

## Last-Mile Delivery in B2C E-Commerce – Common Practices in Some Countries, But What Do They Mean for Businesses in Vietnam?

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**Abstract:** E-commerce is a dispensable aspect of modern society, and technology is constantly developing to keep up with the growth of e-commerce. This study synthesizes those innovative solutions and proposes implications aimed at increasing the efficiency of last-mile delivery in business-to-consumer (B2C) e-commerce in Vietnam. It focuses on the analysis of the experience of some countries in terms of employing last-mile delivery models in urban areas, then investigates the situation of adopting last-mile delivery models in Vietnam, and finally, proposes solutions and recommendations to improve last-mile delivery in Vietnam. The research was carried out from May to August 2021 with the techniques of synthesis, comparison, and data descriptive statistics accompanied by short interviews with delivery drivers. The research suggests that delivery companies should develop collection-and-delivery points (CDPs) and parcel lockers (PLs) besides the traditional attended home delivery (AHD). Moreover, to facilitate the unattended delivery models, online shops should not exaggerate goods' quality to cheat buyers and instead take measures to encourage buyers to make e-payments for their orders. Government and authorities are recommended to continue supervising activities of e-payment, updating legal documents to ensure the information security for customers, advertising digital payment tools in the social network environment to increase buyer awareness of e-payment, and imposing a tough penalty for dishonest or cheating online companies. The research is novel as it suggests means to strengthen alternative, modern models besides AHD, which people are likely to adopt in an ever more busy and modern society.

**Keywords:** attended home delivery, collection-and-delivery points, last-mile delivery, reception boxes, parcel lockers.

## 乙2C电子商务中的最后一英里交付—— 一些国家的常见做法，但它们对越南的企业意味着什么？

### 摘要:

电子商务是现代社会可有可无的方面，技术也在不断发展以跟上电子商务的发展。本研究综合了这些创新解决方案，并提出了旨在提高越南企业对消费者(乙2C)电子商务中最后一英里交付效率的启示。重点分析了一些国家在城市地区采用最后一公里配送方式的经验，然后调查了越南采用最后一公里配送方式的情况，最后提出改进最后一公里配送方式的解决方案和建议。越南发货。该研究于2021年5月至2021年8月进行，采用综合、比较和数据描述性统计技术，并与送货司机进行简短访谈。研究表明，除了传统的有人值守送货上门(AHD)外，快递公司还应开发收集和交付点(CDP)和包裹储物柜(PL)。此外，为方便无人值守的配送方式，网店不应夸大商品质量以欺骗买家，而应采取措施鼓励买家为订单进行电子支付。建议政府和当局继续监督电子支付活动，更新法律文件以确保客户的信息安全，在社交网络环境中

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宣传数字支付工具，以提高买家对电子支付的认识，并对不诚实行为实施严厉处罚或欺骗在线公司。这项研究很新颖，因为它提出了加强除AHD之外的替代现代模式的方法，人们可能会在越来越忙碌和现代的社会中采用这种模式。

**关键词:** 有人值守的送货上门、取货和送货点、最后一英里送货、接收箱、包裹储物柜。

## 1. Introduction

E-commerce, especially business-to-consumer (B2C) commerce, substantially have played a key role in the global economy, making both opportunities and challenges for all countries in recent years. Thanks to digital platforms, people have changed the habit of selling and buying in which they are tending to use the home delivery services instead of buying directly at retail stores. Last-mile delivery (LMD) in the supply chain of the value by B2C e-commerce is firstly associated with sales enterprise by saving delivery costs to end customers, planning fulfillment orders around customer convenience, and increasing customer experience in home-delivery services. It also enables retailers to manage business constraints about on-sale locations. As a result, businesses will be able to reach customers in every place, or customers are allowed to choose a great variety of suppliers whatever they are located. Furthermore, the increasing number of online orders due to the convenient buying experience will generate a great demand for labor in the freight forwarding sector for e-commerce, and third-party logistics providers will develop more and have a chance to reach higher returns. Moreover, the increase in LMD by delivery providers also helps reduce vehicle movements and the number of vehicles required, which offers retailers and operators a better route and finally brings the reduced delivery cost for online buyers. In general, the drastic efficiency of LMD encourages the rise in e-commerce, especially B2C, and then affects the trade of consumer goods in a country.

However, online customers pay more attention to not only the safety of goods and the process flexibility but also to delivery time and cost [5]. Individual customers buy a small number of products while expecting fast delivery [7]. These raise new challenges for couriers and express parcel delivery companies (called delivery companies). Therefore, delivery companies must consider distribution activities, and last-mile logistics has become an important competitive advantage for e-commercial entrepreneurs. In delivery companies, drivers must be delivered to the final destination - the customer's chosen addresses, the so-called "last-mile delivery," which is very costly [3, 8]. This last leg of the supply chain is often less efficient. It comprises up to 28% of the total delivery cost [9], or sometimes high shipping cost is the primary reason for the cancellation of online purchases [10]. Worse still,

most consumers are not present when the deliveries are made. Therefore, unattended parcels require multiple delivery attempts [11]. To improve the efficiency of last-mile delivery, many countries employed multiple unattended models (collection-and-delivery points (CDP), parcel lockers (PL), reception boxes (RB)) besides the traditional attended home delivery (AHD).

Likely, B2C e-commerce in Vietnam has witnessed rapid growth, with sales reaching 12 billion USD in 2020 and is expected to reach 35 billion USD by 2025, ranked the third in ASEAN. With nearly 50 million users participating in buying and selling via the internet, Vietnam has become the country with the highest percentage of online shopping participants in the region. However, the common method of delivering last-mile orders is delivery to recipients at the customer's home or their chosen place [5], causing bottlenecks such as a high rate of unattended parcels or delivery inefficiency due to the driver's losing time to wait for customers. While global economies (including Vietnam) have presented high e-commerce growth rates [2], and the importance of last-mile delivery has increased, there is still a lack of insight into the potential of delivery models [3, 12]. Therefore, the research aims to analyze the strengths and weaknesses of adopted models used in some countries, especially in urban areas, and suggest solutions to improve the last-mile delivery in B2C e-commerce in Vietnam.

## 2. Literature Review

### 2.1. The Concept of Last-Mile Delivery (LMD)

The definition for LMD has been loosely defined. All available definitions converge on a common understanding that LMD refers to the last part of a delivery process [13]. According to Lindner [14], LMD refers to a set of last activities in the delivery cycle, which involves a series of activities and processes conducted for the delivery process from the last transit point to the final drop point of the delivery chain. According to Vietnam Supply Chain Community [15], LMD is considered "the final segment in the logistics network where finished goods are transferred to the consumer or business that ordered and purchased them." In other words, it is the last leg of the product distribution from a fulfillment center to the customers' doorstep. After reviewing the existing definitions by [1, 3, 16, 17] and putting them under synthesized analysis,

we define LMD as the last stretch of a B2C parcel. Receiving goods occurs from the fulfillment center or online shops to the final consignee's chosen destination point (e.g., home, working place, or collection point).

General operations of Last-mile logistics are illustrated in Fig. 1.

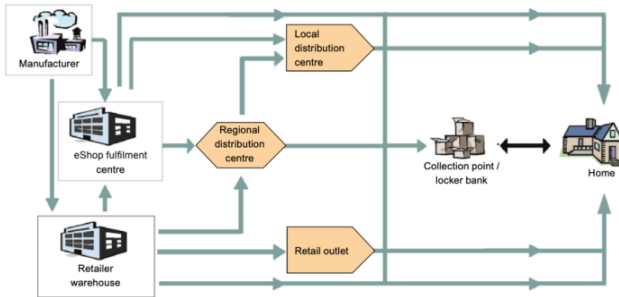


Fig. 1 The common supply chain in last-mile logistics operations [1]

The starting point for all last-mile processes is a retailer warehouse or an e-shop fulfillment center. There are various supply chain options by which the goods reach the final customer. The first option is that goods may be sent directly to final customers by their own vehicles or delivery companies.

The second option is that ordered products are usually taken to another distribution center or retail outlet (transportation hubs) before being delivered to end-user customers' doorstep or collection point where the customers can come and pick them up themselves.

## 2.2. Last-Mile Delivery Models Adopted in Some Countries

The global market has witnessed significant growth in online shopping. In recent years, the acceleration in e-commerce has become much higher because consumers increasingly pay attention to e-commerce for all shopping needs [10]. The customers require speedy order fulfillment and on-time delivery. To meet customers' requirements, delivery companies conduct elaborate planning and scheduling to minimize the traveling cost and delivery time. Various models below for delivering last-mile orders have been successfully implemented by multiple countries, including developing and developed ones like China, Poland, Italy, Belgium, Finland, Germany, and France.

These countries are very different from Vietnam in geography, development level, income, technology and payment infrastructure. However, they have some similarities with Vietnam in e-commerce growth, so their models of LMD are selected for comparison with Vietnam. Some similarities are illustrated as follows:

Table 1 Comparison of sales growth and e-shoppers [2]

	Vietnam	Western Europe	Central and Eastern Europe
B2C e-commerce sales growth	29%	26.30%	29.10%
Number of e-shoppers as percentage of population	55%	61.10%	63%

Table 2 Comparison of B2C e-commerce index (in 2020) [2]

Rank/152 economies on their readiness to participate in e-commerce	Economy	Share of individuals using the Internet (2019 or latest)	Share of individuals with an account (15+, 2017)	Secure Internet servers (normalized, 2019)	UPU postal reliability score (2019 or latest)	2020 index value	Index value change (2019-20 data)
21	Belgium	90	99	79	79	86.8	-1.1
28	Poland	80	87	80	82	82.2	-0.7
29	Italy	76	94	77	80	81.8	0.2
55	China	61	80	54	85	70.1	0
63	Vietnam	69	31	64	83	61.6	0.8

In terms of models, Wang et al. [16] and Tang et al. [17] categorized LMD into four models: attended home delivery (AHD), reception box (RB), collection-and-delivery points (CDP), and parcel lockers (PL). Each model has different characteristics and delivery efficiency.

### 2.2.1. Attended Home Delivery (AHD)

*Concept:* This is the first and most widespread model employed in LMD in which couriers send goods to customers' doorsteps, receive customers' signatures, and then the job is finished. It is used in all countries. Normally, orders are packed and shipped to densely populated areas with a direct shipment strategy. In this method, customers may choose their home, workplace, relative's or friend's home as the destination.

*Advantages and disadvantages:* AHD provides face-to-face opportunities to meet customers and supplies a high level of customer service.

However, it has multiple drawbacks. It lacks flexibility for couriers. For example, couriers always have to waste much time waiting for customers, or without a previously agreed time window, nobody may be at home at the moment of delivery [16]. One more major problem is that customers sometimes state the wrong address so that drivers lose time looking for the right one. This increases the uncertainty of the delivery time, and thus drivers cannot state precisely when they are going to deliver to a specific place. The model also requires qualified drivers with local geographical skills. AHD results in the rising operating cost due to the consequence of the re-delivery of failed deliveries in

the first attempt or small vehicles used to carry goods to consumers' homes [1]. On the other hand, customers have to be waiting at home for the delivery [18]. These factors represent some of the major barriers to online purchases [3]. According to Wang et al. [16], couriers or delivery companies need to contact the receivers before they start to deliver the customers' goods. As a result, first-delivery failure is rare in China.

### 2.2.2. Reception Boxes (RB)

*Concept:* Reception boxes (RB) are boxes permanently installed in the customer's garage, home yard, or a wall outside their home. It is called an independent reception box [16]. Couriers put goods in the boxes, and customers can be alerted of the delivery by mobile phone or email, then they pick up goods at any time using a messaged key or an electronic code.

It is used mostly for parcels but can be used for foods if the boxes are temperature-controlled [7, 16]. This model is much applied in such countries as China and Finland.

*Advantages and disadvantages:* RB has generally attracted final customers because it is more convenient for them on some levels. They could receive items delivered directly to the reception box, and as a result, they are less dependent on delivery time windows. Couriers can shorten the delivery time used at the door, but their delivery efficiencies are improved; it eliminates the re-delivery cost when the customers are not at home in the delivery time window. The previous study proves that 60% of cost reduction is achievable with RB [8].

The great challenge for delivery companies in using RB is the large investment for reception boxes [7, 8, 16]. As a result, delivery companies consider this model only for regular buyers or repetitive purchasing customers with stable demand in placing orders. Also, an independent reception box is only desirable in rural and suburban areas where most people live in single-family detached homes. However, in a high-density area, most families live in blocks of flats; thus, it is not a suitable model [16]. Furthermore, it is applied if buyers accept to pay online upon making an online purchase.

### 2.2.3. Collection-and-Delivery Points (CDP or Pick-Up Points)

*Concept:* Collection-and-delivery points refer to convenience stores, local small businesses (shops, bars), post offices, petrol stations, or other institutions which belong to or cooperate with delivery companies as the place where customers come to pick up goods or return their parcels. The customer can select a preferred point from the provided list on the site for collecting while making an online purchase. The delivery process is handled by delivery companies or by e-retailers themselves, but orders are not delivered to customers' homes or workplaces. Instead, they are delivered to

urban CDPs, and customers are informed via SMS or email that their orders are ready for collection [16].

In practice, CDPs could be set up by couriers themselves or by collaborating with third parties as described in the previous paragraph. The former requires more investment and bears more risk. Thus, it is reasonable for delivery companies to cooperate with other organizations at low operational levels. Retailers could add CDPs recommended by delivery companies which they work with to their retail website to give customers a choice. CDPs should be accessible from major road networks, and parking should be permitted and easy.

This method is greatly employed in many countries such as Japan, China, Belgium, Italy, France, Germany, Poland, New Zealand, and USA. It is one of the best ways to solve the LMD problem [16].

*Advantages and disadvantages:* CDP is beneficial not only to logistics companies but also to customers. For delivery companies, compared to the traditional AHD method, CDPs have been proven to be efficient in terms of solving the problem of missed delivery since the address is always correct when working with them, resulting in fewer delivery locations and improved drop density while optimizing vehicle routing and reducing total delivery time [3]. This mitigates the first-time failure of deliveries and reduces the delivery costs of goods bought online [11]. Moreover, a CDP could serve several delivery points at the same time [16]. For buyers, when CDPs are located in areas that they already visit, their satisfaction will seldom, if ever, be greatly affected because only minimal additional travel by consumers will be necessary to collect a package [19]. Buyers expect CDPs to be the most economical for large orders, through cutting down commissions paid for delivery [16]. CDP model is also good for the cooperating parties as it could increase their visibility, advertise their business and bring them custom—about 25% of CDP users purchase something while they are there when they collect or return a parcel [19].

The drawback of this method is the limited opening hours of shops or CDPs and the fact that delivery companies or retailers need to have a large network of cooperating partners [3].

### 2.2.4. Parcel Lockers (PL)

*Concept:* Parcel lockers are automated dispensing machines that allow the delivery and collection of goods 24 hours a day, 7 days a week. The system can also be used to make return shipments. This can be seen as an unattended CDP (no personal contact) and is made up of groups of reception box units (lockers), which are sited in apartment blocks, workplaces, car parks, railway stations and so on. They may be dedicated to one delivery company or used by many. Lockers have electronic locks with a variable opening code and can therefore be used for different customers.

Customers may be notified via SMS or email of the arrival of their delivery, the box number and location, and the code to open the box. Parcel lockers require the customer to make the final leg of the journey [7]. Recipients can retrieve their packages whenever best suits their schedule, and use the mobile application to manage and track the locations of the packages. The mobile application can also be used to open the lockers via Bluetooth or bar code scanning, and to retrieve package delivery history [20].

Lockers are normally installed in urban areas (either on public or private land) in easily accessible locations and close to places with a high frequency of shipments (service stations, squares, railway stations, subways, supermarkets, residential quarters, shopping malls, office buildings, colleges and universities [3, 21, 22].

In China, parcel lockers have experienced significant development in recent years. Their number has increased from 15,000 to 406,000 from 2014 to 2019 [17]. In the community, the user population may pay more attention to the practical functions of parcel lockers, and establishing pick-up places where people do their daily grocery shopping, for example, would increase the consumers' willingness to use the lockers [23]. Meanwhile, in the business center, lockers should attract many office workers by giving them unique functions and location characteristics. For example, self-pickup parcel lockers for breakfast have appeared in Shenzhen, China, most of which are placed on a street that office workers must pass or near their place of employment. People can order their breakfast on their mobile phones, choose the nearest lockers location, and pick it up on their way to work. It brings great convenience to customers and allows industry 4.0 into their daily lives [24].

In Europe, maximum diffusion of a parcel lockers' network (previously called "pack stations") took place in Poland thanks to the Polish company – InPost, which has also been implementing parcel lockers worldwide for many years. The German companies named DHL also proposed those lockers in 2001, and, from that time, the number of lockers has reached 2,500 units. UPS and Amazon have also adopted this model [7].

*Advantages and disadvantages:* This model is advantageous for all parties in some respects. Packages can be retained for up to 3-5 running days, so the customers need not rush, and they can be proactive in picking up goods at any convenient date and time [3]. It is more reliable than other models because it can eliminate late delivery or non-delivery as customers are notified when their deliveries are placed in the lockers. Smart lockers are fully automated, minimizing service failure caused by human errors during the delivery process. Moreover, transaction costs can also be reduced by using smart lockers, which can avoid the unnecessary opportunity cost incurred by customers

due to late delivery or non-delivery [20]. In delivery companies, drivers can make deliveries at any time, for example, at lunchtime, early in the morning, or late in the evening, to reduce traffic in rush hours in urban areas [3]. From the societal perspective, smart lockers minimize traffic congestion, noise, kerbside vehicular stoppages, and environmental pollution because, instead of using small vehicles to carry goods in AHD, this method allows consolidating multiple deliveries in one trip shipped by a larger transport with a large cargo compartment for lockers [20].

On the other hand, this model has some disadvantages. It requires an infrastructure investment and is only suitable if consumers are willing to make e-payment for the goods during online purchasing. It limits the size of a parcel which cannot exceed the dimensions of the lockers [1, 3]. Another problem is that it allows only one parcel per delivery to one buyer, so e-commerce sellers need to pack carefully. In terms of security, parcel lockers need to be monitored via video cameras to avoid the risk of vandalism and theft. There is a limitation to location availability to install a locker box station. Compared to setting a collection point network, parcel locker model is much more complex because it may face the bureaucratic barriers and requirements when asking for permission to build lockers at a certain place [3].

### 2.3. Comparison among Models of LMD

Wang et al. [16] adopted a mathematical method with simulation experiments used with the software MATLAB to calculate operation efficiency and cost of different models. Operation efficiency could be measured by the average delivery time per order. The result showed that RB is not suitable for urban delivery. Under normal circumstances, CDPs' operation efficiency is the highest, followed by PL (or shared RB) and AHD. AHD's operation efficiency is lowest because of the long waiting time for customers, while CDPs' operation efficiency is the highest due to the simplest operational process. It also reflects that higher operation efficiency does not mean lower cost because different models have different cost components. However, some common cost components include investments in vehicles, handheld terminals, and management expenses. It could be concluded that adopting AHD is wise when daily demand is less than 50 orders in the square of 25 kilometers. At this time, CDPs cost a little more than AHD, while PLs cost a great deal. The initial fixed investment of reception boxes is very large, and the vehicles used in PLs and CDPs cost a lot more than that in AHD. Due to AHD's high variable cost and low operation efficiency, its cost soars sharply in case of an increase in the number of orders. On the contrary, the variable cost of PLs and CDPs is much smaller.

Table 3 Comparison among models of LMD [1, 3]

Characteristics	AHD	RB	CDP	PL
Who covers the last mile	Delivery company	Delivery company	Customer	Customer
Customer present	Yes	No	No	No
Types of products	Any	Packages/groceries	Packages	Packages
Fail to deliveries	High	Virtually none	Virtually none	Virtually none
Delivery window	Fixed time	Delivery company operating hour	CDP opening time	Delivery company operating hour
Drop off time	Long	Short	Very short	Very short
Delivery cost	High	Low	Lowest	Lowest
Limit for parcel dimension	No	Yes	No	Yes
Limitation on parcel number per an order	No	No	No	Only 1 parcel per box for an order
Limitation on withdrawal time	After 2-3 contact times	Depend on buyers	5 days	3 days
Human Contact	Yes	No	Yes	No
Carbon emissions to the environment	Not reduced	Not reduced	Reduced	Reduced
E-payment upon purchasing	Not required	Required	Not required	Required

### 3. Data and Methodology

The study mainly uses a qualitative approach with synthesis, comparison, descriptive data statistics, and SWOT analysis. The study adopts primary and secondary information.

Secondary information is from e-books, journals, reviews, and reports of official studies posted on the internet. In detail, this study firstly reviews prior research publications. With the keyword "last-mile delivery" typed on the Google Scholar website, relevant papers in academic journals come out, which helps the authors to have a profound understanding of LMD. Next, because the research is associated with models employed in e-commerce, the term "mode" or "model" is used to narrow down the sector of papers. From then, some close articles are chosen for reference. Information from e-books, journals, and reports of official studies posted on the internet is collected and analyzed for the rising situation of e-commerce and LMD in Vietnam and other countries.

Primary data is collected from short interviews with drivers of delivery companies. This creates flexibility of responses suitable for drivers, enabling the authors to have more evidence about trouble in delivering parcels to online buyers.

## 4. Analysis of Last-Mile Delivery in B2C E-Commerce in Vietnam

### 4.1. Last-Mile Delivery Models Employed in Vietnam

#### 4.1.1. Attended Home Delivery

It is the most popular model in Vietnam. According to Asia Plus Inc. [4] report, most online buyers in Vietnam want the ordered goods delivered to their home, office, relative's or friends' home, amounting to 99%. Only 1% of online consumers use other models.

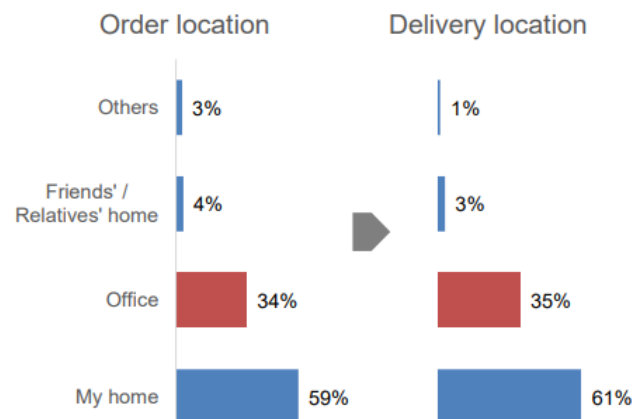


Fig. 2 Places for online customers to order products and receive them in Vietnam [4]

The AHD model for B2C e-commerce in Vietnam could be performed by online retailers or outsourced third-party logistics companies (delivery companies).

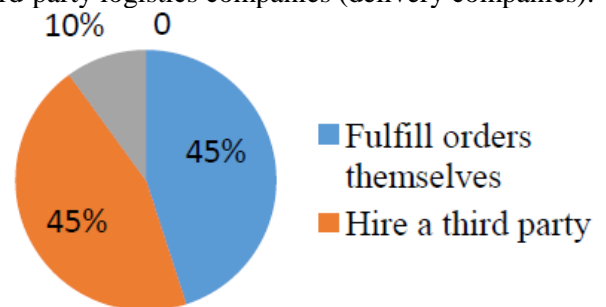


Fig. 3 The rate of fulfilling orders by retailers or third party companies [5]

More details are that some e-commerce platforms for electronic products such as Thegioi Didong, Dienmayxanh, FPTShop, and Nguyenkim do fulfillment service by themselves thanks to their extensive store networks.

On the contrary, the giant Lazada uses its own logistics department, which handles about 55-60% of its orders in parallel with other delivery companies to ensure customer service. Other top sites, namely Shopee and Sendo, use logistics services mostly from third-party delivery companies.

From the authors' experience in keeping an eye on recipients and short interviews with drivers, their waiting time to meet buyers in this model is rather long (normally from 3-5 minutes). Some buyers caused drivers to undergo much more waiting time due to Vietnamese culture, which easily accepts breaching punctuality.

#### 4.1.2. Collection-and-Delivery Points

CDPs have been designed for customers to pick up/send orders from a designated location in Vietnam, but this model is not so popular in the country. There are limited delivery companies to apply it. GHN, one of the leading delivery industry start-ups, is building its network of customer collection points in convenience stores like Shop & Go, Circle K, and Vinmart+ [25]. The customers could be more active in picking up goods instead of trying to stay at the fixed place and keep watching the receiving call from shippers to get the parcel upon shipment arrival.

#### 4.1.3. Parcel Lockers

This is a really rare model in Vietnam. Only Lazada launched the iLogic Smartbox service in Hanoi and Ho Chi Minh City with 20 lockers in 2019. This model, however, has not been developed. It is crucial to have a safe and widely used online payment system to make this model more common.

### 4.2. Delivery Companies Providing E-Logistics in Vietnam

Vietnam has approximately 50 delivery companies providing e-logistics services. Traditional postal service providers such as VN Post, EMS, and Viettel Post have responded to the market by offering solutions for online retailers; their advantages of existing nationwide post office network and high operational capacity allow them to play a strong role in rural areas. In urban areas, leading delivery companies in the last-mile field, such as Giao Hang Nhanh (GHN), Giao Hang Tiet Kiem (GHTK), and NinjaVan, currently are the delivery partners of the key Vietnam's e-commerce platforms. Table 4 provides more information about these third-party logistics companies.

Table 4 Size and capacity of some prominent LMD companies [6]

Delivery companies	Size and Capacity		E-commerce platform partners
GHN (Giaohangnhanh)	63 provinces coverage, over 200 post offices, 800 service points	Over 7,000 employees, over 36,000 SMEs customers nationwide; 150,000 orders per day	Lazada Shopee Sendo Tiki
GHTK (Giaohangtietkiem)	63 provinces coverage, 20 centers points, 500 branches, 99% districts and communes nationwide	1,000 employees; over 1,000 customers; 8,000 drivers	Shopee Vatgia.com
Ninja Van	63 provinces coverage 5 warehouses	1,000 employees, 8,000 customers, over 1 million orders per month	Lazada Tiki Sendo

### 4.3. Challenges of Last-Mile Delivery in Vietnam

#### 4.3.1. Predominance of COD Payment Method

Despite its growing E-commerce market, the e-payment ecosystem in Vietnam is rather inadequate. Getting used to a cash-based society, most online customers still opt for the COD method, which means paying upon receipt of goods. In other words, payment by cash method still dominates online orders.

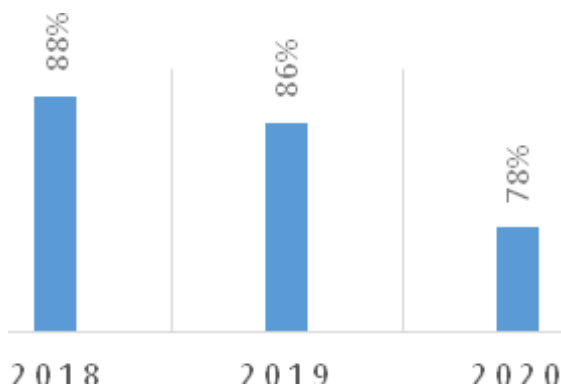


Fig. 4 COD payment rate for B2C e-commerce in Vietnam (2018-2020) [5]

Generally, the percentage of payments by COD in recent years is extremely high, amounting to 88%, 86%, and 78% for 2018, 2019, and 2020, respectively. There is a downward trend in this period, but COD is still especially preferred in Vietnam. Meanwhile, in markets with booming e-commerce in the same region with Vietnam, such as China, Thailand, and Indonesia, COD is not a frequent choice, normally used in only 40 percent of the e-commerce transactions. In European countries, this rate is low, 1-3% [10].

There are some reasons for COD payment predominance. The first is that consumers do not believe in the quality of goods in online transactions, amounting to 70% being worried that the products are of worse quality than advertised [5]. This method allows them to check items before paying. If the goods are not sound as advertised, they return them immediately without any trouble relating to payment. Next, most delivery companies in Vietnam do not charge COD service fees for retailers, and retailers do not charge customers. Therefore, delivery companies

consider COD collection an added service when providing transportation services. Therefore, the customers do not have the motivation to change their behavior. Moreover, a part of consumers distrusts the security of financial institutions when transferring money online.

4.3.2. Increasing Rate of Missed and Failed Deliveries

Due to 99% of online orders being delivered in AHD model, according to the short interviews with drivers, they have to re-deliver goods 2 or 3 times before reaching customers. Another trouble is that buyers specify wrong delivery addresses in their orders, causing drivers to lose time looking for the right address. This adversely affects delivery companies' operational costs and generates more emissions in

urban areas that the country aims to reduce.

Even worse, many buyers cancel their orders, and the average rate is 8-10 percent, according to the results of the survey with drivers. The reason behind this high rate is that Vietnamese easily change their decisions as they make impulsive purchases, buyers run out of money when goods arrive, or shippers cannot contact buyers due to the wrong phone number.

4.4. SWOT Analysis for Last-Mile Delivery in Vietnam

The research provides a SWOT analysis to figure out strengths, weaknesses, opportunities, threats, and combined strategies to enhance LMD in e-commerce in Vietnam.

Table 5 SWOT analysis for LMD in Vietnam

Strengths	Weaknesses
<p>S1: E-commerce in Vietnam witnessed the fast growth of the Internet, proven by the high Internet and mobile penetration rate and the increasing quantity of Internet users.</p> <p>S2: Many convenience stores in Vietnam favorable for the cooperation of delivery companies in delivery.</p> <p>S3: Improved payment infrastructure, providing a variety of payment methods. Besides the COD payment method, shoppers can choose to pay online via e-wallets and transfer money online quickly on smartphones.</p>	<p>W1: Delivery method and payment in Vietnam are at the most basic level (AHD/COD), with high failure in the first time of delivery</p> <p>W2: With the increasing trend of online shopping, the e-commerce logistics supply chain needs to eliminate the intermediary phases so that goods can go directly from the distributor's warehouse to the consumers. However, transportation and warehousing infrastructure in Vietnam has not yet met this requirement (except for foreign brands such as FedEx, DHL Express, and UPS or large-scale e-commerce logistics businesses with modern technology and a network covering all provinces and cities across the country such as Vietnam Post, Viettel Post, and Tin Thanh).</p> <p>W3: The application of technology in e-commerce is still limited. Vietnam's 4.0 technology adoption index ranked only 95/140 countries (Score: 43.3/100) [26].</p>
Opportunities	Threats
<p>O1: Vietnam's e-commerce market keeps rising. The market size is forecasted to reach 52 billion USD in 2025 [27].</p> <p>O2: Vietnam is the fastest growing economy in Asia-Pacific and is strongly attracting foreign investment to become a regional trade center. In particular, the large amount of investment capital helps businesses improve LMD costs.</p> <p>O3: The world's technology is increasingly developing, and e-commerce businesses can learn and apply it to their business models of LMD.</p>	<p>T1: COD for online orders in Vietnam is over 70%, while the figure in China is 32% and in European countries is 1-3%.</p> <p>T2: LMD costs are high, accounting for 28% of the total transporting cost of businesses, while e-shoppers expect low delivery costs</p> <p>T3: Vehicles used in last-mile delivery in Vietnam are still monotonous. Mainly, these are normal motorbikes with a small delivery capacity leading to high costs. Moreover, using a lorry makes it difficult to access places on small roads.</p> <p>T4: Vietnam does not use a postal code system, so when customers receive orders with unclear addresses, such as in hamlets, villages, and communes without house numbers, the obstacles in delivery are huge. Therefore, the delivery success rate is quite low.</p> <p>T5: orders are of small value</p> <p>T6: The goods received are not as expected in terms of quality, different from things posted on the shop's website. Therefore, the return rate is quite high.</p>

Table 6 Actionable strategies

SO	WO
S1 + O1 + O2 + O3 => learning experience using advanced technology from other e-commerce logistics companies.	W2 + W3 + O2 + O3 => upgrading technology, expanding logistics infrastructure
ST	WT
S1 + S2 + S3 + T3 + T4 => adopting CDP	W1 + T4 => maintain ADH model + double check recipient's address
S1 + S2 + T1 => encouraging e-payment for online orders	W1 + T5 => not using reception boxes
S1 + S3 + T1 + T2 => gradually launching parcel lockers into use	
S3 + T5 => not using reception boxes	
S1 + T1 + T6 => imposing penalty from authority agency for dishonest online companies	

5. Implications for Management and Policy Recommendations

In practice, the traditional AHD delivery model presents barriers to the delivery of e-commerce orders at several levels. For example, first-time failed deliveries require repeat deliveries, resulting in additional operational costs; the policies of some companies do not allow staff to receive online shipments during working hours; in urban societies, people's work is often unscheduled, making it difficult for them to wait for shippers. Therefore, in general, the traditional delivery model is no longer suitable for

stimulating the development of e-commerce in all cases. For example, in Belgium, about 30% of delivery occurs in different locations to where the customer lives and works [28]. To improve the efficiency of last-mile delivery in 2BC e-commerce in Vietnam, the following recommendations have been proposed.

First, e-commerce logistics companies should take advantage of investment capital and invest in infrastructure, such as warehouses and distribution centers. Tiki and Lazada are big businesses that are investing significantly in this activity. Warehouses need to be located in a convenient location and equipped with advanced technologies, such as radio identification technology and code scanning.

Second, delivery companies should maintain the model of ADH, which is familiar to all online buyers in Vietnam, while attempting to develop other unattended delivery models. However, online shops need to contact buyers to carefully verify their addresses and contact numbers before sending parcels to delivery companies to ensure that drivers have the correct information. Otherwise, drivers should contact receivers before they deliver their parcels.

Third, delivery companies should increase the use of CDP systems and ensure the visibility of CDPs on e-commerce sites if they are being used. The e-commerce giant Lazada has been employing CDPs together with traditional delivery models, but not many people are aware of this. Therefore, e-commerce sites in general should advertise this emerging delivery method via their own channels or commercials. Because there is less risk of delivery failure and missed delivery, retailers should work with delivery companies to offer a discount of delivery freight to buyers if they agree to use CDPs, perhaps around 5%, as is the case in Poland [7].

Fourth, according to reports surveyed in Poland [7] and China [16], the most important reason customers utilize parcel lockers is the price of deliveries. Parcel lockers should offer free trials in the early stages of development, as in China [17]. In Poland, customers accepting to receive goods via parcel lockers normally receive a 10% discount for deliveries. To make this method more accessible and widespread in the future, retailers and third-party delivery companies need to work together and offer discounts on products or shipping costs to encourage customers to use this new model. Online promotions that demonstrate the cleverness and convenience of parcel lockers by using video advertisements on TikTok and other social media apps should be launched [23].

Fifth, reception boxes do not seem suitable for the Vietnam market, where the frequency and volume of online orders from each customer are often not high, yet the model requires a large investment. As analyzed above in the Chinese context, this method does not suit a high-density population. However, thanks to e-payment, e-wallet, or QR code scanning upon ordering,

the order cancellation rate is reduced, and delivery companies can ask customers to give their permission to release parcels to their neighbors or gatekeepers of apartment buildings.

Sixth, to adopt and then foster the use of other unattended delivery models in society, encouraging e-payment via bank transfer or e-wallet is necessary. Reducing COD payments can mitigate the tremendous barrier to the growth of unattended delivery models in the future. Some digital sites now provide a large discount on delivery costs for digital buyers when they use e-payment upon placing orders. However, there should be a more attractive discount for customers using e-payment for the first time, so that they are patient and curious enough to try this new payment method and gradually convert to using e-payment for online orders. In addition, it is crucial for the government to continue supervising the activities of payment intermediaries and to issue updated legal documents accordingly, based on real practice, to ensure security for customers. Moreover, advertising digital payment tools in the social network environment is also important to make people more aware of them.

Finally, online selling companies should not overexaggerate the quality of goods, which is the concern of 70% of people when placing digital orders and also the biggest reason for their refusal to make e-payments. The Vietnam Competition and Consumer Authority (VCCA) should issue legal documents carrying penalties for dishonest online companies. The number of online selling companies participating in e-commerce transaction platforms in Vietnam is 22% [5]. This figure is not small, so e-commerce platforms should help to control and stop cooperating with dishonest companies that overstate the quality of goods and receive negative feedback from buyers.

## 6. Conclusion and Limitations

The growth of the 2BC e-commerce market has resulted in an increase in the importance of last-mile deliveries in urban areas. Although some last-mile delivery models, such as AHD, CDPs, and PL, are concurrence in practice in Vietnam, little research has addressed the barriers present in these models. This research investigates the strengths and challenges of different parcel delivery models in Vietnam. In general, all models are acceptable for use. When orders are few, it is wise to adopt AHD, but other unattended delivery models (CDPs and PL) become efficient solutions in many other cases. However, there is a need for measures to encourage e-payment for online orders, which facilitates the success of employing unattended models. Overall, the implementation of unattended delivery models is a trend to reduce the operational cost for delivery companies and is considered an important factor for the success of B2C delivery. This review offers insights to both academics and practitioners. On

the academic side, it analyses relevant previous studies about efficiency-oriented innovative last-mile delivery solutions, proposing directions for future research activities. On the practice side, it presents an analysis of the main models of last-mile delivery and the viable innovative solutions that may be implemented, thus offering a tool that could be used while evaluating the right last-mile delivery strategy to be implemented by e-commerce logistics companies.

The proposed solutions are considered from express-delivery and logistics companies' perspectives.

## References

- [1] ALLEN J., PIECYK M., PIOTROWSKA M., MCLEOD F., CHERRETT T., GHALI K., NGUYEN T., BEKTAS T., BATES O., FRIDAY A., WISE S., and AUSTWICK M. Understanding the Impact of E-Commerce on Last-Mile Light Goods Vehicle Activity in Urban Areas: The Case of London. *Transportation Research Part D: Transport and Environment*, 2018, 61: 325–338. <https://doi.org/10.1016/j.trd.2017.07.020>
- [2] UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT. *The UNCTAD B2C E-Commerce Index 2020: Spotlight on Latin America and the Caribbean*. [https://unctad.org/system/files/official-document/tn\\_unctad\\_ict4d17\\_en.pdf](https://unctad.org/system/files/official-document/tn_unctad_ict4d17_en.pdf)
- [3] ZENEZINI G., LAGORIO A., PINTO R., DE MARCO A., and GOLINI R. The Collection-and-Delivery Points Implementation Process from the Courier, Express and Parcel Operator's Perspective. *IFAC-PapersOnLine*, 2018, 51(11): 594–599. <https://doi.org/10.1016/j.ifacol.2018.08.383>
- [4] Q&ME. *Vietnam EC market 2019-2020*. <https://oscartranads.com/wp-content/uploads/2020/02/vietnam-ec-market-2019-20.pdf>
- [5] VECITA. *Vietnam E-Commerce White Book 2020*. Ministry of Trade and Industry, 2021.
- [6] B&COMPANY VIETNAM. *A Landscape View on Vietnam E-Commerce Logistics Market*. 2019. <https://b-company.jp/logistics-en/>
- [7] IWAN S., KIJEWSKA K., and LEMKE J. Analysis of Parcel Lockers' Efficiency as the Last Mile Delivery Solution - The Results of the Research in Poland. *Transportation Research Procedia*, 2016, 12: 644–655. <https://doi.org/10.1016/j.trpro.2016.02.018>
- [8] PUNAKIVI M., YRJÖLÄ H., and HOLMSTRÖM J. Solving the last mile issue: Reception box or delivery box? *International Journal of Physical Distribution and Logistics Management*, 2001, 31(6): 427–439. <https://doi.org/10.1108/09600030110399423>
- [9] WANG, Y., ZHANG, D., LIU, Q., SHEN F., and LEE L. H. Towards enhancing the last-mile delivery: An effective crowd-tasking model with scalable solutions. *Transportation Research Part E: Logistics and Transportation Review*, 2016, 93: 279–293. <https://doi.org/10.1016/j.tre.2016.06.002>
- [10] NETS. *The E-Commerce Report 2020*. <https://www.nets.eu/media-and-press/news/documents/nets-e-commerce-2020-international.pdf>
- [11] KEDIA A., KUSUMASTUTI D., and NICHOLSON A. Locating collection and delivery points for goods' last-mile travel: A case study in New Zealand. *Transportation Research Procedia*, 2020, 46: 85–92. <https://doi.org/10.1016/j.trpro.2020.03.167>
- [12] WINKENBACH M., and JANJEVIC M. Classification of Last-Mile Delivery Models for e-Commerce Distribution: A Global Perspective. In: TANIGUCHI E., and THOMPSON R. G. (eds.) *City Logistics 1: New Opportunities and Challenges*. ISTE Ltd, 2018: London, 209–229. <https://doi.org/10.1002/9781119425519.ch11>
- [13] LIM S. T., JIN X., and SRAI J. S. *Last-mile logistics structures: a literature review and design guideline*. 2015. [https://www.researchgate.net/profile/Stanley-Frederick-Wt-Lim-2/publication/281783277\\_Last-mile\\_logistics\\_models\\_A\\_literature\\_review\\_and\\_design\\_guideline/links/563b55bf08ae405111a75230/Last-mile-logistics-models-A-literature-review-and-design-guideline.pdf](https://www.researchgate.net/profile/Stanley-Frederick-Wt-Lim-2/publication/281783277_Last-mile_logistics_models_A_literature_review_and_design_guideline/links/563b55bf08ae405111a75230/Last-mile-logistics-models-A-literature-review-and-design-guideline.pdf)
- [14] LINDNER J. *Last Mile Logistics Capability: A Multidimensional System Requirements Analysis for a General Modelling and Evaluation Approach*. Technical University of Munich, 2011.
- [15] VIETNAM SUPPLY CHAIN. <https://vietnamsupplychain.com/en/learn/events/view/vietnam-supply-chain-lookout-2017/528>
- [16] WANG X., ZHAN L., RUAN J., and ZHANG J. How to Choose “Last Mile” Delivery Modes for E-Fulfillment. *Mathematical Problems in Engineering*, 2014, 2014: 417129. <https://doi.org/10.1155/2014/417129>
- [17] TANG Y. M., CHAU K. Y., XU D., and LIU X. Consumer perceptions to support IoT based smart parcel locker logistics in China. *Journal of Retailing and Consumer Services*, 2021, 62: 102659. <https://doi.org/10.1016/j.jretconser.2021.102659>
- [18] ZHANG S. Z., and LEE C. K. M. Flexible vehicle scheduling for Urban Last Mile Logistics: The emerging technology of Shared Reception Box. Proceedings of the IEEE International Conference on Industrial Engineering and Engineering Management, Bali, 2016, pp. 1913–1917. <https://doi.org/10.1109/IEEM.2016.7798211>
- [19] WELTEVREDEN J. W. J. B2C E-Commerce Logistics: The Rise of Collection-and-Delivery Points in the Netherlands. *International Journal of Retail & Distribution Management*, 2008, 36(8): 638–660. <https://doi.org/10.1108/09590550810883487>
- [20] YUEN K. F., WANG X., MA F., and WONG Y. D. The determinants of customers' intention to use smart lockers for last-mile deliveries. *Journal of Retailing and Consumer Services*, 2019, 49: 316–326. <https://doi.org/10.1016/j.jretconser.2019.03.022>
- [21] YANG G., HUANG Y., FU Y., HUANG B., SHENG S., MAO L., HUANG S., XU Y., LE J., OUYANG Y., and YIN Q. Parcel Locker Location Based on a Bilevel Programming Model. *Mathematical Problems in Engineering*, 2020, 2020: 5263689. <https://doi.org/10.1155/2020/5263689>
- [22] JANJEVIC M., KAMINSKY P., and NDIAYE A. B. Downscaling the consolidation of goods - state of the art and transferability of micro-consolidation initiatives. *European Transport - Trasporti Europei*, 2013, 54: 1-23. <https://www.openstarts.units.it/handle/10077/8870>
- [23] LIN L., HAN H., YAN W., NAKAYAMA S., and SHU X. Measuring Spatial Accessibility to Pick-Up Service Considering Differentiated Supply and Demand: A Case in Hangzhou, China. *Sustainability*, 2019, 11(12): 3448.

<https://doi.org/10.3390/su11123448>

- [24] XIAO S., FARAJTABAR M., YE X., YAN J., SONG L., and ZHA H. Wasserstein Learning of Deep Generative Point Process Models. Proceedings of the 31st Conference on Neural Information Processing Systems, Long Beach, California, 2017, pp. 3247–3257. <https://proceedings.neurips.cc/paper/2017/file/f45a1078feb35de77d26b3f7a52ef502-paper.pdf>
- [25] YEN H. Demand for e-logistics in Vietnam projected to boom. Hanoitimes, 2019. <http://hanoitimes.vn/demand-for-e-logistics-in-vietnam-projected-to-boom-2145.html>
- [26] WORLD ECONOMIC FORUM. Global Competitiveness Report 2019, 2019. <https://www.weforum.org/reports/how-to-end-a-decade-of-lost-productivity-growth>
- [27] ANH L. Thương mại điện tử Việt Nam sẽ đạt 52 tỷ USD vào năm 2025. Congthuong.vn, 2021. <https://congthuong.vn/thuong-mai-dien-tu-viet-nam-se-dat-52-ty-usd-vao-nam-2025-155590.html>
- [28] CÁRDENAS I., BECKERS J., and VANELSLANDER T. E-Commerce Last-Mile in Belgium: Developing an External Cost Delivery Index. *Research in Transportation Business & Management*, 2017, 24: 123-129. <https://doi.org/10.1016/j.rtbm.2017.07.006>

#### 参考文献:

- [1] ALLEN J., PIECYK M., PIOTROWSKA M., MCLEOD F., CHERRETT T., GHALI K., NGUYEN T., BEKTAS T., BATES O., FRIDAY A., WISE S. 和 AUSTWICK M. 了解电子商务对城市地区最后一英里轻型货车活动的影响：伦敦案例。交通研究D部分：交通与环境，2018，61：325-338. <https://doi.org/10.1016/j.trd.2017.07.020>
- [2] 联合国贸易与发展会议。2020年贸发会议乙2C电子商务指数：聚焦拉丁美洲和加勒比地区。 [https://unctad.org/system/files/official-document/tn\\_unctad\\_ict4d17\\_en.pdf](https://unctad.org/system/files/official-document/tn_unctad_ict4d17_en.pdf)
- [3] ZENEZINI G., LAGORIO A., PINTO R., DE MARCO A. 和 GOLINI R. 从快递、快递和包裹运营商的角度来看收集和递送点实施流程。国际会计师联合会-在线论文，2018年，51（11）：594-599. <https://doi.org/10.1016/j.ifacol.2018.08.383>
- [4] 问答。越南欧共体市场2019-2020. <https://oscartrnads.com/wp-content/uploads/2020/02/vietnam-ec-market-2019-20.pdf>
- [5] 维西塔。越南电子商务白皮书2020。贸易和工业部，2021。
- [6] 民宿公司越南。越南电子商务物流市场的景观观。2019. <https://b-company.jp/logistics-en/>
- [7] IWAN S., KIJEWKA K. 和 LEMKE J. 包裹储物柜作为最后一英里递送解决方案的效率分析——波兰的研究结果。交通研究学报，2016年，12：644-655. <https://doi.org/10.1016/j.trpro.2016.02.018>
- [8] PUNAKIVI M., YRJÖLÄ H. 和 HOLMSTRÖM J. 解决最后一英里问题：收件箱还是送货箱？国际物流与物流管理杂志，2001，31（6）：427-439. <https://doi.org/10.1108/09600030110399423>

- [9] WANG, Y., ZHANG, D., LIU, Q., SHEN F., 和 LEE L. H. 加强最后一英里交付：一个有效的人群任务模型和可扩展的解决方案。运输研究乙部分：物流与运输评论，2016，93：279-293. <https://doi.org/10.1016/j.tre.2016.06.002>
- [10] 网。2020年电子商务报告。 <https://www.nets.eu/media-and-press/news/documents/nets-e-commerce-2020-international.pdf>
- [11] KEDIA A., KUSUMASTUTI D. 和 NICHOLSON A. 定位货物最后一英里旅行的收集和交付点：新西兰的案例研究。交通运输研究纲要，2020年，46：85-92. <https://doi.org/10.1016/j.trpro.2020.03.167>
- [12] WINKENBACH M. 和 JANJEVIC M. 电子商务分销最后一英里交付模式的分类：全球视角。在：TANIGUCHI E. 和 THOMPSON R.G. (编辑) 城市物流1：新机遇和挑战。伊斯特有限公司，2018年：伦敦，209-229. <https://doi.org/10.1002/9781119425519.ch11>
- [13] LIM S. T., JIN X. 和 SRAI J. S. 最后一英里物流结构：文献回顾和设计指南。2015. [https://www.researchgate.net/profile/Stanley-Frederick-Wt-Lim-2/publication/281783277\\_Last-mile\\_logistics\\_models\\_A\\_literature\\_review\\_and\\_design\\_guideline/links/563b55bf08ae405111a75230/Last-mile-logistics-models-A-literature-review-and-design-guideline.pdf](https://www.researchgate.net/profile/Stanley-Frederick-Wt-Lim-2/publication/281783277_Last-mile_logistics_models_A_literature_review_and_design_guideline/links/563b55bf08ae405111a75230/Last-mile-logistics-models-A-literature-review-and-design-guideline.pdf)
- [14] LINDNER J. 最后一英里物流能力：通用建模和评估方法的多维系统需求分析。慕尼黑工业大学，2011年。
- [15] 越南供应链。 <https://vietnamsupplychain.com/en/learn/events/view/vietnam-supply-chain-lookout-2017/528>
- [16] WANG X., ZHAN L., RUAN J., 和 ZHANG J. 如何选择电子履行的“最后一公里”配送模式。工程数学问题，2014，2014：417129. <https://doi.org/10.1155/2014/417129>
- [17] TANG Y. M., CHAU K. Y., XU D., 和 LIU X. 消费者感知支持中国基于物联网的智能包裹储物柜物流。零售与消费者服务杂志，2021年，62：102659. <https://doi.org/10.1016/j.jretconser.2021.102659>
- [18] ZHANG S. Z., 和 LEE C. K. M. 城市最后一公里物流的灵活车辆调度：共享接待箱的新兴技术。IEEE国际工业工程和工程管理会议论文集，巴厘岛，2016年，第1913-1917页。 <https://doi.org/10.1109/IEEM.2016.7798211>
- [19] WELTEVREDEN J. W. J. 乙2C电子商务物流：荷兰收集和交付点的兴起。国际零售与分销管理杂志，2008年，36(8)：638-660. <https://doi.org/10.1108/09590550810883487>
- [20] YUEN K. F., WANG X., MA F. 和 WONG Y. D. 客户使用智能储物柜进行最后一英里交付的意图的决定因素。零售与消费者服务杂志，2019年，49：316-326. <https://doi.org/10.1016/j.jretconser.2019.03.022>
- [21] YANG G., HUANG Y., FU Y., HUANG B., SHENG S., MAO L., HUANG S., XU Y., LE J., OUYANG Y., 和 YIN Q. 包裹储物柜位置基于双层编程模型。工程中的数学问题，2020，2020：5263689. <https://doi.org/10.1155/2020/5263689>

- [22] JANJEVIC M., KAMINSKY P. 和 NDIAYE A. B. 缩小商品合并规模-微合并计划的最新技术和可转让性。欧洲运输-欧洲运输，2013， 54 : 1-23。 <https://www.openstarts.units.it/handle/10077/8870>
- [23] LIN L., HAN H., YAN W., NAKAYAMA S., 和 SHU X. 考虑差异化供需的情况下测量取件服务的空间可达性：以中国杭州为例。可持续性，2019， 11(12) : 3448。 <http://doi.org/10.3390/su11123448>
- [24] XIAO S., FARAJTABAR M., YE X., YAN J., SONG L., 和 ZHA H. 瓦瑟斯坦深度生成点过程模型的学习。第31届神经信息处理系统会议论文集，加利福尼亚州长滩，2017年，第3247-3257页。 <https://proceedings.neurips.cc/paper/2017/file/f45a1078feb35de77d26b3f7a52ef502-paper.pdf>
- [25] YEN H. 越南对电子物流的需求预计将蓬勃发展。河内时报，2019年。 <http://hanoitimes.vn/demand-for-e-logistics-in-vietnam-projected-to-boom-2145.html>
- [26] 世界经济论坛。2019年全球竞争力报告，2019年。 <https://www.weforum.org/reports/how-to-end-a-decade-of-lost-productivity-growth>
- [27] ANH L. 到2025年越南电子商务将达到520亿美元。Congthuong.vn, 2021。 <https://congthuong.vn/thuong-mai-dien-tu-viet-nam-se-dat-52-ty-usd-vao-nam-2025-155590.html>
- [28] CÁRDENAS I., BECKERS J. 和 VANELSLANDER T. 比利时电子商务最后一英里：制定外部成本交付指数。交通运输业务与管理研究， 2017， 24: 123-129。 <https://doi.org/10.1016/j.rtbm.2017.07.006>