THINK Executive White Paper Series

June | 2017

The Logistics Institute – Asia Pacific

E-Commerce Logistics: Asset Utilization and Coordinated Clusters

A Collaboration Between

Presented at:

THINK EXECUTIVE
THE LOGISTICS INSTITUTE - ASIA PACIFIC

THINK Executive Summit

Smart Urban Logistics: From Concept to Collaboration

2 June 2017
Singapore

Organized By: THE LOGISTICS INSTITUTE ASIA PACIFIC

Supported By: EC World REIT

EXECUTIVE SUMMARY

The resurgence and rapid growth of e-commerce as a paradigm has catalysed changes in business as usual logistics. The real crux of the challenges in e-commerce logistics is about precisely matching fulfilment to the needs of each unique operating environment or business model that e-commerce has to address at ever increasing service levels. It demands higher utilisation and coordination of a portfolio of logistics assets that when assembled are considered as the backbone of the e-commerce driven supply chain.

This whitepaper sets out to document the challenges and opportunities in assembling the appropriate e-commerce logistics assets. It serves as a continuation of our previous whitepaper titled "E-Commerce Trends and Challenges: A Logistics and Supply Chain Perspective", by now focusing on portfolio asset utilization and coordination. In many aspects, this whitepaper is another step in the journey and we consider it a work-in-progress.

In this whitepaper, we divide logistics into three types, namely: physical, technology and people asset. Coordination of the three asset categories would ensure a dovetailing with each other and positively influence each other. Inefficiency, scarcity and lower utilization in one asset may impact overall chain responsiveness.

We have organized the whitepaper based on the key ideas that are presented in chapters. In Chapter 1, we set up the e-commerce landscape and the logistical challenges of operating in an increasingly urbanized environment. While the detail of logistics assets types is described in Chapter 2. This is followed by an overview of the challenges in e-commerce logistics assets and how it differs from conventional logistics (Chapter 3).

A more detailed discussion on logistics facilities and vehicle utilization as part of physical assets is presented in Chapter 4, 5 and 6. When e-commerce logistics operate in an urban space, we need to rethink how warehouses are used (Chapter 4) and how they operate to drive efficiency (Chapter 5). Vehicle assets

will need to be utilized better in anticipation of the growth in e-commerce. Hence, Chapter 6 explores self pick-up services that lessens the burden on last mile delivery.

In e-commerce, technology is the ultimate asset enabler. It creates the online marketplace, facilitates payments as well as drives efficiency in logistics and delivery operations. Chapter 7 touches on two technologies that are highly relevant to e-commerce logistics.

Physical and technology assets are not enough, in itself, people will need to be involved and Chapter 8 describes the different stakeholders that require engaging in the e-commerce logistics ecosystem.

In summary, we address the foundational aspects of asset utilization and coordination in e-commerce logistics and provide thought provoking concepts that we have researched to improve efficiency and effectiveness of a portfolio of logistics assets in e-commerce. We hope that these insights provoke further thought and innovation in e-commerce logistics that would benefit the whole community of practice.

This is ongoing work and we hope that you, the reader, in turn will be as motivated as the team of authors and contributors, to share and contribute your own ideas to further enhance the practice and alignment of business asset innovation in e-commerce.

We look forward to sharing this with you at Think Executive Summit: Smart Urban Logistics – From Concept to Collaboration.

Table of Contents


E-COMMERCE
LOGISTICS ASSETS

Chapter 1.

E-COMMERCE FULFILMENT

With the advent of the internet, business-to-customer (B2C) and customer-to-customer (C2C) e-commerce have experienced tremendous growth making it a US$ 1.2 trillion market in 2016 with China and the United States contributing 59% of the share[1]. While developed western countries are more matured, China's e-commerce market has grown rapidly in the 2010s and took over the US as the leader in sales. In the Asia Pacific region, besides China, Japan and South Korea are the next e-commerce leaders as shown in Figure 1.1. When comparing the countries against sales per capita, there is high potential for e-commerce growth in developing countries.

Logistics plays a key role in e-commerce and can be broadly divided into back-end and last mile fulfilment as illustrated in Figure 1.2. Starting at E-fulfilment centres, these global/regional facilities assemble individual orders. Orders then go through parcel hubs and sortation centres to reach the local delivery centres or local depots. The e-fulfilment process enters the last-mile where parcels are deconsolidated to individual orders and placed on delivery routes which are transported typically by lightweight vehicles to collection and delivery points. The intersection of e-commerce fulfilment and urban logistics occurs downstream of the sortation centre and is largely in last-mile fulfilment (although not always the case).

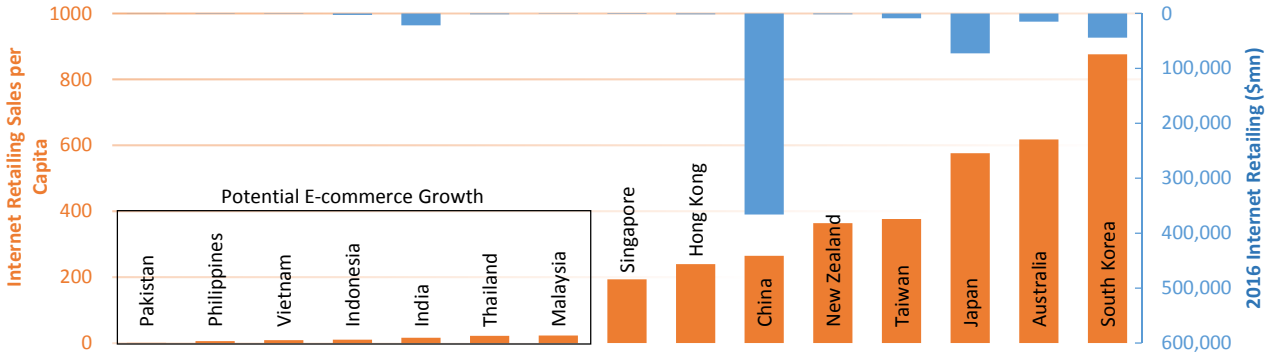


Figure 1.1. E-commerce markets in the Asia Pacific Region

[1] Retailing: Euromonitor from trade sources/national statistics

Against the backdrop of an increasingly urbanised world, e-commerce fulfilment management becomes integral to any e-commerce business. B2C and C2C e-commerce fulfilment in an urban setting is made more challenging due to the following characteristics of e-commerce fulfilment as illustrated in Figure 1.3.

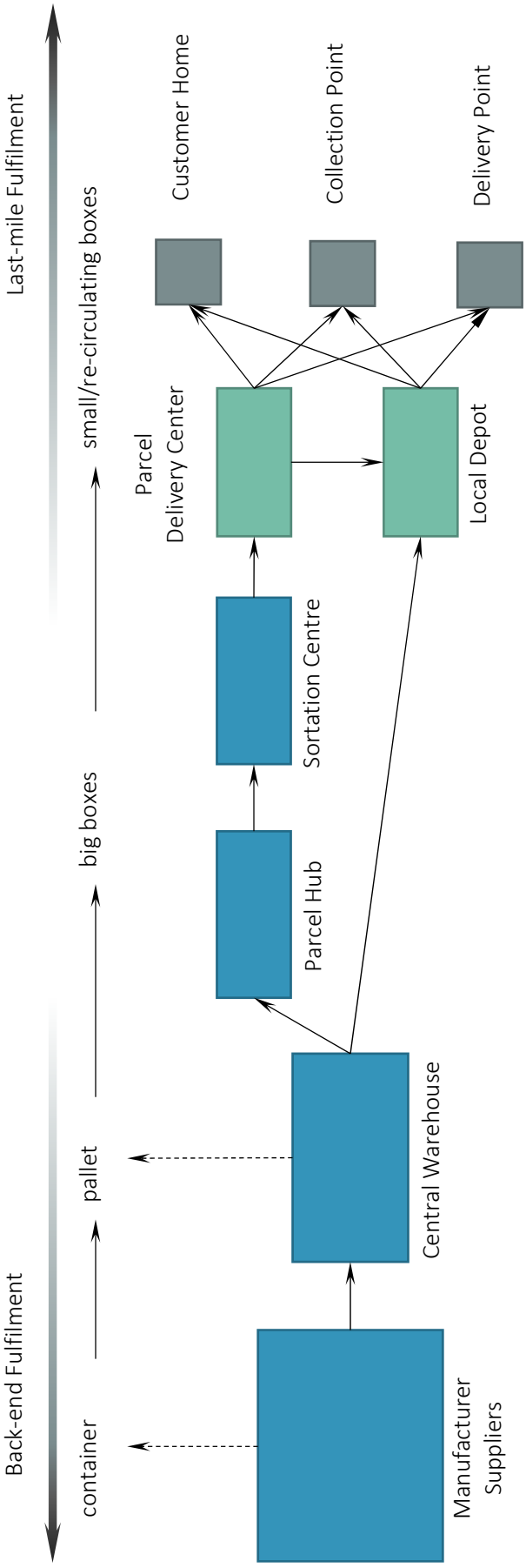
E-commerce has to a large extent fragmented consumer demand spatially and temporally. Home delivery, which is a common service offered by e-tailers, has exponentially increased in number of delivery destinations. Consumers are demanding shorter delivery windows. This fragmentation (less risk pooling) has made demand more variable and that more much difficult to forecast.

E-commerce has created a channel for small suppliers to access the marketplace and provide the opportunity to sell a large variety of products at a small cost. This can sometimes lead to high inventory costs.

Unlike local retailers, consumers' order are less repetitive and in small quantity but demand a shorter lead time. Given the fragmented demand and short lead times and delivery windows, logistics service providers may face underutilization of their ground transportation fleet for last mile fulfilment. These trends force last-mile deliveries to be more responsive but at the same time less efficient. Furthermore, more frequent low-volume deliveries and pick up (for reverse logistics when e-tailers offer return services) contributes greatly to logistics cost and to urban traffic congestion. It is estimated that last mile delivery cost contributes to 45% to 65% of the total fulfilment cost[2].

Other issues of e-commerce fulfilment, which is exacerbated by urban areas, are high cost of land (and hence infrastructure), limited traffic zones, road pricing, limited loading and unloading areas.

[2] *AT Kearney, US E-commerce Trends and the Impact of Logistics. Available at https://www.atkearney.com/consumer-products-retail*



(Adapted from: Adapted from The Geography of Transport Systems, available in https://people.hofstra.edu/geotrans/eng/ch5en/conc5en/evol_retail_logistics.html)

Figure 1.2. E-commerce Logistics Activities

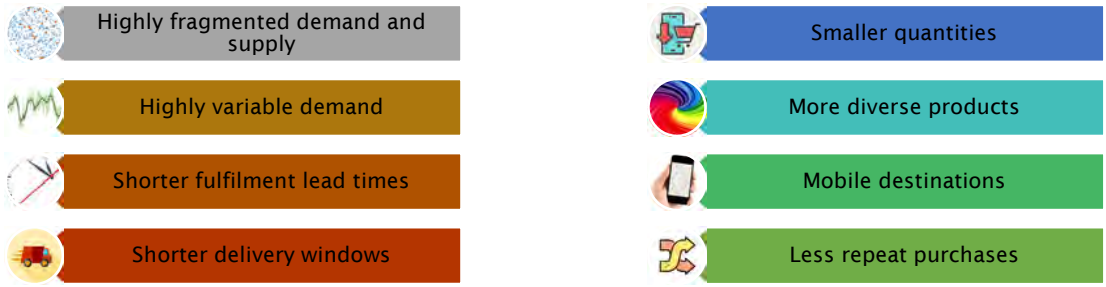


Figure 1.3. Characteristics of E-Commerce Fulfilment in Urban Setting

Chapter 2.

E-COMMERCE LOGISTICS ASSETS

In e-commerce, customers regard the timely and reliable deliveries as important as the products' quality and cost. Customers' satisfaction will eventually shift from pricing to service quality, including logistics service. This makes e-commerce logistics become very critical. It is the first face-to-face interaction between the e-commerce company and the customers. E-commerce companies have to place emphasis on the design of their logistics systems to ensure distribution efficiency and customers' satisfaction for quality, speed, reliability and flexibility in deliveries. They may develop their in-house logistics distribution system or outsource it to other logistics companies. Whichever logistics distribution choices they make, the companies' ability to effectively and efficiently manage their logistics assets and activities is required to provide on-time and reliable deliveries.

There are many categorization for logistics assets described in the literature. In this whitepaper, we categorize logistics assets into three types, namely: physical, technology and people assets, as illustrated in Figure 2.1.

Physical Assets

The logistics physical assets consists of the logistics infrastructure, transportation vehicles (and equipment) and inventory.

1) Logistics infrastructure includes any logistics facilities such as warehouses and collection centers that are used in e-commerce logistics activities as holding or temporary locations before the products are received by the customers. Several additional logistics activities may need to be conducted in the facilities such as products' sorting, repackaging, re-labelling and consolidation.

2) Transportation vehicles and equipment consists of all assets required for executing transportation activities toward customers. It includes internal activities in logistics facilities and transportations between logistics facilities. Equipment may consist of shelving, forklifts, pallets, conveyer systems and so on.

3) Inventory includes the different forms of product (such as raw material, work in process or finished product) that resides in the logistics facilities and transportation vehicles. The inventory is linked with the companies' cash flow to maintain desired level of customer service[3].

Figure 2.1. Logistics Assets Categories

Technology Assets

E-Commerce is highly dependent on Information Technology (IT) beginning from the e-commerce portal and all the way down to last mile delivery services. Specifically for e-commerce logistics, IT plays the linking role among various parties such as e-commerce platform owner, suppliers or merchants and customers. IT for e-commerce logistics may include functionalities for collection and delivery appointment, delivery schedule, online tracking and delivery acknowledgement. IT supports data exchange in the e-commerce. E-Commerce companies use IT to ensure the products flows in efficiently and effectively to fulfil customers' delivery demand.

People Assets

Logistics is a very "people" oriented function[4] that relies on various labour assets (such as the drivers, delivery man and warehouse operators). Labour assets directly affect cost, quality, reliability, responsiveness and customers' satisfaction. Beyond logistics operations, e-Commerce logistics also involves various stakeholders with differing interests. We divide the stakeholders in e-commerce logistics into four types: public, logistics service providers, inventory owners and regulators. These four types will be discussed in more detail in Chapter 8.

[3] The Logistics Institute – Asia Pacific, E-Commerce Trends and Challenges: A Logistics and Supply Chain Perspective, November 2016.
[4] Novack, R. A., Rinehart, L.M., and Wells, M.V. 1992. Rethinking concept foundation in logistics management. Journal of Business Logistics, 13(2): 233-267.

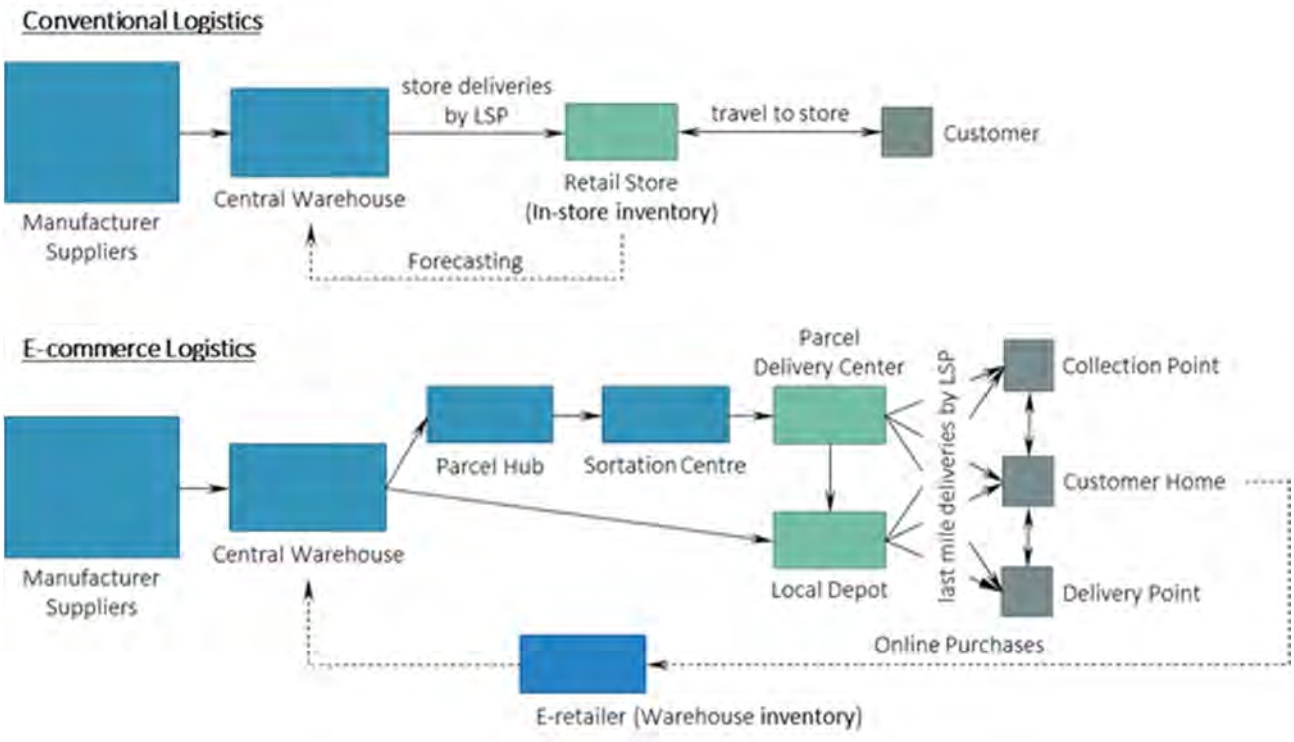
Chapter 3.

CONVENTIONAL AND E-COMMERCE LOGISTICS: ASSET PERSPECTIVE

Conventional (or offline) businesses and retailers require logistics to manage efficient and effective flow of goods from the point of origin (i.e. supplier or manufacturer) to the point of consumption. Conventional logistics commonly comprises three main areas: (1) good transportation via different transportation modes, (2) inventory in transit and inventory stored in logistics facilities and (3) physical handling of materials. It also involves various logistics assets as mentioned in the previous chapter.

Conventional logistics is different from e-commerce logistics as illustrated in Figure 3.1. In the conventional logistics, the point of consumption is mostly the shops or retailers, not end customers. If a customer wants to buy something, he/she needs to travel to the nearest retailer to choose and buy the product. While in e-commerce logistics, the product is delivered closer to end customers and is typically delivered directly to the customers' homes. E-commerce logistics has to be able to handle the large extent of fragmented consumer demand spatially and temporally. With an increased number of delivery destinations and shorter delivery windows, demand forecasting for e-commerce logistics services is much more difficult. In contrast, demand from shops and retailers is easier to forecast as they tend to be more repetitive and in large quantities.

Another difference between conventional and e-commerce logistics is the product movement/distribution model. In conventional logistics, the movement is mostly supply-driven (push) while in e-commerce logistics, the movement is mostly demand-driven (pull).



Adapted from Rodrigue J.P. et al., The Geography of Transport Systems, 2017. Available at: https://people.hofstra.edu/geotrans/eng/ch5en/conc5en/ecommercelog.html

Figure 3.1. Conventional and E-Commerce Logistics

In term of logistics assets, conventional logistics varies from the e-commerce logistics in several aspects, such as: the functions of the logistics facilities, transportation assets required, the role of the players, role of the customers and service level. These aspects impact on how the companies conduct their logistics operations and activities in conventional and e-commerce logistics. Many logistics companies are still operating according to the conventional logistics while trying to fulfil the e-commerce delivery demands. It creates gaps between e-commerce logistics performance and customers' expectations, which leads to the challenges of e-commerce logistics transformation. The higher costs of e-commerce logistics is still not align with the improvement of reliable, on-time, good and responsive logistics services.

Major differences between conventional and e-commerce logistics in term of logistics assets are summarized in Table 3.1.

Table 3.1. Comparison between Conventional and E-Commerce Logistics

	Conventional Logistics	E-Commerce Logistics
Package Size	Consolidated Packages	Small Packages
Packing Requirement	Bundle packing (in boxes, cases etc.)	Individual packing
Main Logistics Facility Functions	Temporary storage facility for distributions	Storing, packing, re-labelling, consolidation
Logistics Facility Requirement	Need sufficient space for storing, loading and unloading activities	In addition to storing, loading and loading space, it needs sufficient space for packaging and handling the increasing volume of express deliveries
Delivery Process	End node for the delivery is retailers/distributors in specific and concentrated locations; the customers purchase and pick-up directly from the retailers	End node for the delivery is the customers in a more widespread locations
Delivery Cycle	Weekly	Daily, hourly
Delivery Reliability	Effecting the goods' availability	Effecting customers' satisfaction
Delivery Failure	Minimum failed delivery	High delivery failure rate
Delivery Time	Static schedule that rarely changed, more flexible time windows; May involved long-term schedule planning	Dynamic schedule, tight time windows; No long-term planning involved
Truck Size	Large-Size Truck with full truck loads	Smaller vehicles
Delivery Tracking System	Delivery tracking may not be required.	Online delivery tracking that can be accessed by end-customer is required.
Warehouse Management System	Simple or basic warehouse management system may be sufficient	Advance (or intelligent) management system may be required to handle enormous number of deliveries


PHYSICAL ASSETS

Chapter 4.

E-COMMERCE WAREHOUSE: CHALLENGES AND OPPORTUNITIES

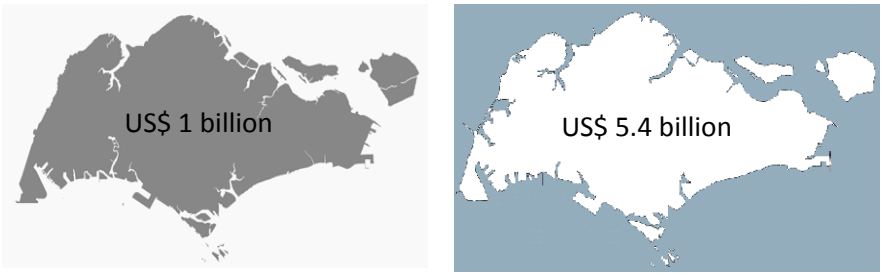
With the rapid growth of e-commerce, high quality warehouse logistics services are increasingly needed to determine the success of e-commerce companies. Besides the demand for efficient commodity, inventory management and higher warehouse utilization rate, the speed and accuracy of onsite logistics movement as well aggregation, analysis and eventual utilization of data are also highly emphasised. In this chapter, we will discuss several challenges for e-commerce warehouses in Singapore and China. Opportunities for e-commerce clusters will also be discussed.

4.1. E-Commerce Warehouse: Challenges in Singapore

E-Commerce market is a new big wave happening in the whole world, including Singapore, which change how people normally conduct economic activities. In Singapore alone, e-commerce was valued at US$ 1 billion in 2015 and projected to be worth US$5.4 billion by 2025[5] as illustrated in Figure 4.1. This 2025 projected figure is bigger than the Singapore casino industry value in 2015 (US$ 4 billion). To accommodate the e-commerce growth, the demand for logistics facilities to meet local and cross-border transactions is increasing.

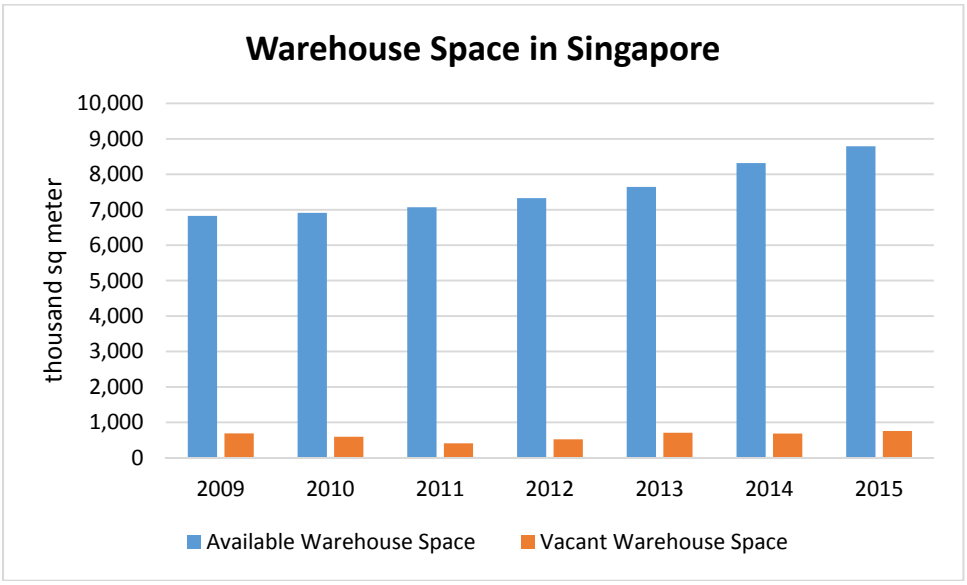
As a small island of approximately 720 km^2 and a growing population, finding available land to build e-commerce warehouses in Singapore is becoming an acute concern for industrial land users. Singapore is a densely populated city where different kinds of activities needs – such as business, industries, utilities, residences, schools, transport – must compete for the limited land resource available. As the city grows, demands on land resource will be inevitably greater. Land scarcity, paired with increasing land cost, becomes the main challenges for e-commerce companies to establish an e-commerce warehouse or hub in Singapore.

[5] Channel News Asia, Singapore e-commerce market to exceed S$7b in 2025: Report, Posted on 24 May 2016. Available at http://www.channelnewsasia.com/news/business/singapore-e-commerce/2811118.html



Value in 2015 Projected Value in 2025

Figure 4.1. e-Commerce market size in Singapore



Source: Singapore Department of Statistics, Yearbook of statistics Singapore 2016, Available at: http://www.singstat.gov.sg/docs/default-source/default-document-library/publications/publications_and_papers/reference/yearbook_2016/yos2016.pdf, May 2017

Figure 4.2. Warehouses space in Singapore 2009-2015

Despite the land scarcity, the warehouse utilization in Singapore is not high. Current warehouses may be designed for specific functions such as a re-packaging facility or hub for distribution in Southeast Asia. Many companies operate their own individual warehouses at less-than-full capacity. It results in underutilized land that could have been used for more value-added activities such as manufacturing and R&D. A number of warehouses remains vacant every year and they account for on average 8% of the total available warehouse space (as is shown in Figure 4.2.).

4.2. E-Commerce Warehouse: Challenges in China

China's e-commerce market has been growing rapidly. The online retail sales was valued approximately RMB 3.95 trillion in 2015[6]. This represents 100% significant growth from 2013. It is projected that the value will keep increasing with an expected annual growth of 19% until 2020 as illustrated in Figure 4.3.

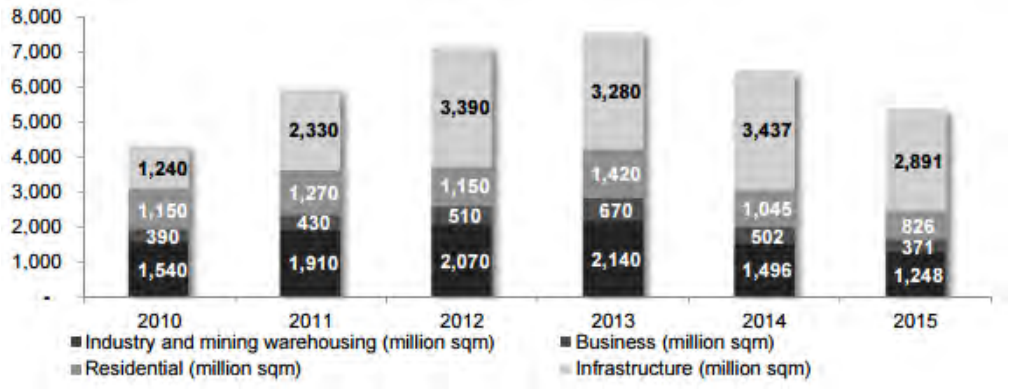
Source: National Bureau of Statistics of the People's Republic of China

Figure 4.3. China E-Commerce Retail Market Size

With this rapid development of e-commerce in China, the need for logistics facilities to support e-commerce activities for local and cross-border is inevitable. Unfortunately, there are several challenges to establish such logistics facilities. Currently, the demand for warehouses outstrips its supply. The condition of the existing warehouses is generally in poor quality. The existing warehouses were designed for conventional logistics that may not be ready for e-commerce logistics. In addition, the Chinese government is tightening the land supply for industrial and mining warehousing purposes as illustrated in Figure 4.4. These factors are affecting the rental cost of these such facilities.

E-Commerce companies may drive an increasing demand of warehouses of larger sizes and higher technological capabilities to accommodate increasing demand of e-commerce deliveries. It would widen the supply-demand gap in warehousing.

[6] National Bureau of Statistics of the People's Republic of China



Source: EC World Reit Prospectus Report, 20 July 2016, available online in http://ecwreit.listedcompany.com/misc/ipo.pdf

Figure 4.4. Land Supply by Usage Type in China

4.3. E-Commerce Warehouse Opportunity: E-Commerce Cluster

One emerging trend in e-commerce warehousing is the establishment of e-commerce industrial clustering which largely exists in the form of integrated e-commerce parks. Industrial clusters have existed for some time now, not only for e-commerce. It was popularized by Silicon Valley for the technology industry and are observed in other industries such as Detroit for US auto-industry, Jepara for Indonesian teak furniture, Jurong Island for petrochemical, Gurgaon for information technology and Midi Pyrénées – Aquitaine for aerospace. An example of e-commerce clusters is the Yangtze River Delta e-commerce cluster as illustrated in Exhibit 1.

E-commerce clusters integrate various stakeholders in e-commerce fulfilment in a single area meant for a concentration of e-commerce related resources, e-commerce ready infrastructure and support facilities. The geographical proximity to related firms promotes greater resource utilization and operational efficiency. This also counterbalances the fragmentation of demand generated e-commerce. For example, for distribution, Logistics Service Providers (LSPs) stand to gain efficiency and increase vehicular utilization from higher volume demanded by the clusters. Also, LSPs can consider larger delivery vehicles which is more cost efficient on a per unit cost basis.

Another benefit of e-commerce clusters is that they can be more resilient to variable demand. It can also help to overcome the land scarcity problem faced by a lot of countries such as Singapore. As an example of the warehouse utilization, during peak period, more space for warehousing and distribution can be leased from the cluster management. During low demand period, the space can be leased to other businesses in the vicinity. Beyond e-commerce fulfilment services, clusters can incorporate other related services such as financial and

credit management, data management, exhibition spaces as well as support services such as lifestyle and entertainment, accommodation, medical, and education to create sustainability for the cluster.

Several approaches or technologies can be implemented in the warehouses within the e-commerce clusters to further increase the functionality and utilization of the warehouses. Two approaches, namely: delivery consolidation and seamless goods moving system, are discussed in Chapter 5.

Exhibit 1: E-Commerce Cluster in North Park of Yangtze River Delta[7]

Hangzhou is the capital and the largest city of the Zhejiang Province in Eastern China. It is one of the largest e-commerce hubs in China and has market coverage over Zhejiang Province. Alibaba Group, which is the world's largest online business-to-business (B2B) is headquartered in Hangzhou, while the business-to-customer (B2C) portals, such as Baidu, Jingdong (JD.com) and Tencent have a sizeable presence in Hangzhou. There are currently more than 470,000 online business entities in Hangzhou. In March 2015, the State Council of the PRC approved the set-up of the China (Hangzhou) Cross-border E-Commerce Pilot Zone in Hangzhou, with special concessions around taxation policy. It further increase the growth of e-commerce in Hangzhou.

With the growth of e-commerce in China, especially in Hangzhou and Zhejiang Province, a good logistics support in Hangzhou would be fundamental to ensure the smoot operations of e-commerce. These logistics supports are offered in North Park and South Park of Yangtze River Delta. The North Park is located in Chongxian New City, north of Hangzhou, while the South Park is located in Fuyang District, south of Hangzhou.

Focusing on the North Park cluster, the cluster can be broadly divided into:

1) Logistics, warehouse and processing zone
   This zone has many business which offer integrated order handling and packaging services for e-commerce clients. Ruyicang, an integrated smart warehousing and third-party logistics service platform launched by Forchn Holdings Group Co., Ltd, is an example of such a business.

2) Port zone
   This zone is designated as the receiving and delivering warehouses and offices. The warehouses in this zone can be built to meet special requirements for specific industries and equipped with cranes to provide convenient transfer of heavy cargoes. It is located in the proximity with the other two zones.

3) Integrated e-commerce services zone
   The e-commerce services zone was delineated to establish a comprehensive e-commerce eco-system that includes e-commerce warehousing and logistics facilities, entrepreneurship and innovation incubators, e-commerce business offices, O2O (offline-to-online or online-to-offline) exhibitions, photography studios, registration agents, talent training, financial services, food and beverage outlets, retail outlets and other e-commerce support activities.

[7] *This section is adapted from EC World REIT IPO Prospectus*

To illustrate these zones clearly, Figure E1 shows World REIT properties in these zones. Fu Zhuo Industrial is located in logistics, warehouse and processing zone. Chongxian Port Investment and Chongxian Port Logistics are located in port zone, while Bei Gang Logistics is located in e-commerce services zone.

Figure E1. EC World REIT Properties in North Park cluster, Hangzhou

North Park as an e-commerce cluster comprises high-quality purpose-build infrastructures and supporting facilities, where e-commerce goods are warehoused and distributed, and e-commerce communities congregate and trade. It provides benefits for e-commerce companies as follows:

1) The e-commerce companies would get benefits from the sharing resources, information, knowledge and policies within the cluster.

2) The e-commerce companies would enjoy reduced administrative expenses, labour cost and warehousing and logistics cost.

3) The e-commerce companies would get operational flexibility and distribution efficiencies through better access to various resources which are complementary to their business.

4) The e-commerce companies would receive full suite of logistics services which help e-commerce start-ups to better address their operation risks.

Chapter 5.

IMPROVING E-COMMERCE WAREHOUSE EFFICIENCY AND PRODUCTIVITY

As the warehouse becomes one of the central parts of the e-commerce logistics now, the efficiency and productivity of the warehouse would impact the e-commerce logistics as a whole. Properly managed warehouse may help the success of e-commerce logistics as well as reduce the overall e-commerce logistics cost. In this chapter, we discuss three approaches and solutions to improve the efficiency and productivity of e-commerce warehouses.

5.1. Warehouse and Distribution Centre Throughput

Cost associated to picking and packing either that the warehouse or distribution centre (DC) takes up 35% to 45% of fulfilment costs[8]. Given that expanding logistics infrastructure is capital intensive, maximizing its efficiency is critical. Picking and packing operations have to be quick and accurate fulfilment and to do so will require some level of economies of scale. It is therefore important to determine if the warehouse or DC is operating at maximum throughput capacity. Using time motion studies, value stream mapping (VSM) and statistical analysis, non-value added activities such as waiting and unnecessary handling can be identified and addressed (Figure 5.1. and 5.2.). While some non-value added activities such as safety checks are essential for logistics operations, there are avoidable non-value added activities that can be minimized to increase the throughput capacity.

An important factor to increase throughput is minimizing the number of unsuccessful picks. This is due to the out of stock within the warehouse or DC. This can be reduced with efficient internal replenishment policies. Another important factor is technology assistance. If there is a bottleneck in the picking process, technology can be used to speed up the process. For example, RFID or barcodes can be used to verify that the right item is picked for the order.

[8] *AT Kearney, US E-commerce Trends and the Impact of Logistics. Available at https://www.atkearney.com/consumer-products-retail*

Erroneous picks are costly not only due to rework but also can cause out of stock for subsequently orders. Algorithms can be used to enable batch picking that consolidates several orders into a pick tour to leverage on common items within the batch to boost efficiency. Technologies like pick-to-light or pick-to-voice can assist pickers to pick faster. Given that travel time during the pick tour can take up to 50% of the total time, routing solutions can be in placed to minimize travel distance and hence travel time which is a non-value added activity.

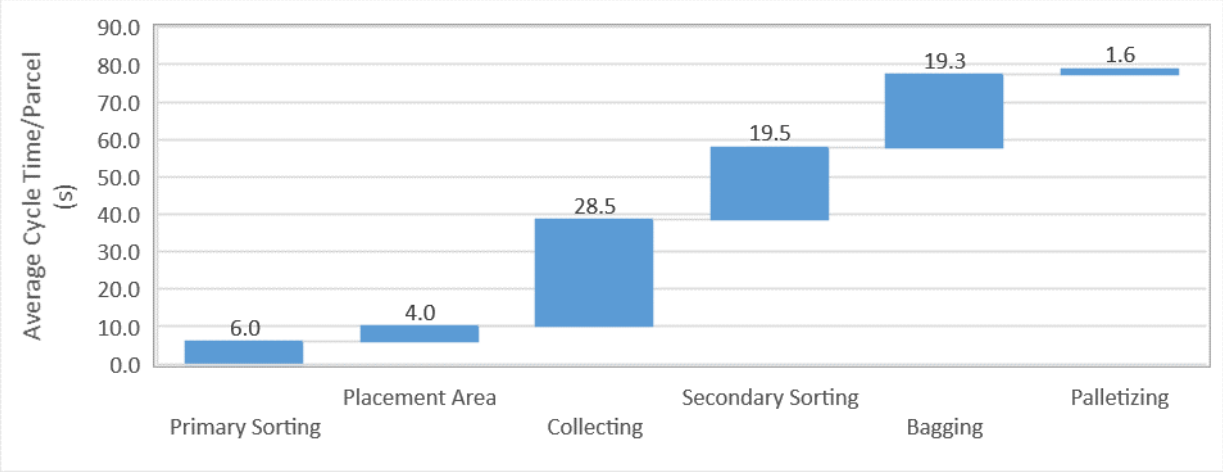


Figure 5.1. Example of Using Time Motion Studies and Value Stream Mapping to Determine Warehouse Operation Bottlenecks

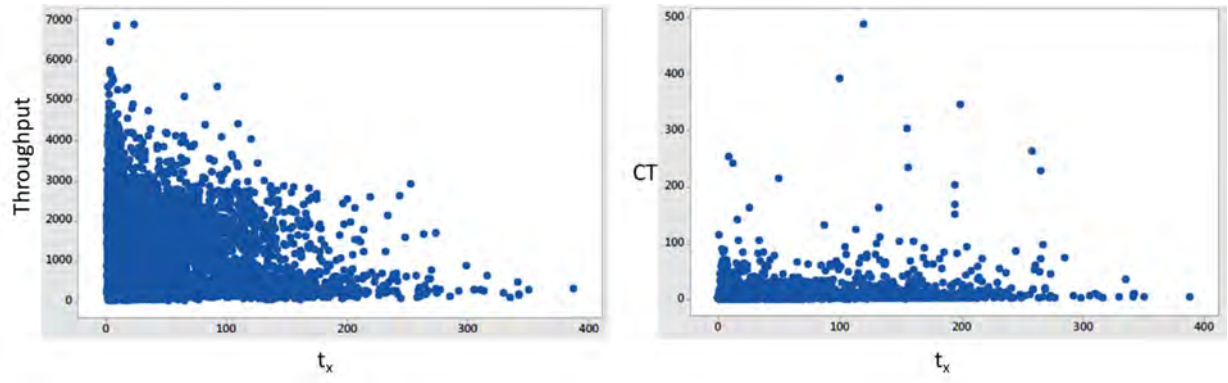


Figure 5.2. Example of Using Statistical Analysis to Determine Indicators of Throughput

5.2. Delivery Consolidation

Given that e-commerce delivery orders are in smaller packages but more frequent, consolidation is required to maintain the logistical efficiency of last mile delivery. Delivery consolidation can be in terms of spatial consolidation, whereby stock points and customers within their respective clusters can be

consolidated; or in terms of time, where by delivery postponement (order lead time) and delivery window are lengthened to consolidate more orders.

In this way, multiple deliveries can be made while reducing transportation cost and optimizing utilization of the delivery vehicle. The opportunities for consolidation are described in Figure 5.3.

The center image shows 3 locations (denoted by the circles) that are being served. Within each circle are location pins of different colours (the colours denoted different delivery days). This means that a total of 7 trips have to be made to the 3 locations to fulfil its orders. The trip is denoted by a truck symbol that also has an indicator to the extent of utilization of the truck.

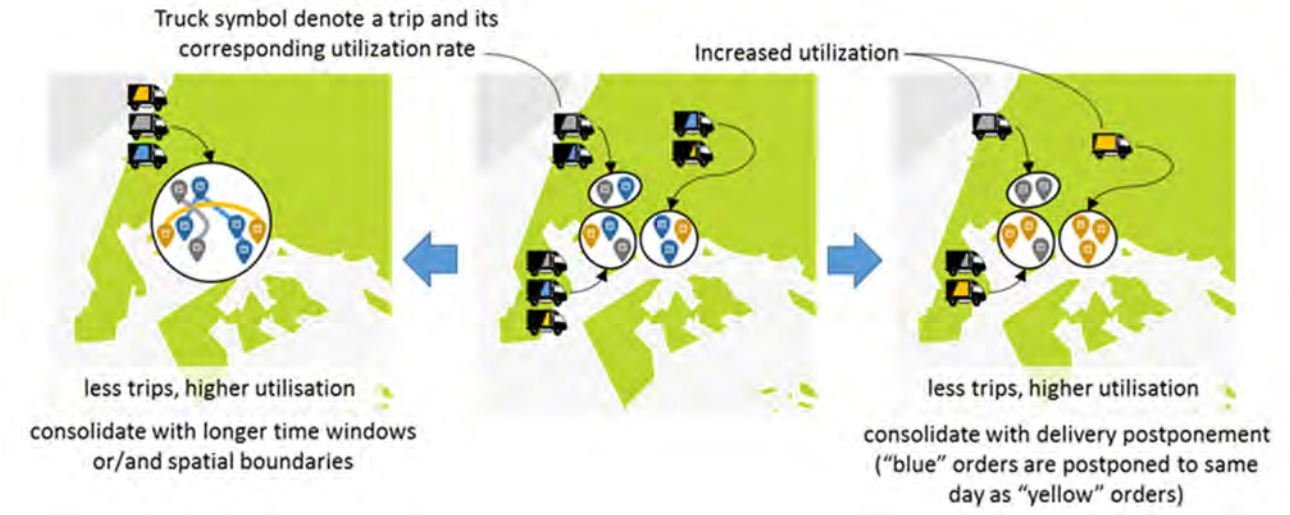


Figure 5.3. Delivery Consolidation by Time Windows, Spatial Boundary and Postponement

To reduce the number of trips and increase utilization, orders can be consolidated with long time windows and hence each trip can increase its geographical coverage. This is observed in the left image with an enlarge circle. This method of consolidation requires only 3 trips, 1 trip per day to fulfil its orders while making milk runs within its coverage. Orders can also be consolidated through delivery postponement as showed in the right image (Figure 5.3). Here, deliveries for one of the days (blue) are merged with the other days (in this example, yellow) hence requiring less trips. Both methods of consolidation increases the utilization as shown.

5.3. Seamless Goods Moving System

Current typical industrial developments, companies within the development have individual logistics infrastructure such as warehouses and loading/unloading zones with many of them not fully utilized as the flow of goods are disperse. In addition, much of the land is used to fulfil logistical needs such as wide roads, internal driveways, warehouses and loading/unloading zones. Consolidation of the logistics function within the industrial developments seeks to reduce the inefficiencies within the estate as well as to better utilize land space. The consolidation can be facilitated by a 3PL whereby the 3PL manages the entire logistics from incoming, storage, internal transfer to outgoing (less production operations). To the companies within the development, the logistics function is outsourced. At the development level, consolidation will help in reducing the storage size and the number of loading and unloading zones. Consolidation of inventory will minimize the need for individual companies to construct wide internal driveways.

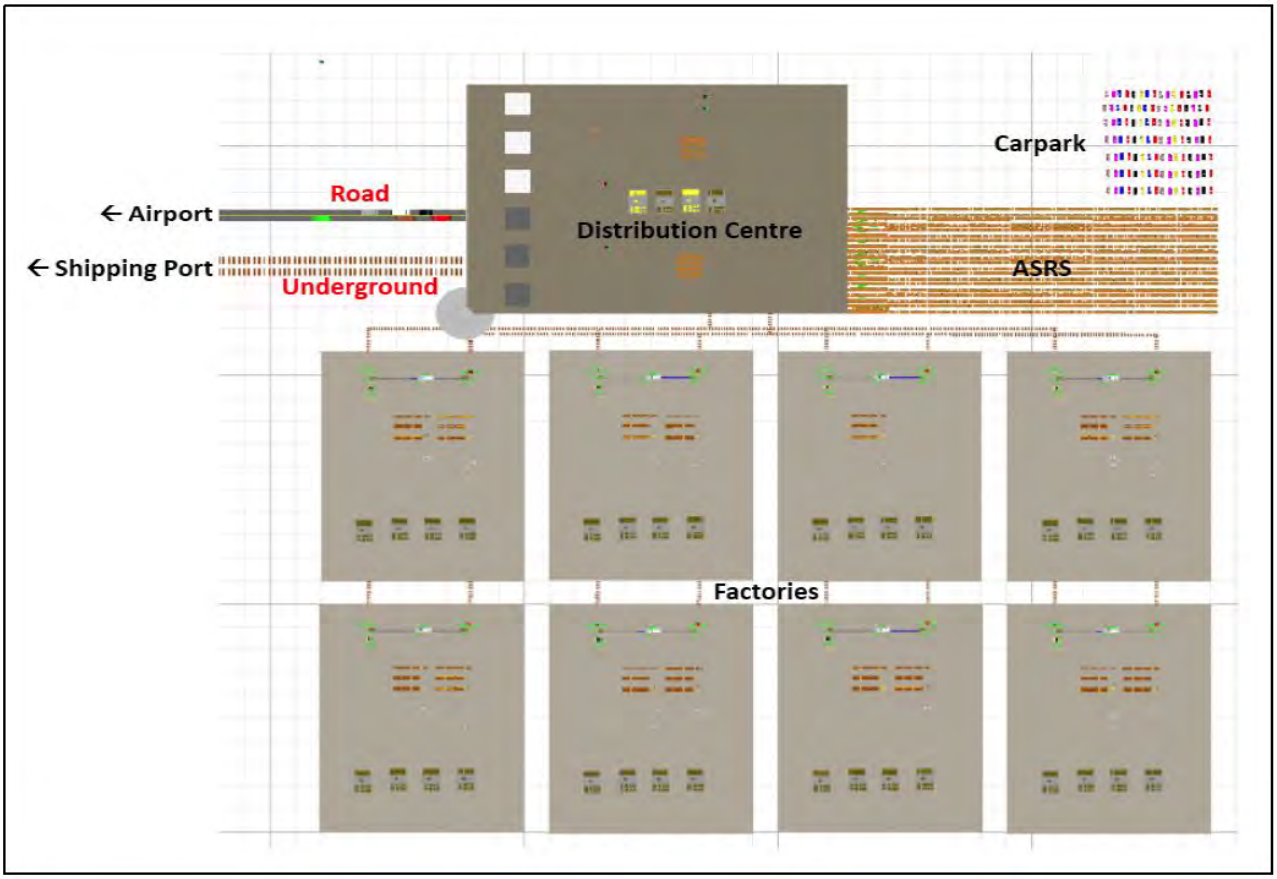


Figure 5.4. Example of a modelled GMS

A seamless goods moving system (GMS) is a central underground logistics center that aims to optimize the goods handling processes by using goods consolidation and warehouse sharing for the various companies within the development. Its layout will facilitate receiving, storage and distribution functions for the

consolidated goods as showed in Figure 5.4. To effectively manage the flow of goods, a network of conveyor belts and automated guided vehicles should be deployed coupled with Warehouse Management System (WMS) and Enterprise Resource Planning (ERP) systems that coordinates customers' orders and inventory planning. The high reliance on automation is key to unlocking not only logistical efficiency within the development but also to replace the current heavy vehicles used in transporting goods. These heavy vehicles are not suitable for the underground complex due to environmental pollution as well as the need for wide underground roads.

With an underground GMS, the ground level road network can be freed of many industrial vehicles which causes traffic congestion, noise and environmental pollution around the estate development. An extension of the GMS is the linkage to other logistical centers such as seaports, urban consolidation centers and bypass areas prone to traffic congestion such as central business district for urban markets and immigration and customs for inter-country freight.

Chapter 6.

REDUCING LOGISTICS COST USING SELF-PICK-UP SERVICES

Other than warehouse, another important physical assets in e-commerce is collection delivery points (CDP) for self-pick-up services for end-customers. The self-pick-up service is an alternative to the more popular delivery option during last mile fulfilment. With self-pick-up, orders are delivered to a temporary storage area at dedicated pick-up locations where customers have a collection time window to collect. There storage area are collection and delivery points (CDPs) which can either be private or public and unattended or attended as illustrated in Figure 6.1. The use of pick-up service helps save time and transportation assets, as additional trips to customer destinations are eliminated. To better accommodate the self-pick-up services, CDPs should be located near residential or commercial areas so that customers can collect their orders at their convenience. This avoids the need for customers to wait for delivery.

Locating CDPs optimally is crucial to the self-pick-up service to balance fulfilment efficiency and customers' satisfaction. Another key consideration is the number of CDPs and what type should be set up. Unattended CDPs such as automated lockers have will have installation and maintenance cost to be considered. Different CDPs have different capacity-cost profiles too so it is important to understand the demand and expected service levels of the target customer. Other considerations for employing self-pick-up service is accessibility and collection procedure. The advantages of self-pick-up is summarized in Figure 6.2.

	Private	Public
Unattended CDP	• Locker point or communal reception box owned by private LSP • Invest cost covered by private LSP • Customers using delivery services from private LSP can collect and return their goods	• Locker point or communal reception box is provided by the government to facilitate last-mile deliveries • Can be operated or managed by the government itself or by a private LSP • Any LSP company would be able to use it by paying a fee
Attended CDP	• Dedicated collection point (such as a store or petrol station) to collect and return goods from a private LSP • Collection point can be managed by the LSP or by other parties with specific contract with the LSP • Store personnel will manage the goods	• Government offices or facilities or public transport infrastructure can be used as collection and return points for certain deliveries • Local building staff will manage the goods

Source: The Logistics Institute – Asia Pacific, (2016), E-commerce Trends and Challenges: A Logistics and Supply Chain Perspective

Figure 6.1. Types of Collection and Delivery Points (CDPs)

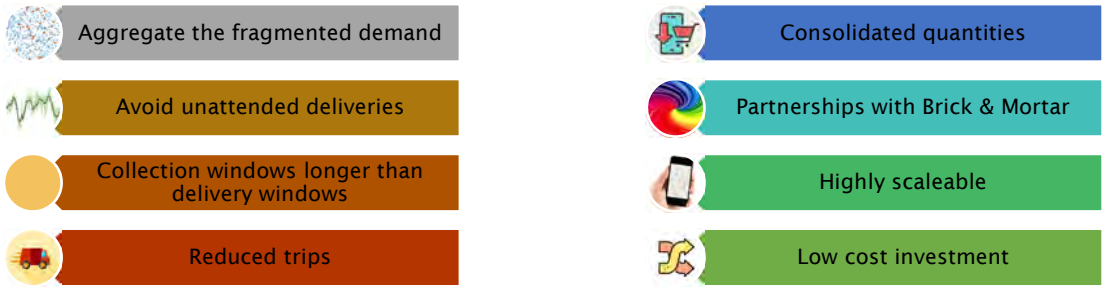


Figure 6.2. Benefits of Self-Pick-Up Services using CDPs

The potential of self-pick-up services are abound and has been implemented by companies around the world. Companies like Amazon[9], Singpost[10], InPost[11] have used automated lockers for parcel collection. Specific to the grocery industry, the likes of Tesco[12], Asda[13], Waitrose[14], Woolworth[15] have implemented self-collection stations for their Click and Collect services. Companies like

[9] Amazon, available at: https://www.amazon.com/b?node=6442600011
[10] POPstation, available at: https://www.mypopstation.com/
[11] InPost, Global Reach. Available at: https://inpost24.com/en/inpost-lockers/global-reach
[12] Tesco, Grocery Click+Collect. Available at: https://www.tesco.com/collect/
[13] Asda, Click and Collect. Availble at: http://www.asda.com/click-and-collect/
[14] Waitrose, Click & Collect Lockers. Available at: http://www.waitrose.com/home/groceries/click-collect-lockers.html
[15] Woolworth, Click & Collect. Available at: https://www.woolworths.com.au/Shop/Discover/shopping-online/click-collect

convenience chain store 7-Eleven[16] and grocer Coles[17] has employed locker systems as well as attended collection and delivery points (CDPs).

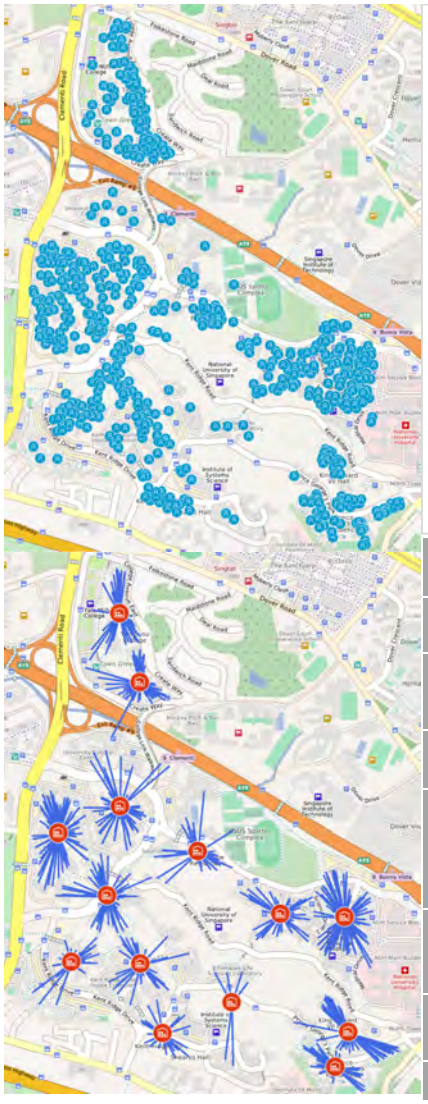
To demonstrate the reduction of logistics cost using self-pick-up service, a simulated self-pick-up service was modelled within National University of Singapore (NUS) campus to compare the cost efficiency of this last mile fulfilment method as compared to delivery. The land area considered is 1.55km^2. A cost analysis was performed. For delivery, the cost for the vehicle, driver and fuel were considered. For the self-pick-up service, the cost of the vehicle, driver, fuel, investment and operation of the reception boxes were considered as logistics costs. The cost of potential loss of customer due to self-pick-up was also added.

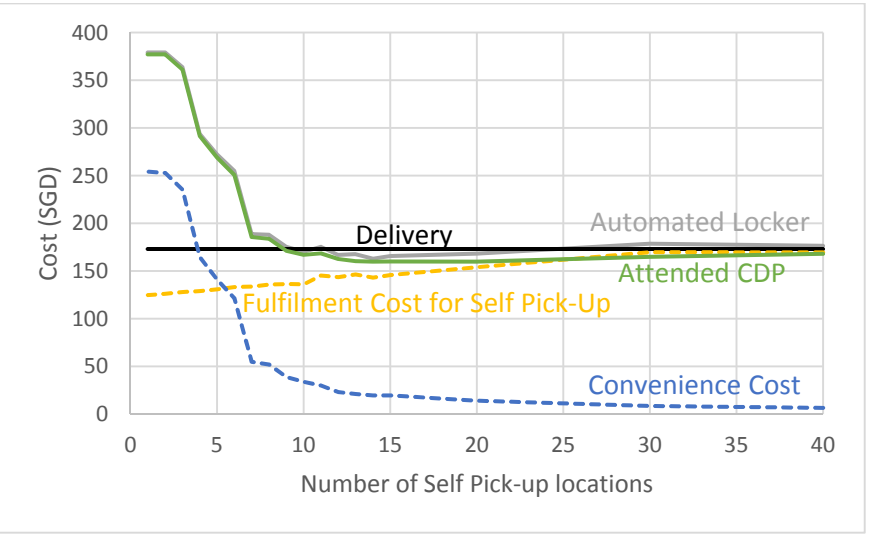
Two modes of self-pick-up service was analysed: automated locker systems and attended CDP. We simulated the installation and operation of automated lockers and a fee for attended CDP similar to those mentioned above and varied the number of pick-up locations. The analysis was performed using GIS data of the orders from NUS within the span of 30 days. Using clustering analysis, the pick-up locations were determined for both the automated locker systems and attended CDP. The results for self-pick-up and delivery are shown in Figure 6.3.

Using delivery cost as a benchmark, the logistics cost of the self-pick-up option was lower for the range of 1 to 40 pick-up locations. The inclusion of the loss of customer creates a minimum for the total costs with 14 pick-up locations for both automated lockers and attended CDP. With 14 pick-up locations, the automated lockers and attended CDP have a 17% and 19% reduction in fulfilment cost respectively compared against delivery. GIS tools such as the one used in the simulation can be used to support decision makers in identifying suitable locations.

[16] Yamato Transport Pte. Ltd., What is 7-CONNECT Locker?. Available at: https://www.yamatosingapore.com/courier/7-connect-locker/

[17] Coles, Click&Collect. Available at: https://shop.coles.com.au/online/mobile/national/info/click-collect





	Delivery	Automated Locker	Attended CDP
Deliveries	33.9/day	To 14 locations	
Average Daily Fulfilment Time	5.36 h	3.04 h	2.99 h
Average Daily Distance Travelled	37.2 km	26.5 km	
Daily Fulfilment Cost - **Delivery** - **Infrastructure** - **Operation**	**S$173** S$173 - -	**S$143** S$106 S$23 S$14	**S$140** S$106 - S$34
Average Distance for Customers to Travel	-	101 m	
Daily Inconvenience Cost	**-**	**S$20**	
Total Cost	**$173**	**$163**	**$160**

Figure 6.3. Example of determining CDP locations for Self Pick-up Service using GIS tools and Cost analysis


TECHNOLOGY ASSETS

Chapter 7.

IMPROVING RELIABILITY OF E-COMMERCE LOGISTICS USING INFORMATION TECHNOLOGY

Technology becomes an integrated part of e-commerce industry. Among other things, e-Commerce relies on technology for the market place, payment gateway and also for logistics.

For logistics services, many e-commerce companies are leveraging on technology to attain a competitive edge through reduced logistics costs, increased productivity and improved customer services, including more reliable and on-time delivery services. The use of IT aids e-commerce companies to manage both physical and people assets. For example, technology can help to improve utilization of warehouse and transportation assets as well as monitor the status of inventories in real-time. Technology can also impact people assets by reducing the time and effort in performing different logistics activities. Overall, IT enables e-commerce companies to fulfil e-commerce deliveries in a timely and effective manner.

In this chapter, we discuss two technologies that can be implemented to help e-commerce fulfilment. The first one is technology implementation in warehouse while the second one is technology implementation in last mile.

7.1. Smart Card Technology in Warehouse

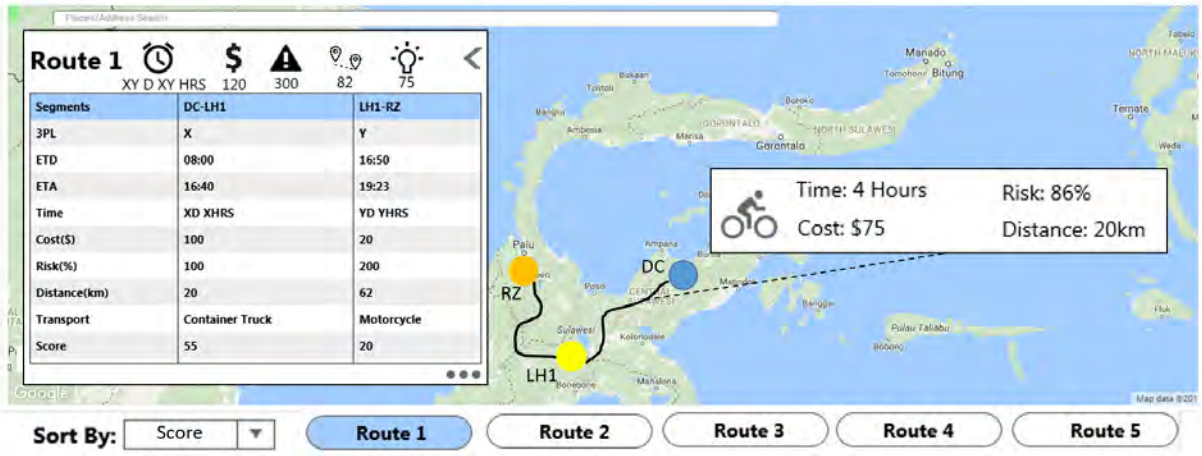
Smart card technology can be introduced to help warehouse operations. The technology has been applied successfully to several supply chain domains to enable track and trace capability for big assets such as cases, boxes, and pallets over the entire chain. The smart-card is equipped with reusable electronic paper that enables it to store and display information. It is also possible to overwrite data with new changes.

Warehouse operation integrated with smart card technology is one where cases (or any form of inventory) moving in and out of the warehouse is attached with a smart card. The card digitally stores product and delivery information such as ordering time and location, delivery route, driver name, goods receipt time, product information, and so on. Such information can easily be revised and updated to the system through an operator's device such as a smartphone. Using smart card technology, paper documents and printed ID barcodes are no longer used. Activities related to such documents, e.g. printing, matching, and verifying documents, are also no longer necessary.

7.2. Real-Time Tracking System and Dynamic Vehicle Routing

With the advancement in today's communication and software technology, it is possible to monitor, manage, and analyse the urban logistics and transportation information across a wide spectrum of parameters (locations, travel time, travel mode, weather, etc.) to derive cost-effective comparisons. A time-cost-disruption GIS visualization of logistics data (routes, locations, travel times, cost, real-time disruptions, etc.) can be developed to support dynamic logistics and transportation management. The tool can be used to evaluate the effectiveness and robustness of urban logistics and transportation strategies. These will aid C-suite executives in making decisions on logistics and transportation strategies.

A time-cost-disruption tool may allow users to indicate different nodes (such as logistics facilities or retail area or customers) of interest in the city level. Delivery trips are made between these nodes. The best routes that can fulfil deliveries within the areas of interest are computed and visualized on a map. The details, including a risk score, are also shown. By default, the tool displays the best optimized routes based on the computed score index.



Source: TLIAP Executive White Paper Series, Supply Chain Risk Identification in an Uncertain Future – Concepts, Methods & Tools, January 2017

Figure 7.1. Top Route Display on Map on the Time-Cost-Disruption Tool


PEOPLE ASSETS

Chapter 8.

E-COMMERCE STAKEHOLDERS AND THEIR INTERACTIONS

E-Commerce fulfilment management involves various stakeholders with different interests that can be conflicting to each other. Stakeholder overview and interaction are discussed in this chapter.

8.1. Stakeholder Group

The stakeholders can be clustered into 4 groups: public, logistics service provider, inventory owner and regulators, as illustrated in Figure 8.1. The first group is the public segment. The urban population, which encompasses the people living and working within the urban environment, is an important stakeholder as e-commerce fulfilment activities and urban planning will have direct impact on the public. Urban residents desire a good living environment, reliable public transport services and the convenience that comes along with urban living and yet want minimal hindrance of traffic and noise. Advocacy groups are part of the public that are formed over a variety of urban-related issues such as congestion, urban development projects, urban living, and sustainability. In a way, the public serves as a check and balance on urban and logistics developments within its area be it from businesses or the regulators.

The second group is the provider of logistics services for e-commerce. The consumer, from the public group, is the main source of demand for e-commerce fulfilment activities and hence interacts with the host of logistics service providers, in particular carriers that would perform last mile fulfilment. 3PL/4PL, freight forwards and warehousing services would comprises the upper echelons of the supply chain to bring goods and services in and out of the urban environment. Figure 8.1 shows the differences between the difference LSPs. Typically, LSPs are interested in providing logistics services with high cost efficiency and utilization.

The third group is the inventory owners which are typically manufacturers, suppliers, wholesalers and retailers. They use logistics service providers to

facilitate the movement of goods. The group seek to profit through the sales of goods and services and hence, the group is typically interested in market share and product visibility.

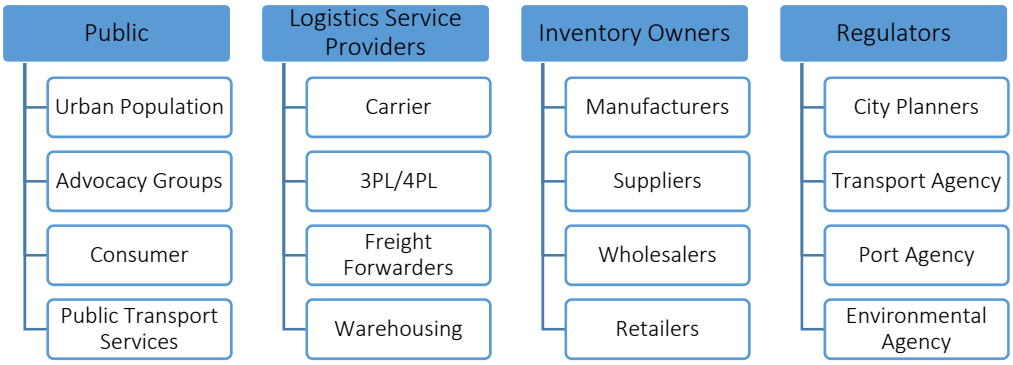


Figure 8.1. E-Commerce Stakeholder Groups

The last group of stakeholders are regulators. Specific to the built-in environment are city planners that coordinate developments, which includes urban and e-commerce logistics projects. At a state or national level are governmental agencies for transport, port and the environment. These agencies are highly relevant to the planning of a city and through policies can potentially influence the development of e-commerce fulfilment. The regulators ultimately serves the public, including the consumer. The planning would require a balanced approach to meeting multiple objectives such as transport efficiency, congestion, environmental pollution due to transport, road safety, and infrastructure. Hence, it is critical for e-commerce businesses to be acutely aware of development in the public service space.

8.2. Stakeholder Interaction

An example of stakeholder interaction is the rise of car-free or car-restricted zones. The call for such a policy is usually created by the public and/or regulators to create a more people-centric city with less traffic congestion, less roads, less roads, less noise and environmental pollution. Such restrictions put constraints on LSPs to provide last mile fulfilment would could affect their service delivery. Although such urban policies are more popular in Europe, some Asia Pacific cities have already implemented them.

In Hong Kong, the Discovery Bay development and Ma Wan island prohibits the access of private cars but allows buses and delivery vehicles. In China, Dayan Old Town in Lijiang prohibits all vehicles.

When property prices rises due to the aggregation of people to a certain area or due to urban development, warehousing companies are compiled to relocate to more affordable areas, typically, in the fringe of the urban areas or to shrink their floor space. At times, the land on which warehouses are built are The relocation of storage areas undoubtedly will affect last mile deliveries within the urban area while the shrinkage of warehouse floor space forces inventory owners to be selective on the types of products stored.

Some businesses have utilized crowd-sourcing to enable service delivery. In a shared economy, technology start-ups have disrupted the fulfilment process. For example, in the grocery industry, companies like Honestbee has a dynamic pool of pickers (from the public) to help consumers buy their grocery and deliver them to the consumers' downstep. This reduces the demand for retailers' delivery services which negatively impact their transport resource utilization. Start-ups like Uber offers the public to utilize their mostly underutilized private cars to taxi passengers and deliver items, such as freshly cooked food and parcels.

SUMMARY

Chapter 9.

SUMMARY AND KEY TAKE-AWAYS

Setting out on the e-commerce journey needs effective use of logistical assets both in utilization and coordination. In this whitepaper, we have presented key ideas that we believe may shape the future of e-commerce logistics by classifying them broadly into physical, technology and people assets. Ultimately for any e-commerce solution, a combination of assets is required. The table below summarized how technologies can benefit each idea surrounding the physical asset, as well as the key stakeholders required.

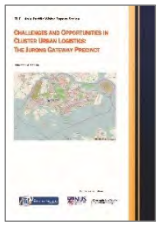
Table 9.1. Summary and key take-aways

Ideas for Physical Assets	Technology Assets			People Assets
	Smart Card Technology	Real-time Tracking	Dynamic Vehicle Routing	
E-commerce Industrial Cluster	✓	✓		• LSPs • City Planners
Warehouse: Improving Throughput	✓			• Warehousing
Vehicles: Delivery Consolidation		✓	✓	• Carrier • Retailers • Consumer
Seamless Goods Moving System	✓	✓	✓	• LSPs • Regulators (Transport, Port)
Collection and Delivery Points	✓	✓	✓	• Carrier • Retailers • Consumer • City Planners

TLI-Asia Pacific White Papers Series includes:

E-Commerce Trends and Challenges: A Logistics and Supply Chain Perspective (Volume 16-Nov-TI)

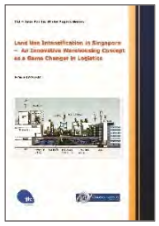
Technical Report: Urban Logistics In Singapore: Jurong Gateway Precinct



Challenges and Opportunities in Cluster Urban Logistics: The Jurong Gateway Precinct (Volume 14-Nov-CUL)

The Estate-Wide Goods Mover System (eGMS) – A Discussion Brief (Volume 14-Mar-IR)

Collaborative Urban Logistics: Synchronized Last-Mile Logistics for Sustainable, Efficient Urban Delivery (Volume 13-Nov-CUL)



Land Use Intensification in Singapore – An Innovative Warehousing Concept as a Game Changer in Logistics (Volume 13-Nov-IR)

Collaborative Urban Logistics – The Synchronized Last Mile

Please visit www.tliap.nus.edu.sg for more reports

The Logistics Institute – Asia Pacific
National University of Singapore
21 Heng Mui Keng Terrace, #04-01
Singapore 119613
Tel: (65) 6516 4842 • Fax: (65) 6775 3391
E-mail: tlihead@nus.edu.sg • Website: www.tliap.nus.edu.sg