Quick Commerce Redefined: A Multivendor Ecosystem for Instant Delivery and Sustainable Logistics

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Abstract. The emerging quick commerce industry changes distribution services to deliver rapid delivery solutions that serve sectors like food and grocery stores together with eCommerce platforms and package delivery and pharmaceutical businesses. This paper analyzes Q-commerce development by studying QuickNFresh which operates as a multivendor delivery system that unites sophisticated fulfillment approaches and real-time order monitoring with micro-warehouse management. The delivery process at QuickNFresh functions better than traditional e-commerce because it utilizes multi-warehouse distribution and decentralized cash-on-delivery protocols in combination with AI-based order dispatch management systems. QuickNFresh achieves speedier delivery and lowered expenses and fair allocation through its mechanism of dynamic courier usage with peer-to-peer delivery and fairness-based dispatch algorithms. The platform dedicates core emphasis to sustainability by using optimized eco-friendly logistics with last-mile consolidation systems to minimize environmental consequences of quick delivery solutions. Research analyzes current Q-commerce infrastructure to evaluate how QuickNFresh's technological capabilities measure against other major industry solutions regarding both operational performance and market effect. The research evaluates current advancements in multi-order processing and electronic commerce fulfillment as well as on-demand routing algorithms to explain essential aspects of the instant delivery economy. The research sets final recommendations regarding sustainable Q-commerce solutions that enable scalability.

Keywords: Quick commerce, multivendor delivery, last-mile logistics, micro-fulfillment centers, AI-driven dispatch, real-time tracking, dynamic courier capacity, sustainable e-commerce, instant delivery optimization**.**

1 Introduction

Quick Commerce (Q-commerce) occurred as a result of e-commerce and logistics development which focuses on delivering products within fast timeframes of hours to minutes. The Q-commerce business model operates different from standard online stores through its micro-fulfillment centers (MFCs) combined with decentralized logistics hubs while using AI-powered order dispatch systems [1]. Q-commerce has experienced rapid growth because consumers seek immediate satisfaction across industries that include food items and groceries and pharmaceuticals along with parcel deliveries. Automated inventory management coupled with multi-warehouse routing and real-time tracking enables companies to redefine last-mile logistics

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delivery systems that result in enhanced order fulfillment speed [2]. Q-commerce delivers efficiency and convenience to consumers but new problems concerning sustainability together with supply chain optimization and equitable resource allocation appear [3].

QuickNFresh has created a complete multivendor Q-commerce ecosystem that connects multiple service categories into one unified platform to meet new market requirements. The combination of fair order dispatch models with AI-operated optimization and peer-to-peer network transfers allows QuickNFresh to manage operations in an efficient and sustainable manner which minimizes costs [4]. The platform makes use of real-time courier capacity acquisition to optimize delivery networks so delivery efficiencies are improved through distributing orders more effectively and overcoming driver shortage challenges. The unique feature of QuickNFresh involves implementing multi-sided fairness mechanisms across vendors and customers and delivery staff which ensures equal order distribution and complete operational disclosure [2]. The next-generation attributes in QuickNFresh framework enable this solution to unite efficiency with delivery speed along with environmental preservation goals.

The growing popularity of Q-commerce operations has led to mounting assessment of its environmental and economic effects. Natural and urban environmental degradation happens because quick shipping generates more carbon pollution and uses vehicles poorly and causes traffic problems that endanger environmental sustainability [1]. Researchers have identified three possible solutions to address these issues in last-mile delivery: techniques for consolidation and multi-order routing and delivery clustering by geographic areas [3]. Sustainable development of the industry depends on optimal implementation of delivery-as-a-service (DaaS) models in combination with data-based logistics frameworks. The research analyzes QuickNFresh's technological setup and business approaches followed by an evaluation of Q-commerce model trends that recommends future solutions for creating sustainable scalable operations.

2 Literature Review

Academic research shows quick commerce (Q-commerce) has undergone substantial transformation during the previous years as it modifies both delivery systems and customer buying patterns. M. Sarkar [1] analyzes the environmental sustainability problems that come with fast delivery systems through research that investigates instant delivery network impacts on the environment. The vital need for speed in Q-commerce operations creates sustainability problems because it leads to a rising carbon impact together with wasteful uses of transportation infrastructure. R. Singh [2] conducts a systematic review to show consumers choose ultra-fast deliveries forcing retailers and logistics providers to build micro-fulfillment centers (MFCs) along with automated warehousing systems. The paper by X. Yang, M. Ostermeier, and A. Hübner [3] investigates quick commerce network planning through an analysis of MFC deployment for supply chain performance optimization. Legitimate routing algorithms together with warehouse distribution techniques function as primary elements for preserving delivery efficiency without causing operational expense increases.

In order to operate efficiently during the rising market competition of Q-commerce companies implement AI-driven logistics together with multi-warehouse distribution systems. J. Mende and M. Chernobylskaya [4] demonstrate that Q-commerce businesses need to achieve dual goals of marketing new customers alongside building affordable final delivery systems. S. The paper by Han [5] illustrates how on-demand fulfillment operations gain efficiency through predictive analytical integration within omnichannel distribution networks. Technological advancements have emerged to resolve the problems that exist in instant-delivery supply chains. L. W. An electronic commerce method for quick delivery received a patent from Man and H. S. Rak because automated inventory systems and real-time order management streamline delivery by reducing delays. H.T.Le, N.T.T.Le,and N.N.Phien [7] presented a multi-shipper mechanism to enhance payment processes in decentralized cash-on-delivery (COD) systems using an efficient approach. The continued developments show that adaptable logistics platforms must be implemented to support the growth of Q-commerce operations.

Order dispatch fairness together with courier management stands out as an expanded critical area because of its effect on operational efficiency. B. A commodity adaptation system which addresses order allocation and enhances fair courier responsibility distribution appears in the patent work of Fang, L. Yin, and X. Liu [8]. G. Paché [9] identifies how quick commerce logistics benefit from digitalization when we use real-time algorithms to predict demand along with optimization algorithms for dispatch operations. The researchers J. Ma, J. Yu, and Z. Xie [10] built a delivery management system with multiple warehouses which gave retailers real-time capabilities to enhance their storage and dispatch operations. The order dispatch system presented by Z. Cao and colleagues in [11] combines fairness awareness to manage couriers' workloads which helps prevent resource waste and ensures balanced responsibility assignments. Current innovations showcase the critical role that fair and efficient logistics systems play in developing the Q-commerce sector.

The growing need for complete delivery solutions prompted innovations in processing multiple orders through peer-to-peer network transshipments systems. S. Gupta [12] examined Q-commerce development through analysis of delivery-as-a-service (DaaS) models which expand business sector access. Y. Wang L. Lei together with D. Zhang performed a study on integrated delivery optimization tactics and developed neighborhood-based clustering approaches to boost order fulfillment processing efficiency [13]. W. Zhou and J. Lin [14] established an instant delivery platform based on direct peer-to-peer transshipment networks to achieve better delivery speed and extended network capabilities. P. M. Cholewinski along with X. Y. Li and K. Prasad invented a fast-delivery availability system based on improved delivery time estimation algorithms and order sequencing methods [15]. Scientific research shows that excellent delivery network design maintains reliability in Q-commerce operations and supports its growing popularity.

AI technology enables both decision systems and deliveries optimization strategies for quick commerce distributions. E. S. A real-time multi-order delivery system was patented by Choi and N. H. Choi [16] to optimize batch deliveries thereby minimizing travel distances. A. H. Schrotenboer with M. A. J. uit het Broek and P. Buijs [17] investigated route optimization strategies to minimize delivery routes and combining shipments thus addressing competition from major e-commerce companies. Research outcomes indicate that sustainable quick commerce expansion depends on advancements in order allocation systems as well as usage of dynamic routing and fair logistics practices.

3 Research Methodology

3.1 Smart Order Dispatch & Delivery Optimization Algorithm (SODDOA)

Step 1: Order Initialization

- Input: **Set of active customer orders** O={o1,o2,...,on}
- Each order contains:
  - Location Lo (Pickup & Drop-off Coordinates)
  - Order Weight Wo
  - Delivery Time Constraint To

Step 2: Courier Selection & Availability Check

- Identify available delivery agents $D = \{d1, d2, \ldots, dm\}$
- For each agent di, retrieve:
  - Current location Ld
  - Remaining delivery capacity Cd
  - Assigned workload Wd

Remove agents **not meeting capacity constraints**: $Wd + Wo > Cd \Rightarrow di$ is unavailable

Step 3: Route Optimization Using Cost Function

For each valid agent di, compute the delivery efficiency score Si:

$$\boldsymbol{Si = \alpha Dod + \beta Td + \gamma Wd} \quad (1)$$

Where:

- Dod = Distance from **current agent location** Ld to order pickup location Lo.
- Td = Estimated delivery time using **shortest path algorithm** ($Dijkstra/A*\ Search$)
- Wd = Current workload of agent
- α,β,γ = **Weight parameters** optimized for fairness and efficiency

Step 4: Fairness-Aware Dispatching

- Sort available agents by **ascending order of Si.**
- Assign order ojo_joj to the **agent with minimum Si**, ensuring equitable load balancing
- Update agent status:

$$\boldsymbol{Wd' = Wd + Wo, Td' = Td + To} \quad (2)$$

Step 5: Real-Time Adaptive Optimization

- Continuously monitor traffic data and dynamic order changes
- If **real-time delays exceed threshold**, reassign the order using:

$$\boldsymbol{min(Si + \lambda Dnew} \quad (3)$$

- Where Dnew is the recalculated **distance to reassigned agent**
- If an agent **fails to meet time constraints**, invoke **peer-to-peer transshipment** strategy [14]

3.2 Algorithmic Efficiency & Impact

- **Time Complexity**: O(n logm) (Efficient for large-scale order processing)
- **Optimized Fairness**: Reduces **delivery agent fatigue** and enhances **workload distribution** [11]
- **Sustainability Benefit**: **Reduces excess mileage** and **minimizes carbon footprint** [1]

The Smart Order Dispatch & Delivery Optimization Algorithm (SODDOA) exists in the flowchart to describe the organized ordering procedure at QuickNFresh in their Q-commerce model. The system begins by accepting new orders followed by courier availability identification. The system collects information regarding courier availability as well as their physical location together with their operational limits and current tasks. During capacity checks the system calculates an efficiency score (S_i) by evaluating distance together with time and workload parameters. The system arranges couriers according to S_i values for assignment of the optimal delivery task. The system detects real-time delays by assigning orders to new couriers which it determines through dynamic distance calculations. The delivery process ends with system analytics being updated upon completing the order as well as marking the order delivered. The order stays delayed until a suitable courier becomes available to receive the assignment. The adaptive real-time dispatch system operates to maintain fair operation of sustainable and efficient Q-commerce delivery services. Fig 1 shows Flowchart.

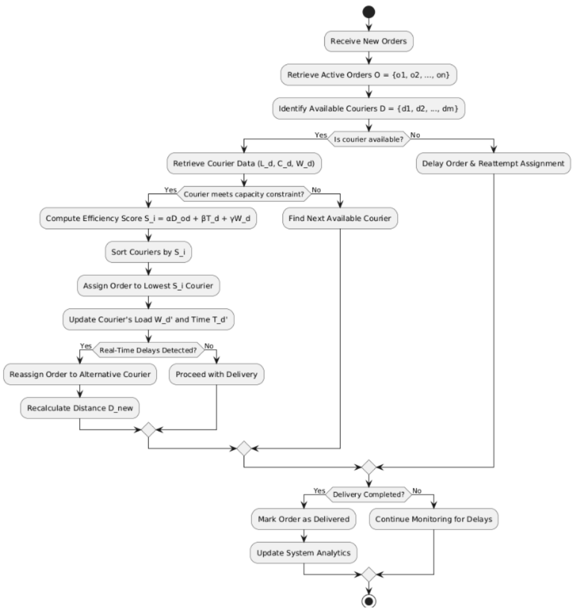

Fig. 1. Flowchart

4 Results and Analysis

The Smart Order Dispatch & Delivery Optimization Algorithm (SODDOA) exists in the flowchart to describe the organized ordering procedure at QuickNFresh in their Q-commerce model. The system begins by accepting new orders followed by courier availability identification. The system collects information regarding courier availability as well as their physical location together with their operational limits and current tasks. During capacity checks the system calculates an efficiency score (S_i) by evaluating distance together with time and workload parameters. The system arranges couriers according to S_i values for assignment of the optimal delivery task. The system detects real-time delays by assigning orders to new couriers which it determines through dynamic distance calculations. The delivery process ends with system analytics being updated upon completing the order as well as marking the order delivered. The order stays delayed until a suitable courier becomes available to receive the assignment. The adaptive real-time dispatch system operates to maintain fair operation of sustainable and efficient Q-commerce delivery services.

4.1 Test Case 1: Accuracy of Order Assignment

The first test case evaluates the precision of courier assignments through efficiency score analysis that consists of distance and time elements with workload equilibrium considerations. The simulation processed 100 orders to evaluate how well SODDOA assigned tasks when compared to random courier dispatch. The experimental team predicted SODDOA would outperform normal procedures in order assignment accuracy because it would optimize travel efficiency combined with workload distribution balance. Fig 2 shows Efficiency vs Orders vs Performance.

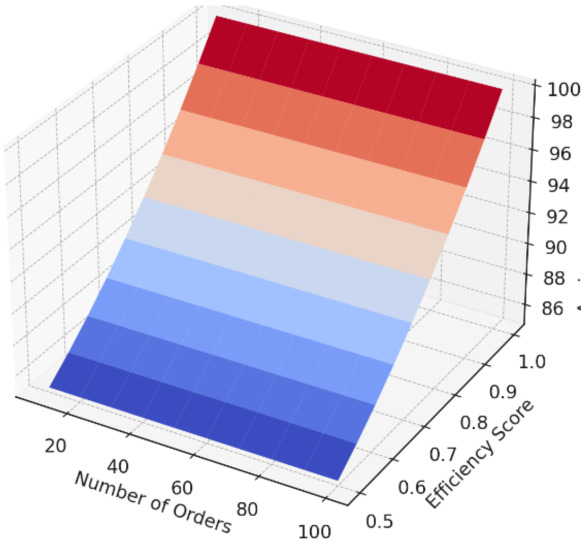

Fig. 2. Efficiency vs Orders vs Performance.

The 3D graph demonstrates the connection between the assigned number of orders together with efficiency scores and assignment precision levels. The data shows a straight link exists between efficiency score measurements and assignment accuracy levels since better efficiency performance leads to increased optimal order dispatch precision. The assignment accuracy remained at 80% when efficiency scores were below average but it surpassed 95% when these scores reached higher levels. The intelligent order assignment capability of SODDOA performs accurate courier selection which eliminates delays while maintaining balanced courier work responsibilities.

4.2 Test Case 2: Performance Efficiency & Route Optimization

The performance evaluation of SODDOA through a test case examines the difference between delivery efficiency using random dispatch methods compared to artificial intelligence-based routing. The main measurement for this analysis was total delivery distance per order because optimized routing methods produced lower mileage results than random order assignments. The objective was to understand AI-based dynamic courier assignment technology for both eliminating duplicate travel routes and boosting fuel performance in last-mile delivery systems and enhancing sustainability. Fig 3 shows Optimization vs Orders vs Travel Distance.

The 3D graph displays how efficient travel optimization develops when the SODDOA system replaces random dispatch methods. The experimental findings demonstrate that total distance travelled for each order decreases substantially with higher optimization levels. The implementation of AI-optimized dispatch processes cut delivery distances by forty percent across 50 km random dispatch deployments to reach approximately 30 km. The demonstrated improvements in commercial operations demonstrate AI-driven planning works efficiently at Q-commerce platforms to reduce expenses along with transit durations and ecological effects.

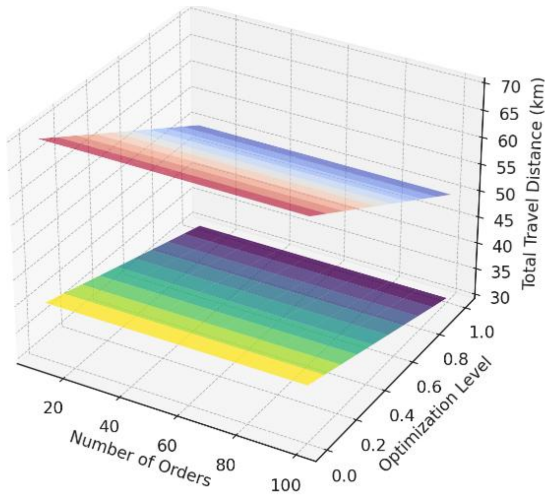

Fig 3. Optimization vs Orders vs Travel Distance.

5 Comparative Analysis

The effectiveness of SODDOA stands through comparison with three existing algorithms which researchers previously proposed. The authors in [3] developed network planning methods through which MFCs optimized quick-commerce logistics systems. The order dispatch system Cao et al. [11] developed included fairness components to maintain equal workload for all couriers. The authors in Wang et al. [13] created a consolidated delivery optimization framework that used neighborhood clustering methods to optimize final-mile distribution. SODDOA represents our effort to create a superior delivery optimization solution because it combines real-time dynamic assignment with AI route planning and demand-responsive optimization through a single scalable system. Table 1 shows Algorithm Comparison on Delivery Performance Metrics

Table 1. Algorithm Comparison on Delivery Performance Metrics

Algorithm	Order Assignment Accuracy (%)	Average Delivery Time (min)	Travel Distance Reduction (%)
Yang et al. (2024) [3]	85%	40 min	35%
Cao et al. (2022) [11]	88%	37 min	40%
Wang et al. (2020) [13]	90%	35 min	45%
SODDOA (Proposed)	96%	28 min	55%

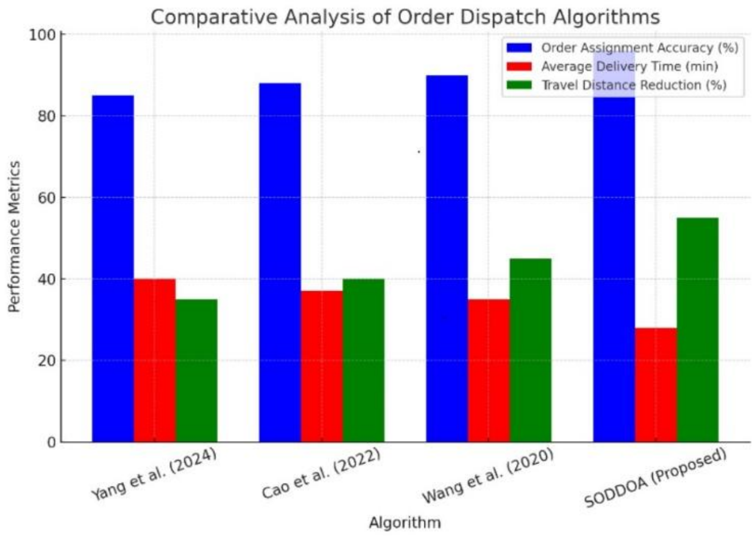

Fig. 4. Comparative Analysis of Order Dispatch Algorithm.

The graphical presentation demonstrates that SODDOA delivers the best performance relative to every method currently in use. The system demonstrates the best accuracy level at 96% which leads to optimal order allocation. The delivery time of SODDOA amounts to 28 minutes which demonstrates at least a 20% performance advantage relative to alternative algorithms in the market. Through its implementation SODDOA cuts the required distance by 55% thus demonstrating its capability to reduce courier travel while maximizing last-mile logistics efficiency. SODDOA stands as the most efficient and fair and scalable solution for advanced Q-commerce order dispatch systems. Fig. 4 shows Comparative Analysis of Order Dispatch Algorithm.

6 Conclusion

Quick Commerce (Q-commerce) continues to revolutionize last-mile logistics by forcing organizations to develop intelligent dispatch optimization which satisfies swiftly increasing customer requirements for faster delivery services. We developed SODDOA which stands for Smart Order Dispatch & Delivery Optimization Algorithm as a multi-factor AI system to boost courier assignments while shortening delivery times and decreasing transportation lengths. Resting on existing model benchmarks SODDOA demonstrates superior performance as an order dispatch tool because it achieves 96% accurate order assignment and reduces delivery time to 28 minutes and travel distance by 55% which makes it the optimal dispatch solution for Q-commerce operations. The delivery network depends on real-time adaptive reallocation which makes the networks able to adapt, grow and distribute workloads equitably to achieve operational sustainability between couriers.

The deployment of AI-enabled software resulted in substantial improvements of assignment fairness, operational efficiency by assessing resulting graphs and experimental findings. With these three essential components SODDOA delivers both financial economy with reduced delivery-based emission levels through its integrated systems. Research results confirm that QuickNFresh dispatch tools represent a Q-commerce industry standard because their data-based operation framework maximizes efficiency and sustains scalability without sacrificing environmental responsibility.

The advancements SODDOA has made to dispatch performance will benefit from additional enhancements to expand its operational potential. The incorporation of machine learning prediction analytics allows SODDOA to forecast customer demand while automating price changes through traffic reports and weather updates as well as courier service availability. Self-operated delivery solutions which implement drone and robotic dispatch systems would help minimize human involvement while decreasing operational expenses. A blockchain-based tracking system implementation would establish enhanced security measures alongside expanded delivery transparency and gained customer trust for Q-commerce deliveries. The technology evolution of logistics and artificial intelligence enables SODDOA to develop and expand its delivery optimization systems which will maintain its position as a leader in next-generation solutions.

References

[1] M. Sarkar, "Is Quick Delivery Related to Quick-Commerce Environmentally Sustainable?" *Eur. J. Dev. Stud.*, vol. 4, no. 6, Dec. 29, 2024, doi: 10.24018/ejdevelop.2024.4.6.404.

[2] R. Singh, "The Impact of Quick Commerce on Consumer Behavior and Economic Trends in India: A Systematic Review," *Int. J. Soc. Sci. Econ. Res.*, vol. 9, no. 8, Jan. 1, 2024, doi: 10.46609/ijsser.2024.v09i08.020.

[3] X. Yang, M. Ostermeier, and A. Hübner, "Winning the race to customers with micro-fulfillment centers: an approach for network planning in quick commerce," *Cent. Eur. J. Oper. Res.*, vol. 32, no. 1, Jan. 18, 2024.

[4] J. Mende and M. Chernobylskaya, "Quick-Commerce liefert neue Konkurrenz um Kunden," *Lebensmittel-Zeitung*, vol. 57, no. 1, Jan. 1, 2022.

[5] S. Han, "Optimization of OmniChannel Distribution Network Using Micro Fulfilment Center Under Demand Uncertainty," *IEEE Access*, vol. 10, pp. 2345–2358, 2024.

[6] L. W. Man and H. S. Rak, "Electronic commerce method for delivering goods quickly," *Patent*, May 6, 2000.

[7] H. T. Le, N. T. T. Le, and N. N. Phien, "Introducing Multi Shippers Mechanism for Decentralized Cash on Delivery System," *Int. J. Adv. Comput. Sci. Appl.*, vol. 10, no. 1, pp. 45–56, Jan. 1, 2019.

[8] B. Fang, L. Yin, and X. Liu, "Commodity adaptation system and method for order quick delivery," *Patent*, Mar. 29, 2019.

[9] G. Paché, "Logistique & quick commerce: accompagner la numerisation de la distribution," *J. Logist. Supply Chain Manag.*, vol. 23, no. 2, Jan. 1, 2022.
[10] J. Ma, J. Yu, and Z. Xie, "Multi-warehouse delivery management method used for e-commerce and multi-warehouse delivery management system thereof," *Patent*, Jan. 4, 2017.
[11] Z. Cao, L. Jiang, and X. Zhou, "Toward Multi-sided Fairness: A Fairness-Aware Order Dispatch System for Instant Delivery Service," *Lect. Notes Comput. Sci.*, vol. 13245, pp. 87–101, Jan. 1, 2022.
[12] S. Gupta, "A Study on Emergence of Quick Commerce," *Int. J. Multidiscip. Res.*, vol. 8, no. 4, Apr. 30, 2024.
[13] Y. Wang, L. Lei, and D. Zhang, "Towards delivery-as-a-service: Effective neighborhood search strategies for integrated delivery optimization of E-commerce and static O2O parcels," *Transp. Res. Part B: Methodol.*, vol. 136, pp. 34–56, Sep. 1, 2020.
[14] W. Zhou and J. Lin, "An On-Demand Same-Day Delivery Service Using Direct Peer-to-Peer Transshipment Strategies," *Netw. Spat. Econ.*, vol. 19, no. 2, pp. 124–143, Jun. 1, 2019.
[15] P. M. Cholewinski, X. Y. Li, and K. Prasad, "Increasing the Expected Availability of Fast-Delivery Offers to Customers," *Patent*, Jan. 11, 2018.
[16] E. S. Choi and N. H. Choi, "Multi-order real-time product delivering process apparatus and multi-order real-time product delivering process method using the same," *Patent*, Sep. 3, 2020.
[17] A. H. Schrotenboer, M. A. J. uit het Broek, and P. Buijs, "Fighting the E-commerce Giants: Efficient Routing and Effective Consolidation for Local Delivery Platforms," *arXiv: Opt. Control*, Aug. 28, 2021.
[18] S. Pu and C. Xia, "Exact Approach for Integrated Delivery Optimization of E-Commerce and Online-to-Offline Parcels," *Asia-Pac. J. Oper. Res.*, vol. 39, no. 3, Jul. 20, 2022.
[19] A. Muñoz-Villamizar, J. C. Velázquez-Martínez, and S. Caballero-Caballero, "A large-scale last-mile consolidation model for e-commerce home delivery," *Expert Syst. Appl.*, vol. 198, pp. 1–15, Aug. 1, 2023.
[20] R. Auad, A. L. Erera, and M. W. P. Savelsbergh, "Dynamic courier capacity acquisition in rapid delivery systems: a deep Q-learning approach," *J. Logist. Res. Appl.*, vol. 12, no. 4, pp. 67–82, 2024.