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Evaluating the use of an urban consolidation centre and electric vehicles in central London

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ABSTRACT

The paper focuses on the role that can be played by urban consolidation centres (UCCs) in reducing freight traffic and its environmental impacts in towns and cities. It is based on the before and after evaluation of a trial led by a major stationery and office supplies company in which urban freight deliveries in central London made from a depot in the suburbs using diesel vehicles were replaced with the use of an urban micro-consolidation centre located in the delivery area together with the use of electrically-assisted cargo tricycles and electric vans. The results show that the total distance travelled and the CO_2eq emissions per parcel delivered fell by 20% and 54% respectively as a result of this delivery system. However, the evaluation has also indicated that the distance travelled per parcel rose substantially in the City of London delivery area as a result of the electric vehicles having far smaller load limits in both weight and volume compared with diesel vans. But, at the same time, the trial system was able to virtually eliminate CO_2eq emissions per parcel delivered in the City of London. The trial proved successful from the company's perspective in transport, environmental and financial terms. The company therefore decided to continue the operation beyond the end of the trial with it being officially launched during 2010.

1. Introduction

This paper focuses on the potential for urban consolidation centres (UCCs) to alleviate local environmental and traffic problems within urban areas. The paper begins with a brief overview of UCCs and their potential benefits. It then presents the results of a UCC trial that took place in the City of London in 2009. This involved the use of a consolidation centre in the delivery area from which electric vans and tricycles were operated for delivery to receivers. The traffic and environmental impacts of the operation before and during the introduction of the UCC and electric vehicles are quantified.

A UCC is a logistics facility that is situated in relatively close proximity to the urban area that it serves be that a city centre, an entire town or a specific site such as a shopping centre, airport, hospital or major construction site. Goods destined for these locations are dropped off at the UCC. The UCC operator sorts and consolidates these loads dropped off by logistics companies and makes delivers to the final destinations, often using environmentally friendly vehicles such as electric and gas-powered goods vehicles, and electrically-assisted tricycles [1].

By improving the lading factor of goods vehicles making final deliveries in congested locations, UCCs reduce the total distance travelled by delivery vehicles in urban areas, as well as reducing greenhouse gas emissions and local air quality pollutants associated with these journeys (both through reductions in the total distance travelled, and through the use of low emission vehicles) [2]. In addition the total kerbside time and space occupied by vehicles making on-street deliveries can be reduced through consolidation further reducing the impact of freight operations on traffic congestion. Other social and environmental advantages can include noise reductions through the use of quieter vehicles, reductions in conflicts between goods vehicles and other road users, and greater pedestrian safety [3,4].

The logistics companies dropping their loads at the UCC benefit by avoiding the need to enter congested urban areas and thereby saving time and costs. Those receiving goods from the UCC benefit in terms of delivery reliability. In addition to consolidation and final delivery, a range of other value-added logistics and retail services can also be provided at the UCC including off-site stockholding, consignment unpacking, preparation of products for display and price labelling. These can benefit receivers by reducing their on-site space requirements, saving time by reducing the tasks that have to be performed on-site, and enhancing productivity and sales in core activities.

Initial research into UCCs as an urban freight initiative commenced in the early 1970s and has continued ever since with levels of interest in this approach increasing during the last decade (see for example [1,5–8].

2. Background to the trial

In 2009 a major supplier of stationery and other office supplies to businesses in the UK made the decision to trial a new urban delivery

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system in the City of London in order to reduce the environmental impacts of their delivery operation. This decision was taken as part of the company's corporate social responsibility and environmental efforts [9]. However, it was also necessary for the new scheme trialled to produce a cost-effective service which met their customers' needs if it was to be implemented on a permanent basis [10]. The trial involved the use of an urban micro-consolidation centre together with electrically-assisted cargo tricycles and electric vans. This centre, located in the City of London delivery area, was used as a transhipment facility for the transfer of parcels from the suburban depot onto the electric vans and tricycles for final delivery. The trial of the urban micro-consolidation centre and the deliveries made from it were operated by a new company[1] specialising in green urban freight deliveries. The trial therefore implemented two major logistics and technological changes simultaneously. First, the use of a micro-consolidation centre adjacent to the delivery area in an attempt to reduce the total stem mileage and greenhouse gas emissions travelled by vehicles to and from the suburban depot and the delivery area in the City of London. Second, to substitute electric vans and tricycles for diesel-powered vans for making deliveries in the customer catchment area.

The customers to whom deliveries were made were all located in the City of London which is the historic core of London with an area of 2.9 km^2. It contains London's business and financial centre. The City of London lies within the Clear Zone Partnership which is used as a testing ground to research, trial, monitor and set best practice for new transport technologies, innovations and physical measures, to be implemented on a local or regional scale. Since 1999 the London Borough of Camden, the City of London and the City of Westminster have worked jointly to achieve this. This resulted in the London Borough of Camden making a small financial contribution towards the trial. All the other costs were met by the office supplies company, which expected the new delivery system to have similar costs to their existing system. The system was trialled in the City of London as it comprises a high concentration of the company's delivery locations. This results in a relatively short travel distance between delivery locations.

The trial was the first of its kind in the UK combining an urban micro-consolidation centre and electric vans and tricycles, with the exception of some far smaller inconsequential pilots [11]. Similar electrically-assisted cargo tricycles are also being operated for urban freight deliveries in other countries, the most notable example being La Petite Reine in France [12].

The trial was of particular interest as the company's existing delivery system prior to the trial already involved a high degree of product consolidation and hence high vehicle lading factors. It did not therefore typify the types of operation in which UCCs are usually considered beneficial – namely systems with poor load consolidation. The trial represented the first attempt to fully evaluate the transport and environmental impacts of using a UCC in conjunction with electric vehicles in such a supply chain.

3. Operation before the trial

The situation before the introduction of the trial was studied by interviews with the office supplies company's managers and drivers and a survey in which a researcher accompanied a driver on a typical delivery journey in order to collect detailed operational data.

Prior to the trial the office supplies company operated a distribution system for deliveries in the City of London that involved using 3.5 tonne gross weight diesel-powered vans that were despatched from a warehouse located 29 km away in the London suburbs. Seven vans carried out multi-drop delivery journeys to customers in the City of London. A total of approximately 1,200 parcels were delivered per day, all to business addresses. The delivery area has very heavy traffic flows in the morning peak and comprises a mix of very narrow roads and wider roads on which no stopping is allowed. Vans were loaded at the warehouse overnight and drivers arrived to start their delivery journeys from 06:00 onwards. The vans used had a payload capacity of 1.3–1.6 tonnes and 9–10 m^3. The vans had external dimensions of 5.71 m long and 1.98 m wide. Each van typically travelled approximately 15,000 km per year. Each van journey to the City of London consisted of 140–180 parcels. Some addresses received a single parcel while others received several. At some stops the driver was able to make deliveries to several addresses due to their close proximity to one another. In these cases the driver returned to the van to collect the parcels for each delivery in turn. In total the drivers made 20–25 stops per journeys. The vans typically returned to the depot by lunchtime. Up to two additional afternoon delivery journeys to the City of London were also made by vans from the depot.

Table 1 provides detailed data from the delivery journey to the City of London on which the surveyor accompanied the driver. The distance between each stop was measured, and the stop time and start time recorded (the duration of each stop was calculated as the elapsed time between the vehicle arrival and departure at the stopping location). The office supplies company verified that this journey was representative of their van operations.

Table 1 reflects the difference in average speeds in the City of London and the journey in the rest of London to and from the suburban depot. The difference between the journey speed to the City of London and the return journey to the suburban depot is due to the latter taking place during the late morning off-peak. The journeys to and from the suburban depot accounted for approximately one-third of the total journey time, while the driving between deliveries in the City of London and the stopping time while making deliveries accounted for 21% and 48% of total journey time respectively.

4. Operation during the trial

During the trial the office supplies company's delivery operation continued to serve the same clients with the same volumes of product

Table 1
Data from the observed diesel van delivery journey prior to the trial (October 2009).

Operational features	Diesel van
Distance travelled on journey	
Distance from suburban depot to City of London (each-way) (km)	29
Distance travelled by van in City of London (km)	10
Total distance travelled by van on delivery journey (km)	68
Deliveries on journey	
Number of stops to make deliveries	20
Number of parcels delivered during journey	168
Parcels delivered per stop	8.4
Time use (as % of total journey time)	
"Stem" driving time from depot to first stop	21%
Time running on the road between first and last stop	21%
Time unloading between first and last stop	48%
"Stem" driving time from last stop to depot	10%
Total journey time (hours and minutes)	05:24
Driving speed	
Driving speed from depot to City of London (km per hour)	26
Driving speed from City of London to depot (km per hour)	48
Driving speed in the City of London (km per hour)	8
Fuel use	
Fuel use (litres per 100 km)	12.8
Fuel use in litres per journey	8.7
Fuel use per parcel delivered (litres)	0.052

Source: own survey 2009.

[1] The operator of the micro-consolidation centre, tricycles and electric vans was GNewt Cargo.