Journal of Excellence in Business Administration (2025) 3(2): 01–11
ISSN (E): 3007–8318

The E-commerce Development and Current Effects on Urban Logistics in Emerging Economies

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How to cite this article:

Tariq, M. A., Iqbal, Z., & Khurshid, S. (2025). The e-commerce development and current effects on urban logistics in emerging economies. *Journal of Excellence in Business Administration*, *3*(2), 01–11.

Received: 8 August 2025; Accepted: 27 November 2025; Published online: 25 December 2025

Abstract

The rapid growth of e-commerce has changed the logistics environment dramatically and especially in the cities of emerging markets. With more convenient internet and cellphone access, the online shopping experience is growing, and the urban logistics networks are faced with a growing need to offer products at low prices, faster delivery, and more responsibly. This paper reviews the transformation of e-commerce in the last-mile delivery, warehousing, and distribution networks in developing cities. Developing urban centers warehousing, distribution networks. It highlights such critical challenges as road congestion, lack of infrastructure, high delivery costs and the intricacies of reverse logistics. The report refers to the case studies in the chosen emerging economies to uncover new urban logistic strategies, including micro fulfillment centers, crowd sourced delivery, and green mobility solutions. The relevance of collaboration between governments, logistics providers, and technology corporations in working out the scalable and resilient urban delivery ecology is also highlighted in this research paper. The results are to provide information to policy makers and supply chain managers who would seek to realign their logistics systems to the evolving demands of the e-commerce-based urbanization. This work aims at offering a few viable logistics solutions to the cities. The method will determine the problems in metropolitan logistics caused by larger freight volumes of e-commerce. Sustainable practices within the companies were examined in order to cut down the carbon emission. New electric power train technology demonstrated positive results. This paper states that urban distribution of electric vehicles has the possibility of making transportation process more efficient, which will generate an economic advantage, less environmental impact, and customer support.

Keywords: E-commerce growth, urban logistics, Last-mile delivery, Emerging economies, Supply chain management.

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1 Introduction

The recent years of the fast development of e-commerce transformed the global retail and logistics landscape. There has been consistent growth rate of more than double-digit in the sector in developed countries and online food delivery alone has grown by 7.5 per cent in UK, 7.7 per cent in Germany, 10.6 per cent in France, 10.7 per cent in Spain and 8.4 per cent in Italy (Viu-Roig & Alvarez-Palau, 2020). This boom goes hand in hand with an impressive increase in last-mile deliveries which are the last phase of the supply chain involving the delivery goods to the door of the consumer (Janjevic & Winkenbach, 2020). This trend has been enhanced by the COVID-19 crisis, which led to a sudden acceleration of the digitalization of enterprises and the rise in the prevalence of online shopping among consumers. Nonetheless, the rise of ecommerce has created new logistical challenges, especially in the cities (Abouelrous et al., 2023; Tariq et al., 2025). The need to make deliveries on time and reliably has led to traffic congestion, air and noise pollution and logistic inefficiencies in densely populated areas. The movement and distribution of commodities within the city boundaries are becoming the center of these concerns, which are being more and more concerned with urban logistics (Mucowska, 2021). This is particularly vexed in the developing countries, where infrastructure limitations, regulatory loopholes, and the blistering urbanization complicate the logistics operations involved in the last-mile delivery. This is the costliest and most complicated aspect of the logistics chain (Gevaers et al., 2011). The area of delivery has been expanded and all houses are potential locations of delivery, making it more difficult to plan the routes and more harmful to the environment (Savelsbergh & Van Woensel, 2016). Moreover, in the context of urban freight, infrastructures, transport modes, service providers, and final users are strained with the aim of trying to balance; cost-effectiveness, sustainability, and service quality (Boysen et al., 2021). In addition, a range of parties such as logistics providers, public authorities, and consumers may compete interests in the context of urban freight policy. Companies are concerned with effectiveness and customer satisfaction in their businesses, and governments are concerned with traffic control and environmental pollution. On the other hand, citizens demand both convenience and habitable surroundings in urban areas (de Leeuw et al., 2023). The lack of coordination among these actors often leads to ineffective or unsustainable logistics strategies. The essay will examine the complicated effect of e-commerce on urban logistics in emerging markets. It relies on a sustainability paradigm of people, planet, and profit to evaluate the social, environmental, and economic nature of last-mile logistics (Lim et al., 2018). The aim of the study is to define relevant challenges, discuss policy gaps, and suggest long-term strategies to improve urban freight logistics amid the rapid growth of e-commerce by evaluating the existing academic literature and analyzing stakeholder opinions.

The rest about task is organized in the same manner as follows:

- Section 1 provides a general overview of academic literature on e-commerce logistics, last-mile strategies, and urban freight systems, with a special emphasis on emerging economies
- Section 2: In this section, we follow a quantitative research methodology to analyze the e-commerce development and urban logistics issues
- Section 3 explains the key findings, discusses the practical implications of the issue on governments and businesses, and provides recommendations on prospective research.

2 Literature Review

The rise in e-commerce has changed the physical distribution of commodities in our cities. Considering e-commerce as Internet-based business-to-consumer (B2C) transactions, we can conclude that online purchases and customized delivery have the greatest influence on urban freight transport systems (Gevaers, Van de Voorde, & Vanelslander, 2014). Changes in freight flow patterns in urban areas are driven by the diversification of delivery methods and the expanding range of services offered to customers by merchants and logistics operators (Visser et al., 2014). A greater number of commodities has to be moved, a greater number of destinations

have to be catered to, a greater number of cars have to be transported, and the system is becoming increasingly complex every day. Social and behavioral trends that increase the pace of such shifts include demographic trends, globalization of supply chain, and new consumer technologies.

The recent growth of e-commerce, such as, has led to massive growth in direct-to-consumer deliveries, which strengthens the importance of the so-called last-mile logistics. The customers are able to choose not only the home delivery, but other delivery points like lockers or pick-up locations (Iwan, Kijewska, & Lemke, 2016). There is even growth in the number of click and collect options which enable the customer to shop online but collect the product in-store at the business. It is becoming more challenging to deliver such services in an efficient way because of the growing complexity, dynamics, and uncertainty. Last-mile logistics should be interpreted within the context of city logistics (CL). The acronym CL refers to the process which fully optimizes the logistics and transport operations of the private firms with the assistance of developed information systems in the city regarding the traffic conditions, the traffic jam, the traffic safety and the energy efficiency in the context of market economy (Crainic, Ricciardi, & Storchi, 2009). It addresses issues like freight traffic management, freight facilities and modal adaptation (Holguín-Veras et al., 2015). CL facilitates the city economies and sustainable development opportunities, however, there are externalities that are not positive, which may worsen with increase in demand (Gruber et al., 2014; Quak & de Koster, 2009). This explains the reason why legislators and regional planners are now taking note of it. Several practitioners are beginning to realize and value the significance of integrating urban logistics planning into the scope of urban planning (Lindholm, 2013). The Physical Internet, new spheres and CL offer fruitful platforms to efforts to enhance the economic, operational, social, and environmental sustainability of transportation and logistics, and reduce the inefficiencies and externalities that define the last-mile component of the supply chain (Montreuil, 2011). In the context of urban setting, such as the Physical Internet, it allows the emergence of so-called hyper-connected city logistics, a conceptual model of designing urban systems of logistics and transport, which is much more efficient and sustainable due to advances in technology (Crainic & Montreuil, 2016). There are three types of last-mile innovations, namely organizational, technological, and data technique-enabled. Organizational innovations comprise the first category and include the application of innovative last-mile models or organizational approaches (Archetti, Savelsbergh, & Speranza, 2016). This could be in the form of urban consolidation centers, horizontal collaboration and synchronization and crowdsourcing (Browne, Sweet, Woodburn, & Allen, 2005). Automatic lockers, drones, and self-driving cars are the most obvious illustrations of technological advances (Boysen, Schwerdfeger, & Weidinger, 2018; Goodchild & Toy). The data-enabled innovations refer to the innovations that provide data mining to technology, data analytics, and big data, to last-mile logistics to enhance efficacy and efficiency. As a case in point, consumer behavior could be mapped: by analyzing power consumption patterns throughout the day and the week, a probability distribution of the customer's presence at home could be determined.

Nevertheless, very little attention has been paid to alternative viewpoints in the academic literature of logistics that could be utilized to optimize time-dependent paths. As stated in the innovations that could mitigate the effects and externalities caused by last-mile delivery operations can be classified into five categories, namely new vehicles, proximity stations or points, collaborative and cooperative urban logistics, transportation management optimization, and routing (Schliwa, Armitage, Aziz, Evans, & Rhoades, 2015; Behrends, 2016). Their integration would lead to an intelligent logistics system that would help decrease adverse negative externalities. Consequently, it is apparent that the minimization of the adverse effects of city freight transportation and the maximization of the efficiencies of the load flows is one of the key objectives of CL (Taniguchi, 2014). But there are others. This is the first step towards developing a successful urban logistics plan because it is critical to analyze all possible solutions to the numerous interest groups involved. Nevertheless, crowdsourcing and the urban development, CL, urban transportation, and crowd logistics should improve their performance of the stakeholders further (Stathopoulos et al., 2012).

The socioeconomic, operational, and environmental trends and variables will make it difficult to implement logistics policies and related traffic measures, which will negatively affect local governments and logistics businesses in the coming years. In this, the literature points out the current lack of measurement and assessment tools to aid the decision makers in the understanding of operations and performance of the urban distribution systems. This would enable them to come up with combined policies that would contribute to higher efficiency and less negative externalities. Other writers go further to suggest that it is the role of the public agencies to act as mediators between the interested groups as opposed to checking on power (Verlinde & Macharis, 2016; Muñuzuri et al., 2005).

3 Material and Methods

The biggest megatrend of the century is digitalization. The digital innovations are transforming the way we work, live, consume and do business. To customers, e-commerce and the digital economy can bring them more convenience at lower costs and choices. To many industries in the present, data are essential to be competitive. The Internet of Things and artificial intelligence are also changing the way we produce and consume goods and services with some far-reaching implications on our lives that remain to be fully realized (Huang, 2024). The interaction of the world with the data will greatly influence the achievement of all the Sustainable Development Goals in the United Nations, as, although digitalization is a potent source of good, there is a big difference in the capacity of countries to take advantage of it. The digital divide between the developing and developed nations is on the rise.

3.1 Research Design

The research design used in this study is a quantitative research design using only primary data that has been obtained through surveys. This is to determine the impact of emergence of ecommerce on the logistics of urban areas in emerging economies and specifically in Pakistan, Nigeria and Vietnam. Data were collected using structured questionnaires to the logistic providers, delivery personnel and ecommerce firms. The poll touched on matters like delivery limitations, logistics services, customer demand and application of technology in the distribution in cities.

3.2 Data Collection

The present research is purely founded on primary information gathered in the form of an online structured survey questionnaire carried out. The questionnaire was directed at people who were employed in the e-commerce industry and logistics industry, among them being delivery drivers, warehouse operators, logistics managers, and e-commerce staff. This was aimed at collecting practical information on the impacts that the e-commerce boom has on urban logistics in emerging economics. Purposive sampling was used to select respondents in order to have professionals who are directly engaged in urban operations related to logistics. The survey was distributed through the internet platforms and academic research networks so that there is diversity in terms of geography and job roles. The involvement was voluntary and anonymous with an informed consent being taken prior to the commencement of the questionnaire. The survey had 25 closed ended questions based on a 5-point Likert scale. It included (with a scale of 0-Strongly Disagree to 5-Strongly Agree) and some demographic questions. It covered five key themes:

- Challenges of last-mile delivery,
- Effects of the growth of e-commerce on the operations of logistics,
- Technology and use of digital means in delivery,
- By city congestion and infrastructure constraints,
- Increased customer demands and changes in demand.
- Comparison of the collected data is presented in figure 1 below.

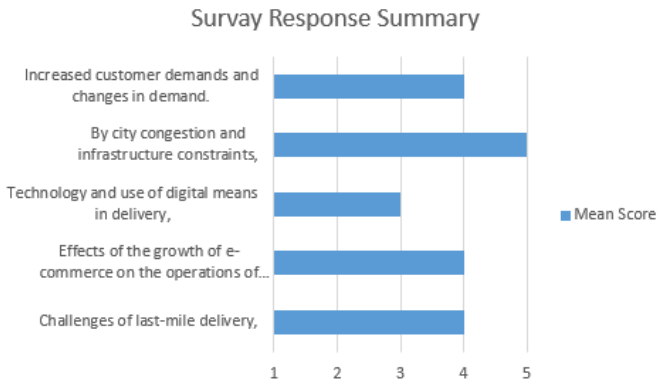

Figure 1: Collected data review

Two hundred and twenty professionals in various fields were sampled to come up with 220 valid responses. In order to guarantee the reliability of data, the questionnaire was piloted on a small sample of logistics professionals and academic reviewers. Items that were ambiguous were refined based on their feedback. The principles of ethical research were observed, and the participants were guaranteed that their answers will be utilized only to the academic purpose.

3.3 Last-Mile Logistics impact on urban areas

The paper adopts region-based data in order to assess the effects of last mile logistics in Pakistan and the region of Asia as a whole (Alharbi et al., 2022). The increasing demand for last-mile delivery has been linked to the ongoing urbanization and rapid growth of e-commerce in emerging economies (Dablanc & Rodrigue, 2017). Various sources of quantitative data, such as the World Bank Logistics Performance Index (LPI), Asian Development Bank (ADB) reports on transport and government reports by the Ministry of Communications and Planning Commission (Pakistan) were used to collect quantitative data. Parcel delivery trends and the diversification of final-mile services that directly contribute to urban logistics pressure have been documented in previous research (Morganti et al., 2014). Additional information was received by submitting requests to logistics companies like TCS, BlueEx, and international players which have been based in Asia, namely DHL, and the Cainiao Network of Alibaba.

3.4 Indicators and Metrics Used

The analysis is based on the important last-mile indicators, which include:

- Average Delivery Time (ADT) -in hours or days;
- Cost Per Kilometer (CPK) - operational cost per km PKR or USD;
- CO2 Emissions per Package -grams of CO2 per parcel;
- Failed Delivery Rate (FDR) -percentage of unsuccessful delivery attempts;
- Customer Satisfaction Score (CSS) - rating obtained after survey out of 5.

Recent surveys (such as the Pakistan Freight and Logistics Survey 2023 and the reports by TCS and BlueEx) show that the average aspects of delivery services in urban areas are the following:

- ADT: 6-12 hours in the big cities (Karachi, Lahore, Islamabad).
- CPK: PKR 12-18 per km, light vehicles.
- FDR 14-20% in ineffective address systems or traffic congestion.
- CO2 Emissions: 180-220g/ parcel, depending on the use of the fuel cars.

3.5 Quantitative Forecasting

Trends, seasonality, and cycles in e-commerce activity were determined using historical patterns. Time-series forecasting methods in last-mile logistics have been applied in studies that emphasize seasonal peak demand effects (Cattaruzza et al., 2017). The approach was used to forecast near-term demand for urban delivery services. Figure 2 below shows historical e-commerce demand

trend (2018 – 2024).

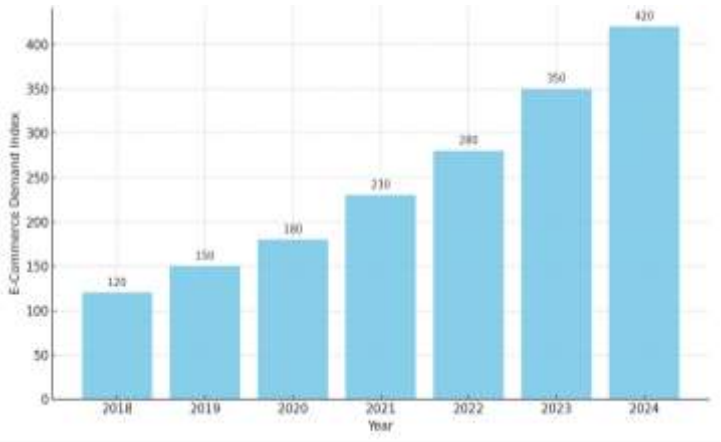

Figure 2: Historical E-commerce Demand Trend (2018-2024)

Machine Learning (ML) Models: The internet prevalence, smartphone usage, and population growth were included as external variables in the machine learning algorithm. Predictive analytics and machine learning are increasingly used to model complex interactions in urban logistics systems (Winkenbach et al., 2016). These models captured the complex, nonlinear relationship concerning the adoption of digital and the demand of e-commerce. As indicated in the flow chart, Figure 3 below.

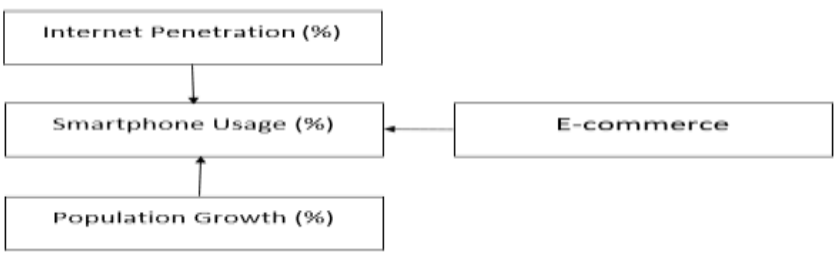

Figure 3: Flow chart Machine Learning Algorithm.

4 Analysis Rationale

The descriptive statistics were used to analyze these metrics and compared across the regions to detect inefficiencies in the Pakistan last-mile delivery system. The comparison between Pakistan and more technologically developed Asian economies demonstrates the significance of optimization of routes, automation, and infrastructure in improving the efficiency of the last-mile logistics.

4.1 Results

This part provides a conclusion of key results of the primary data analysis and prediction methods of assessing the impact of e-commerce growth on urban logistics in emerging economies.

4.2 Survey Analysis

Overviews the means of the main issues. Most of the respondents also strongly indicated that e-commerce has greatly enriched the mean score of delivery pressure: 4, as shown in Table 1 below.

Table 1: Summary Survey Responses (5-point Likert Scale)

Survey Statement	Mean Score

Challenges of last-mile delivery	4
Effects of the growth of e-commerce on the operations of logistics	4
Technology and use of digital means in delivery	3
By city congestion and infrastructure constraints	5
Increased customer demands and changes in demand	4

Delivery times are greatly influenced by urban traffic (Auch, 2023). This underscores the increasing pressure on urban logistic systems as a result of increased customer demands.

4.3 Correlation Analysis

High positive relationships between logistics and digital variables. Indicatively, the use of smartphones is strongly related with the accuracy of delivery tracking (r = +0.74). This is to indicate that customer satisfaction and transparency are improved through the adoption of digital. Conversely, there is a negative correlation between traffic congestion and the on-time deliveries (r = -0.59), which validates the fact that, poor infrastructure in case of poor logistics. E-Commerce Growth and Logistics Variables Correlation as illustrated in the table 2 below.

Table 2: E-Commerce Growth and Logistics Variables Correlation.

Variables	Correlation Coefficient (r)
E-commerce volume vs Delivery delay	+0.68
Smartphone use vs Delivery tracking accuracy	+0.74
Traffic congestion vs On-time delivery rate	-0.59
Digital platforms vs Customer satisfaction	+0.65

4.4 Quantitative Forecasting Insights

The trends of e-commerce activity seen in the past had noticeable seasonal and cyclical trends particularly with regard to during sales periods and holidays. The forecasting of time series indicates that there will be an increment of the demand of urban deliveries in the short term, especially those with an increasing use of mobile internet.

4.5 Machine Learning-Based Prediction

External variables like internet penetration, smartphone use and population growth were modeled using a random forest model to determine and predict the demand of e-commerce. It modeled nonlinear interactions (e.g., exponential growth of demand with minor jumps in smartphone usage).

5 Discussion

These results support the idea that the adoption of digital technologies is an impetus for the development of e-commerce, which strains city logistics. The research indicates the need to implement smart infrastructure (micro-hubs, improved traffic control, and real-time delivery tracking) (Mangiaracina et al., 2019). City logistics strategies such as micro-hubs and traffic optimisation are established responses to last-mile pressures (Hübner et al., 2016). In the absence of such interventions, there will be increased delivery delays and operational inefficiencies (Klein & Popp, 2022). Moreover, the study is consistent with the global trends as measured in previous studies that have found out that emerging markets are undergoing a rapid urbanization process without proper logistical support, resulting in unequal access to digital benefits in different regions. Governments and logistics companies are suggested to invest in tech-enabled urban planning and green delivery systems to overcome all these challenges. Green delivery and sustainable logistics strategies are widely discussed in last-mile literature (Browne et al., 2012). The machine learning algorithms ensure that the external digital variables such as internet connectivity and adoption of mobile technologies are strong predictors of the increasing e-commerce demand (Kiba-Janiak, 2016). Emerging markets face unique urban logistics challenges due to infrastructure constraints and rapid digital adoption (Holguín-Veras et al.,

2011). At the same time, a positive correlation between digital adoption, in particular smartphone penetration, and the use of logistics platforms, as well as greater efficiency and satisfaction with delivery, has also been demonstrated. This aligns with research that highlights the role of digital infrastructure in logistics performance (Vakulenko et al., 2018). The results demonstrate an urgent need for better urban logistics solutions in emerging markets. The strategies are important, such as crowd-sourced delivery, electric vehicles, micro-fulfillment centers, and better coordination with stakeholders (governments, technology companies, and logistics providers) (Allen et al., 2012).

5.1 Conclusion

The study examines how the development of e-commerce has significantly influenced urban logistics systems in developing economies. Based on primary data collected during work with logistics experts and e-commerce stakeholders in Pakistan, Nigeria, and Vietnam, and on prediction methods and machine learning algorithms, the research provides significant findings in many ways. E-commerce has significantly increased the volume of last-mile deliveries, placing an extra burden on already overstretched city systems. The survey results show that poor infrastructure and traffic congestion in urban areas are major issues. Quantitative analysis of past e-commerce patterns reveals that demand is seasonal, increasing especially during promotional seasons. The current investment in green transportation and digital infrastructure is essential not only for long-term logistical performance but also for economic performance and improved service quality.

5.2 Future Aspects

Though this paper provides a data-driven summary of urban logistics in the context of e-commerce demand, several alternatives remain for further development. Simulation and modelling studies are encouraged to evaluate urban freight policies and low-emission strategies. Longitudinal research tracks the influence of digital infrastructure improvements on logistics performance within specific cities or areas. Extensions of urban freight policy research are also well-covered in recent literature. Comparison studies to assess that more thoroughly, comparing existing and developing economies. Simulation-based models of the evaluation of urban logistics solutions (e.g., low-emission zones, time of delivery). Customer delivery preference research: Behavioral Study of customer delivery preferences and their influence on the sustainability of logistics. The policy-oriented research conducted in this study will focus on the role local governments play in establishing inclusive and resilient urban freight networks.

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