



ROLE OF E-COMMERCE IN TRANSFORMING LAST-MILE DELIVERY IN INDIA

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ABSTRACT

The rapid expansion of e-commerce in India has significantly transformed the logistics and last-mile delivery ecosystem. Last-mile delivery, which represents the final stage of the supply chain between distribution centres and consumers, has become a critical factor influencing customer satisfaction, operational efficiency, and the competitiveness of e-commerce businesses. The growth of online shopping, increasing smartphone and internet penetration, digital payments, and changing consumer expectations have created a strong demand for faster, more reliable, flexible, and cost-effective delivery services. This study examines the role of e-commerce in transforming last-mile delivery in India, with particular emphasis on technological innovation, delivery models, customer expectations, and logistical efficiency. Technologies such as artificial intelligence, route optimization, GPS tracking, automation, data analytics, delivery management platforms, and emerging electric-vehicle solutions are reshaping traditional delivery practices. The study also highlights the growth of hyperlocal delivery, same-day and next-day delivery, pickup and drop-off points, and crowdsourced delivery models. Despite these developments, last-mile logistics continues to face challenges including traffic congestion, inadequate infrastructure, high delivery costs, rural connectivity gaps, address-related difficulties, environmental concerns, and workforce management. The paper argues that effective integration of e-commerce platforms with advanced logistics technologies can improve delivery speed, reduce operational costs, enhance transparency, and strengthen customer satisfaction.



KEYWORDS: E-Commerce; Last-Mile Delivery; Logistics; Digital Transformation; Supply Chain Management; Artificial Intelligence; Route Optimization; Real-Time Tracking;

INTRODUCTION

E-commerce has emerged as one of the most significant drivers of transformation in India's retail and logistics sectors. The rapid growth of online marketplaces, increasing internet and smartphone penetration, digital payment systems, and changing consumer preferences has created a strong demand for efficient and reliable delivery services. Consumers increasingly expect convenient ordering, real-time order tracking, multiple delivery options, faster delivery, easy returns, and competitive prices. As a result, logistics has become a strategic component of the e-commerce business

model, particularly the last-mile delivery stage, which connects distribution centres, fulfilment centres, stores, or local hubs with the final customer.

Last-mile delivery is often considered the most complex and expensive component of the supply chain. In India, the challenges are particularly significant because of high population density in urban areas, traffic congestion, diverse geographical conditions, varying address systems, limited logistics infrastructure in some regions, and the large distances involved in serving rural and semi-urban markets. The expansion of e-commerce has encouraged logistics companies and online retailers to develop innovative solutions to overcome these challenges. Hyperlocal delivery networks, fulfilment centres, parcel lockers, pickup and drop-off points, crowdsourced delivery, and technology-enabled delivery platforms are increasingly being adopted to improve operational efficiency and customer convenience. Technological development has played a central role in transforming last-mile delivery. Artificial intelligence, machine learning, GPS, route optimization, cloud computing, data analytics, Internet of Things (IoT), automated sorting systems, and digital delivery-management platforms enable businesses to monitor shipments and optimize delivery operations. Real-time tracking allows customers to receive accurate information about their orders, while route-optimization technologies can help delivery personnel select efficient routes and reduce travel time and fuel consumption.

NEED AND SIGNIFICANCE OF THE STUDY

The rapid growth of e-commerce in India has transformed traditional shopping and distribution systems. Increasing internet penetration, smartphone usage, digital payments, and online shopping have created greater demand for efficient last-mile delivery. Last-mile delivery is the final stage of the supply chain and directly connects e-commerce companies with customers. Its efficiency affects delivery speed, cost, reliability, and customer satisfaction. The growing popularity of same-day and next-day delivery has increased the need for innovative logistics solutions. Traffic congestion, high transportation costs, inaccurate addresses, failed deliveries, and inadequate infrastructure create major challenges for delivery services. E-commerce companies are therefore adopting advanced technologies such as artificial intelligence, GPS, data analytics, route optimization, and real-time tracking. The study is needed to understand how these technologies are improving delivery operations and reducing logistical difficulties. It also examines the development of hyperlocal delivery, fulfilment centres, pickup points, and flexible delivery models.

The significance of the study lies in its contribution to understanding the changing relationship between e-commerce and logistics in India. Efficient last-mile delivery can reduce operational costs, improve customer experience, and strengthen the performance of e-commerce businesses. The study also highlights the importance of sustainable delivery practices such as electric vehicles, optimized routes, delivery consolidation, and environmentally friendly logistics. E-commerce-driven logistics can improve market access for consumers and businesses in rural and semi-urban areas. The findings can help e-commerce companies and logistics providers develop more effective delivery strategies. The study can also provide useful insights to policymakers regarding urban transportation, digital infrastructure, and sustainable logistics development. Changing consumer expectations make reliable and transparent delivery increasingly important for customer retention. Technological innovation can help overcome several traditional limitations of last-mile logistics. The study is therefore significant for businesses, consumers, logistics professionals, researchers, and policymakers. Overall, it provides an understanding of how e-commerce is reshaping India's last-mile delivery ecosystem and supporting the development of a faster, smarter, more inclusive, and sustainable logistics network.

OBJECTIVES OF THE STUDY

The primary objective of this study is to examine the role of e-commerce in transforming last-mile delivery systems in India. The study aims to understand the growth and development of e-commerce-driven logistics and its influence on traditional delivery practices. It seeks to examine the

major factors responsible for the transformation of last-mile delivery in the Indian e-commerce sector. The study aims to analyse the role of technology in improving delivery speed, efficiency, accuracy, and reliability. It focuses on the use of artificial intelligence, GPS, data analytics, route optimization, automation, and real-time tracking in delivery operations. The study also aims to identify the emerging delivery models adopted by e-commerce companies. It examines the importance of same-day, next-day, hyperlocal, and flexible delivery services. The study further aims to assess the major operational and infrastructural challenges faced by last-mile delivery providers. It seeks to understand the impact of last-mile efficiency on customer satisfaction and service quality.

Another objective is to analyse the economic and operational benefits of efficient last-mile delivery for e-commerce enterprises. The study aims to examine how improved logistics can reduce transportation costs, delivery delays, failed deliveries, and resource wastage. It also seeks to assess the role of e-commerce in expanding delivery networks in rural and semi-urban areas. The study aims to identify the challenges associated with geographical accessibility, transportation infrastructure, and address management. It further examines sustainable practices such as electric vehicles, optimized routing, delivery consolidation, and environmentally friendly packaging. The study aims to understand the contribution of digital platforms and logistics partners to efficient delivery management. It also seeks to analyse the importance of real-time shipment visibility and digital communication between customers and delivery providers. The study aims to identify opportunities for innovation and future development in India's last-mile delivery sector. It seeks to provide useful suggestions for improving efficiency, affordability, customer satisfaction, and sustainability. Finally, the study aims to develop a comprehensive understanding of how e-commerce, technology, and logistics innovation are collectively shaping the future of last-mile delivery in India.

RESEARCH METHODOLOGY

The present study adopts a descriptive and analytical research methodology to examine the role of e-commerce in transforming last-mile delivery in India. The study is primarily based on secondary data collected from books, research journals, government reports, industry publications, company reports, newspapers, and reliable online sources. Relevant information is gathered on e-commerce growth, logistics networks, delivery models, technological innovations, consumer expectations, and challenges associated with last-mile delivery. The study focuses on the Indian e-commerce and logistics sector and examines developments in both urban and rural markets. A qualitative approach is used to understand the transformation of traditional delivery systems. The collected information is systematically reviewed and classified according to technological, operational, economic, consumer, and environmental dimensions. Comparative analysis is used to understand changes in conventional and technology-enabled delivery practices. The study also considers the role of artificial intelligence, GPS, data analytics, route optimization, automation, and real-time tracking. Secondary statistical information is used wherever relevant to support the analysis. The methodology helps identify major trends, opportunities, and challenges influencing last-mile delivery in India.

The study analyses the relationship between e-commerce expansion and improvements in last-mile logistics performance. Key parameters considered include delivery speed, cost efficiency, reliability, flexibility, customer satisfaction, accessibility, and sustainability. Emerging models such as same-day delivery, next-day delivery, hyperlocal delivery, pickup points, and crowdsourced delivery are examined. The study also evaluates challenges such as traffic congestion, inadequate infrastructure, failed deliveries, address-related problems, high operating costs, and rural connectivity. Sustainability-related practices, including electric vehicles, optimized delivery routes, consolidated shipments, and environmentally responsible packaging, are also considered. The collected data is interpreted through descriptive analysis, comparative assessment, and thematic analysis. The study does not rely on primary surveys unless specifically undertaken; therefore, findings are based mainly on the availability and reliability of secondary information. Appropriate care is taken to compare information from

different sources and identify consistent trends. The methodology provides a systematic framework for understanding how digital commerce and technological innovation are reshaping last-mile delivery.

RESEARCH DESIGN

The present study adopts a descriptive and analytical research design to examine the role of e-commerce in transforming last-mile delivery in India. The research design provides a systematic framework for studying the relationship between the growth of e-commerce and changes in logistics and delivery systems. The study focuses on the Indian e-commerce sector and its influence on the efficiency, speed, reliability, and accessibility of last-mile delivery. Secondary data is used as the principal source of information for the study. Data is collected from government publications, industry reports, research journals, books, company reports, newspapers, and reliable digital sources. The research design covers important dimensions such as e-commerce expansion, delivery infrastructure, technological development, consumer expectations, and emerging logistics models. The study examines the use of artificial intelligence, GPS, data analytics, route optimization, automation, and real-time tracking in delivery operations.

The research design also considers the major challenges and opportunities associated with e-commerce-based last-mile delivery. Factors such as transportation costs, traffic congestion, inadequate infrastructure, failed deliveries, address-related difficulties, and rural connectivity are examined systematically. The study evaluates the impact of improved delivery systems on customer satisfaction, operational efficiency, and business competitiveness. Environmental aspects such as electric vehicles, optimized routes, delivery consolidation, and sustainable packaging are also included within the research framework. Comparative analysis is used to examine traditional delivery practices and technology-enabled delivery systems. Information is organized into relevant themes to identify major patterns and emerging trends. The research design enables the study to assess both the positive contributions and limitations of e-commerce-driven logistics transformation. It also provides a basis for examining the future potential of technology-enabled and sustainable last-mile delivery in India. The findings are interpreted through qualitative and descriptive analysis of available evidence.

SAMPLE SIZE / SAMPLING METHOD

For the present study, a sample size of 200 respondents may be considered appropriate for collecting primary data on the role of e-commerce in transforming last-mile delivery in India. The respondents may include regular online consumers, delivery personnel, logistics executives, and e-commerce users who have experience with online ordering and delivery services. A structured questionnaire can be used to collect information regarding delivery speed, reliability, tracking facilities, customer satisfaction, delivery costs, technological adoption, and emerging delivery practices. A sample of 200 provides a manageable base for descriptive statistical analysis while allowing representation of different categories of respondents. Previous Indian e-commerce studies have successfully used purposive and other non-probability approaches when a complete sampling frame was unavailable.

The study may adopt purposive sampling with convenience sampling as the sampling method. Purposive sampling will ensure that respondents have relevant experience with e-commerce and last-mile delivery, while convenience sampling can facilitate access to respondents through online questionnaires and direct contact. Respondents will be selected based on their willingness to participate and their experience with e-commerce delivery services. The proposed sample can be distributed across consumer and logistics-related groups to obtain a broader perspective.

This sampling approach is suitable where a comprehensive population list of all e-commerce users and delivery workers is not readily available. However, because non-probability sampling does not give every population member a known probability of selection, the findings should be interpreted as indicative rather than fully representative of the entire Indian population.

PERIOD OF STUDY

The present study on “Role of E-Commerce in Transforming Last-Mile Delivery in India” considers the period 2020 to 2023. This period has been selected because it represents a significant phase of transformation in India's e-commerce and logistics ecosystem. During these years, online shopping expanded considerably, while consumer expectations regarding delivery speed, convenience, tracking, and reliability also increased. The period also captures the development of same-day delivery, hyperlocal delivery, quick commerce, digital tracking, automated logistics, and technology-enabled route optimization. Recent industry estimates indicate that India's e-commerce last-mile delivery market has continued to expand strongly, with increasing emphasis on faster delivery and technology-driven logistics.

The study uses information available during 2020–2023 to analyse changes in delivery infrastructure, logistics models, technological adoption, consumer behaviour, and sustainability practices. The period includes the important post-pandemic expansion of digital commerce and the subsequent growth of quick-commerce and rapid-delivery models. It also enables comparison of traditional delivery practices with emerging technology-based systems. Industry evidence shows that e-commerce has become an important driver of India's express logistics sector, while investments in technology, automation, and last-mile infrastructure have increased. Therefore, the selected period provides a relevant basis for evaluating the transformation, challenges, and future direction of last-mile delivery in India's e-commerce sector.

TOOLS OF ANALYSIS

The study “Role of E-Commerce in Transforming Last-Mile Delivery in India” uses descriptive, comparative, and analytical tools to interpret the collected data. Since last-mile delivery involves factors such as delivery speed, cost, reliability, technology adoption, customer satisfaction, and sustainability, both quantitative and qualitative techniques can be applied. Recent studies on e-commerce last-mile delivery commonly examine technological, economic, environmental, and customer-related dimensions.

For quantitative data, Microsoft Excel or SPSS may be used for tabulation, percentage calculations, averages, correlation analysis, and graphical presentation. Qualitative information can be examined through thematic and content analysis. These tools are appropriate because current last-mile research increasingly focuses on technology adoption, route optimization, customer experience, and sustainability. The combination of these analytical techniques enables the study to identify major patterns, assess the effectiveness of e-commerce-driven delivery transformation, and develop meaningful conclusions regarding the future of last-mile delivery in India.

LITERATURE REVIEW

The literature on e-commerce and last-mile delivery shows that the final stage of the supply chain has become a critical factor in the success of online retail. Datta examined last-mile delivery practices in Indian e-commerce companies and highlighted route selection, delivery time windows, and appropriate delivery methods as important determinants of logistics efficiency and service quality. The study also emphasized that effective last-mile delivery can provide a competitive advantage to e-commerce businesses. International research by Mangiaracina and colleagues reviewed innovative solutions for B2C e-commerce last-mile delivery and identified failed deliveries, customer density, automation, parcel lockers, crowdsourcing, and dynamic delivery solutions as important areas of concern. Kumar and Chidambara's systematic review of urban e-commerce delivery literature found that last-mile delivery has significant economic, environmental, social, and technological implications, while spatial impacts remain comparatively under-researched. Research on consumer behaviour further indicates that delivery time, delivery charges, flexibility, and availability of different delivery options strongly influence customer expectations and behaviour.

Recent literature increasingly focuses on technology and innovation in Indian last-mile logistics. Studies identify artificial intelligence, machine learning, Internet of Things, route optimization, real-time tracking, automation, and digital fulfilment systems as important tools for improving delivery efficiency and customer satisfaction. Research on Indian e-commerce also identifies infrastructure limitations, traffic congestion, address-related problems, delivery failures, high operating costs, and reverse logistics as continuing challenges. Recent studies emphasize that sustainable delivery practices, alternative delivery arrangements, and technology-enabled logistics can improve operational performance while reducing environmental impacts. The literature therefore establishes that e-commerce is transforming last-mile delivery from a conventional transportation function into a technology-driven, customer-oriented, and strategically important component of supply-chain management. However, there remains a need for more India-specific research examining the combined effects of technological adoption, consumer satisfaction, delivery efficiency, sustainability, and rural and semi-urban connectivity. The present study attempts to address this gap by examining the changing role of e-commerce in India's last-mile delivery ecosystem.

DATA ANALYSIS AND INTERPRETATION

The data collected for the study "Role of E-Commerce in Transforming Last-Mile Delivery in India" is systematically classified, tabulated, and analysed to understand the changing nature of delivery services. The analysis focuses on major variables such as delivery speed, reliability, order accuracy, real-time tracking, delivery flexibility, customer satisfaction, technology adoption, and delivery costs. Percentage analysis and frequency distribution can be used to present respondents' opinions in a simple and understandable manner. Mean scores and weighted averages can be applied to measure the relative importance of different last-mile delivery factors. Recent research in India identifies delivery speed, order accuracy, communication, reliability, and flexibility as important dimensions affecting customer satisfaction. Comparative analysis is also used to examine traditional delivery systems against technology-enabled e-commerce delivery models. The interpretation helps identify the extent to which digital technologies have improved delivery efficiency and customer experience. AI, GPS, route optimization, and data analytics are increasingly being applied to improve delivery operations in India.

The analysis further examines the challenges experienced by customers and logistics providers, including delayed deliveries, failed delivery attempts, traffic congestion, inaccurate addresses, high delivery costs, and inadequate communication. Customer satisfaction is interpreted in relation to timely delivery, tracking transparency, product condition, return services, and delivery flexibility. Statistical tools such as correlation and chi-square tests may be used to identify relationships between technology adoption, delivery performance, and customer satisfaction. Recent Indian research has found significant associations between technology adoption and improved delivery accuracy, while route optimization has been linked with reduced delivery delays. Tables, bar charts, pie charts, and percentage distributions can be used to present the findings clearly. The interpretation of the collected data provides a basis for assessing the effectiveness of e-commerce-driven last-mile transformation. It also helps identify opportunities for improving efficiency, reducing costs, enhancing customer satisfaction, and developing sustainable delivery systems in India.

DISCUSSION OF FINDINGS

The findings indicate that e-commerce has significantly transformed last-mile delivery in India from a conventional transportation activity into a technology-driven and customer-oriented service. Delivery speed, reliability, order accuracy, tracking transparency, and flexibility have emerged as important factors influencing customer satisfaction. Recent Indian studies similarly report that efficient last-mile delivery contributes substantially to customer satisfaction, trust, and loyalty. The increasing demand for same-day, next-day, and quick delivery has encouraged e-commerce companies to redesign their logistics networks and establish local fulfilment centres, hyperlocal delivery systems, and flexible

delivery options. The findings further indicate that real-time tracking has improved communication between customers and delivery providers. Artificial intelligence, GPS, route optimization, data analytics, and automated systems are increasingly being used to improve delivery planning and operational efficiency. Current developments in India's logistics sector also show greater use of AI and data analytics for demand forecasting, route planning, and disruption management. Thus, technological integration has become an important factor in improving the speed, accuracy, visibility, and reliability of last-mile delivery.

The findings also reveal that the transformation of last-mile delivery has created several challenges. High transportation costs, traffic congestion, failed delivery attempts, inaccurate addresses, increasing customer expectations, and pressure for faster delivery continue to affect logistics performance. The growth of quick commerce has intensified these pressures by creating expectations for extremely short delivery times, although scheduled and slotted delivery models remain relevant for larger and planned purchases. Sustainability is another important concern because increasing parcel volumes can lead to greater vehicle movement, fuel consumption, congestion, and environmental impacts. Recent research focusing specifically on Indian B2C e-commerce identifies sustainability risks and emphasizes the need for mitigation strategies that improve both efficiency and resilience. The findings therefore suggest that the future of India's last-mile delivery depends not only on speed but also on cost efficiency, customer satisfaction, technological capability, worker and infrastructure considerations, and environmental sustainability. Overall, e-commerce is reshaping India's logistics ecosystem by encouraging innovative delivery models and digital technologies while simultaneously creating a need for more sustainable, inclusive, and efficient last-mile solutions.

MAJOR FINDINGS OF THE STUDY

- ❖ The study finds that the rapid expansion of e-commerce has significantly transformed last-mile delivery practices in India.
- ❖ Last-mile delivery has become a major determinant of customer satisfaction, loyalty, and trust in e-commerce services.
- ❖ Delivery speed and reliability are among the most important factors influencing customers' overall online shopping experience.
- ❖ Real-time order tracking has improved transparency and allows customers to monitor their shipments more effectively.
- ❖ Artificial intelligence, data analytics, GPS, and route-optimization technologies are increasingly improving delivery planning and operational efficiency.
- ❖ Route optimization helps reduce unnecessary travel, delivery delays, fuel consumption, and operating costs.
- ❖ Technology adoption has contributed to improvements in delivery accuracy and shipment visibility.
- ❖ Same-day, next-day, hyperlocal, and quick-commerce delivery models have changed consumer expectations regarding delivery speed.
- ❖ Scheduled or slotted delivery continues to remain important for larger orders and routine purchases despite the growth of instant delivery models.
- ❖ The findings indicate that customer expectations have shifted from simply receiving products to receiving them quickly, conveniently, reliably, and transparently.
- ❖ Delivery communication through SMS, mobile applications, notifications, and tracking systems has become an important component of customer service.
- ❖ Order accuracy and proper handling of products contribute significantly to customer confidence in e-commerce platforms.
- ❖ Failed deliveries remain an important operational challenge because of customer unavailability, inaccurate addresses, and communication difficulties.

- ❖ Traffic congestion and inadequate transportation infrastructure continue to affect last-mile delivery efficiency in Indian cities.
- ❖ High delivery costs remain a major concern for e-commerce companies, particularly when individual orders require separate delivery trips.

RECOMMENDATIONS / SUGGESTIONS

The study recommends that e-commerce companies should strengthen their last-mile delivery infrastructure to meet the growing demand for fast, reliable, and cost-effective services. Greater use of artificial intelligence, machine learning, GPS, route optimization, real-time tracking, and data analytics should be encouraged to improve delivery planning and reduce delays. Current developments in India show that AI and data-driven systems are increasingly being used for route planning, demand forecasting, and logistics decision-making. E-commerce firms should develop more local fulfilment centres, micro-hubs, and strategically located warehouses to reduce delivery distances and improve service in Tier-2 and Tier-3 cities. Address verification and digital mapping systems should be improved to reduce failed deliveries and repeated delivery attempts. Companies should provide customers with flexible delivery slots, accurate tracking, convenient pickup points, and easy rescheduling facilities. Logistics providers should strengthen communication between customers, sellers, warehouses, and delivery personnel. Delivery personnel should receive regular training in digital tools, customer service, road safety, and efficient delivery practices. Collaboration between e-commerce companies, logistics providers, local retailers, and public agencies should be encouraged to create integrated delivery networks. The Department of Posts' recent collaboration with Flipkart for nationwide last-mile parcel delivery demonstrates the potential of partnerships to expand delivery capabilities.

Sustainability should become an important component of India's e-commerce last-mile delivery strategy. Companies should gradually increase the use of electric vehicles, route consolidation, shared logistics infrastructure, and environmentally responsible packaging. Research identifies limited sustainable infrastructure, traffic congestion, high initial investment, and lack of technical knowledge as major barriers to sustainable last-mile delivery in India. Government and financial institutions should therefore provide suitable incentives, financing mechanisms, charging infrastructure, and technical support for the transition toward electric delivery fleets. Delivery consolidation, load pooling, micro-hubs, and optimized routing should be promoted to reduce unnecessary vehicle kilometres and emissions. Companies should balance the demand for ultra-fast delivery with profitability and environmental responsibility rather than treating speed as the only performance indicator. Data privacy and cybersecurity should also be strengthened as logistics operations become increasingly digital. Finally, policymakers should improve urban logistics infrastructure, digital addressing systems, charging networks, and regulations supporting sustainable freight movement. These measures can help create a last-mile delivery ecosystem that is efficient, affordable, technologically advanced, customer-oriented, inclusive, and environmentally sustainable.

CONCLUSION

The study concludes that e-commerce has played a transformative role in reshaping last-mile delivery in India. The rapid expansion of online shopping has increased the importance of efficient, reliable, flexible, and customer-oriented delivery systems. Last-mile delivery has evolved from a conventional transportation function into a strategic component of e-commerce operations. Technologies such as artificial intelligence, data analytics, GPS, real-time tracking, automation, and digital fulfilment are improving route planning, shipment visibility, delivery accuracy, and operational efficiency. The growth of rapid and quick-commerce models has further changed consumer expectations regarding delivery speed and convenience. At the same time, initiatives such as India

Post's technology-driven modernization and its integration with e-commerce platforms demonstrate the growing importance of digital infrastructure in strengthening nationwide last-mile connectivity.

However, the transformation also creates challenges related to high delivery costs, traffic congestion, failed deliveries, infrastructure limitations, reverse logistics, workforce management, and environmental sustainability. The study finds that future success cannot depend only on faster delivery; it must balance speed, affordability, reliability, customer satisfaction, profitability, and sustainability. Recent research on Indian B2C e-commerce identifies sustainability risks in last-mile delivery and emphasizes the need for integrated mitigation strategies. Therefore, greater adoption of electric vehicles, optimized routing, shared logistics infrastructure, micro-fulfilment centres, sustainable packaging, and data-driven delivery management is required. Government support through improved urban freight infrastructure, digital addressing, logistics coordination, and sustainable transportation policies can further strengthen the sector. Overall, e-commerce is creating a more digital, intelligent, flexible, inclusive, and technology-driven last-mile delivery ecosystem in India, and continued innovation will be essential for making this transformation economically viable and environmentally sustainable.

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