

## Problems of “Last-Mile Delivery” And Discussion

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**Abstract:** With the rapid development of e-commerce and consumers' continuous pursuit of convenience, the last-kilometer de-livery problem has become one of the key challenges in the contemporary logistics industry. This paper provides a literature review of studies related to the last-kilometer delivery problem, including existing challenges and solutions. The results show that the last-kilometer delivery problem involves multiple aspects, such as delivery efficiency, envi-ronmental sustainability, and user experience. In response to these problems, scholars have proposed a series of inno-vative solutions, including logistics network optimization, intelligent distribution systems, and new distribution mod-els. However, there are still some challenges to the last-kilometer distribution problem, and further research and prac-tice are needed to find more effective solutions.

**Keywords:** Last mile delivery, distribution efficiency, environmental sustainability, user experience,

## 1. INTRODUCTION

With the rapid rise of e-commerce and advances in Internet technology, the way people shop has been revolutionized. More and more consumers are choosing to buy goods online and expect to receive their goods quickly and easily. However, this way of shopping poses a new challenge, the problem of last-mile delivery. Last-mile distribution refers to the process of delivering goods from logistics centers or warehouses to end-users, and is one of the most critical, costly and complex aspects of the entire logistics supply chain<sup>[1,2]</sup>.

The last-mile distribution problem has several challenges. First, distribution efficiency is a major issue. Consumers are increasingly demanding fast delivery, and they expect to receive their orders in a short period of time, and some even want instant delivery. However, achieving efficient last-mile delivery is still difficult due to factors such as traffic congestion, delivery worker restrictions, and delivery route planning<sup>[3,4]</sup>.

Secondly, environmental sustainability is also a key issue. With the increasing severity of global climate change, it is becoming increasingly important to minimize the negative

impact of logistics activities on the environment. Last-mile distribution usually involves a large amount of transportation, especially trucks and light vans, whose emissions adversely affect air quality and carbon emissions. Therefore, finding environmentally friendly distribution solutions, such as reducing tailpipe emissions, promoting electric vehicles and using renewable energy, has become an urgent task<sup>[5]</sup>.

In addition, user experience is an important aspect of last-mile delivery. Consumers' satisfaction with their shopping experience directly affects their loyalty to brands and e-commerce platforms. If there are problems with the delivery process, such as delays, loss or damage, consumers may be disappointed and negatively impact future shopping behavior. Therefore, providing a good user experience, including on-time delivery, transparent delivery tracking and flexible delivery options, is crucial for e-commerce companies and logistics service providers<sup>[6,7]</sup>.

In this paper, we will provide an overview of the research related to the last-mile delivery problem and discuss the existing challenges and solutions. It is hoped that it will provide insights into the current state of research on the last-mile

delivery problem and its solutions, and provide useful insights for academia and the industry on improving the efficiency of last-mile delivery, promoting environmental sustainability, and optimizing user experience.

## 2. Challenges to the Last-mile Delivery Problem

### 2.1 Distribution Effectiveness

Delivery efficiency is one of the main challenges in last-mile delivery. Especially in the scenarios of same-city delivery and just-in-time delivery, consumers' expectations for fast delivery are increasing. However, achieving efficient delivery is not easy. Here are some of the common problems that lead to inefficient delivery:

- a. Traffic congestion: Urban traffic congestion is one of the main factors for delivery inefficiency. Traffic congestion slows down the speed of delivery vehicles, increasing delivery time and cost<sup>[8]</sup>.
- b. Distributor constraints: There are a limited number of distributors, and the increase in the volume of orders may exceed their delivery capacity. This leads to delays and delays in delivery tasks<sup>[9]</sup>.
- c. Route Planning: Effective route planning is the key to improving distribution efficiency. However, complex urban road networks and diverse distribution points complicate route planning. Optimizing distribution routes to reduce travel distance and time becomes a challenging task<sup>[10]</sup>.

To address these challenges, scholars and the industry have proposed a number of solutions, including route planning based on intelligent algorithms, the use of real-time traffic information, and the optimization of delivery worker scheduling. By utilizing technology and data analytics, delivery efficiency can be improved and delivery time and cost can be reduced.

### 2.2 Environmental Sustainability

As global climate change intensifies and environmental concerns become more pronounced, achieving environmental sustainability has become an important challenge for last-mile distribution. Traditional modes of distribution often rely on fuel-driven vans and light trucks, which produce tailpipe emissions that adversely affect air quality and carbon emissions.

The environmental sustainability challenges are mainly in the following areas:

- a. Air quality: Exhaust emissions from fuel-driven vehicles have a negative impact on air quality in cities. The large number of delivery vehicles traveling on busy city streets leads to increasing air pollution problems.

b. Carbon emissions: Logistics activities are one of the important sources of carbon emissions. Fuel-driven vehicles used in both long-distance transportation and last-mile delivery generate significant GHG emissions. Reducing carbon emissions has become an urgent need to combat climate change<sup>[11]</sup>.

To address these environmental sustainability challenges, a number of measures are needed:

- a. Promotion of electric vehicles: Electric vehicles are an important way to reduce tailpipe emissions and carbon emissions. The use of electric distribution vehicles reduces environmental pollution and has lower operating costs.
- b. Use of Renewable Energy: Vehicles powered by renewable energy can reduce reliance on traditional energy sources and lower carbon emissions.
- c. Aggregated distribution: Through aggregated distribution, multiple orders are combined into a single delivery task, reducing the number of delivery vehicles and the distance traveled to improve delivery efficiency and environmental sustainability<sup>[12]</sup>.

### 2.3 User Experience

User experience is also one of the challenges that cannot be ignored in last-mile delivery. Consumers have high expectations for on-time, reliable and convenient delivery services. The following are the major problems faced by user experience:

- a. Delivery Delays: Delivery delays are one of the main reasons for poor user experience. Orders may not be delivered on time due to traffic problems, delivery staff scheduling, etc.
- b. Lost or damaged parcels: During the delivery process, parcels may be lost or damaged, causing inconvenience and dissatisfaction to consumers.
- c. Lack of Delivery Tracking and Transparency: Consumers want to be able to track their orders in real time and understand the progress of delivery. Lack of delivery tracking and transparency affects user satisfaction with delivery services<sup>[13]</sup>.

The following measures need to be taken to enhance user experience:

- a. Provide on-time delivery: Ensure that orders are delivered on time as promised and minimize delivery delays.
- b. Provide delivery tracking: Provide consumers with real-time delivery tracking information of their orders to keep them informed of the progress of their orders.
- c. Enhance parcel protection and security: Ensure that parcels are properly protected during the delivery process to minimize loss and damage<sup>[14]</sup>.

In conclusion, last-mile delivery faces multiple challenges in terms of delivery efficiency, environmental sustainability, and user experience. By addressing these challenges, logistics efficiency can be improved, environmental burdens can be reduced, and consumer satisfaction can be enhanced.

### 3. Solutions to the Last-mile Delivery Problem

#### 3.1 Logistics Network Optimization

Logistics network optimization is one of the most important solutions to improve the efficiency of last-mile distribution. Through rational design and optimization of logistics network, distribution costs can be reduced, distribution time shortened and overall distribution efficiency improved.

- a. Centralized Warehousing and Distribution Center: Establishing a centralized warehousing and distribution center can optimize the distribution process through centralized storage and centralized sorting. This can reduce unnecessary duplication of distribution and improve distribution efficiency.
- b. Multi-channel inventory management: Combine online and offline inventory to realize multi-channel inventory management. This can better meet consumer demand and provide faster and more flexible distribution.
- c. Optimized warehouse location: Reasonably choose the location of the warehouse to make it closer to the areas where consumers are concentrated in order to shorten the transportation distance and distribution time.
- d. Dynamic Route Planning: Use real-time traffic data and advanced route planning algorithms to dynamically plan optimal distribution routes. This can reduce distribution distance and time and improve distribution efficiency.

#### 3.2 Intelligent Distribution System

Intelligent distribution systems use advanced technologies and algorithms to optimize and automate the distribution process in order to improve distribution efficiency and accuracy.

- a. Route Optimization Algorithm: Using intelligent algorithms to optimize distribution routes, it takes into account factors such as traffic conditions, concentration of distribution points, and the ability of distribution personnel in order to find the best routes.
- b. Real-time distribution scheduling: Through real-time monitoring and scheduling system, distribution tasks are assigned to the most suitable distributors to optimize the use of distribution resources and timely adjust the distribution plan to cope with unexpected situations.
- c. Automated distribution equipment: The introduction of automated distribution equipment, such as robots and self-driving vehicles, can reduce manual operations and

improve distribution efficiency. These devices can perform autonomous distribution in specific environments and integrate with intelligent distribution systems.

- d. Data analysis and forecasting: Big data analysis and forecasting technologies are utilized to accurately forecast distribution demand and provide intelligent deployment and resource planning based on demand.

#### 3.3 New Distribution Models

In addition to traditional delivery modes, some new delivery modes have emerged to cope with the last-mile delivery problem.

- a. Aggregate distribution: Reducing the number of delivery vehicles and the distance traveled by combining multiple orders into a single delivery task. This mode can improve distribution efficiency and reduce the impact on the environment.
- b. Micro warehousing distribution: Setting up small warehousing locations in cities to be closer to consumers and provide fast delivery services. This model can reduce delivery distance and time and improve user experience.
- c. Self-pickup points and smart cabinets: Provide self-pickup points and smart cabinets as delivery options so that consumers can choose to pick up their packages on their own according to their time and location. This model can improve delivery flexibility and convenience.

In conclusion, logistics network optimization, intelligent delivery systems and new delivery modes are key solutions to the last-mile delivery problem. These solutions provide strong support for solving the last-kilometer distribution problem by improving distribution efficiency, optimizing resource utilization and enhancing user experience. However, there is still a need for further research and practice to improve these solutions and adapt them to changing market demands and technological developments.

### 4. Case Studies of the Last-mile Delivery Problem

#### 4.1 Amazon Prime Now

Amazon Prime Now is an instant delivery service launched by Amazon to address the challenge of last-mile delivery. The service enables fast delivery by establishing warehouses and distribution centers located in city centers. Consumers can place orders through Amazon's mobile app and receive their items in a short period of time.

Prime Now uses a variety of technologies and strategies to improve delivery efficiency and user experience. First, they use real-time traffic data and advanced route planning algorithms to optimize delivery routes and reduce delivery time and distance. Second, they build partnerships with local partners to fulfill delivery tasks more quickly. In addition, Prime Now has

introduced automated delivery equipment, such as drones and robots, to increase the speed and efficiency of deliveries.

Prime Now's success story shows that by optimizing the logistics network, using technological innovation and working with partners, it can effectively solve the last-mile delivery problem and provide fast and convenient delivery services.

#### **4.2 UberEats**

UberEats is an online takeout delivery service launched by Uber. It connects restaurants and consumers for fast last-mile delivery by utilizing Uber's network and platform.

UberEats uses an intelligent delivery system and dynamic route planning to optimize the delivery process. They use real-time data and algorithms to assign delivery tasks to nearby riders to minimize delivery time and distance. In addition, UberEats offers real-time delivery tracking so that consumers can see the progress of their orders in real time.

The success story of UberEats shows that by drawing on the sharing economy model and smart delivery technology, it can effectively solve the last-kilometer delivery problem and provide convenient and fast takeout delivery services.

#### **4.3 DHL's Urban Distribution Solutions**

DHL is one of the world's leading logistics companies and has come up with a range of solutions in the field of urban delivery. They have used a variety of strategies to address the challenges of last-mile delivery.

First, DHL has introduced environmentally friendly means of transportation such as electric vehicles and bicycles to reduce carbon emissions and air pollution. These modes of transportation are better suited for distribution in urban environments and offer greater flexibility.

Second, DHL enables dynamic route planning and delivery task optimization with the help of intelligent distribution systems and real-time data analytics. They utilize real-time traffic information and order data to automatically select the best routes and the most appropriate delivery personnel to improve delivery efficiency and accuracy.

In addition, DHL has introduced delivery solutions such as smart parcel boxes and smart cabinets. Consumers can choose to drop their parcels into the smart cabinets and then pick them up themselves at a convenient time and place. This model reduces the direct contact of delivery staff and improves delivery efficiency and user experience.

The case of DHL's urban delivery solution shows that the problem of last-mile delivery can be effectively tackled and sustainable and efficient urban delivery services can be

provided through environmentally friendly transportation, intelligent delivery systems and new delivery models.

Overall, the urban delivery solutions of Amazon Prime Now, UberEats and DHL are successful cases of the last-mile delivery problem. Through the optimization of logistics networks, the application of intelligent delivery systems and new delivery models, these companies have achieved remarkable results in improving delivery efficiency, protecting the environment and enhancing user experience. These cases provide lessons and inspiration for other companies, inspiring continuous innovation and improvement of last-mile delivery solutions.

### **5. CONCLUSION**

The last kilometer delivery problem has attracted extensive research attention in the field of logistics and e-commerce. This paper synthesizes the challenges, solutions, and related case studies of the last-kilometer delivery problem. The following conclusions are drawn from a comprehensive analysis of existing studies:

The challenges of the last-kilometer delivery problem are diverse and complex, including traffic congestion, environmental impact, delivery efficiency, and user experience. These challenges require integrated solutions and cooperative participant efforts.

Solutions to the last-mile delivery problem are diverse and include technological innovations, optimization methods, and sustainability measures. The application of emerging technologies such as smart delivery systems, IoT technologies, and drone delivery offers new possibilities for solutions.

The case studies show that practical applications for the last-kilometer delivery problem have been tried and validated in different regions and industries. These case studies provide valuable experiences and insights for solutions in practice.

The literature review shows that there are still some limitations in the research of last-kilometer delivery problems, such as data availability, practical application complexity, and regional differences. Future research can focus on multi-modal delivery solutions, data-driven decision making, and social and economic impacts.

The solution of the last-mile delivery problem is important for enhancing logistics efficiency, improving user experience, and realizing sustainable development. To address the challenges and promote further development in this area, all parties should strengthen cooperation, promote technological innovation and standardization, and actively introduce user participation and feedback mechanisms. By working together, a more efficient, sustainable and user-satisfied last-mile delivery system can be

realized, bringing better logistics services to cities and consumers.

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