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Last mile delivery activities in the city centre – Insights into current practices and characteristics of delivery trips

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Abstract

Efficient and reliable freight delivery and pickup services are important for the functioning of businesses in the inner-city area as well as consumption of product and services for residents, visitors and employees. The study investigated the delivery activities of freight carriers in Melbourne, Australia. Responses were collected from 55 freight carriers that provided detailed and up-to-date description of their delivery fleets and characteristics of their delivery trips. The collected responses expand the knowledge about parcel deliveries to receivers in inner-city areas. The acquired insights enable policy makers and scholars to be well-informed on the current state of last mile freight in the inner-city area. This contributes to proposing practical policy suggestions for balancing the competing needs for space and access for freight vehicles and liveability in the inner-city area.

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1. Introduction

City centres represent major destinations for last mile delivery and pick-up activities with very limited supply of available and affordable commercial and industrial land to establish and operate logistics facilities (Marcucci et al. 2015). For large metropolitan areas especially in Europe, Asia and Australasia, the city centre often serves as the most important financial, trade, tourism and service hub in the whole metropolitan area with hundreds of thousands of workers, visitors and residents commuting and visiting these city centres. Freight deliveries and pickups within this area are very complex due to the various and conflicting nature of freight demand, physical structure of area, conflicting and sensitive surrounding uses and pedestrians as well as the high density of the delivery points and stops.

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Ensuring efficient deliveries and streamlined relationship between freight carriers and receivers in the inner-city have never been more critical due to the time-sensitive delivery expectations by end-customers. In large cities, the last mile link extends geographically over a large distance of tens of miles or kilometres as logistics facilities have been relocated to suburban areas while many businesses and retailers are in the inner-city areas (Aljohani and Thompson 2016). The last leg (hundreds of metres) of delivery in the inner-city area represent a major choke point and severe operational challenge for freight carriers. For this last leg of delivery, the operational practices of freight carriers, challenges and issues impacting the carriers, type of freight vehicles, requirements of receivers as well as the size and type of parcel might be significantly different from freight deliveries to other receivers located in other parts of the metropolitan area. The inefficiencies and delivery challenges of freight carriers are considerably exacerbated in the inner-city area (Aljohani and Thompson 2019).

Butrina et al. (2017) argue that there is a lack of understanding with respect to freight movements in the last hundreds of metres of the delivery within congested and dense inner-city areas. Thus, it may not be adequate to deal with the shortcomings and challenges of this last leg of the delivery using the same approaches and solutions that were proposed for freight deliveries in other parts of the metropolitan area. For instance, some existing studies assume that delivery vans enter the city centre almost fully loaded or couriers can park their vehicles immediately outside the delivery address of the receivers. It can be argued that these erroneous assumptions have contributed to the failure of some proposed solutions as they were irrelevant and impractical to the actual practices and requirements of freight carriers in the inner-city area. Various local authorities acknowledge the increasing presence and utilisation of LCVs by freight carriers in the inner-city area. However, there is limited data on their characteristics, activities and behaviour compared with intra-metropolitan last mile delivery. Moreover, many transport agencies in different cities implemented comprehensive freight strategy plans for the metropolitan area. Yet, very few cities took further actions to set suitable last mile freight plans for the inner-city area.

The purpose of this study is to investigate and describe the attributes of the delivery trips that occur entirely within the inner-city area. The information is obtained from responses collected using an online survey with freight carriers in Melbourne. The research motivation originates from the limited existing knowledge about characteristics of delivery trips that are addressed for receivers inside congested city centres. The main contribution of the article is a detailed and up-to-date description of delivery trips including vehicle type, load utilisation, number of stops and of parcels delivered per stop. This article is organised as follows: section 2 presents a review of the literature on last mile deliveries within the inner-city area, while section 3 describes the applied methodology. Section 4 provides the results and analysis of the collected responses of the online survey. Section 5 discusses the implications of the results. Section 6 provides a concluding summary and recommendations for future research.

2. Literature review

2.1. Overview of last mile delivery in the city centre

This section presents examples of parcel deliveries to receivers in city centres from different parts of the world to provide an indication of the current delivery operations in the last leg of delivery. The extremely diverse mix of commercial receivers and individual consumers within the inner-city area require different and sometimes conflicting type, size and frequency of deliveries. A large volume of the parcels delivered by freight carriers in the central city area are mostly non-palletised and below 30 kg (Kutlu et al. 2013). For instance, Tozzi et al. (2013) indicated that shops in the city centre in Parma, Italy receive 5 parcels (45 kg) per delivery with a delivery frequency between 2 and 7 times per week while businesses in other parts received about 13 parcels (161 kg), on average. Moreover, Eidhammer et al. (2016) reported that retailers and HoReCa establishments in Oslo’s city centre attract about 4.7 shipments (1,777 kg) and 5.3 shipments (2,650 kg) per week. High-rise towers with a mixture of commercial, retail and residential receivers generate and attract a significantly large number of express and fragmented deliveries. For example, Jaller et al. (2015) estimated that about 4% of the total truck traffic in Manhattan, New York was generated by only 56 large buildings in the area. Browne et al. (2016) described that more than 40% of all freight vehicles delivering to a major office block in central London were associated with parcel and mail flows. Similarly, Aljohani and Thompson (2018) pointed out that freight vehicles performing express parcel deliveries and pickups represent about 27% of the total number of freight vehicles using on-street loading zones in Melbourne’s CBD.
Many local governments applied various restriction policies limiting large freight vehicles from entering the city centre based on weight, class or time (Dablanc et al. 2013). This contributed to freight carriers depending more on light commercial vehicles (LCVs) to make deliveries and pick up services in the inner-city area compared to primarily trucks in suburban parts. Visser et al. (2018) pointed out the significantly increasing use of LCVs in the congested inner-city areas is due to the LCVs’ improved operational efficiency and costs compared to trucks as well as limited parking spaces. For instance, the share of LCVs movements is almost 82% of all freight movements in Melbourne’s CBD compared to only 18% heavy truck movements (Casey et al. 2014). It is worth noting that several local governments just started reporting actual figures on the use of LCVs in urban areas compared to movements of heavy freight vehicles in urban areas.

Pronello et al. (2017) reported that a freight carrier usually operates about three delivery vans to deliver products to their customers in Torino’s city centre, Italy with a vehicle fill-in rate of 50-75%. Allen et al. (2018) highlighted that a parcel delivery van usually performs on average 37 stops to deliver 118 items to 72 customers per delivery round in central London. Jaller et al. (2013) estimated that a freight carrier (excluding express parcel) performs, on average, about 15-18 deliveries per truck in Manhattan, New York. Moreover, the rate of successful deliveries on first attempt for B2B deliveries is usually higher compared to B2C deliveries as home deliveries often require multiple attempts due to the unavailability of consumers at home when the courier reaches their residential address (Allen et al. 2018). Failed deliveries adversely impact the efficiency and transport cost of couriers as drivers return multiple times to successfully complete the delivery to the receivers (Kim et al. 2018). A study conducted in London revealed that 13-14% of all online purchase deliveries in the UK arrived either late or when the resident was not at home, which resulted in £771 million additional costs for retailers and carriers (IMRG 2014).

2.2. Operational challenges and issues of last mile delivery in the inner-city area

The efficiency of freight carriers in the inner-city area is adversely affected due to exacerbated traffic congestion, limited parking and loading infrastructure and unsustainable delivery vehicles. Jaller et al. (2013) highlight that the poor accessibility of streets in the city centre, which are mostly old and narrow with large concentration of pedestrianised zones, impedes the reliability of freight carriers to comply with the time-sensitivity requirement of deliveries to receivers. The congested inner-city area often does not provide adequate and effective on-street infrastructure to conduct parking and loading activities for freight vehicles. Specifically, Marcucci et al. (2015) emphasise that inefficient on-street loading zones (OLZ) and parking space in the city centre as well as lack of off-street loading facilities further complicate freight deliveries into the area. Moreover, the limited availability of OLZ contributes to the significant parking fines issued on couriers for illegal parking in the inner-city area.

Alho and e Silva (2014) argue that when freight vehicles are forced to park far away from receivers, the size of parcels that couriers could carry is significantly constrained. A survey conducted with freight carriers in central London illustrated that couriers spent about 62% of their time parked. The study also suggested that the average walking distance to deliver goods to the receivers was 105 metres per customer (Allen et al. 2018). Aljohani and Thompson (2018) observed that 29% of freight vehicles in Melbourne’s CBD had to park more than 60 metres from the receiver. However, Aiura and Taniguchi (2006) suggested that up to 50 metres between the on-street loading space and the address of the receiver would be an acceptable distance according to responses collected from drivers in Kyoto, Japan. The long walking distance is significant especially for drivers that perform multiple deliveries. Thus, couriers might be forced to overstay the allowable parking time at the OLZ to perform multiple deliveries.

Consequently, these freight movements cause negative social, environmental and economic impacts on society and businesses. The last mile delivery is considered as the most expensive link within the overall freight transport network as its share of the total freight transport cost is 53% while it may reach 75% in case of e-commerce deliveries (Wang et al. 2016). Moreover, last mile freight causes almost 16%-50% of transport-related emissions (Arvidsson and Pazirandeh 2017). Moreover, it is estimated than a delivery van conducting last mile delivery would generate on average 21.7 kg of CO₂ for a 80 km delivery trip (Edwards et al. 2010). However, the above figures should be interpreted with caution due to the inclusion of last mile delivery activities across the whole urban area.
3. Methodology

This paper attempted to investigate the freight trips of freight carriers to perform delivery and pickup activities to receivers inside the congested inner city. The study utilised an online survey with freight carriers to provide an up-to-date synopsis of the operational practices of freight carriers in the last leg of last mile delivery and highlight in great detail the difficulties encountered when performing delivery and pickup services. The online survey was completed by transport managers of freight carriers in Melbourne, Australia. The survey collected selected operational data to characterise and analyse the delivery activities and operational challenges only within the inner-city area including: product, class and number of freight vehicles, average vehicle fill rate, number of stops per vehicle, average number of parcels delivered per stop and the rate of successful delivery on the 1st attempt.

A desktop research for freight carriers operating in Melbourne revealed that there are about 300 delivery companies that belong to four business classification groups under the transport, postal and warehousing classification according to ANZSIC classifications. The warehouses of freight carriers and shippers are disbursed across clearly defined geographical sub-regions (5 clusters) in Melbourne. Accordingly, multi-stage cluster sampling was applied to select potential freight carriers to participate in the survey. This sampling strategy enabled achieving more representative sample of the population than a single sampling technique as well as reaching a larger sample size. Thus, the applied sampling technique resulted in a sample size of 200 freight carriers based on the 20 sub-clusters (4 business classifications in 5 geographical clusters). The sample size included a diverse mix of freight carriers that included small and large delivery companies servicing different types of products. Accordingly, the researchers invited all 200 freight carriers to participate in the survey. In total, 55 completed responses were collected from transport managers of freight carriers. The responses were collected from freight carriers serving receivers in central Melbourne from different sub-industries. The 55 freight carriers represent about 20% of all freight carriers that operate in Greater Melbourne.

4. Results and analysis: Characteristics and description of the delivery trips of freight carriers in the inner-city area

The majority of delivery and pickup activities in Inner Melbourne are performed using delivery vans as 66% of the participating freight carriers expressed that they utilised delivery vans for their operations. However, the share of delivery vans increases to more than 80% for deliveries and pickup activities in Melbourne CBD due to the difficulties to operate and park trucks in congested parts in the city centre. Moreover, light trucks (less than 4.5 tonnes gross weight) were utilised by about 20% of the freight carriers while medium trucks (more than 4.5 tonnes gross weight) represented about 14% of the respondents. Fig. 1 presents a break-down of the typical fleet size for each vehicle class utilised by the participating freight carriers. The most common fleet size typically includes up to 3 trucks. It can be inferred that freight carriers are not only switching from freight trucks to delivery vans in the last leg of delivery inner-city areas, but also the size of their delivery fleet in terms of number of delivery vans is becoming larger to satisfy the delivery requirements of receivers.

Moreover, the freight carriers reported mixed responses with respect to the average vehicle fill rate based on the type of vehicle and delivered products. A minor share of the respondents (16%) revealed that their vehicles leave their depot more than 70% loaded. These vehicles were primarily used to deliver clothing and cleaning products using delivery vans in a single delivery round per day. However, 27 freight carriers (49% of the respondents) indicated that their vehicles leave their depot around 50-70% fully loaded. Alternatively, 19 freight carriers (35% of respondents) reported that their vehicles leave their depot around 40-50% loaded, which were primarily trucks delivering homeware, whitegoods and office supplies as well as a minor share of food & beverages. Additionally, the respondents were asked to indicate how successful their couriers were in delivering parcels on 1st attempt to receivers. The rate of successful delivery on 1st attempt is highly influenced by the type of receiver (business versus home delivery). The respondents suggested that 70-80% of deliveries to businesses are usually delivered on 1st attempt while less than 60% of home deliveries are successfully delivered on 1st attempt. Furthermore, the participants pointed out that
express parcel B2B deliveries achieved a lower rate (around 70%) versus B2B deliveries to retailers/food outlets (more than 80%).

Fig. 1. Distribution of the typical fleet size for each class of freight vehicle performing delivery and pickup activities in Inner Melbourne.

Fig. 2 illustrates the distribution of the daily number of stops for each vehicle class. It can be seen that the range of delivery stops performed by delivery vans is more diverse than freight trucks. The majority of freight carriers reported that delivery vans typically perform less than 80 stops depending on the type of products as 63% of respondents indicated the number of delivery stops was around 40-80 stops. Delivery vans usually perform more than 60 delivery stops to food outlets whereas deliveries to clothing and consumer electronics were performed in around 50 and 60 delivery stops, respectively. Alternatively, delivery vans perform around 60 delivery stops for deliveries to commercial establishments in high-rise towers including cleaning products and office supplies. Moreover, delivery vans typically perform around 65-75 daily stops for express parcel deliveries to commercial and residential receivers. However, some large express couriers perform more than 100 delivery stops on delivery vans. For light and medium trucks, the number of stops is significantly lower as most freight trucks typically perform less than 40 stops in central Melbourne. This is in contrast to delivery vans that more commonly perform more than 40 delivery stops. The respondents mentioned that most deliveries using medium trucks were for office supplies and food outlets, which required a large number of bulky parcels at each stop. Some of these medium trucks performed only 20-40 stops for these receivers. Moreover, most medium trucks performed around 20 stops for deliveries of appliances and homeware. Additionally, deliveries to large food outlets were carried out by medium trucks in less than 20 delivery stops. It can be summarised that the average number of stops for a delivery van in the inner-city area is 55-60 stops while a light truck and medium truck typically perform 40-45 stops and 25-30 stops respectively.

Fig. 2. The share of number of stops for each class of freight vehicles performing delivery and pickup activities in Inner Melbourne.
5. Discussion

The survey conducted with freight carriers revealed very valuable insights and detailed understanding on the current practices and activities of freight carriers in the inner-city area. The survey findings confirm that majority of couriers perform a high number of delivery stops to neighbouring receivers using delivery vans with underutilised load capacity. Freight carriers are usually clustered in freight-intensive industrial land in the suburban parts of the metropolitan area. It is very common that you have different delivery vans delivering products from nearby depots within these suburban parts to business and retailers in the same zone in the inner city. The relatively low vehicle fill rate underlines the under-utilisation of the cargo area in most freight vehicles that perform deliveries to receivers in inner-city areas. Due to the various delivery requirements of receivers and large number of delivery stops, the vehicle fill rate of delivery vehicles are highly unoptimised. The efficiency and cost-effectiveness of last leg of last mile delivery in inner-city for freight carriers are adversely exacerbated due to inefficient loading infrastructure, high number of stops with low number of delivered parcels, failed and repeated deliveries. The increasing demand for fragmented and express deliveries coupled with these inefficiencies and issues will further complicate and constrain freight carriers to maintain offering a reliable, profitable and efficient delivery service to receivers in the inner-city.

The responses highlighted that delivery trips inside the inner-city area are significantly different from other parts in the metropolitan area with respect to the type of freight vehicle and utilisation of the vehicle. The findings reaffirmed the preference of freight carriers to operate delivery vans in the CBD area due to their improved maneuverability, capability and reliability to perform a large number of stops and lower operating costs compared to trucks. For deliveries to receivers in other parts, the efficiency of the freight carriers doesn’t suffer from the longer travelled distance and heavy congestion compared to the inner-city area especially with many DCs of the shippers being located in the suburbs. Consequently, freight carriers could perform multiple delivery rounds to receivers in other parts. Moreover, many respondents stressed that it was efficient for them to use trucks in other parts as they deliver larger quantities with fewer stops. This facilitated increasing the vehicle fill-in rate, which enabled them to deliver more parcels to large receivers in other parts compared to the inner-city area.

Many previous studies on last mile delivery failed to capture the complexity of the last leg of the delivery in the city centre. Many proposed solutions have been trialled to increase the efficiency of freight carriers by increasing the drop density and reducing direct deliveries by using parcel lockers. However, the majority of receivers still prefer direct deliveries. While parcel lockers might be attractive to freight carriers, they may be forced to perform unoptimised and inefficient delivery trips with a large number of stops to satisfy the demands of receivers. Furthermore, consumers are increasingly demanding same- or next-day delivery as well as flexible and customer-tailored delivery channels. At the same time, a large share of the customer base is reluctant to bear the additional delivery cost. Consequently, the profitability and efficiency of the last leg of delivery for express couriers are adversely diminishing compared to other sectors in the urban freight industry.

The responses revealed somewhat different figures with respect to the characteristics of the delivery trips in similar studies performed in Europe and USA. For instance, the average number of daily stops for a delivery van (about 60) reported in this study is much larger than the London-based study (37) (Allen et al. 2018). However, the total number of delivered parcels is similar between both studies (100 parcels). Moreover, the study reported a higher figure (53%) for the main decision-maker (the driver) of the delivery route and order than the Torino-based study, which expressed that about 36% of the deliveries were planned by drivers (Pronello et al. 2017). Moreover, the high number of stops for express parcel deliveries by a delivery van suggest that almost all drivers perform a single delivery to high-rise towers. Conversely, Kim et al. (2018) reported in their study of deliveries to a high-rise building in Seattle, USA that about 72% of the drivers performed a single delivery while only 28% of the drivers completed multiple deliveries. Furthermore, average number of parcels per stop (4 - 7) in this study is similar to the average delivery size to shops and retailers in Parma, Italy (5 parcels) (Tozzi et al. 2013).

Although the study has successfully presented insights into last mile deliveries in the inner-city from an Australian perspective; however, the study findings need to be interpreted with caution due to above differences when compared with other regions. As Melbourne represents the lynchpin in the logistics industry in Australia, the study findings presented valuable insights that could be useful for other large cities in the Australasian region. The delivery practices of many of these freight carriers are similar in other Australian cities such as Sydney and Brisbane. It can be argued that the only variation in results would be from delivering different products as they require conflicting delivery
practices. Moreover, the study findings are likely to be more suitable and transferrable to cities with a severely congested city centre that suffers from limited on-street parking infrastructure and heavy utilisation of delivery vans.

6. Conclusion

The dense inner-city area attracts significant movements of freight vehicles. This study acquired a deep understanding of the practices of freight carriers to perform delivery and pickup services within the inner-city. The acquired industry’s insights facilitate an enhanced understanding and depict an accurate picture of the current state of last mile delivery in the inner-city for scholars, policy makers and transport planners. Consequently, appropriate and practical solutions could be proposed to enhance the efficiency of freight carriers and alleviate the negative impacts of their operations in the inner-city area. Ameliorating the last mile delivery in the congested inner-city area offers a win-win and efficient solution for local authorities, freight carriers, receivers and residents. There are two primary fields that might offer practical and relevant solutions to address the challenges and efficiencies of last mile freight activities in the city centre: freight demand management (FDM) policies and enhancing the parking and loading infrastructure. Receivers usually have more market power than carriers and shippers and can significantly influence the timing, size and frequency of deliveries, which are usually during business hours and high traffic congestion periods.

FDM policies such as off-hour delivery and receiver-led consolidation initiatives encourage receivers to induce changes on the delivery activities of carriers and shippers. These policies attempt to encourage behavioural changes in the freight demand patterns of receivers by modifying the destination, timing, frequency and mode of deliveries (Holguín-Veras and Sánchez-Diaz 2016). Local authorities can engage large receivers and building managers of high-rise towers in the city centre to coordinate and consolidate their deliveries from multiple freight carriers as currently constructed. Freight behavioural research should be conducted to appraise the interest of these receivers and determine what policy levers might influence their participation.

The regulations and allocations of on-street loading spaces need to be updated to reflect changes in the practices of freight carriers in the city centre. Local authorities might argue that there are enough loading spaces in the city centre. However, they are not efficiently managed and distributed as illegal users are parking at these loading spaces. The OLZ policies should take into consideration the various parking requirements for the different classes of freight vehicles and receivers’ sub-industries. In addition, it might be necessary to convert some OLZ in busy locations to serve as temporary staging areas for freight carriers especially in dense retail and business precincts. Local authorities should also take advantage of advancements in Internet of Things (IoT) technologies, license plate recognition and Smart Occupancy Signs to enable booking of the OLZ and displaying the details of the booking. These Adaptive Displays could be operated as virtual on-street loading zones that become active only when there is a booking.

References


