



## Leveraging Digitalization in Last-Mile Logistics

Dr. Manish Shashi,

School of Management,  
Walden University, Minneapolis, MN, USA.

**ABSTRACT:** Moving goods from the transportation hub to the final delivery destination is also termed last-mile delivery or last-mile logistics in supply chain management and transportation planning. The primary objective of any supply chain transportation design is to improve efficiency, optimize processes, reduce transportation costs, and minimize disruptions in terms of financial metrics. The surge in digital online buyers worldwide also contributes significantly to traffic fluctuations as retailers try to secure delivery of their commodities in already congested transportation network. Transportation is one of the leading causes of global carbon emissions, and unfortunately, last-mile delivery is solidly in that category. Creating sustainability goals by including an eco-friendly last mile is essential for any organization. Digital transformations by leveraging digital enablers are creating more streamlined, more innovative, and more efficient holistic business processes in meeting the target of last-mile delivery. In this study, we focus on the possibilities of implementing digital strategies for last-mile delivery. The analysis of findings shows that digital strategy and digital technology enablers, such as autonomous robotics, machine learning, tracking and monitoring system, and transportation optimization software, helps in optimizing last-mile delivery processes.

**Keywords:** Last Mile, Logistics, Digitalization, Resiliency, Sustainability, Supply Chain.

### I. INTRODUCTION

Last-mile logistics, also known as last-mile delivery, is all about transporting goods to the final delivery destination (the customer's door) from a distribution hub. In logistics terminology, there are first-mile, middle-mile, and last-mile deliveries. First-mile delivery means shifting products from the manufacturing factory to a local or regional transportation or distribution hub. Connecting the hub of the other side of the country from a distribution hub is done in the second mile. The last mile, considered more significant, takes care of delivery from the distribution hub to the final destination, including the residential address of end customers, stores, and businesses. When we gauge the customer experience, the first touch doesn't mean a thing when we don't ensure the last mile of business is more customer-focused and smarter [1]. Last-mile delivery aims to be accurate, affordable, and quick, but unfortunately, it accounts for 53% of total shipping costs. Fig 1 shows the biggest challenge for logistics providers in the United States in 2020. Increasing delivery cost is a big concern and is 54% of all costs [13]. More than half of U.S. respondents in a survey stated that rising delivery costs are the main issue they have in providing last-mile delivery.

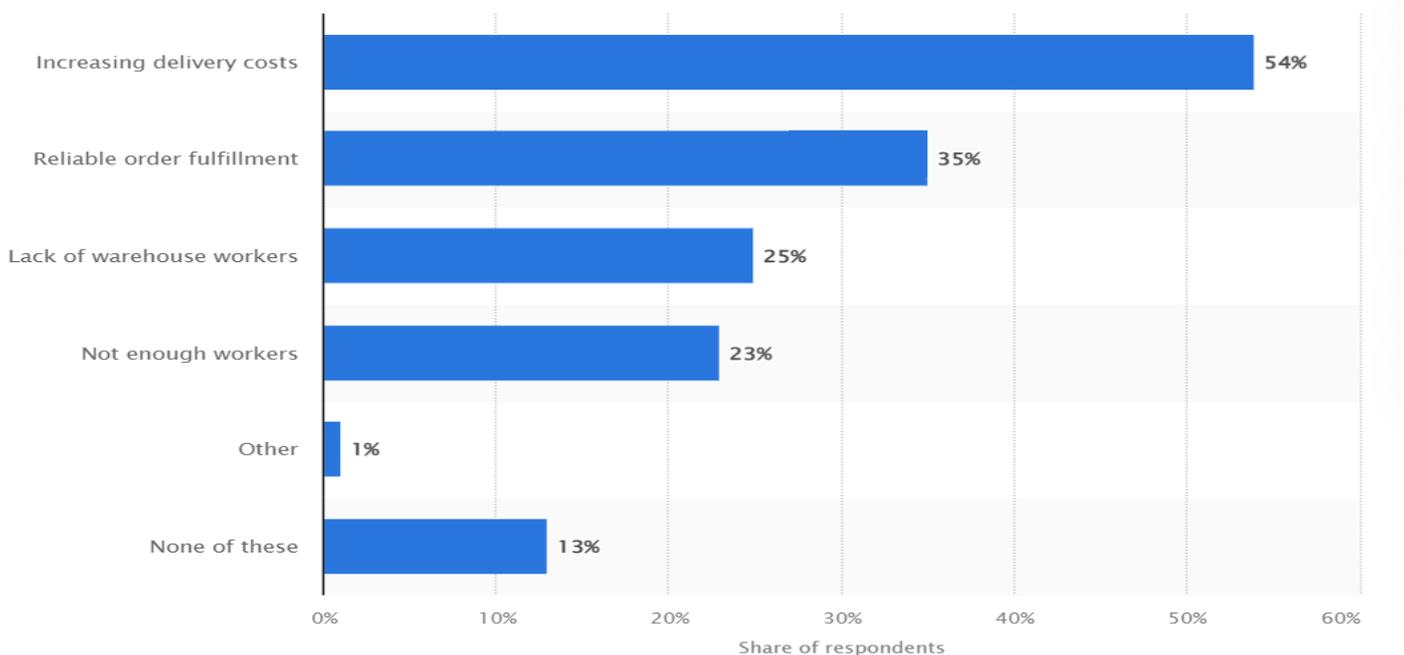


Fig 1. The biggest challenge for logistics providers in last-mile delivery in the USA (Source: Statista, 2023).

The extra mileage induced by this growing demand, with delivery vehicles contributing between 16 and 50 percent of vehicle emissions in urban areas, urges new environmentally sustainable solutions. A transition from traditional logistic systems strategies to more sophisticated ones is necessary to satisfy the current online market's increasing demand and, at the same time, meet sustainability requirements, which can only be achieved through digital innovation. (Miguel, 2019). Organizations have already acknowledged the significant impacts of innovative digital technologies as enablers of sustainable initiatives and for improving supply chain performances (Fuchs, 2008). Business managers in organizations face significant threat levels by not embracing digital transformation in supply chain transportation processes [6].

## II. PROBLEM STATEMENT

The last mile of product delivery accounts for more than 53% of the total shipping cost [1]. Delivery costs are topping the list for logistics providers for last-mile delivery. The global cost of last-mile delivery in 2018 was \$1.99 billion and is expected to reach \$7.69 billion by 2027 [9]. It is the biggest challenge for logistics-providing companies. Inefficiency must be looked at, and processes must be optimized. Otherwise, inefficiency may lead to prohibitive costs driving overheads and cutting overall profits. The specific business problem is that many supply chain managers need strategies to implement digitalization in last-mile delivery.

## III. PURPOSE STATEMENT

This paper aims to understand the concept and relationship by integrating distinct bodies of the last mile of logistics in supply chains.

## IV. RESEARCH METHODOLOGY

A multidisciplinary systemic review is conducted by reviewing various literature on transportation planning, supply chain, last-mile logistics, and sustainability.

## V. LITERATURE REVIEW

A survey carried out amongst retailers and manufacturers in 2017 by the global retail supply chain stated that reducing costs and improving margins were considered the most critical priorities of last-mile delivery initiatives [3]. Fig 2 depicts that last-mile delivery is the most expensive part of the fulfillment chain. It costs an organization an average of \$10.1 per package delivery. Business charges \$8.08 to cover this cost, taking the hit of their profits margin rest in each sold product [1].

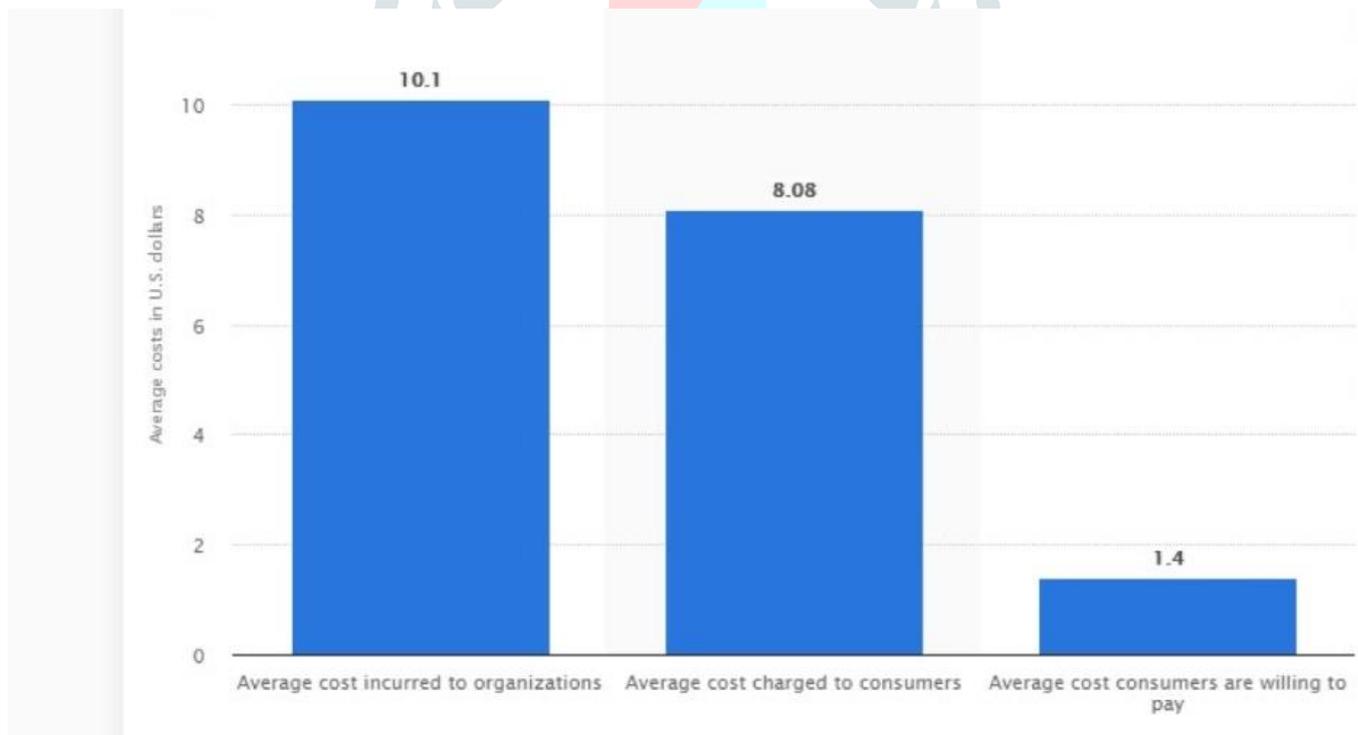


Fig. 2: Average cost per package incurred (source: Statista, 2023).

Banker, 2023 [2] discussed the APQC survey focused on last-mile delivery visibility. Consumers expect faster delivery speeds, but at the same time, they want visibility into their deliveries. 47% of respondents stated that customer visibility into real-time status extends into the "last mile" of delivery. For 25% of respondents, this visibility is only present to a small extent (or not at all for 3%). Respondents also rated the extent to which their organizations provide digital assistants that enable customers to view the real-time status of their order or shipment. This real-time view is only present to some extent for one-third of respondents. For almost half, though, this is available significantly [2].

**Robots for last-mile delivery:**

Mercedes Benz vans invested in starship technologies to develop ground-based autonomous robots. It helped them combine the advantages of a van with an autonomous robot. It was a strategic move that significantly improved the efficiency of last-mile delivery. The constraint is that the robot can only travel short distances under its power and then return to the warehouse to be reloaded after each delivery. The introduction of the van as a mobile hub widens the operational radius of the robots significantly while also rendering superfluous the cost-intensive construction and operation of decentralized warehouses [5]. Fig. 3 shows the autonomous robots used in Mercedes Benz vans for last-mile delivery.



Fig 3. Starship delivery robots (Source: Mercedes-Benz, n.d)

**Sustainability in last-mile delivery:**

Sustainability also takes a big hit if not controlled in last-mile delivery. As per one estimate, with no improvement, we can expect a 32% jump in carbon emissions from urban delivery traffic by 2030. The lack of sustainability severely impacts a company's profitability, not only the environment losing out [7]. Greening the last mile is critical for today's supply chain leaders. Most importantly, creating concrete sustainability goals that include a more eco-friendly last mile is an essential step in the fight against climate change. But companies with business models that prioritize sustainability can also win with customers. More sustainable last-mile delivery models can also potentially add to the bottom line through greater efficiencies and enhance a company's brand image.

**VI. ANALYSIS OF THE FINDINGS**

Technological advances in automation offer the opportunity to develop newer, more sustainable, and more efficient delivery systems [8]. Recent technological advancements in automated vehicles (e.g., driverless vehicles, robots, unmanned aerial vehicles), machine learning, and SaaS-based transportation optimization software are creating the ground for developing innovative delivery models that could transform the landscape of last-mile delivery. Crowdsourcing is a business model which allows organizations to offer more delivery options to their customers and meet the demand for rapid and same-day delivery. The model is discussed in detail.

**Crowdsourcing model:**

It is a method of fulfillment that uses networks of non-professionals, post offices, and local courier services to deliver goods directly to customers. It was initially famous for grocery deliveries, but nowadays, even local retailers are using this model to reduce delivery costs and maximize supply chain reach. It helps reduce costs in managing staff, training, and procuring delivery vehicles. Despite more interest in same-day delivery in online shopping, most consumers still prefer the cheapest form of home delivery, with an estimated share of 23 percent of consumers preferring same-day delivery and a share of 70 percent selecting the cheapest delivery option [4]. Yuan Wang et al. [11] proposed a compelling large-scale mobile crowdsourcing where a massive pool of crowd-workers performs last-mile delivery. To proficiently settle the model, they formulated it as a network min-cost ow problem and proposed different pruning methods that drastically decrease the network size. Their outcomes demonstrate that their solution can uphold real-time delivery optimization in the large-scale mobile crowdsourcing problem [11].

**Digitalization:**

The supply chain needs help and ways to keep pace with the last mile. Implementing digitalization in the supply chain can be one of the solutions and may revolutionize the last mile. Digitalization allows transparency and accountability to better keep up with customer demand at no additional stress to your supply chain and may help with simplified last mile from start to finish. Some of the digital tools to consider:

- A. Transportation optimization software: End-to-end efficiency in the supply chain is critical to a seamless last mile. Using correct transportation optimization software, dispatchers and planners can design and optimize transportation [10]. It will also help dispatchers to plan and schedule all vehicle routing in the network, ensuring timely pick-up and drop-off of products. Real-time forecasts can be achieved through state-of-the-art simulations, analytics, geo services, scenario management, and data integration. Per one estimate, transportation costs can be reduced by 20% and planning efforts by 60% by precise and time decisions leveraging the transportation software.
- B. Autonomous robots: Autonomous robots present an opportunity for enhancing last-mile delivery in urban settings.
- C. Tracking and monitoring system: Tracking the products moving to the last mile through land, sea, or air is critical to avoiding disruptions and keeping delivery on track. These real-time updates will also help in satisfying customers by providing delivery updates.
- D. Implementing machine learning in the shipping process: using machine learning, organizations can analyze large caches of data and analyze those to find connections between different sets of information. Standardization of critical data is also enabled, alleviating some of the complexity of last-mile delivery.

Digital transformation in last-mile deliveries can help meet customers' expectations, reducing delivery costs by designing efficient processes. However, some of the challenges that organizations face in implementing digitalization and mitigation strategies in last-mile deliveries are described as under:

1. **Strategizing the right plan:** Implementing technologies like artificial intelligence (A.I.) and machine learning (MI) in last-mile delivery processes is a way to go. However, technology adoption needs to be driven by desired business outcomes. It may differ from the organizational context also. Digital transformation is also about people involved in processes and not only the technologies. Organizations must have crystal clear ideas of their short-term, mid-term, and long-term plan in tackling challenges associated with last-mile deliveries.
2. **Flexibility:** In B2B (business to business) and B2C (business to customer), last-mile delivery is complex. Organizations need to design flexible processes while implementing digitalization in last-mile delivery processes. Digital software selected to assist in the process also needs flexibility for scaling up and down and changing as per business requirements.
3. **Customer connection:** Any digitalization process aims to stay connected with customers instead of focusing on internal processes. Efficiencies gained in the back office will only help if customers are happy with late deliveries. Any digitalized SaaS-based delivery management tools must aid in providing transparency, on-time delivery, and staying connected with organizations' transportation ecosystems, including back office, fleet management systems, drivers, and customers.
4. **Implementation methodology with robust change management processes:** A use case must be created and referred to before implementing digital technologies. Technologies also need to be easy to use. A small site should be selected for the pilot, and when successful, it must be rolled out to all the sites. A change management process can bring everyone on board for innovative and smarter ways to handle last-mile delivery.

## VII. CONCLUSION

As the term suggests, last-mile delivery is to move the object to its final destination from its last distribution hub. It is the costliest and most time-consuming in the entire delivery process. The rapid growth of e-commerce and online retailers and customers' expectations of same-day and on-demand delivery made last-mile delivery an urgent logistic challenge. Several factors increase the operational cost of last-mile delivery, such as limited delivery services in urban and rural areas, lack of visibility which result in a failed delivery, and lack of secure proof-of-delivery to prevent common last-mile scams and fraudulent activities. Organizations with business models that prioritize sustainability can also win with customers. More sustainable last-mile delivery models can increase the bottom line through greater efficiencies and enhance a company's brand image.

Organizations look at different ways to optimize last-mile delivery because, from the customer's perspective, last-mile delivery is most important and memorable. Automatization and digitalization solutions appear beneficial within last-mile delivery. Automated models, such as robotics and drones, have now transitioned from the prototyping phase to contribute significant roles in serving delivery markets. The benefits of Mercedes-vans and starship autonomous robots were discussed in earlier sections. By combining these two technologies, Van customers are getting access to new services of robotics and new business models.

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