

Last-Mile Delivery Challenges in Urban Logistics: A Comparative Study of Developing and Developed Economies

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Abstract—The most decisive and expensive part of urban logistics, which directly determines the quality of services, operational efficiency, and customer satisfaction, is last-mile delivery. The fast development of e-commerce and on demand has exacerbated the pressure on the delivery systems, exposing structural vulnerabilities in both the developing and developed economies. Nevertheless, these problems vary greatly because of the differences in infrastructure, the usage of technology, the regulatory framework, and urban planning. This paper will offer a comparative analysis of last-mile delivery issues in these economic settings. The main limitations found in developing economies are a lack of proper transport infrastructure, ineffective addressing systems, traffic, and a lack of digital integration. Conversely, the developed economies experience high operational expenses, stringent environmental policies, labor unavailability, and consumer demands that are increasingly fast and flexible. The research is based on the current literature that explores the adaptation of logistics systems to these circumstances, with a specific focus on technological interventions, including route optimization and intelligent logistics platforms. It suggests a systematic model that emphasizes the differences in the operations and notes the necessity of context-dependent, technology-enhanced policies to enhance the efficiency of urban delivery worldwide.

Keywords—Developed economies, Last-mile delivery, Supply chain performance, Urban freight logistic, Urban transport systems.

I. INTRODUCTION

Last-mile delivery is becoming one of the most important parts of the modern urban logistics network since it directly influences efficiency in delivery, customer experience, and the supply chain performance in general. As the e-commerce and various on-demand service platforms are rapidly expanding, pressure on the logistics networks is increasing to find ways of delivering goods at reduced costs, faster, and more reliably. Nevertheless, the last mile is the most complicated and expensive part of the supply chain, and it frequently takes a large percentage of the overall logistics expenses [4,10].

The intricacy of last-mile delivery is further increased in urban setting whereby a high population density, traffic jams, and scattered points of delivery lead to inefficiencies in the operation. These problems are not universal since developing and developed economies have logistics of structures and constraints that are fundamentally different. In the developing economies, the last-mile delivery systems are frequently inefficient due to insufficient infrastructure, bad road systems, non-formalized addressing systems, and weak digital logistics integration [11,14]. On the other hand, the developed economies have issues pertaining to the high cost of operation,

stringent environmental laws, labor crunch, and increasing customer demands for quick and adaptable delivery services [18,20].

Although there is a widespread body of research on urban logistics and last-mile delivery systems, most of the existing studies are based on the development or the developed economies separately. This disjointed solution constrains the knowledge of structural variations between these two circumstances and the elaboration of internationally viable logistics plans. Moreover, the current literature is more likely to focus on technological solutions without due consideration of the infrastructural and socio-economic limitations that affect the logistics performance of various regions [12,17].

This research fills this gap by offering a comparison of the last-mile delivery issues in developing and developed economies. It suggests a systematic model that analyses the major aspects, including infrastructure capacity, technology usage, and efficiency in operations. The task is to determine systemic differences in the performance of urban logistics and the emphasis on context-specific solutions to the last-mile delivery efficiency.

The value of the present study is that it combines a relative logistics study with a systematic assessment system that can provide policy-makers, logistics operators, and city planners with valuable insights. The study helps to create more adaptive and efficient urban logistics by emphasizing the differences between the issues of last-mile delivery in different economic conditions.

II. LITERATURE REVIEW

A. Concept of Last-mile Delivery in Urban Logistics

This research is based on the theoretical background of the urban logistics system and contingency theory. According to contingency theory, the performance of an organization is determined by the fit between the capabilities of the organization and the environment. This means that in the case of last-mile delivery, logistics plans need to be adapted to infrastructural, technological, and regulatory conditions. Also, the theory of urban logistics focuses on how the freight transport system interacts with urban spatial systems in terms of the importance of city design, population density, and policy frameworks in determining efficiency in deliveries.

The last-mile delivery is the most expensive component of the logistics chain that directly affects the efficiency of the services, customer satisfaction, and the overall efficiency of the

supply chain [1,6]. It involves movement of products between the centres of distribution and the final consumers in the urban areas, which most of the time is characterised by congestion, disjointed points of delivery, and time-sensitive demand structures.

It is known that most of the overall logistics costs are ascribed to the last-mile operations due to poor routing, failed product delivery, and urban-density delivery growth [4,10]. As the global trend of urbanization and uptake of e-commerce continues to rise, the complexity of the last-mile operations has risen in both developing and developed economies.

B. City Logistics Problems In Emerging Economies.

Last-mile delivery systems in developing economies have very severe infrastructural and institutional constraints. This is due to the inefficiencies in delivery occasioned by poor road networks, poor addressing systems, and informal settlement structures that further contribute to the cost of operation [11,14].

In addition, the real-time tracking, route optimization, and demand forecasting models are constrained by the absence of the use of digital logistics platforms. This contributes to a high level of delivery uncertainty and increased reliance on manual coordination mechanisms [13,16]. Traffic congestion, which is especially common in highly urbanising cities, further complicates delays and makes it less reliable in terms of the delivery of goods [15].

As per the literature at hand, logistics inefficiency in the developing economies is more structural than operational, i.e., to change it requires long-term plans to invest in infrastructure and digital transformation [17].

C. Developed Economies Urban Logistics Systems.

On the contrary, developed economies have fewer infrastructural and more operational last-mile delivery challenges. The high cost of labor, strict environmental laws and regulations, and the requirements of the customers to receive the products in a day or even within a few hours have a great impact on the logistics strategies [18,20].

Progressive logistics technologies have been adopted by developed economies to address these challenges: optimization of route algorithms, autonomous delivery systems, and urban consolidation centers [19,22]. The innovations will minimize the time of delivery, reduce environmental impacts, and improve operational efficiency.

However, despite the advances in technologies, the last-mile logistics systems continue to have critical operational challenges in terms of congestion in the urban centers and sustainability constraints [21].

D. Comparative Economies Among the Developing And Developed Economies.

A literature review shows that there are significant differences between the nature of the challenges of the final mile in the various economic environments. The significant obstacles that developing economies struggle with are a deficiency of infrastructure and inefficiency of the systems, but the developed ones strive to optimize, to be cost-effective, and in accordance with sustainability [8], [25]. These are the principal differences that are outlined in Table 1.

TABLE I: Comparative overview of last-mile delivery challenges

Dimension	Developing Economies	Developed Economies
Infrastructure	Weak and inconsistent	Highly developed
Technology adoption	Low digital integration	Advanced logistics technologies
Primary challenge	Accessibility and infrastructure gaps	Cost efficiency and sustainability
Delivery systems	Informal and fragmented	Structured and automated
Traffic conditions	Severe congestion, unregulated	Managed but dense urban traffic

E. Last-mile Logistics Technological Interventions.

Recent studies show that there is a growing significance of technology in modifying the last-mile delivery system. Online platforms, AI, and live trackers are also increasingly being the most used tools in both economic environments to enhance the effectiveness of logistics [24], [25].

In developed economies, there is a focus on automation and optimization technology, such as predictive analytics and autonomous delivery systems. In the emerging markets, emphasis is made on basic digital infrastructure, mobile logistics solutions, and flexible tracking to increase coordination and visibility [23].

Regardless of these changes, the literature indicates that technology alone would not perform without the facilitating infrastructure and regulatory alignment, particularly in developing economies, where the infrastructure of the underlying logistics remains underdeveloped [12], [17].

The main weakness of the current research, however, is the propensity to consider technological innovation as a blanket solution without properly considering the differences in contexts. Numerous studies presuppose the uniformity of advanced logistics technologies across different regions and do not take into account infrastructural and institutional preparedness for effective implementation. This brings a disparity between the theoretical and practical applications, especially in developing economies.

III. COMPARATIVE FRAMEWORK PROPOSED FOR THE LAST-MILE DELIVERY SYSTEMS

A. Methodology

The research design that is used in this study is a qualitative comparative research design, which relies on literature review and conceptual analysis. Peer-reviewed articles, industry reports, and policy documents that are relevant were analyzed to determine important dimensions that affect performance in last-mile delivery. The research uses a thematic synthesis method to group challenges into the infrastructural, technological, and operational levels.

This was followed by the creation of a comparative framework to be used to assess the differences between the developing and developed economies. These dimensions are chosen because they have been found in previous logistics and supply chain research to be important attributes of determining the performance of delivery. This method allows a comparative analysis of economic circumstances in a systematic and theory-based manner.

B. Framework Overview

In this paper, the hypothesis is a comparative analytical model that will be used to analyze the performance of last-mile delivery in developing and developed economies. The framework has three primary dimensions that are in the infrastructure capability, technology adoption, and operational efficiency. The dimensions are used to assess the systemic differences in the performance of urban logistics and identify the factors contributing to inefficiencies in the delivery in economic contexts.

The framework is rooted in the fact that the performance of the last-mile delivery process is not only related to the logistics strategy but also to the environmental factors in the external environment, such as the urban planning systems, the implementation of the regulatory provisions, and the level of development of the digital infrastructure.

TABLE II: Dimensions of the comparative last-mile logistics framework

Dimension	Description	Evaluation Focus
Infrastructure Capability	Physical logistics infrastructure such as roads, warehousing, and addressing systems	Accessibility, connectivity, and reliability
Technological Adoption	Level of digital integration in logistics systems	Tracking systems, automation, and analytics
Operational Efficiency	Effectiveness of delivery execution processes	Cost, speed, and delivery success rate

C. Last-mile Systems Structural Differences.

The comparative analysis demonstrates that the emerging economies possess structurally limited systems of logistics that are characterized by broken infrastructure and the absence of digitalization. On the other hand, highly developed economies are under the governance of extremely efficient logistics ecosystems that include advanced technologies and city planning.

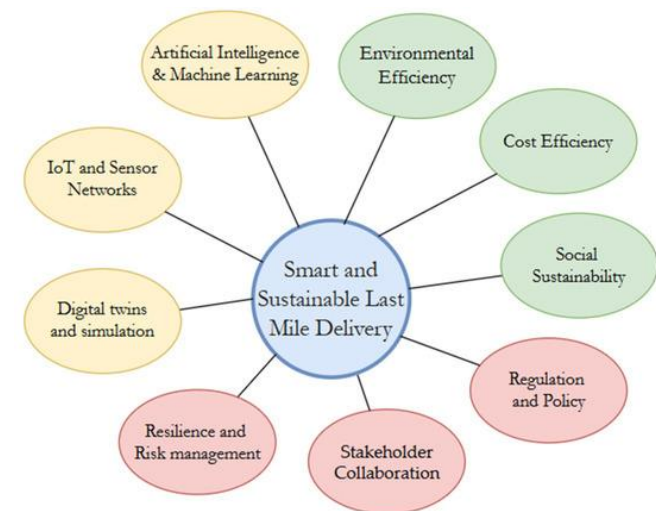


Fig. 1. Comparative framework of last-mile delivery systems in developing and developed economies

Manual coordination and an informal delivery mechanism are usual in developing economies, and increase unpredictability in the delivery and inefficiency in operations. The advanced economies, in their turn, are enjoying the benefits

of the integrated logistics platforms, automated routing systems, and advanced technologies of fleet management that contribute to reliability and scalability [18,21].

This figure illustrates a side-by-side comparison of last-mile delivery systems in developing and developed economies. The left side represents developing economies, showing fragmented infrastructure, manual delivery coordination, and limited digital integration. The right side represents developed economies, highlighting automated logistics platforms, optimized routing systems, and integrated digital supply chain networks. The center of the diagram shows shared performance indicators such as delivery time, cost efficiency, and customer satisfaction.

D. Technical and Operational Divergence.

One of the influencing factors in the performance of last-mile delivery in different economies is the use of technology. They are increasingly being used in the developed economies to enhance efficiency in their operations and reduce the variability of delivery time through artificial intelligence, predictive analytics, and autonomous delivery systems [24,25].

On the other hand, the developing economies face problems in implementing the latest logistics technologies due to infrastructural barriers, high implementation costs, and low digital literacy of the logistics ecosystems. This has caused a narrow range of technology solutions, which are confined to mere tracking and mobile-based coordination systems.

TABLE III: Comparative performance indicators in last-mile logistics

Indicator	Developing Economies	Developed Economies
Average delivery time	High variability	Low variability
Cost efficiency	Low	High
Technology usage	Limited	Advanced
Delivery success rate	Moderate to low	High
Customer satisfaction	Inconsistent	High and stable

E. Framework Implications

The proposed framework focuses on the point that the optimization of the efficiency of the last-mile delivery process cannot be achieved with the help of generalized solutions, but with context-specific solutions. The development of infrastructure and the straightforward digitalization of logistics should be a priority in the developing world. Optimization, sustainability, and improvement of automation should be given importance in the developed economies.

The creation of interventions based on the specifics of each economic environment and its advantages and disadvantages is made possible with the help of such a comparative framework.

IV. DISCUSSION

The comparative framework developed in the given research indicates that the structure of the last-mile performance of the delivery in urban logistics is preconditioned by fundamentally different structural conditions of the developing and developed economies. The nature of infrastructure, technological maturity, regulatory environments, and spatial organization of cities influence last-mile logistics, and not the latter is a pure operational issue.

Among the key findings of the analysis, which is a peculiarity of developing economies, is the inefficiency of the last-mile delivery, primarily due to the structural limitations. These include a lack of good road infrastructure, an informal system of street addressing, a discontinuous logistics network, and discontinuous urban planning. These limitations result in the inability to predict the delivery routes, further unpredictability in the time of travel, and uncertainty in operations [11,14]. This gives rise to the reactive nature of logistics systems in such environments where the most relevant aspect is adaptability, and not optimization.

Whereas developed economies possess more developed logistics ecosystems, where the physical infrastructure is relatively stable and well-integrated. However, it is the operational efficiency pressures rather than structural deficiencies that are driving challenges in these regions. High costs of labor force, strict environmental regulations, and growing consumer expectations to receive products within a rather short time (even on the same day) compel logistics providers to make optimization processes continuous and adopt modern technologies [18,20]. It demonstrates that logistics maturity does not eliminate the problems but transforms the nature of the problems.

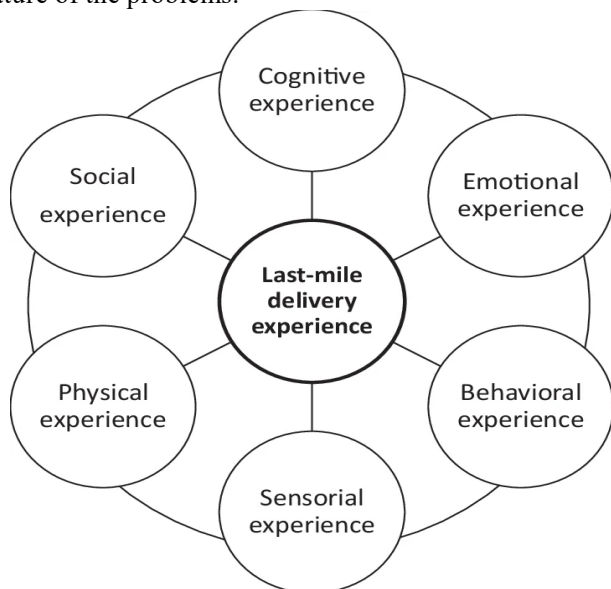


Fig. 2. Structural drivers of last-mile delivery performance in developing and developed economies

This figure depicts a comparative example of the main drivers that affect the last-mile delivery performance. It compares developing and developed economies in terms of the ability to develop infrastructure, the adoption of technology, the regulatory framework, and the density of towns. Deficits in infrastructure and institutional inefficiencies characterize developing economies, whereas optimization needs, sustainability needs, and technological integration characterize developed economies. The model emphasizes the convergence of these factors to decide the cost of delivery, speed, and reliability of the service.

The discussion also indicates that the use of technology is a prominent but unequal aspect in both environments. The developed economies are increasingly relying on innovative

technologies in the field of logistics, such as artificial intelligence-based route optimization, real-time monitoring, predictive analytics, and self-driving delivery systems [24,25]. These systems are very efficient in their operations and reduce uncertainty at a high cost, and require significant investment and solid digital infrastructure.

Such technologies are not popular in the developing economies due to the absence of financial resources, the underdeveloped digital infrastructure, and the incompatibility of the systems. As such, the logistics operations are prone to being based on rudimentary mobile-based tracking systems and manual coordination operations. This technological disparity also solidifies the disparities in the performance of the delivery of the two economic classes.

The key takeaway of this research is that technological solutions may not be used to tackle last-mile delivery challenges. The readiness of infrastructures proves to be one of the preconditions for efficient logistics optimization. The benefits of the highly developed logistics technologies will be confined in the absence of a well-developed transport infrastructure, standardized address system, and uniform urban infrastructure. This implies that the logistics performance is subject to the structural readiness, as well as technological maturity.

The findings have policy implications, such as differentiation of intervention strategies. The developing economies need to work on the fundamentals, including infrastructure development, urbanization strategy, and the readiness of digital logistics. This includes improving roadways, formalising the address system, and enabling scalable logistics infrastructure. Conversely, the developed economies should strive to enhance efficiency in the system through automation, sustainability programs, and advanced predictive logistics systems.

The other area where the research has contributed to the literature is the fact that it brings together infrastructural, technological, and operational areas in one comparative study. However, unlike in the past, where the research has been undertaken to investigate the last-mile logistics in specific economic set-ups, the present one provides a systematic framework of cross-economy contrast, which proves to be a more holistic view of the global logistic disparity.

Despite these contributions, there are limitations to the study. The framework is based on secondary literature rather than the empirical evidence in the area, which may not be specific to the context. Moreover, the within-country variations between the developing and developed economies are not directly modelled, but they may have a more significant influence on the outcomes of the logistics.

Overall, this discussion indicates that the problem of last-mile delivery is more context-specific rather than homogeneous. To address these issues, it ought to be context sensitive and embrace strategies that combine the incorporation of technology with infrastructural as well as institutional reality.

The results based on the comparative framework can give a more profound insight into the influence of systemic variations on the performance of last-mile delivery in economic settings. The analysis combines infrastructural, technological, and

operational views and steps beyond the observation in isolation and provides a comprehensive understanding of the logistical issues of the city.

V. CONCLUSION

This paper has explored the issue of last-mile delivery in urban logistics based on comparative research between the developing and developed economies. It was found out that the factors that directly impact the last-mile delivery performance are a mix of infrastructural readiness, technological maturity, regulatory provisions, and urban spatial arrangement, but not the logistics operations.

The findings suggest that emerging markets have structural constraints that cannot be overcome and significantly affect the efficiency of delivery. These include bad transport infrastructure, bad addressing system, bad digital integration of logistics, and bad city logistics networks. As a result, logistics there is becoming characterized by a high level of uncertainty in delivery times, by more traveling hours, and by lower reliability in the services. The fact that the rate at which the e-commerce market and cities are being urbanized is growing at a faster rate than the infrastructure is also problematic.

On the contrary, the situation in developed economies is more stable in terms of logistics, the infrastructure is developed, and the levels of digital integration are high. Their struggles are, however, turning more operational optimization-based, rather than structural shortcomings. The high price of labor force, harsh environmental regulations, and the growing consumer needs of faster and more convenient delivery services strained the innovation of the logistics and efficiency improvement on a routine basis.

The study also proves that the utilization of technologies is a crucial, but unequal parameter in the establishment of the final-mile delivery performance. Advanced systems such as route optimization, real-time tracking, predictive analytics, and automated delivery systems, based on artificial intelligence, are also being enjoyed by the developed economies. These technologies are effective, with fewer doubts and contented clients. However, in economies with a low level of development, technology is not widely adopted yet due to a lack of infrastructure, financial constraints, and a low degree of interoperability between systems that constrain the potential of the digital transformation of logistics.

In order to summarize these findings, we can offer the overall comparative scheme of the issues of last-mile delivery in Figure 3.



Fig. 3. Integrated comparative model of last-mile delivery challenges

This figure introduces a combined overview of the last-mile delivery issues in both developing and developed economies. It illustrates the relationship between the infrastructure capability, adoption of technologies, regulatory environment and operational efficiency. The model indicates that structural and infrastructural constraints are the main factors limiting the development of the economies in the developing world, whereas the pressure of optimization, sustainability, and efficiency drives the development of the developed world. These determinants interact to produce the desired output variables: the delivery time, cost efficiency, and service reliability.

The research influences the existing literature in the development of a systematic comparative framework, integrating different dimensions of urban logistics performance. The study is an analytic prism that unites the differences in systems and similar issues within the framework of a wide spectrum of economies, as compared to previous research that concentrates on the exploration of the last-mile delivery on the economic scales of each specific economy.

In political and management terms, the findings suggest that there can not be a universal solution to the improvement of last-mile logistics. The emerging markets require strategic investment in the aspects of infrastructure development, digitalization of logistics, and urban planning reforms. Alternatively, developed economies should concentrate on the methods of optimization that will enhance sustainability and reduce operational expenses, besides enhancing delivery efficiency through state-of-the-art technological systems.

In practical terms, the research offers practical information to logistics companies and city planners. To logistics operators, the results highlight the need to tailor delivery plans to local infrastructural realities as opposed to using worldwide standard models. The study points out to policymakers that they should consider integrated urban logistics planning, which integrates both infrastructure development and digital transformation into one.

Although the study has made contributions to it, it has limitations because it has utilized secondary literature, and it has not been empirically validated in the field. Moreover, the country-level variations in logistic performance were not explicitly modeled, yet could have a very strong influence on the outcomes of the last-mile delivery.

Overall, it can be said that the effectiveness of the last-mile delivery is both a matter of structural readiness and technological capacity. Future research should focus on empirical validation of the proposed framework, the incorporation of real-time logistics data, and extend to hybrid logistics frameworks that will be able to bridge the gap between developing and developed economies.

And, in the end, the paper supports the thesis that the last-mile delivery problems cannot be resolved by implementing homogeneous solutions. Rather, sustainable and efficient urban logistics is needed, which should be a context-sensitive and system-based approach. The suggested framework is a basis for future empirical studies and policy-making to streamline the last-mile delivery systems in various economic contexts.

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