CASE STUDIES ON VAN USE IN LONDON

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ABSTRACT

Two case studies on van use in London were developed. The approach is the collection of coherent datasets at company level that are linking together business observations, vehicle fleet data, the logistics activities on delivery rounds, distance and load with energy use and CO_2 impact dimensions. The objectives of urban freight sustainability measures are to apply new vehicle and logistics organisation concepts for deliveries, and the objective of a 'before-after' evaluation is to assess their detailed impacts on business, transport and environment. Here, only the 'before' situation and its impacts are recorded. An adapted methodology for before-after assessments was set-up for urban freight deliveries. We obtain reference values, against which potential future efficiency improvements could be compared and evaluated. The two companies are a large UK parcel service and a large Business to Business commercial firm. The comparison illustrates the rather different level of CO2 per item and per kg that has been achieved by the two companies. Of course, this is a reflection of the rather different nature of each operation. Whereby one company has a round structure that requires vehicle distance travelled of 44 miles per day and the other has a much lower typical daily round distance – this is the result of two factors (a) a greater stem mileage for Case Study 2 and secondly a rather higher drop density for Case Study 1). Given the broadly similar load factors by weight achieved by each company in the operations surveyed, the analysis highlights the importance of assessing the distribution network design when considering ways to achieve lower energy use per unit delivered. It also demonstrates the need for care in assuming average values of energy use for apparently similar types of operation. Both companies could be said to use vans to distributer parcels yet the nature of the operation when examined in more detail illustrates the potential variability in the relative fuel consumption per unit delivered.

INTRODUCTION

This study presents the results of a survey of freight deliveries by vans in London involving two companies. Its objective is not only to provide decision makers with new insights and new data, but also to present results that might allow them to take better informed decisions on how to improve the sustainability of the usage of vans in urban areas.

The data used in the study has been collected at the company level and has involved several different approaches including observational work by researchers, as well interviews with company representatives to collect vehicle fleet, round and fuel consumption data. Analysis has also been carried out to determine the CO_2 emissions of these operations.

The secondary objective of the survey is to obtain reference values, against which future efficiency improvements can be compared. These reference values, or benchmarking, can be used not only for comparing one company with another, but also within one company for evaluating situations before and after the introduction of new technology or organisational changes.

From a policy making perspective, the increasing amount of delivery work by van in cities over recent years is a growing issue, especially at a time when policy makers are aiming to improve transport sustainability in urban areas.

Clearly, regarding the growing van fleet and its use in Western Europe, there is a need to reduce:

- the total distance driven
- the demand for road space in city centres, both in terms of moving traffic and in terms of kerbside space requirements
- the quantity of fossil fuel used in deliveries and the related pollutant emissions

In terms of initiatives to increase the sustainability of goods delivery in urban areas, there are several examples of operational experiments in London. These include the use of electric and alternatively-fuelled vans, Cargocycles (electrically assisted freight tricycles), consolidation centres, Delivery and Servicing Plans (in which establishment receiving goods collection and delivery trips take steps to reduce goods vehicle activity), and collaborative purchasing plans. In order to assess the affects resulting from such initiatives it is important to have robust assessments of the situation before such changes are implemented. The work presented in this paper is intended as an initial attempt to provide such an assessment of the existing operations of diesel vans used which can be used in before-after assessments.

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This paper starts by providing some background about recent trends in van use in London. It then presents the approach used to collect van operations data, the choice of suitable indicators, together with consideration of data validation and data quality, and boundaries of the observed systems. The paper then presents the results of the two case studies. These case studies rely on small-scale surveys which were conducted by the authors. The paper ends with a comparative analysis of the case studies and conclusions.

BACKGROUND

In 2008 there were more than 3 million vans were licensed in Britain, which is 9.5 per cent of all licensed vehicles. Vans accounted for 13.4 per cent of total road traffic in Britain in 2008 (DfT, 2010). Van traffic has increased by 40 per cent in Britain between 1997 and 2007 and has accounted for 31 per cent of all new traffic in that period (DfT, 2009). In London, vans travelled a total annual mileage of about 4 billion kilometres in 2005, which was equivalent to 12 per cent of total road traffic in London (TfL, 2008).

Vans are widely used for courier and parcel collection and delivery work in urban areas in Britain. A recent survey on Regent Street in central London helps to demonstrate this. In a two-day observation of all goods vehicle activity on Regent Street (i.e. vans and heavy goods vehicles), courier and parcel collection and delivery work accounted for 21 per cent of all goods vehicle activity. Vans were responsible for 77 per cent of this courier and parcel collection and delivery on Regent Street (Ove Arup and Partners, 2009).

The London Freight Plan (TfL, 2007) provides a strategy intended to improve the sustainability of freight transport in London. Part of this strategy involves addressing data gaps, as without the necessary data it is not possible to understand, assess and monitor goods vehicle performance. The research presented in this paper addresses one such data gap concerning van operations in London. It provides data on the following:

- Vans activity (i.e. light goods vehicles below 3.5 tonnes gross vehicle weight),
- Goods delivery and collection operations by vans,
- Van activity indicators derived from the data collected.

DATA COLLECTION METHODS AND INDICATORS USED

Several methods of data collection were trialled in the study including:

- Vehicle fleet and fleet operation survey,
- Vehicle trip diary survey,
- Qualitative interview with managers and staff at the freight operator.

It was necessary to acquire data that was already archived by the company (i.e. existing data) and then to supplement this with newly acquired information. The data collected using these methods in the case studies included:

- Freight operator data (type of goods carried and sectors served) was collected in order to understand the business activities.
- Vehicle and fleet data (vehicle weight, vehicle capacity by volume and by weight, mean usage time per day, mean annual mileage) was collected to provide better understanding of van capacity across the fleet operation.

- Origin-destination data and vehicle round data (number of stops etc.) were collected in one of the case studies, to allow to better understand the detailed pattern of van collection and delivery rounds in urban areas.

The companies selected for the two case studies both operated a van fleet making parcel deliveries and collections in central London.

Listed below are the indicators surveyed and their corresponding units of measurement, or in some cases the data that enabled us to calculate the indicator. Consideration of indicators used in previous freight data collection studies were taken into account in this selection (DfT, 2006; McKinnon, 2004 and 2007).

- Fleet – number of vehicles by category
- Vehicle capacity – measured by weight or volume
- Trips description – type of journeys, type of rounds and number of rounds per day
- Distance – in miles per year, miles per day, miles per item
- Load – in items, kg or volume units per year or per day
- Logistics efficiency – one of the possible indicators to explore logistics efficiency is the relation of distance and load, expressed in miles per item delivered. Other indicators, explained further below, are items per stops, stops per round and rounds per day.
- Vehicle Fill - measured as a degree of loading against the capacity of the vehicles, by weight, volume or deck length.
- Empty Running – percentage of miles run empty
- Fuel Consumption – measured in mpg or l/100km and total litres per year or per day
- GHG equivalent, emissions of CO_2 equivalent – measured in total kg CO_2e
- CO_2 efficiency – measured in kg CO_2e per item or per kg of item loaded.

To calculate the CO_2 efficiency, the total fuel use in litres is calculated out of mpg and total distance data by period of time (day, year) multiplied by the emission factor, then divided by the number of items for this period. This can be mathematically expressed using following formula:

$$CO_2e_L = \frac{(F \times D \times E)}{L}$$

with:

CO_2e_L: CO_2 equivalent expressed in kg CO_2equivalent per item loaded ($_L$) or per kg loaded

F: Fuel use, expressed in litres per period of time, or in litres/100km or mpg

D: Distance per period of time, expressed in miles or km

E: Emission factor converting fuel use in CO_2 equivalent

L: Load expressed in number of items or load weight in kilogrammes

For calculating F, if only miles per gallon data is available, then the following conversion formula is used to obtain a figure in litres/100km and then l/km:

$$l/100\ km = \frac{282.5}{mpg}$$

To obtain the total litres per period for F, the l/km value is multiplied by the km distance D covered for the same period of time.

For E, the value for total litres is converted into kg CO_2 equivalent, using the conversion factor of DEFRA (2009):

1 litre diesel fuel = 2.6692 kg CO_2e.

To calculate the GHG efficiency of the logistics operations, this total amount is divided by the number of items or in kg delivered during the same period of time. The calculation is either based on an annual average or a daily average, depending on the availability of the company data.

CASE ONE: PARCEL OPERATIONS IN CENTRAL LONDON

A large parcel delivery company was surveyed, with the aim of collecting van operating data for one of their London depots. The operation from this depot is considered to be typical of inner city parcels collection and delivery activity in London and Britain. The company surveyed is a market leader for parcel services in Britain. The depot has a fleet of 72 diesel-powered vans that are used for parcel deliveries in the centre of London. The depot is located in a central location; this results in a short stem mileage to the first delivery location. The driving time between the depot and the first delivery location is usually less than half an hour.

A typical van delivery and collection round from this depot starts at 08:00 in the morning around 8 and terminates before 12:00. The van is then typically used to perform another round starting at about 13:00 and terminating before 16.00. The average distance travelled per day by each van is approximately 14 miles. A van delivers an average of 114 parcels and collects 49 parcels per day. The vehicles perform an average of 84 stops per day; this corresponds to 1.93 items per stop for vans. Table 1 shows key indicators for the van fleet operations at the depot.

	Indicators	**van <3.5t**
Fleet	Number of vans	72
	Vehicle: empty weight	1600
	Vehicle: max weight	3500
	Vehicle capacity by weight	1900
Distance	Miles/vehicle/day	13.8
	Miles/vehicle/year	4309
Empty running	% of total distance run empty	0
Load	Load factor by weight as % of capacity	85.5
	Load weight of one day (collections and deliveries)	1625
	Number of items delivered per vehicle per day	114
	Number of items collected per vehicle per day	49
	Mean weight of one item in kg	10
	% volume capacity used at departure	70
Distance and load	Miles/item	0.085
	Average number of unloading stops per day	84.4
	Average number of items/stop	1.93
Energy use	Miles per gallon (mpg)	16
	Litres/100km	17.656
	Fuel efficiency in litres/kg	0.00243
	Litres/item	0.02437
	Fuel use in litres per van per day	3.972
GHG	CO_2 from freight transport only in kgCO_2e/item	0.06505
	CO_2 from freight transport only in kgCO_2e/kg	0.00650

Table 1: KPIs for diesel van parcel operations in London from the depot
Source: Authors 2010

The load factor by volume for vans at departure from the depot is 70 per cent, while the average van load factor by weight is 85.5%. This indicates that the vehicle load weight and space is well utilised in the operations. Overall, the operation results in an average 65 grams CO_2e per item, and 6.5 gCO_2e per kg for urban freight collection and deliveries from the depot.

CASE TWO: B2B PARCEL DELIVERIES IN CENTRAL LONDON

The second case involved a business to business (B2B) commercial company operating a warehouse in the suburbs of London and delivering to its clients in central London. The characteristics of the operation are rather typical of many goods delivery operations in London. The depot is situated outside the city centre, but not far outside. This allows relatively fast travel to the destination area and back to the depot. The depot is only used to make deliveries in London, other depots operated by the company are used to make deliveries outside London.

The company is a market leader in its sector with a national share of approximately 30% in the UK. From the London depot studied, a total of about 10,000 parcels per day are distributed by van or small truck to the region of London each day. The deliveries are made by a mix of own account vehicles and subcontractor vehicles. There are more than 200 staff based at the depot, of which 90 are van and truck drivers, including subcontractors. Vans operated from the depot are all diesel-powered. Data were collected during an accompanied vehicle round, interviews with the driver about their van and round, interviews with colleagues and the fleet manager at depot, and interviews with headquarter managers on van use and on fuel use.

Vans deliver 100 to 180 parcels per day, and collected up to 10 parcels per day during their activity in London. The mean number of deliveries in 2008 was 147/van/day for city centre work. The vans typically make one round per vehicle/driver per day. There is a variation by day of the week, with Monday having usually a lower amount of deliveries than other week days.

The surveyor travelled on one round of one van in order to collect detailed operational data. This round was considered to be representative of the company's other delivery rounds in central London. The number of parcels collected and delivered by the observed vehicle during its day's work was 168. Key indicators for the observed delivery round from the depot are shown in Table 2.

Fleet	Number of vans operating from the depot	90
	Vehicle capacity (payload) in kg	1320
	Volume capacity in m^3	10
Distance	Distance per day in miles (mi)	44
	Distance in inner city area (City of London) in mi	6
Distance and load	Miles per item	0.262
	Unloading stops per day	20
	Parcels per stop	8.4
Load	Number of parcels delivered and collected	168
	Total load weight in kg at start	1216
	Load factor by weight at start in %	92
	Mean weight of one parcel in kg	7.2
	Volume used in m^3 at start	2.5
	Load factor by volume at start in %	25
	Deck utilisation at start in %	50
	Load weight at the end in kg	40
	Load factor by weight at the end in %	3
Empty running	Empty running as % of total distance	0
Energy use	Fuel use per parcel delivered in litres	0.0541
	Fuel use in mpg	22
	Fuel use in l/100km	12.84
	Fuel use in litres per van per day	9.09
GHG	CO_2 for van collection and delivery in kgCO_2/parcel	0.144
	CO_2 for van collection and delivery in kgCO_2e/kg	0.020

Table 2: KPIs for the observed diesel van round in London from the depot
Source: own survey 2009

A mean fuel use of 22 mpg was obtained for activities in the central London area. This compares to the mean fuel use observed in another van survey (DfT, 2006), in which the fuel use value for "car-derived vans" was 15.3 litres per km, corresponding to 15.3 mpg.

The total distance travelled on the observed round was 44 miles, of which 19 miles was the stem mileage (one-way) from the depot to the first customer, and 6 miles is the distance covered within the delivery area between the first and the last client. Therefore, the distance travelled per parcel on this observed round was 0.262 miles. It has been calculated that 144 grams CO_2e per item were emitted on the observed round. Due to a high load factor by weight of 92%, the CO_2 efficiency by weight is 20 grams CO_2e per kg.

COMPARISONS BETWEEN CASE STUDIES

Table 4 contains a selection of the indicators captured during the small scale survey.

		Case study 1	**Case study 2**
Distance	Miles/vehicle/day (vans and trucks)	13.8	44
Load	Number of items/vehicle/day	163	168
Distance and Load	Miles/item (vans and trucks)	0.085	0.262
Energy use	Mpg (vans and trucks)	16	22
GHG	CO_2 from freight transport in kg CO_2/ item	0.06505	0.144
	CO_2 from freight transport only in kgCO_2e/kg	0.00650	0.020

Table 4: Comparison of KPIs from the two case studies.

The comparison illustrates the rather different level of CO2 per item and per kg that has been achieved by the two companies. Of course, this is a reflection of the rather different nature of each operation. Whereby one company has a round structure that requires vehicle distance travelled of 44 miles per day and the other has a much lower typical daily round distance – this is the result of two factors (a) a greater stem mileage for Case Study 2 and secondly a rather higher drop density for Case Study 1). Given the broadly similar load factors by weight achieved by each company in the operations surveyed, the analysis highlights the importance of assessing the distribution network design when considering ways to achieve lower energy use per unit delivered. It also demonstrates the need for care in assuming average values of energy use for apparently similar types of operation. Both companies could be said to use vans to distributer parcels yet the nature of the operation when examined in more detail illustrates the potential variability in the relative fuel consumption per unit delivered.

CONCLUSION

This report presents a study of parcel operations by vans aimed at improving knowledge about these operations and their sustainability, especially in urban areas. Such data and knowledge about current van operations will prove helpful when studying the effect of various initiatives intended to improve the sustainability of such operations, as it will provide data for the 'before' situation against which new operations can be compared.

The data collection method used in the study had a very low survey burden for the companies involved, and allowed us to better understand the detailed patterns of van use for parcels operations. The potential application of this type of survey work to gather operational data appears large and consideration should be given to extending the analysis to other types and sizes of van operations. It has application both in terms of understanding current operations and in assessing the affects of different types of freight transport sustainability initiatives.

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