avoid costly fines for late deliveries or missed time frames, resulting in cost savings.

**c. Improved inventory management:** Efficient last-mile delivery is critical to improved inventory management. Businesses may limit the risk of stockouts and overstocking by ensuring that items are delivered on time. This can result in cheaper inventory holding costs and increased cash flow (Krajewski et al., 2016). Furthermore, effective last-mile delivery enables organisations to better track and manage their inventories, resulting in higher overall supply chain efficiency (Krajewski et al., 2016).

**d. Expanded market reach:** Efficient last-mile delivery allows firms to access a bigger market by expanding their delivery options to additional places. This may be especially useful for organisations wanting to enter new geographic areas or target new client demographics. Businesses that provide timely and dependable delivery services can attract new consumers and expand their market share.

**e. Environmental sustainability:** Efficient last-mile delivery can help to improve environmental sustainability by lowering the carbon footprint of delivery operations (Ranieri et al., 2018). Businesses may reduce greenhouse gas emissions and their environmental effect by optimising delivery routes and utilising eco-friendly vehicles (Ranieri et al., 2018). This can help firms achieve their sustainability objectives and contribute to a greener future.

**f. Competitive advantage:** Efficient last-mile delivery may provide organisations a competitive advantage in the marketplace (Jacobs et al., 2019). Businesses may differentiate themselves and gain more clients by providing better delivery experiences than their competition. This might result in greater market share and profitability.

### 2.3 Challenges Faced in Last-Mile Logistics

Various literatures have explored the challenges associated with achieving an efficient last-mile delivery. Some of those challenges are:

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Challenge	Description	Source
Congestion	Traffic congestion not only causes delivery delays, but it also increases fuel consumption and carbon emissions.	(McKinnon et al., 2015) (Ranieri et al., 2018)
Delivery Time Windows	Tight delivery time windows can be difficult to achieve, especially in congested metropolitan regions with limited access and parking and unpredictable circumstances during freight deliveries.	(Boyer et al., 2009) (Deflorio et al., 2012) (Figliozzi & Tipagornwong, 2017)
Cost Pressure	Rising fuel prices, labour expenses, and increased consumer expectations for free or low-cost delivery all put pressure on companies to optimise their delivery operations. Balancing cost-effectiveness and service quality is an ongoing problem for logistics managers.	(Ranieri et al., 2018) (Olsson et al., 2019)
Urbanisation	Urbanisation leads to increased delivery volume and restricted room for delivery vehicles. As more people migrate into metropolitan areas, delivery routes grow more complicated, resulting to increased prices and longer delivery times.	(Boyer et al., 2009)
Embracing Sustainability	Businesses face growing pressure to lessen their environmental effect. Greenhouse gas emissions from delivery trucks contribute to climate change, and there is an increasing need for environmentally friendly delivery methods.	(Bates et al., 2018)
Managing Customers' Expectations	Managing customers' expectations is difficult, especially given the development of e-commerce and the desire for quick and dependable deliveries.	(Jacobs et al., 2019)

Coordinating with Multiple Stakeholders	Last-mile logistics frequently includes several stakeholders, such as merchants, logistics providers, customers, and local governments. It can be challenges to coordinate with all these entities.	(Gonzalez et al., 2023)
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Other challenges include overcoming logistical complexities, ensuring visibility throughout the process, choosing the right delivery method, and achieving cost efficiency.

## 2.4 Strategies for Overcoming Last-Mile Delivery Obstacles

Several factors, such as traffic congestion, expensive delivery costs, and rising consumer demands, might impede efficient last-mile delivery. However, businesses may use a variety of tactics to overcome these challenges and enhance their last-mile delivery operations.

- 1. Route optimisation:** Businesses may use advanced routing software and algorithms to design more effective delivery routes that save trip time, fuel consumption, and vehicle wear and tear (Bakogianni & Malindretos, 2021). This technique not only lowers expenses, but it also increases delivery speed and customer satisfaction.
- 2. Technology integration:** Integrating technology into last-mile delivery operations may help overcome challenges including communication delays and ineffective tracking systems. Real-time tracking and Global Positioning System (GPS) navigation systems, for example, enable vehicles to alter routes based on traffic conditions, increasing delivery efficiency and dependability (Karlı & Tanyaş, 2024). Furthermore, mobile applications may give clients with real-time delivery updates, which improves transparency and satisfaction.
- 3. Alternative delivery options:** Offering alternative delivery choices, such as click-and-collect services or parcel lockers, can assist companies overcome delivery schedule constraints and client availability (Filiopoulou et al., 2022). These solutions provide clients greater flexibility and convenience, lowering the risk of missed deliveries and increasing overall delivery efficiency.
- 4. Collaborations and partnerships:** Collaboration with other firms and logistics partners can assist solve last-mile delivery challenges by pooling resources and infrastructure. Businesses, for example, might collaborate with local merchants or delivery providers to use their existing networks and lower delivery costs (Gonzalez et al., 2023). Partnerships with technology suppliers can also help firms gain access to advanced delivery management systems while improving operational efficiency.
- 5. Sustainable practices:** Implementing sustainable practices in last-mile delivery operations can help organisations overcome environmental and regulatory challenges. For example, employing electric cars or bicycles for delivery can lower carbon emissions and enhance urban air quality (Bates et al., 2018). Implementing green delivery strategies, such as route and package optimisation, can also assist minimise waste and increase overall sustainability.

## 2.5 Future Trends in Last-Mile Delivery Solutions

The last-mile delivery industry is quickly expanding, propelled by technological breakthroughs, shifting customer tastes, and the demand for more sustainable logistical methods. Several future developments are predicted to impact the last-mile delivery environment, presenting new solutions and possibilities for companies in this industry.

- 1. Data analytics and Artificial Intelligence (AI):** Data analytics and artificial intelligence (AI) are predicted to transform last-mile delivery by providing more precise demand forecasting, route optimisation, and consumer behaviour analysis (Akdogan & Ozceylan, 2021). These technologies can help organisations increase delivery efficiency, lower costs, and improve the entire customer experience.
- 2. Autonomous vehicles:** Autonomous vehicles, such as drones and self-driving delivery robots, are projected to play an important part in last-mile delivery in the future. These trucks can negotiate traffic more effectively, reducing delivery times and operational expenses for businesses (Alverhed et al., 2024).

3. **Micro-fulfilment centres:** Micro-fulfilment centres, which are small warehouses located closer to metropolitan areas, are becoming more popular for last-mile deliveries. These centres speed up order processing and lower the distance travelled by delivery trucks, resulting in more efficient and sustainable delivery operations (Yang et al., 2024).
4. **Sustainable delivery practices:** Sustainability is becoming increasingly important in last-mile delivery, with companies using eco-friendly practices such as electric cars, reusable packaging, and alternate delivery methods (Bates et al., 2018). These approaches not only minimise environmental damage, but also appeal to environmentally aware customers.
5. **On-demand delivery services:** Consumers who anticipate fast and easy delivery alternatives are increasingly turning to on-demand delivery services, which are powered by smartphone apps and real-time tracking (Jacobs et al., 2019). These services are flexible and convenient, allowing clients to arrange delivery at their leisure.

### 3. Research Methodology

The research followed a literature review-based methodology, aimed at synthesizing existing knowledge on the benefits and challenges of last-mile delivery. This qualitative approach involved systematic identification, evaluation, and synthesis of relevant literature to provide a comprehensive understanding of the topic. Key databases such as Google Scholar, JSTOR, PubMed, IEEE Xplore, and Scopus were used to locate peer-reviewed journal articles, conference papers, and dissertations. Relevant books that provide in-depth analysis and theoretical insights were also consulted. A combination of keywords such as "last-mile delivery," "logistics," "e-commerce," "customer satisfaction," "operational efficiency," "urban logistics," and "environmental impact" were used to search for the relevant articles. Studies published in the last ten years, focusing on last-mile delivery, and available in English were utilized. Non-peer-reviewed articles, studies not focused on last-mile delivery, and articles without accessible full texts were excluded. Titles and abstracts were reviewed to filter out irrelevant studies. After that key information were extracted, including study objectives, methodologies, findings, and conclusions. Extracted data were organized using a reference management tool like Zotero or EndNote to facilitate easy retrieval and citation. The data was analysed by identifying common themes, patterns, and trends related to the benefits and challenges of last-mile delivery. The findings were structured in a clear and logical format, starting with an introduction, followed by a synthesis of the literature, and concluding with a discussion of the implications, limitations, and future research directions.

### 4. Discussion

The growing significance of last-mile delivery is driven by the rise of e-commerce and the increasing expectations for swift and reliable service. While the benefits of an efficient last-mile delivery system are substantial, the challenges it poses are equally formidable. Efficient last-mile delivery is paramount in meeting and exceeding customer expectations. Fast delivery options, such as same-day or next-day services, significantly enhance the shopping experience, fostering greater customer satisfaction and loyalty. For instance, companies like Amazon have set high standards for delivery speed, leading to increased consumer expectations across the industry. Businesses that excel in last-mile delivery can distinguish themselves in a crowded marketplace. Superior delivery services not only attract new customers but also help in retaining existing ones. This competitive edge is particularly evident in urban markets where consumers prioritize convenience and speed. Modern last-mile delivery systems offer a range of flexible options to meet diverse consumer needs. Features such as real-time tracking, delivery window selection, and multiple delivery points (e.g., home, locker, store pick-up) provide significant convenience, enhancing the overall customer experience. The assurance of quick and reliable delivery can lead to increased sales volumes. Customers are more likely to complete their purchases if they trust that their orders will arrive promptly. This trust reduces shopping cart abandonment rates and boosts conversion rates. However, on the other hand, Last-mile delivery often represents the most expensive segment of the shipping process. The costs associated with labour, fuel, vehicle maintenance, and technology can be substantial. Companies must find ways to balance these costs while maintaining service quality. For example, small-scale retailers may struggle to compete

with larger entities that have more resources to absorb these costs. Urban areas present unique challenges, including traffic congestion, limited parking, and complex delivery routes. In contrast, rural areas pose difficulties such as longer distances between delivery points and lower delivery density. These logistical issues require sophisticated route planning and optimization strategies to manage effectively. The environmental footprint of last-mile delivery is a growing concern. Increased delivery vehicle traffic contributes to higher carbon emissions and environmental degradation. Addressing this issue requires the adoption of sustainable practices, such as using electric vehicles or optimizing delivery routes to reduce travel distances and emissions. Implementing advanced technologies, such as artificial intelligence (AI), Internet of Things (IoT), and real-time GPS tracking, can enhance efficiency but also requires significant investment and technical expertise. Businesses must continuously update and integrate these technologies into their operations to stay competitive. The bar for delivery speed and reliability is continually being raised. Meeting these high consumer expectations without incurring prohibitive costs is a significant challenge. Companies must innovate and streamline their processes to deliver faster and more reliably while managing costs.

The discussion on the benefits and challenges of last-mile delivery highlights the dual nature of this critical phase in the supply chain. While the benefits, including enhanced customer satisfaction, competitive advantage, flexibility, and increased sales, are substantial, the challenges related to high costs, logistical complexities, environmental impact, technological integration, and rising consumer expectations cannot be overlooked. Businesses must navigate these challenges with strategic planning, technological adoption, and sustainable practices to optimize their last-mile delivery operations and meet the evolving demands of consumers. Understanding and addressing these dynamics is essential for companies aiming to succeed in the highly competitive landscape of modern logistics and e-commerce.

## 5. Conclusion

To conclude it can be said that in the world of contemporary logistics, last-mile delivery has arisen as an important and problematic component. This final stage of the supply chain entails moving items from a transportation hub to the destination, which is commonly a customer's doorstep. The significance of last-mile delivery cannot be emphasised, as it serves as the point of interaction between a company and its consumers, directly impacting their pleasure and loyalty.

Efficient last-mile delivery provides several benefits to organisations. For starters, it improves customer satisfaction by making sure delivery are on schedule and trustworthy. Customers value on-time deliveries and are more likely to repurchase from firms that satisfy their delivery expectations. Second, it saves money for businesses by optimising routes, reducing fuel use, and simplifying processes. Innovative delivery techniques, such as locker-based deliveries and crowd-shipping, further improve cost effectiveness.

Despite its advantages, last-mile delivery poses various obstacles. Identifying the optimum delivery routes and time slots may be difficult, especially in congested cities. Managing consumer expectations is another difficulty, as they increasingly anticipate same-day or next-day delivery. Last-mile logistics has additional hurdles due to logistical complications including repeated delivery attempts and returns handling.

To tackle these obstacles, organisations use a variety of tactics. Route optimisation with powerful algorithms and real-time tracking systems improves delivery efficiency. Collaboration with stakeholders, such as consumers, delivery partners, and local authorities, is essential for managing expectations and organising logistical operations. Furthermore, emerging delivery technologies, such as autonomous cars and drones, are predicted to revolutionise last-mile delivery in the future.

Looking ahead, technology improvements and sustainability measures will shape last-mile delivery in the next years. The combination of artificial intelligence and machine learning will provide predictive analytics for demand forecasting and route optimisation. Last-mile delivery's environmental effect will be reduced by adopting sustainable techniques like micro-fulfilment centres and electric cars.

## 6. Future Research Directions

In future the research can be conducted into electric vehicles, drones, and other green technologies which can help reduce the environmental impact of last-mile delivery. Studies can be undertaken, investigating sustainable packaging solutions to minimize waste and environmental footprint. Furthermore, research can be conducted exploring the establishment of strategically located urban logistics hubs to streamline last-mile delivery. Studying consumer behaviour and preferences regarding delivery options to tailor services that meet In future studies can be pursued analysing the impact of existing regulations on last-mile delivery and proposing changes to facilitate innovation while ensuring safety and sustainability.

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