



Parcel locker systems in a car dominant city: Location, characterisation and potential impacts on city planning and consumer travel access

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ABSTRACT

Automated systems enabling customers to pick-up e-purchased goods from designated 24 h Parcel Locker pick-up points are proliferating. While they offer the promise of improved access to goods and reduced travel for consumers and delivery vehicles, the integration of these systems in cities, and their impact on access, generally and by mode are understudied.

This paper explores the development, site characteristics and regional location characteristics of Parcel Lockers in five South East Queensland (SEQ) cities, Australia, and discusses implications for urban and transport planning in a car-oriented city.

Micro level site analyses for 45 locker locations provide information on facilities (e.g. access by modes and universal accessibility, ground level, tenure type, safety). Hierarchical cluster analysis helps identify categories of locations. Suburb-level census and land use data as well as distance from transportation infrastructure and other Australia Post facilities were gathered and used to compare regional suburbs with and without Parcel Lockers. Logistic regression identifies the suburb level characteristics associated with the presence of a Parcel Locker ($n = 273$).

Parcel Lockers in Brisbane are generally located at Australia Post locations, on commercial streets, shopping centres, suburban arterials and industrial parks. Automobile access and nearby parking is nearly ubiquitous, whereas alternative transport access is limited. Though site locations are constrained by commercial decisions, proximity to highways, to public transport, population density, a good balance of jobs and population, and higher rates of household Internet access are associated with the presence of a Parcel Locker.

Documenting and assessing site characteristics and regional location of Parcel Lockers can help ensure its optimal and adequate integration and distribution across the region to satisfy city and transport planning goals. In its current state, Australia Post's Parcel Lockers partially meet the objectives of a sustainable city.

1. Introduction

E-commerce is profoundly changing the retail landscape and associated consumer activity. Increases in delivery of parcels have presented important last mile logistical challenges for delivery companies (Morganti et al., 2014a). Moving from a business-to-business (B2B) model to a business-to-consumer (B2C) model requires handling smaller parcels and increases the amount of required drop-off points. These changing operational features have forced delivery companies to adapt their distribution practices to accommodate doorstep deliveries to consumers (European Commission, 2012; Gonzalez-Feliu et al., 2013; Heitz and Beziat, 2016).

Home deliveries run into the inevitable problem of unattended deliveries, which, at best, jeopardizes the safety of a package, and, at

worst, requires repeated deliveries, creating more greenhouse gas emissions and vehicle travel (Moroz and Polkowski, 2016). Furthermore, consumers living in denser areas, in residential towers, with roommates, or with no valet service may be unable to receive packages safely at home. Missing a delivery may also require a pick-up from a collection point with unsuitable location or time requirements (Kedia et al., 2017). As a response, more and more operators have been offering alternative options to home deliveries. These have been classified by Moroz and Polkowski (2016) as manned or unmanned Collection and Delivery Points (CDP) or by Morganti et al. (2014a) as Pick-up Points (PP). Using these systems, both consumers and logistics companies avoid the 'missed delivery' problem and reduce distance and time travelled by creating a consolidation point for multiple packages.

Australia Post has developed two services since 2012: 1) Parcel

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Collect, manned collection points, usually in existing post offices or concessions, with varying levels of slightly extended pick-up hours; and, 2) Parcel Locker, the unmanned version consisting of automated lockers synchronized with a mobile application or web based account. Users are required to register to the system and upon completing an online purchase, signal the use of a pre-specified locker for delivery. Users can be associated with one or more Parcel Lockers and choose which will be used for a given transaction. Other literature uses terminology like Automated Collection Points (ACP) to refer to systems such as Australia Post's Parcel Lockers. New 24-h secured Parcel Lockers are proliferating in Australia. Understanding how this disruptive technology is deployed and integrated to cities and how it may contribute to the broader objectives of cities and transport planning is the goal of this paper.

While there is an emerging body of research on CDP systems in Europe (Crocco et al., 2013; Ducret, 2014; Morganti et al., 2014a, 2014b; Iwan et al., 2016; Moroz and Polkowski, 2016), Parcel Lockers more specifically have not been studied by themselves very frequently. The urban and transportation planning aspect has also seldom been addressed save for Morganti et al. (2014a) analysis of distribution and travel time in France. Moreover, the car dominant city design typical of Australian cities provides a distinct context for the deployment of these systems as compared with Europe. Kedia et al. (2017), in the equally car dominant New Zealander city of Christchurch, have for example documented the availability of nearby parking as a key issue in the acceptance and use of ACP systems by users. Save for Collins (2015) on the hypothetical choice (Stated preference) to use lockers, the timing of pick-up, and the mode selected to make the pick up, the Australian context has not been studied. The fact that Australia Post is a government-owned corporation that operates the postal service, operates owned or rented locations across the country and is rolling out Parcel Lockers in conjunction and competition with its manned collection points presents a particularly interesting case for investigation.

1.1. Objectives

The impacts of Parcel Locker systems on urban and transportation planning are understudied. How these systems should best be distributed in space to ensure that urban commercial functions be maintained or improved in a context of sustainable city development is still unclear. This paper explores the distribution of Parcel Locker locations across SEQ and provides a micro level assessment of sites with respect to safety, ease of use, universal accessibility and multimodal support. A macro level analysis explores how locations match targeted user demographics, regional transportation access, population and employment centres and areas with fewer Parcel Collect services. This should contribute to an enhanced understanding of the advantages, disadvantages, options, and constraints of locating Parcel Lockers in specific places. As local authorities such as Gold Coast City develop freight transportation plans, there is an interest in providing urban planning guidance on the integration of these fast growing systems. Equally, the South East Queensland Regional Plan 2017 (SOQ, 2017) recognises the importance of developing initiatives on digital infrastructure and new technologies, of reinforcing the importance of fairness, of prioritising public and active transport and of valuing the role of design and placemaking. It is within this context that this project observes the development of Parcel Lockers.

After extracting pertinent CDP literature with respect to transport and urban planning, we layout a framework identifying issues in urban sustainability and provide more details on the Australian case. We then present the data collection and results in two stages: a micro level analysis of site characteristics and a macro level analysis of regional site location. We conclude with the idea that Parcel Locker systems in Brisbane, at least in their current state, are more likely to perpetuate automobile dependent travel behaviour than to support more sustainable travel modes and reduced travel. Important opportunities can

however be captured to reverse this situation and ensure that Parcel Lockers can serve as technologies that improve quality of life, contribute to cities becoming more sustainable, and make city opportunities more accessible and more equitably distributed.

2. An emerging literature and knowledge derived from collection point research

The most prominent perspective used to study Parcel Lockers is that of the logistics and business management where lockers are touted as remedies to the last mile logistics problem in a context of increasing B2C parcel delivery (Iwan et al., 2016; Lemke et al., 2016). The research is composed of emissions models comparing locker pick-ups to other delivery options (Spijkerman, 2016) and interviews with managers to determine best practices, interest and evolving trends (Weltevreden, 2008; Ocicka and Raźniewska, 2016). The work is predominantly interested in the freight and provider side, and shows that European providers are typically private enterprises sometimes with multiple operators on the same territory (Ducret, 2014). This contrasts with Australia Post's experience as a Government Business Enterprise that dominates the market.

2.1. Links with individual travel and transportation planning

With respect to travel behaviour of shoppers, access mode options (Iwan et al. 2016), distances to stores or to CDP, and opportunities to trip chain or integrate shopping in existing trips (Collins, 2015; de Oliveira et al., 2017) have been identified as potential influences on online shopping and CDP use. We found no existing assessments of the ease with which locker sites can be accessed via different modes or how lockers are located in cities to facilitate integration to trip chains even though integration to existing trip seems to be a frequent and desirable assumption.

At an early stage in their rollout, Weltevreden (2008) suggested only small mobility effects could be observed based on Dutch user survey data. A five-minute driving distance was presented as the critical accessibility threshold for lockers to be successful, and multiple options near home should be present for lockers to be interesting to users (Weltevreden, 2008), again suggesting that lockers must be usable along routes of existing trips going in various directions.

If initial assessments suggested that e-commerce had the potential to reduce personal travel, increases in greenhouse gas emissions, vehicles kilometres and congestion associated with last mile deliveries may very well counter balance these benefits (Cullinane, 2009; Edwards et al., 2009; Lachapelle and Jean-Germain, 2018). Urban sustainability research has compared home deliveries and conventional shopping. In Edwards et al.'s (2010) study, home delivery and conventional shopping had similar CO2 emissions but on average home deliveries had reduced emissions. Bus-accessed purchases were on par with these home deliveries.

2.2. User base

Consumer attitude studies towards these new technologies reveal high satisfaction rates associated with such systems and added benefits in terms of convenience for users (Lemke et al., 2016; Iwan et al., 2016; Crocco et al., 2013; Vakulenko et al., 2017) and reduced perceived queuing time (Bengtsson and Vikingson, 2015). This last study does point to a personal security concern and expresses consumers' desire to have transactions monitored by a video surveillance system.

Not all consumers are potentially interested in using such systems. Moroz and Polkowski (2016) found for example that users are generally younger, Millennials, more Internet savvy, often composed of recent immigrants and university students. At least earlier adopters are. While lockers are touted as a green solution by governments (European Commission, 2012) and providers, surveyed youth did not perceive

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