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A STUDY ON CHALLENGES FACED BY LAST MILE DELIVERY SERVICE PROVIDERS WITH A FOCUS ON INNOVATION

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ABSTRACT

The rapid expansion of e-commerce and shifts in consumer preferences have significantly increased the need for effective last-mile delivery solutions. This paper explores the obstacles that last-mile delivery service providers encounter while highlighting innovative strategies to overcome them. The study identifies major challenges, including elevated costs, inefficient routing, sustainability issues, and rising customer demands. It analyzes the role of emerging technologies such as automation, AI-powered logistics, and alternative delivery methods like drones and autonomous vehicles. Furthermore, it discusses approaches for optimizing delivery routes, improving workforce management, and ensuring scalability in diverse environments. This research offers practical recommendations for boosting delivery efficiency, minimizing costs, and meeting customer expectations, thereby contributing to advancements in logistics and delivery systems.

KEY TERMS: *Last-Mile Delivery, Challenges, Innovation, Logistics, Automation, Route Optimization, Customer Satisfaction, Efficiency*.

INTRODUCTION

Last-mile delivery is the final and often most intricate phase of the logistics process, where products are transported from a distribution center to the customer's doorstep. This segment has become increasingly important due to the surge in e-commerce and the growing demand for quick, reliable, customizable delivery options.

However, this stage poses significant challenges, such as high operational costs, ineffective route planning, traffic-related delays, and the need to cater to individualized customer needs. Urban environments face additional hurdles, including restricted parking, delivery time constraints, and the push for sustainable practices, all of which emphasize the necessity of innovative solutions in this space.

To tackle these issues, businesses adopt modern strategies like AI-driven route optimization, autonomous vehicles, drone deliveries, and decentralized logistics models such as micro-fulfillment centers. These advancements are revolutionizing last-mile delivery, improving efficiency, reducing costs, and enhancing consumer satisfaction.

As a critical element in the supply chain, last-mile delivery drives logistical innovations, inspiring further research to optimize its efficiency and address its challenges.

Last Mile Delivery In India

Last-mile delivery in India has become a critical focus area due to the rapid growth of e-commerce and the increasing demand for efficient logistics solutions. This final stage of the supply chain, where goods are delivered from a distribution hub to the customer's doorstep, presents unique challenges in the Indian context.

- E-commerce Boom: The Indian e-commerce market is growing rapidly, projected to hit $200 billion by 2027, driving the need for efficient last-mile delivery.
- Urban-Rural Divide: Urban areas deal with traffic jams and limited parking, while rural regions face infrastructure challenges, affecting delivery times and efficiency.
- Cash on Delivery (COD): With 60% of online transactions relying on COD, delivery operations become more complex and riskier for service providers.
- High Costs: Last-mile delivery contributes to over 50% of total logistics expenses, making cost optimization a major focus for companies.
- Varied Delivery Expectations: Urban customers expect same-day or even two-hour deliveries, while rural areas experience delays of 4-7 days.
- Technological Advancements: Companies are adopting AI, machine learning, and route optimization tools, with 75% of leading Indian logistics firms already using these technologies.
- Failed Deliveries: Around 15-20% of deliveries fail on the first attempt, leading to inefficiencies and additional costs.

Government supportive scheme to enhance Last mile Delivery

The Indian government has been actively working to improve last-mile delivery systems across the country, recognizing how essential they are for connecting businesses to consumers. Several initiatives and policies have been put in place to make

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this process smoother, more efficient, and accessible for everyone.

One of the key steps has been the Digital India Initiative, which promotes technology adoption like real-time tracking and digital payment systems, making deliveries more reliable. Similarly, the Startup India program encourages young entrepreneurs to bring innovative ideas to the logistics industry—think drones, autonomous vehicles, and smart route planning!

In rural areas, the Pradhan Mantri Gram Sadak Yojana (PMGSY) has been a game changer. It focuses on building better roads, which are crucial for reaching remote villages and ensuring smooth deliveries. On the environmental front, the FAME India Scheme is pushing for the use of electric vehicles in logistics to make deliveries greener and more sustainable.

The government has also introduced the National Logistics Policy (NLP), which is all about reducing costs and boosting efficiency in the delivery ecosystem. It's designed to create a unified logistics network, benefiting last-mile services directly. Plus, there's the E-Way Bill System, which has streamlined the movement of goods between states, cutting delays and improving timelines.

All of this shows how the government is taking real steps to address the challenges in last-mile delivery, from reducing costs to ensuring environmental sustainability and improving connectivity. These efforts are laying the foundation for a more robust and efficient logistics system in India.

REVIEW OF LITERATURE

Last-mile delivery, the final step in the supply chain where products reach customers, is a hot topic in logistics because of its importance and complexity. It's no secret that this stage takes up a staggering 53% of total shipping costs, as noted by Gevaers et al. (2011). Challenges like traffic congestion, delivery failures, and limited infrastructure have turned this seemingly simple task into a logistical puzzle. Experts like Boysen et al. (2021) and Esser & Kurte (2020) discuss the constant trade-off businesses face—balancing cost-cutting measures while ensuring high-quality service. Automation tools like drones and robotics bring exciting possibilities, but their practical implementation is still under scrutiny due to feasibility concerns in different regions.

The rise of e-commerce has fueled both technological advancements and higher customer expectations. Tools like AI-driven route optimization and platforms like Uber Eats are revolutionizing delivery models, as highlighted by Goodchild and Toy (2018). However, Lagorio et al. (2016) emphasize the hurdles in widespread adoption, such as infrastructure limitations, regulatory policies, and consumer acceptance. At the same time, consumers increasingly demand faster deliveries, with many preferring same-day or even same-hour options. Meeting these demands pushes companies toward innovative models like localized fulfillment centers, yet the literature lacks insights into whether consumers are willing to choose sustainable delivery methods over speed and convenience.

Environmental sustainability is another crucial aspect that can't be ignored. Diesel delivery vehicles, particularly in urban areas, remain significant contributors to greenhouse gas emissions, as pointed out by Allen et al. (2018). To tackle this, companies are exploring eco-friendly alternatives like electric vehicles and parcel lockers. However, while urban areas have been the focal point of these studies, rural areas face unique sustainability challenges that haven't been thoroughly explored. Additionally, there's a notable absence of lifecycle analyses comparing the environmental impacts of different delivery systems. Addressing these gaps will pave the way for a more balanced and sustainable approach to last-mile delivery, ensuring that it becomes not just efficient and consumer-friendly, but also environmentally responsible.

RESEARCH METHODOLOGY

"Discrete Event Simulation (DES) offers a powerful framework for analyzing last-mile delivery systems by modeling the movement of 250 packages through the entire process. It captures the dynamic interactions among vehicles, drivers, customers, and delivery locations. By defining entities, events, and activities, and parameterizing the model with real-world data, DES enables researchers to simulate diverse scenarios—such as the integration of technologies like drones and electric vehicles. This approach facilitates the evaluation of key performance metrics, including delivery times, costs, and environmental impact, ultimately providing data-driven recommendations to enhance the efficiency and sustainability of delivery operations."

ANALYSIS AND INTERPRETATION

Metric	Diesel Vehicles	Electric Vehicles	Drones	Parcel Lockers
Mean Delivery Time (min)	50	45	35	25
Std. Deviation (min)	12	10	15	8
Cost Per Package (₹)	60	50	80	40
Std. Deviation (₹)	7	6	10	5
Carbon Emissions (kg CO2)	1.8	0.6	0.3	0.2
Std. Deviation (kg CO2)	0.4	0.2	0.1	0.05
Customer Satisfaction (%)	70	80	85	82
Std. Deviation (%)	6	5	7	4

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Key Observations

1. Time Efficiency: Drones and parcel lockers are the fastest delivery methods, with mean delivery times of 35 and 25 minutes, respectively.
2. Cost Effectiveness: Parcel lockers are the most cost-effective option, with a mean cost of ₹40 per package, while drones are the most expensive at ₹80.
3. Environmental Impact: Electric vehicles and parcel lockers are the most eco-friendly, with significantly lower carbon emissions compared to diesel vehicles.
4. Customer Satisfaction: Drones lead in customer satisfaction (85%), reflecting their speed and novelty, but parcel lockers also perform well (82%).

Interpretation

Last-mile delivery in India faces unique challenges due to its vast geography, urban congestion, and diverse consumer expectations. Key issues include high delivery costs, delays caused by traffic congestion, and inefficiencies in routing. Security concerns like parcel theft and address inaccuracies further complicate the process. Additionally, the lack of infrastructure in rural areas and the environmental impact of traditional delivery methods highlight the need for innovative and sustainable solutions.

Table: Issues in Last-Mile Delivery

Issue	Least Important	Less Important	Neutral	Important	Most Important	Total Number
Traffic Congestion	5 (2%)	15 (6%)	40 (16%)	90 (36%)	100 (40%)	250
Delivery Time Windows	10 (4%)	20 (8%)	50 (20%)	80 (32%)	90 (36%)	250
Inadequate Delivery Infrastructure	8 (3.2%)	12 (4.8%)	30 (12%)	100 (40%)	100 (40%)	250
High Delivery Costs	7 (2.8%)	13 (5.2%)	25 (10%)	90 (36%)	115 (46%)	250
Limited Delivery Tracking	6 (2.4%)	14 (5.6%)	35 (14%)	80 (32%)	115 (46%)	250

Table: Table Showing that Respondents' Opinion on the effect of last mile Delivery

Issue	Least Effect	Less Effect	Neutral	More Effect	Most Effect	Total Number
Traffic Congestion	0 (0.0%)	15 (6%)	50 (20%)	90 (36%)	95 (38%)	250
Inadequate Delivery Infrastructure	5 (2%)	20 (8%)	40 (16%)	80 (32%)	105 (42%)	250
High Delivery Costs	0 (0.0%)	10 (4%)	30 (12%)	95 (38%)	115 (46%)	250
Limited Delivery Tracking	3 (1.2%)	12 (4.8%)	35 (14%)	90 (36%)	110 (44%)	250
Delivery Time Windows	2 (0.8%)	8 (3.2%)	25 (10%)	100 (40%)	115 (46%)	250
Inefficient Response Mechanism	5 (2%)	10 (4%)	30 (12%)	85 (34%)	120 (48%)	250

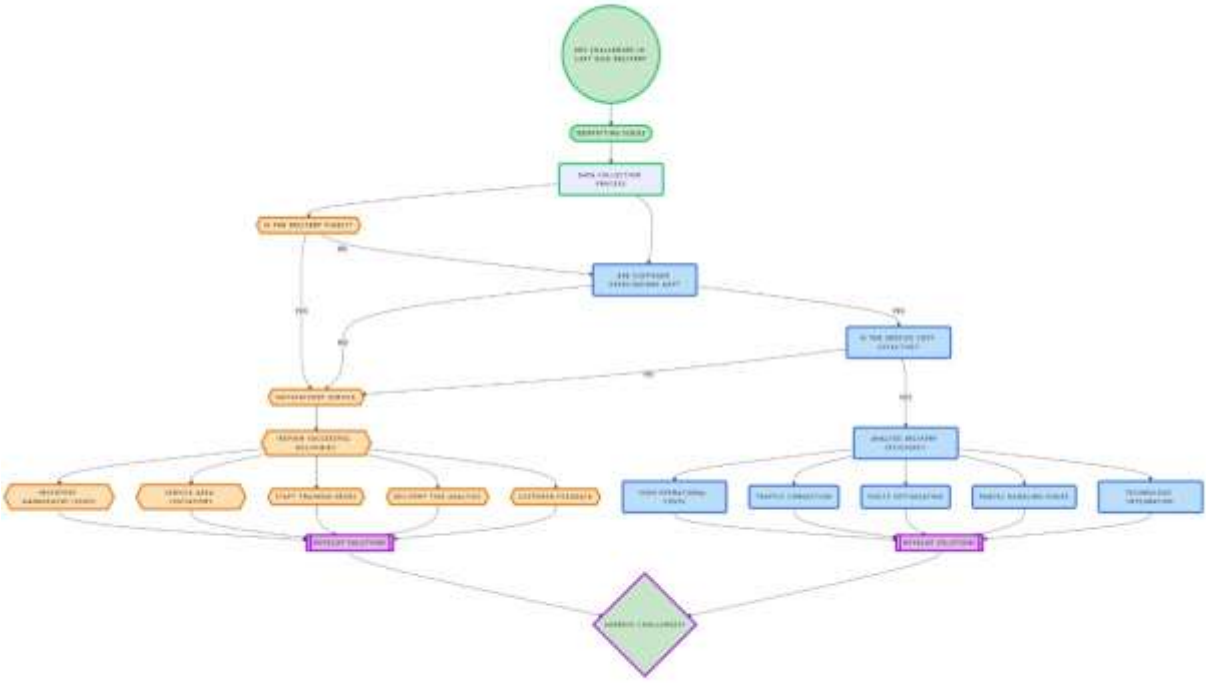
Interpretation

Both tables highlight key challenges in last-mile delivery, with high delivery costs (46%) and limited delivery tracking (44%-46%) being the most critical issues across both datasets, emphasizing the need for cost-effective strategies and robust tracking systems. Traffic congestion (36%-38%) and inadequate infrastructure (42%) are significant barriers, requiring route optimization and infrastructure improvements. Additionally, inefficient response mechanisms (48%) and strict delivery time windows (46%) underline the need for dynamic scheduling and improved customer support. Addressing these issues holistically can enhance efficiency and customer satisfaction.

FINDINGS

The findings highlight critical challenges in last-mile delivery. High delivery costs and limited tracking capabilities are the most significant issues, impacting efficiency and customer satisfaction. Traffic congestion and inadequate infrastructure also present substantial barriers, emphasizing the need for optimized routes and better facilities. Strict delivery time windows and inefficient response mechanisms further underscore the importance of dynamic scheduling and robust customer support systems. Addressing these areas can significantly improve overall operational performance.

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SUGGESTIONS

- Strengthen **route optimization practices** to minimize delays caused by traffic congestion and enhance delivery efficiency.
- Address **inadequate infrastructure resources**, such as delivery hubs and road conditions, to improve the operational flow of last-mile deliveries.
- Improve **real-time tracking capabilities** by incorporating IoT-enabled sensors and GPS for better transparency and customer satisfaction.
- Enhance **cost management strategies** by employing technologies like predictive analytics and shared delivery models to reduce high delivery costs.
- Promote **green delivery initiatives** by adopting electric vehicles and energy-efficient delivery practices to lower environmental impacts.
- Streamline **delivery response mechanisms** through AI-driven tools and agile approaches for faster issue resolution.
- Provide **flexible delivery schedules** by implementing dynamic delivery time windows based on customer preferences and real-time traffic data.
- Conduct **regular training sessions** for delivery personnel to ensure high-quality service and adherence to best practices.
- Encourage **collaborative efforts** between logistics companies and local authorities to manage traffic regulations and improve road networks.
- Implement **advanced technologies**, such as drones, autonomous vehicles, and blockchain, to tackle tracking issues and optimize overall delivery systems.

REFERENCES

1. *Gevaers et al. (2011): [Characteristics and Typology of Last-mile Logistics from an Innovation Perspective in an Urban (https://ideas.repec.org/h/elg/eechap/14398_3.html)*
2. *Boysen et al. (2021): [Last-mile delivery concepts: A survey from an operational research perspective] (https://link.springer.com/article/10.1007/s00291-020-00607-8)*
3. *Esser & Kurte (2020): [KEP-Studie 2020 - Analyse des Marktes in Deutschland] (https://www.forschungsinformationssystem.de/servlet/is/515681/)*
4. *Goodchild and Toy (2018): [Delivery by Drone: An Evaluation of Unmanned Aerial Vehicle Technology in Reducing CO2 Emissions in the Delivery Service Industry] (https://urbanfreightlab.com/publications/delivery-by-drone-an-evaluation-of-unmanned-aerial-vehicle-technology-in-reducing-co2-emissions-in-the-delivery-service-industry/)*
5. *Lagorio et al. (2016): [Urban freight demand estimation: A probabilitydistribution-based method](https://www.researchgate.net/profile/Alexandra-Lagorio/publication/336253716_*
6. *Allen et al. (2018): [Environmental sustainability in last-mile delivery: Challenges and opportunities] (https://www.tandfonline.com/doi/pdf/10.1080/02671522.2019.1615116)*

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7. Mangiaracina et al. (2019) – Innovative solutions to increase last-mile delivery efficiency in B2C e-commerce *https://www.emerald.com/insight/content/doi/10.1108/IJPDLM-10-2018-0305/full/html*
8. *Deutsch & Golany (2018) – A parcel locker network as a solution to the logistics last mile problem https://www.tandfonline.com/doi/full/10.1080/00207543.2017.1421785*
9. *Gatta et al. (2019) – Public transport-based crowdshipping for sustainable city logistics https://www.mdpi.com/2071-1050/11/1/145*
10. *Mladenow et al. (2016) – Crowd logistics: The contribution of social crowds in logistics activities https://www.emerald.com/insight/content/doi/10.1108/IJWIS-03-2016-0012/full/html*
11. *Morganti et al. (2014) – The impact of e-commerce on final deliveries https://www.sciencedirect.com/science/article/pii/S2352146514001871*
12. *Moshref-Javadi & Winkenbach (2020) – A truck and drones model for last-mile delivery https://www.sciencedirect.com/science/article/pii/S0307904X19306758*
13. *Dell'Amico et al. (2020) – Matheuristic algorithms for the parallel drone scheduling TSP https://link.springer.com/article/10.1007/s10479-019-03452-0*
14. *Fikar et al. (2018) – A decision support system using cargo-bikes for last-mile distribution https://www.tandfonline.com/doi/full/10.1080/13675567.2017.1395830*
15. *De Oliveira et al. (2017) – Potential demand of automated delivery stations in Brazil https://www.sciencedirect.com/science/article/pii/S0739885916301397*
16. *Gambella et al. (2018) – The vehicle routing problem with floating targets https://pubsonline.informs.org/doi/abs/10.1287/ijoc.2017.0770*
17. *Preference-Aware Delivery Planning for Last-Mile Logistics https://arxiv.org/abs/2303.04333*
18. *A Coalition Game for On-demand Multi-modal 3D Automated Delivery System https://arxiv.org/abs/2412.17252*
19. *Last Mile Delivery with Drones and Sharing Economy https://arxiv.org/abs/2308.16408*
20. *Predicting Drivers' Route Trajectories in Last-Mile Delivery Using A Pair-wise Attention-based Pointer Neural Network https://arxiv.org/abs/2301.03802*
21. *Integrating Driver Behavior into Last-Mile Delivery Routing: Combining Machine Learning and Optimization https://www.sciencedirect.com/science/article/abs/pii/S0377221723003429*
22. *An Optimization Model for Vehicle Routing Problem in Last-Mile Delivery https://www.sciencedirect.com/science/article/abs/pii/S0957417423002907*
23. *A Machine Learning Optimization Approach for Last-Mile Delivery and Third-Party Logistics https://www.sciencedirect.com/science/article/pii/S0305054823001260*
24. *A Large-Scale Last-Mile Consolidation Model for E-Commerce Home Delivery https://www.sciencedirect.com/science/article/pii/S0957417423017025*
25. *Data-Driven Optimization for Last-Mile Delivery https://link.springer.com/article/10.1007/s40747-021-00293-1*
26. *A Novel Two-Phase Approach for Optimization of the Last-Mile Delivery Problem with Service Options https://www.mdpi.com/2071-1050/15/10/8098*