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Exploring Co-Modality Using On-Demand Transport Systems

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Abstract

Integrating passenger and freight transport systems, known as co-modality, is becoming more feasible due to recent developments in information and communication technologies (ICT) such as smart phones and global position systems (GPS). This paper uses simulation of an on-demand transportation scheme in which passengers and parcels can travel together to explore the benefits of co-modality when compared to existing schemes. It is shown that, depending on the demand, co-modality can provide improved experiences for both operators and passengers/customers.

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Keywords: co-modality; demand-responsive transportation; simulation

1. Introduction

Co-modality involves the use of alternative modes for increasing the efficiency and sustainability of transport systems (Commission of the European Community, 2006). Recently public transport systems have been considered for urban freight transport. Integrating passenger and freight transport systems is becoming more feasible due to recent developments in information and communication technologies (ICT) such as smart phones and global position systems (GPS).

A combination of passenger and freight transport can be realized using buses or taxis for carrying goods as well as passengers. Passenger transport companies can benefit from carrying goods by utilising space on less crowded vehicles and shippers benefit by having a convenient courier service as an option (Thompson and Taniguchi, 2014).

Demand Responsive Transport (DRT) is a user-focused form of public or private transport with flexible scheduling and flexible routing of small- or medium-sized vehicles to pick-up and drop-off passengers to their desired locations in a shared-ride mode. Traditionally DRT services require pre-booking (e.g., bus on demand), and/or are designed to provide transport from/to a hub (e.g., airport or hotel shuttles), with varying degrees of automated routing and

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dispatching. DRT can provide the accessibility and personal security benefits of taxi services at a reasonable cost to the user.

Simulation of DRT combines both optimisation and transport modelling to explore the performance of different schemes under different demands. A review of individual-based DRT simulation can be found in Ronald et al. (2015b).

This paper uses simulation of a parcel/passenger on-demand transport scheme to explore its performance in different scenarios, particularly varied demand. An evening scenario is demonstrated, in which passengers would like to travel to a restaurant to eat, and customers would like to order take-away to be delivered to their home. The vehicles operate as either passenger, parcel, or co-modal vehicles. Household travel survey data from Melbourne, Australia is used to generate demand for both passengers and customers. Our hypothesis is that the utilisation of shared vehicles for parcels and passengers results in improved performance.

Section 2 describes related work, focusing separately on on-demand delivery and passenger services, before moving to co-modal services. The model and experimental design is described in section 3. Results are discussed in section 4, before conclusions and future work are presented in section 5.

2. Related Work

2.1. On-demand passenger services

The classic example of an on-demand passenger service is a taxi service. Traditionally, these vehicles have been either hailed on the street or booked over fixed-line phones.

Some traditional public transportation has an on-demand option. For example, the Telebus service in the outer eastern suburbs of Melbourne has a fixed route and timetable (with some flexibility), but can deviate to passengers' home if they pre-book via telephone (before the bus leaves its first stop) or they request upon boarding at a stop (see Public Transport Victoria (2013) for an example of one of the services).

With the advent of smartphone technology, taxi services can now use apps to take bookings. The most well-known at the moment is Uber (Uber, 2015), which uses an app to connect drivers and passengers directly.

On-demand services can also be shared. The Kutsuplus service in Helsinki, Finland, takes bookings up to 60 minutes in advance (Rissanen, 2014). Passengers ride together on a minibus, but do not necessarily share origins nor destinations.

Similar services such as car- or bike-sharing could also be seen as on-demand.

2.2. Delivery on-demand

Uber Rush (Uber, 2014b) is an environmental-friendly delivery platform that Uber launched in April, 2014. It uses bike messengers and on-foot messengers to bring small items (no more than 30 pounds) from point A to point B in Manhattan and its neighbourhood Brooklyn and Queens. Using the Uber app, the delivery progress can be tracked, and the location of package can be easily traced and shared with the recipient. Uber Rush provides an innovative courier delivery system, which could be used effectively and efficiently in heavy congested urban areas.

Uber Essentials (Uber, 2014a) was another ambitious experiment undertaken in Washington D.C. As a pilot project everyday products were delivered by registered Uber cars. Uber users could make an order (from a list of most popular grocery items) in the app and have it delivered within 10 minutes. Even though this pilot ran for only a few weeks from December 2014 to January 2015, Uber claims that this experiment was highly praised by its customers. This trial allows the operators to identify the value of the service, providing an opportunity to improve with a better business model in the future.

2.3. Co-modality

The use of passenger vehicles for freight transport is becoming more common. Three axes have been recommended for improving mobility in modern transportation networks, firstly, "to improve the sharing of road space between passenger's flows and goods flows", secondly, "to shift passengers and goods flows from private motorised road transport to other urban transport modes" and finally, "to introduce distribution facilities" (Trentini and Malhene,