Key Performance Indicators for the Pallet Distribution Network sector

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1. INTRODUCTION

1.1 Purpose

This was the first survey for the pallet distribution network sector. It set out to provide benchmarks for a range of vehicle utilisation and fuel efficiency factors, and to identify what actions fleet operators could take to give improved performance.

1.2 Background

The Government funded TransportEnergy BestPractice programme has supported vehicle energy use surveys in a number of commercial sectors, in order to highlight the range of consumption rates and existing best practice. Previous surveys have been conducted in the food retail sector (initially temperature-controlled only), the automotive sector, non-food retail sector and road legs of airfreight.

There are significant environmental pressures on operators, in terms of emissions from engines, vehicle noise levels and restrictions placed on access to many sites. In addition, and of increasing significance, is the impact of road congestion. This causes delay, which adds to vehicle running costs, but also increases energy consumption. Importantly the operator has much less control over remedial action.

Better operators will aim for improved fleet utilisation through 24 hour scheduling, by adopting night time deliveries (where not prevented by local authority restrictions) or through developing new services. Factors such as access restrictions contribute to peak demands on operators' resources, which can lead to lightly utilised fleets, and can contribute to higher traffic congestion. But these factors always require a fine balance between tight scheduling and the need to allow for congestion and other restrictions. The relative efficiency of a transport fleet depends in part on wider supply chain factors, and could be driven by, for example, the need for higher customer service.

The pallet network sector is in part a response to these pressures, allowing users to benefit from a degree of consolidation, and pooling of resources around the UK. It mirrors the express parcel networks based around a central hub. With as many as ten networks currently operating, nightly throughputs of over 5,000 pallets through a single network are now being achieved. They offer a range of services to customers, and companies have to meet these requirements so that service will often take precedent over absolute efficiency and vehicle utilisation. However, by belonging to a network these companies can improve their own utilisation in ways they may not otherwise achieve.

1.3 The Steering Group

A steering group comprising three participating networks, TransportEnergy and THE LOGISTICS BUSINESS, oversaw the whole survey process. This group guided the development of the survey and agreed the Key Performance Indicators (KPIs) to be measured, the timing of the survey, and developments of the data collection spreadsheet, to ensure that the results met the needs of participating companies.

The participating networks in the steering group were Pall-Ex, Palletline and The Pallet Network.

1.4 The Survey Process

From the pallet networks available (a fast changing sector, with most no older than five years and others either starting up, re-launching or failing within the last two) presentations were made to principals and regional representatives. This led to a number of member companies being put forward for the survey, with a regional spread to ensure that differences in geography and population distribution were covered.

From an initial population of 22 fleets, results were presented by a sample of 17 fleets. The reduction was due mainly to resource issues and the impact of individual activity profiles at the time. Participants were asked to complete a workbook, designed specifically to collect the relevant data.

Each company provided data separately on their collection and delivery fleets and the trunking activity. In some cases fleet vehicles were used to trunk at night, and for collection and delivery during the day, although generally these two activities had separate fleets. Because all participants use their membership of a pallet network to supplement their own customer work, the vehicles are not necessarily employed on pallet network business full-time. In the case of collection and delivery work the vehicles will often carry consignments for both network and non-network customers at the same time. In fact the decision to route consignments collected via the network may not be taken until the consignment is being unloaded at the vehicle's base. This was allowed for in the survey, whereby if the majority of a vehicle's activity was pallet network traffic, then all of its activity was recorded and analysed.

1.5 The Pallet Distribution Sector

The Pallet Distribution Network sector offers a range of nationwide collection and delivery services to its customers, with differentiation between next day delivery and 2/3-day delivery (economy service). The offer to customers is based on their consignments being palletised, and it is usual to limit the maximum number of pallets per consignment, typically to six pallets. Some of the networks differentiate further by offering consignment rates for half and quarter pallets, based on weight and/or height of loaded pallet.

The main feature is the hub through which all pallets are moved and transhipped. Each network comprises a number of individual freight transport companies, who belong to it through a variety of contractual arrangements, such as members, licensees or shareholders.

Member companies tend to join and participate in a network in order to get extra throughput, to improve their vehicle utilisation and efficiency. The vehicle utilisation is a key driver. The benefits to them of belonging to a network are:

1. the network will provide them a cost effective route for deliveries of their own consignments through other network members;

2. the network members will generate delivery work for them that they would not otherwise get, and so contribute to improved fleet utilisation.

1.6 Mode of operation

Network members depend on other members to supply the consignments for delivery within their designated areas, which are typically a range of postcodes. However, the consignments that they collect are from their own customers, for delivery outside their own designated territory.

They collect from their customers and make deliveries to network consignees within a defined geographical area. This is often defined by area postcodes.

In simple terms the daily cycle follows the pattern, as illustrated in Figure 1:-

- A member company (Number 1), collects a consignment from a customer on vehicle Z;

- The consignment is brought back to the depot;

- The company decides to send it and a number of other consignments via the pallet network, as this is a more economical way for it to fulfil its contract with its own customers;

- These consignments are loaded onto the company's trunk vehicle(s) and are sent to the Pallet Hub to arrive at an agreed time that evening;

- With all other member companies' trunk vehicles arriving at the Hub before a deadline, all trailers are unloaded;

- The pallet consignments are sorted by their destination (member company);

- The pallets are loaded on to their destination vehicles, against a pre-determined schedule;

- Each member company receives their vehicles later that night and unloads them (the consignment from Number 1 is received by Number 5);

- These Network Pallets are added to that company's collection and delivery fleet for that day, (in this case Vehicle F);

- Each vehicle then delivers pallets to consignees, and carries out some collections to start the process again.

Economy consignments contribute to efficiency, as they are not necessarily despatched to or from the hub, or from local delivery depots on Day 1 (Collection being Day 0). This allows them to be moved on a leg when there is capacity available (within the service criteria), and therefore they either improve vehicle fill where they are added, or they are held back so that vehicles are not run when they would otherwise be lightly loaded.

Because the customers who originate the freight are customers of the local company collecting the consignment, it is up to that company to decide whether or not a particular consignment goes via the Pallet Network. As a consequence the receiving company who will carry out the final delivery will not necessarily know the details of the next day's consignments until all collections are back at depots around the country. They then have to schedule all the deliveries onto their fleet along with deliveries they have received from other sources.

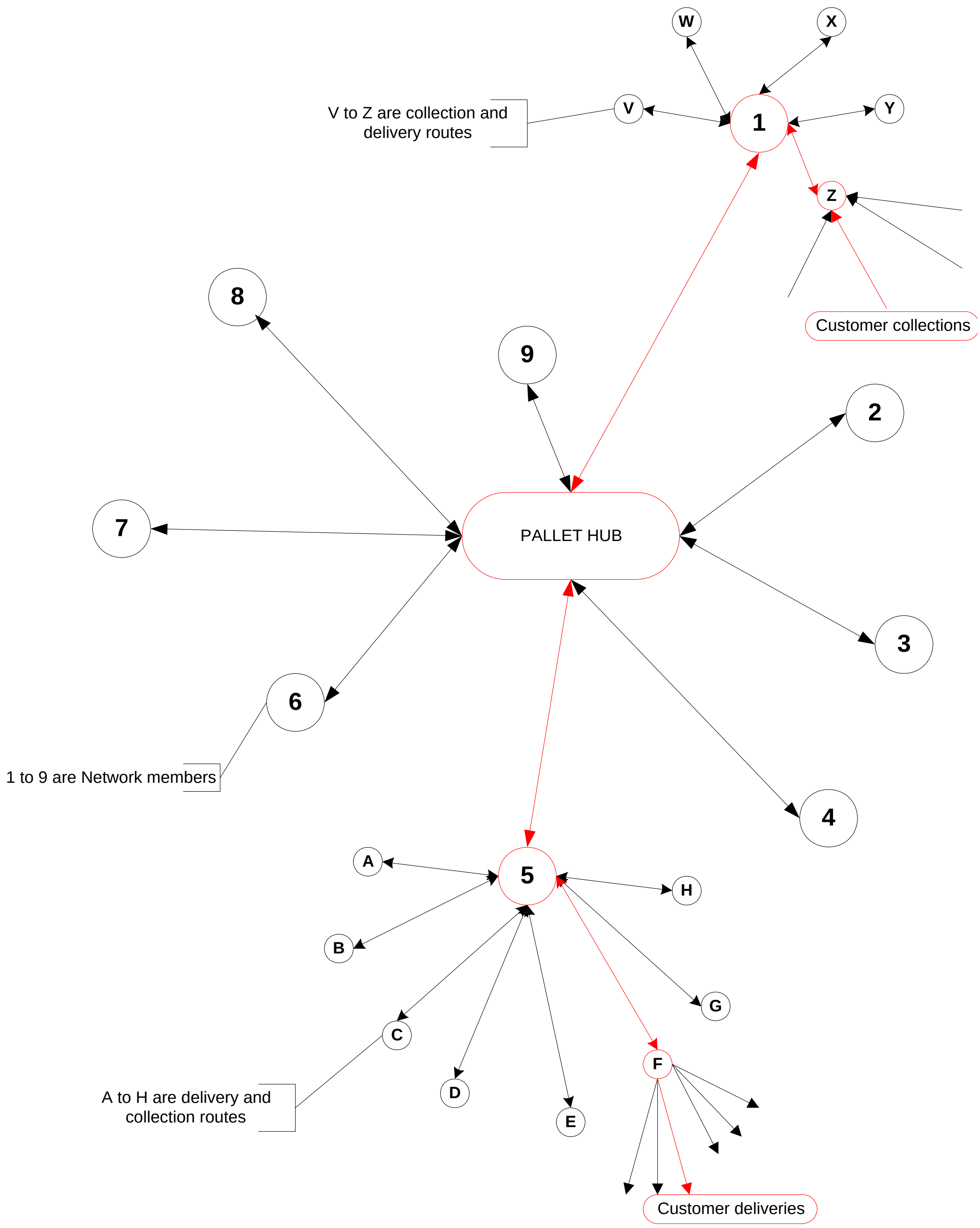

Figure 1 Example of pallet distribution network

2. CHOICE OF KEY PERFORMANCE INDICATORS

Through previous surveys of TransportEnergy BestPractice a series of KPIs had been developed, and these were used as a basis for discussion with the steering group. With some minor changes they met the needs of the pallet distribution networks. The original KPIs had been developed on principles stemming from well-documented research into the use and effectiveness of KPIs. The agreed categories fulfilled a number of key requirements, namely:

- relevant to operators;
- understood by those compiling the data;
- measured energy usage;
- were easily scaleable from individual vehicle to a sector analysis;
- related to data already collected by operators to measure their effectiveness.

A range of other data was collected in order to correlate actual energy consumption with other factors, including the use of delivery windows and fitment of air management kit. This led to an agreed suite of five KPIs. The existing spreadsheet used in previous KPI surveys was adapted to include the relevant data collection functionality. The five KPIs, which are described in more detail below, are:

1. vehicle fill;
2. empty running;
3. time utilisation;
4. deviations from schedule;
5. fuel efficiency.

2.1 Vehicle Fill

Utilisation is measured in three different ways - by weight, by cube and by deck length, expressed as the number of pallets that would fit on the deck. In practice cube data was not recorded by any of the participating companies, as this is not considered to be a controlling factor in any operation. The main determinant for vehicle fill is the number of pallets. Even weight is not important to many operators and is recorded typically by consignment, not individual pallet. Because there is scope within weight and cube limits to stack pallets this is done to improve productivity and utilisation. However, not all consignments will be stackable due to fragility or shape, so for trunk vehicles high cubic capacity, double-deck (or even triple-deck) trailers are most common. In these cases the deck capacity was recorded as the sum of all decks.

The data was recorded by each trip leg, noting the capacity of each vehicle in terms of cube, weight and pallets, and the actual load in the same terms, but excluding legs of empty running.

2.2 Empty Running

This is interpreted strictly as an empty vehicle or trailer. Unlike the closed loop routes used in the retail and automotive sectors, pallet networks do not move returnable assets such as roll-cages and stillages. Empty legs are excluded from vehicle utilisation calculations.

2.3 Time Utilisation

Seven categories of vehicle use were defined and every hour each vehicle was assessed as to its role within that hour, to produce a picture of how fleets were used throughout the 48 hour survey period. The seven categories used were:

1. running on the road;
2. driver rest periods, whilst on the road;
3. being loaded or unloaded;
4. pre-loaded, awaiting departure;
5. delayed and inactive whilst loaded;
6. being maintained or repaired;
7. empty and stationary.

2.4 Deviations from Schedule

Delays to planned trips were recorded against six key reasons that highlight why these occur, together with the time lost as a result. Where schedules are tight any delay can have a significant impact on later deliveries and collections. The six categories used were:

1. lack of a driver;
2. own company actions, such as waiting for load completion (but excluding 1);
3. delayed at collection point (but excluding 1 and 2);
4. delayed at delivery point (but excluding 1 and 2);
5. traffic congestion;
6. vehicle breakdown.

2.5 Fuel Efficiency

This was measured in two ways. Firstly consumption by kilometres per litre, which is easy to benchmark against similar vehicles across any number of operators and sectors. Where possible fuel usage data was collected for each vehicle or type of vehicle for the 48 hour period of the survey. If this was not available then companies were asked to submit their average data for each vehicle type. In some cases both were provided which allowed a comparison and sense check to be made. However, on its own it does not demonstrate the work performed for the given amount of energy use.

The second measure is that of energy intensity, which is expressed as millilitres of fuel consumed per pallet carried per kilometre travelled. This shows the effectiveness of the fuel consumed by relating it to the work performed, in this case carriage of goods and distance travelled. An example is shown in Table 1.

Vehicle type		18 tonne gvw rigid	
Route details	Pallets carried	Kilometres	Pallet/kms
Leg 1	12	48	576
Leg 2	8	76	608
Leg 3	5	15	75
Leg 4	0	33	0
Total		172	1,259
Fuel used		45.3 litres, or 45,300 millilitres	
Fuel consumption rate		3.8 kilometres per litre	
Calculation of energy intensity		45,300 /1,259 = 36.0	

Table 1 Energy intensity example

3. SURVEY METHODOLOGY

The survey took place over 48 hours from 1800 on 24th February to 26th February 2004. The time of 1800 hours was selected as a start time because it was the quietest time for activity amongst most of the participating operations. By then most delivery and collection trips are finished and the night trunk departures are just beginning. This allowed for the most complete vehicle shifts to be included. The days selected were expected to be average in terms of activity levels.

3.1 Data Input

A suitable spreadsheet had been developed from earlier surveys, and this was adapted to suit the Pallet Network sector and the additional information that the Steering Group thought it appropriate to collect. Using a formatted series of worksheets, companies entered information about their operations, fleet and detail of actual trips undertaken, split into three clearly defined areas.

3.1.1 General Data

In the first spreadsheet companies were asked for a range of data about their operations and vehicle fleets to be surveyed, such as age and type of vehicle, or fitment of air management equipment. Information was also collected on activity levels throughout the year in order to put the survey period in context.

3.1.2 Trip Data

For all vehicle trips undertaken by the defined fleets during the 48 hour period data was requested about distance, each leg activity, size of load carried and vehicle and load dimensions, deliveries made and delays. This provided the data from which all the utilisation reports were produced, and combined with some of the general data, the fuel usage.

3.1.3 Hourly Audit

Against a range of seven defined activities companies were asked to show what each vehicle was doing every hour throughout the survey period, in order to get a picture of peak usage times and the amount of idle time.

3.2 Training for Participating Staff

As companies agreed to join the survey they were asked to nominate the staff that would be responsible for the data collection process so that they could be involved in the build up and be trained in using the spreadsheet. From the time that companies agreed to participate until the survey dates regular e-mails kept people informed of any developments and reminded them of what was required. This was to maintain interest and prevent companies from dropping out.

A series of three workshops was held two weeks before the survey dates. These workshops were for those staff actually responsible for collating the data, although they would often be managing others who would be recording data throughout the survey period. The prime aim of the workshop was to ensure that users fully understood how to use the spreadsheet and ensure that the data captured was accurate. It also helped that the collectors and analysers had met, as this made any subsequent telephone conversations easier.

The issued spreadsheet included a comprehensive help facility within the application, together with a user guide, so users were able to familiarise themselves with its structure and the required content prior to the survey.

As part of the familiarisation process all users were asked to complete the General Data worksheet prior to the start of the survey. This also reduced the workload on users and the project team during the survey period, and highlighted any users who needed further assistance. It was valuable in making users think about what they were going to need for the survey itself.

Throughout the time that users were completing the spreadsheet a telephone support line was made available. During the actual survey period this was for 24 hours a day, but as most users separated the data collection from the data input there was no demand on this support during the busy survey period.

4. FLEET COMPOSITION AND STATISTICS

4.1 Companies

From the original volunteers 15 companies actually participated in the survey, spread across the participating networks, providing most of the data required. Not all aspects of the data were available from every participating company, so some analyses will be based on less than 15 record sets. The participating companies are listed in Appendix 1.

4.2 Fleet Profile by Type

A total of 183 vehicles or combinations were monitored by the survey, covering seven different types ranging from 7.5 tonne rigid to 44 tonne articulated vehicles. The body types were predominantly curtain-sided, and most common vehicle types were up to 18 tonne rigid for collection and delivery work, and 44 tonne articulated for trunk work.

	Collection and delivery	**Trunk**
Total vehicles (Rigids & trailers)	118	31
Tractor units	8	26*
Rigid vehicles	105	0
Draw-bar vehicles	0	2
Articulated trailers	13	29
Box vehicles	4	3
Curtain-sided	113	26
Double-decks	2	19
*Tractor units were typically used day and night, although some of this may have been on non-network activity		

Table 2 Vehicle types

4.3 Fleet Profile by Age

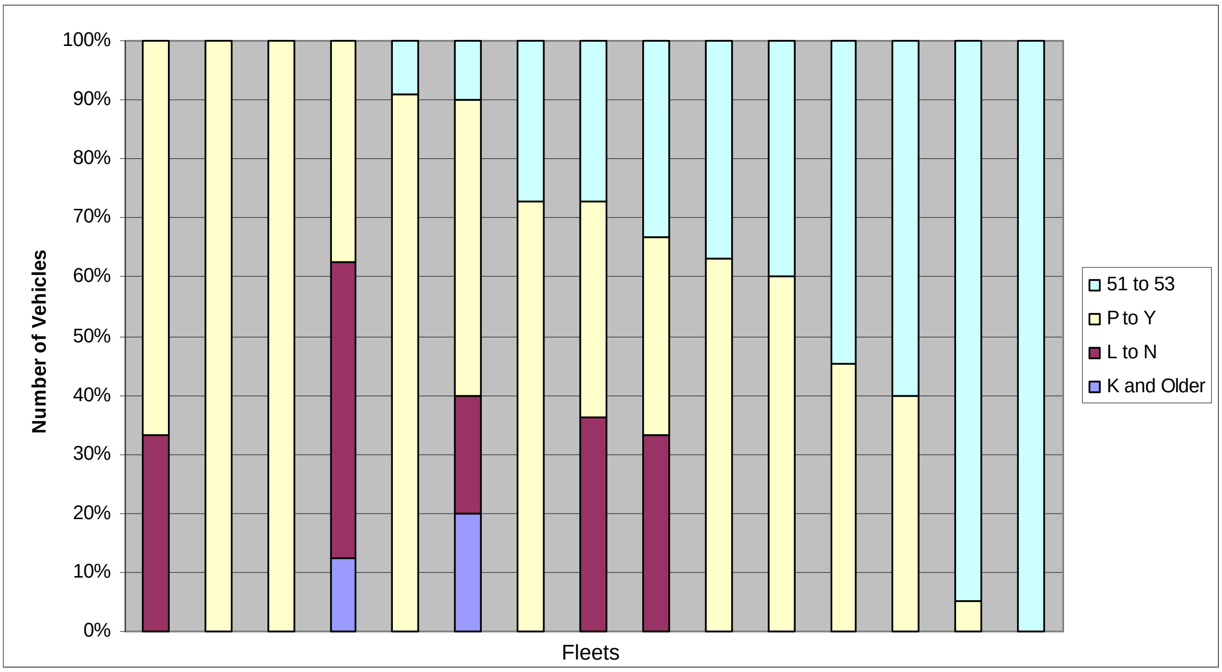

Figure 2 Age profile by vehicle fleet

Vehicle age was categorised according to first registration dates approximately applicable to the various Euro engine specifications, laid down in Directive 91/542. Vehicle operators have had to conform to the introduction of tighter noise and emissions limits through the introduction of type-approval limits, known as 'Euro' 1, 2 & 3. There will be a further tightening with the mandatory introduction of new standards under Euro 4 from 2005 and Euro 5 from 2008. The survey shows that five out of 15 fleets were operating vehicles registered to coincide with either older Euro 1 or non-Euro engine specifications. One fleet comprised only vehicles registered since the Euro 3 specification engines applied. In detail, using the Euro specification shorthand, the total fleet comprised of Euro 3 – 41 vehicles, Euro 2 – 78 vehicles, Euro 1 – 19 vehicles, and pre-Euro – 3 vehicles.

5. SURVEY RESULTS – COLLECTION & DELIVERY

5.1 Summary Statistics

The overall summary of collection and delivery activity by the survey fleets is shown in Table 3.

Collection and delivery survey data	
Vehicles	118
Trips	238
Legs	2,273
Average legs per trip	9.55
Total distance - kilometres	36,565
Average kilometres per leg	16.43
Average kilometres per trip	156.9
Pallets delivered	3,373
Pallets collected	1,465
Delivery only legs	1,721
Collection only legs	407
Collection and delivery legs	23
No collection or delivery legs	122

Table 3 Summary of collection and delivery fleet activity

Collections will be made the same day they are requested, if this is before a defined cut-off time. Delivery service is the driver, with all networks offering a combination of premium (next day) and economy (2/3 day) lead times. The next day service would normally be before midday, and the economy consignments allow some flexibility to improve vehicle scheduling and vehicle utilisation.

5.1.1 Vehicle Types

The dominant vehicle type for collection and delivery work is the 2 axle rigid, up to 18 tonne gvw, as shown in Figure 3. Within the survey a number of fleets used their night trunk vehicles for collection and delivery work, where the throughput justified a larger vehicle. This included instances where trailers were left at customers' premises for loading throughout the day.

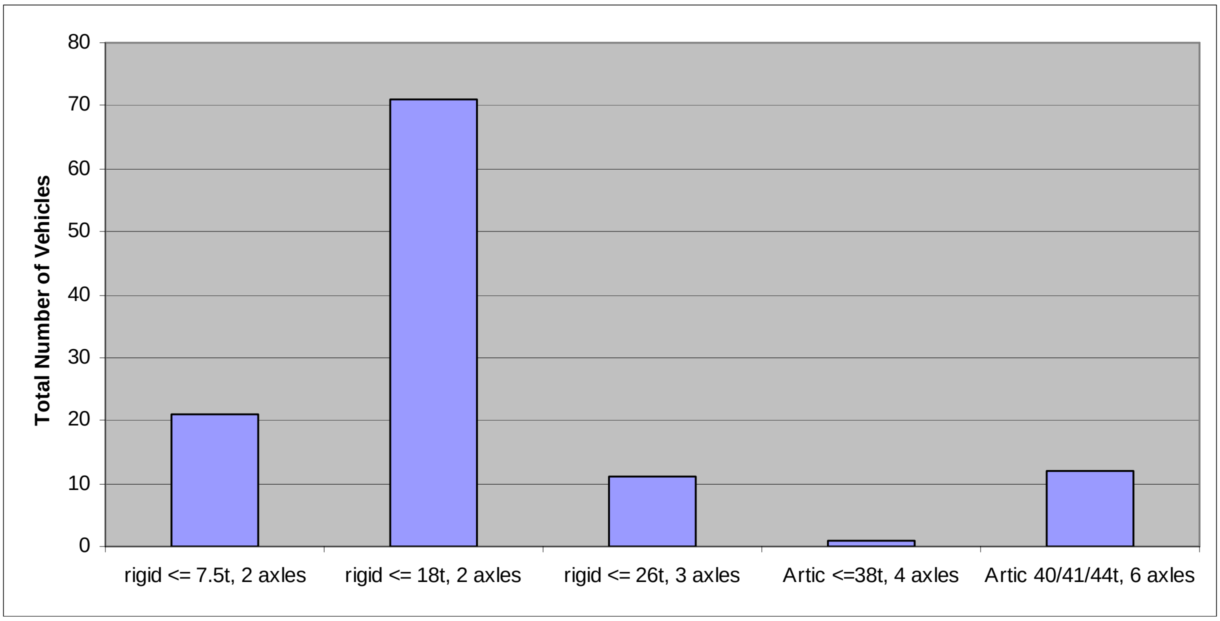

Figure 3 Number and type of vehicles

5.2 Vehicle Utilisation

The percentages shown for vehicle utilisation are based on those legs where the vehicle was actually laden. Empty legs run are ignored in this calculation. Allowance is made for the distance run for each leg to give the utilisation percentage. So for all laden legs run by a vehicle the capacity available is the physical capacity (by weight, cube or number of pallets) multiplied by the total distance run with a load, in kilometres. The utilisation measures each leg by its load (weight, cube or number of pallets) multiplied by its distance. The total of all laden legs is then measured against the capacity available. In the survey there was no measure of cube for the loads carried although some participants did record the cube available, so this measure could not be analysed.

5.2.1 Utilisation by weight

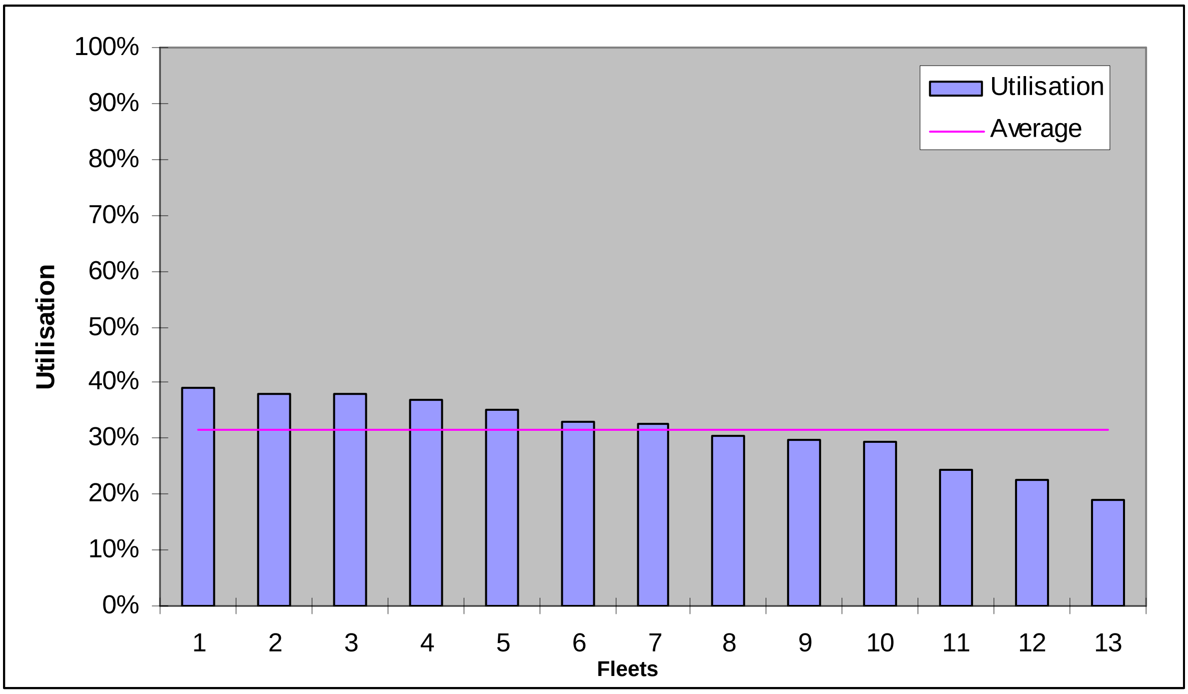

Figure 4 Vehicle utilisation by weight

The nature of pallet collection and delivery work is for a vehicle to be scheduled as full as possible on departure, to perform both delivery and collection activity, in order to return as full as possible with consignments for the overnight trunk to the hub.

Therefore utilisation will start off relatively high and then reduce through the early part of a trip, and possibly improve later as collections are made. If delivery and collections are not carried out on the same trip, or a fleet has a significant imbalance between the size of its collection and delivery throughput, then this will not be the case. Delivered pallets were more than double those collected (3,338 versus 1,458).

The average utilisation of weight-carrying capacity was only 31.7%, suggesting that this is not the dominant factor in vehicle fill. In order to cope with unpredictable throughputs it is necessary for vehicles to be able to cope with both large, light loads and small heavy consignments. One limiting factor on utilisation for delivery and collection trips is the time taken to complete the schedule. In some operations the number of deliveries and collections may be a limit to what can be loaded, as can the finite limit of a driver's shift. These results compare to other sectors' averages of 51% (non-food retail) and 53% (food retail).

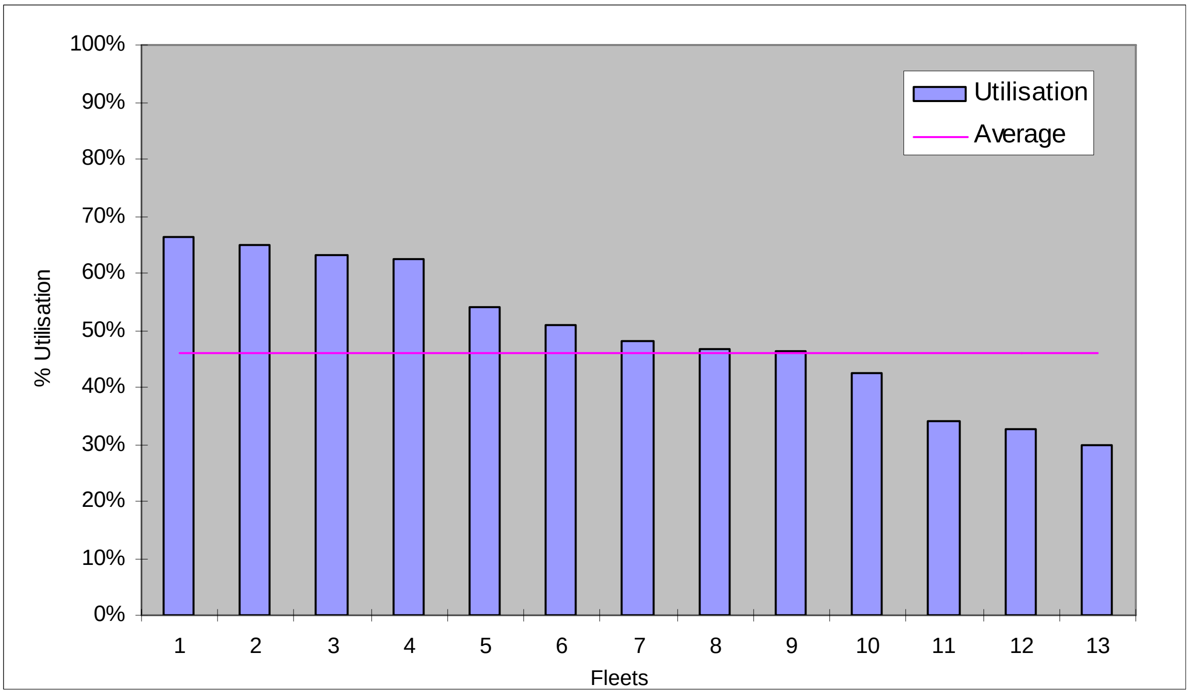

Figure 5 Vehicle utilisation by weight for first legs

Because vehicles are scheduled to be as full as possible when they start a day's delivery run, the data for the first leg of each trip has been analysed separately. This shows an improved average weight utilisation of 46.02%.

The Pareto chart, in Figure 6, gives the detail behind the average percentages. It plots each leg's utilisation showing a range of values consistent with a multiple delivery operation. Very few last legs are empty indicating that nearly all vehicles returned with some collections for despatch to their hub.

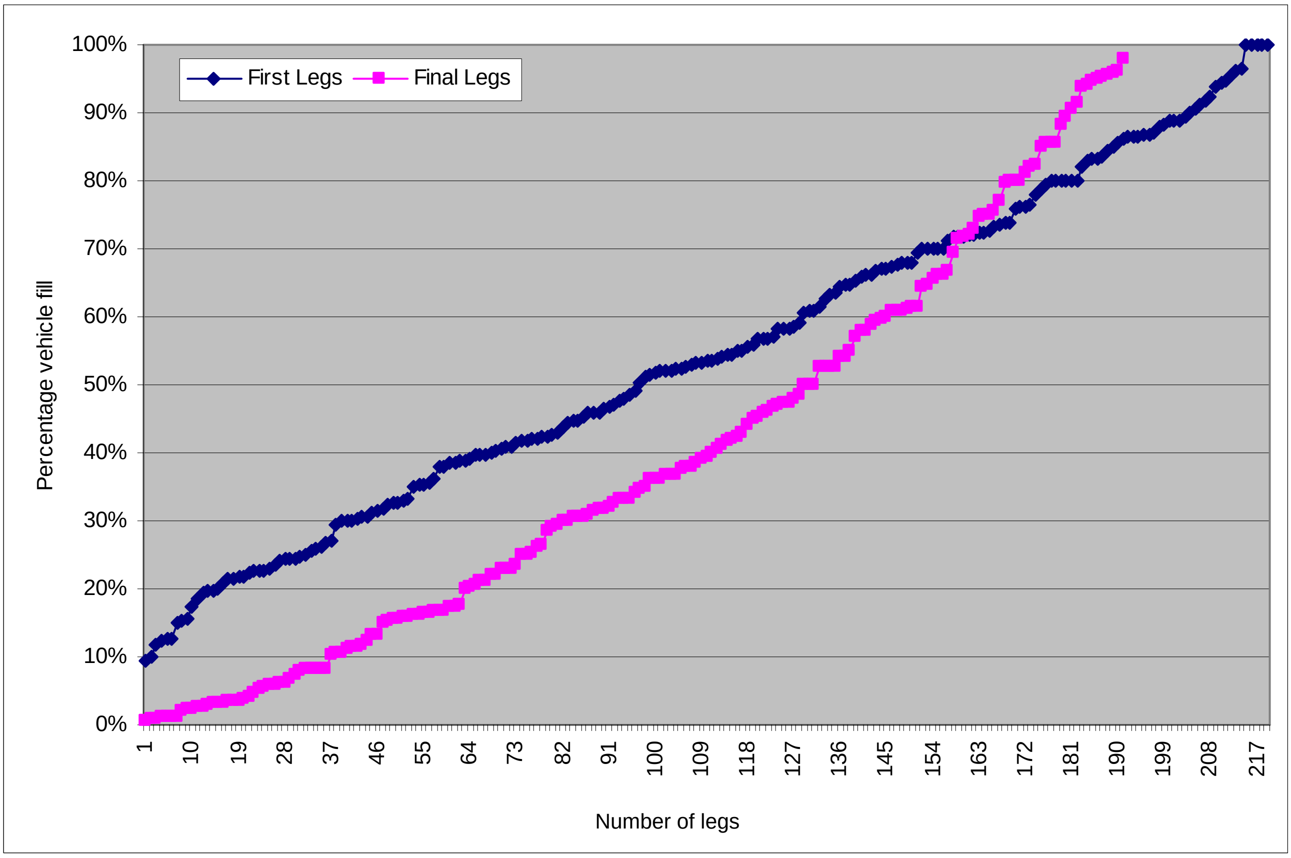

Figure 6 Distribution of weight utilisation by first and last legs

5.2.2 Utilisation by deck length

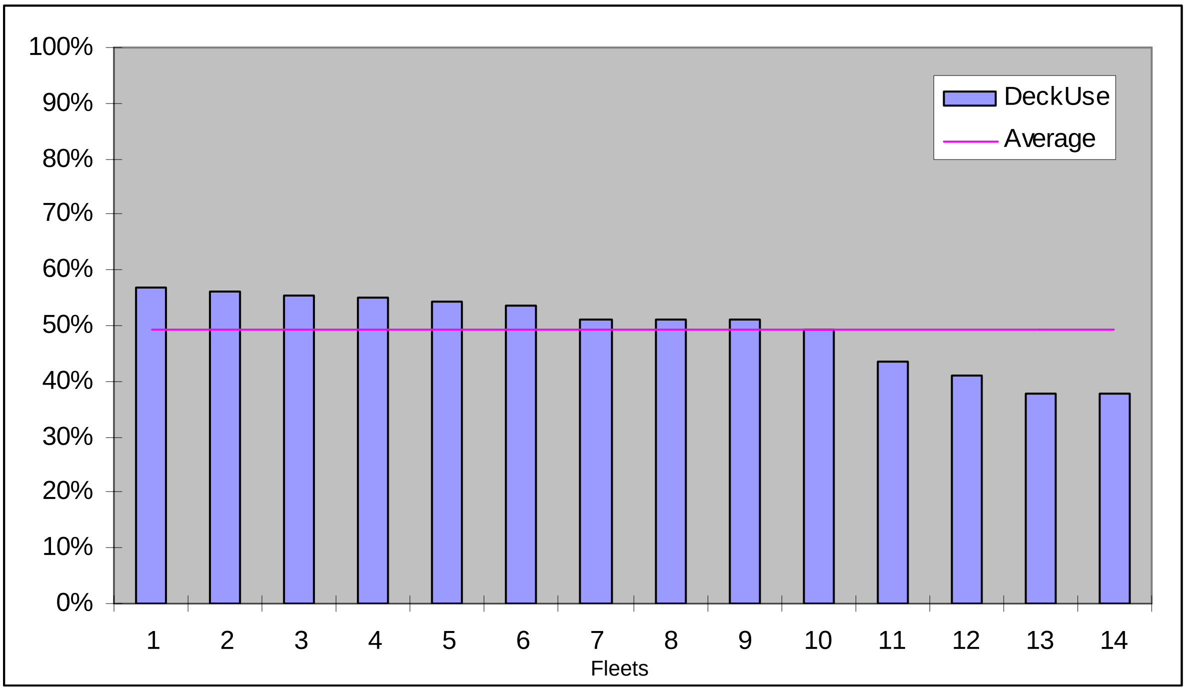

Figure 7 Vehicle utilisation by deck length

This measure is effectively a reflection of the number of pallets carried by each fleet vehicle, against its capacity. It shows the impact of multi-drop vehicle route schedules, where the aim is to fill the vehicle for its day's deliveries and to collect as much as possible later in the day to provide to the network.

In a situation where a vehicle is loaded to the maximum at the start of its day and empty at the end, then, with reasonably consistent consignment sizes, the average utilisation will be 50%. The results reflect this with an average of 49.4%. However, as there is collection activity contributing to this average, then some vehicles started the day less than fully loaded. In fact, the results show some legs are above 100% utilisation (achieved by double stacking pallets). This average compares to 69% and 74% achieved by the food retail and non-food retail surveys respectively.

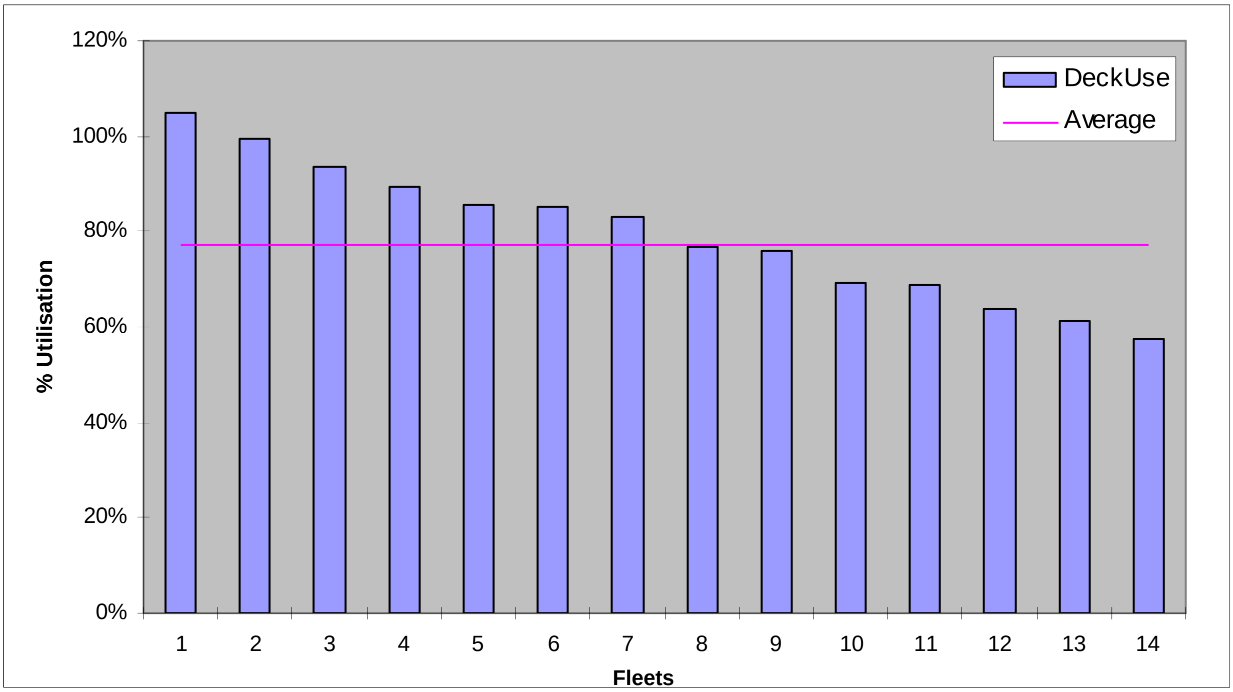

Figure 8 Vehicle utilisation by deck length for first legs

Focusing on the utilisation of the first leg provides a more realistic picture as this is the most that can be fitted onto a vehicle given the various constraints of deck length, service requirements and time to complete the route. It shows a dramatically different position. Half the fleets achieved an initial utilisation of over 80% of the deck length. Utilisation of over 100% was achieved by stacking pallets, where safe to do so, and vehicle planners will aim to do this wherever possible. Even the worst first leg utilisation of just over 60% compares well to the food retail overall average of 69%.

With collection of consignments for the hub taking place after, or during delivery, the fleets return to base with a significant number of pallets loaded. A chart, Figure 9, shows the last leg utilisation, when the collection quantity will be at its highest, with an average deck length utilisation of 40%.

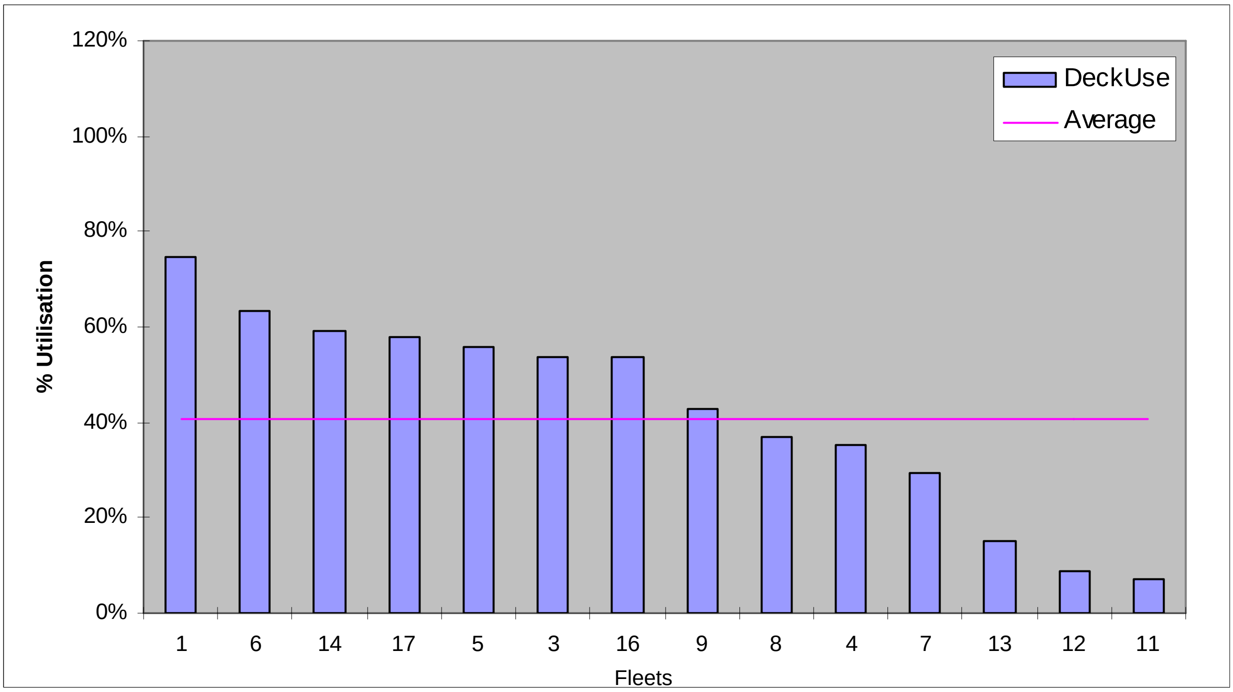

Figure 9 Deck length utilisation for last legs

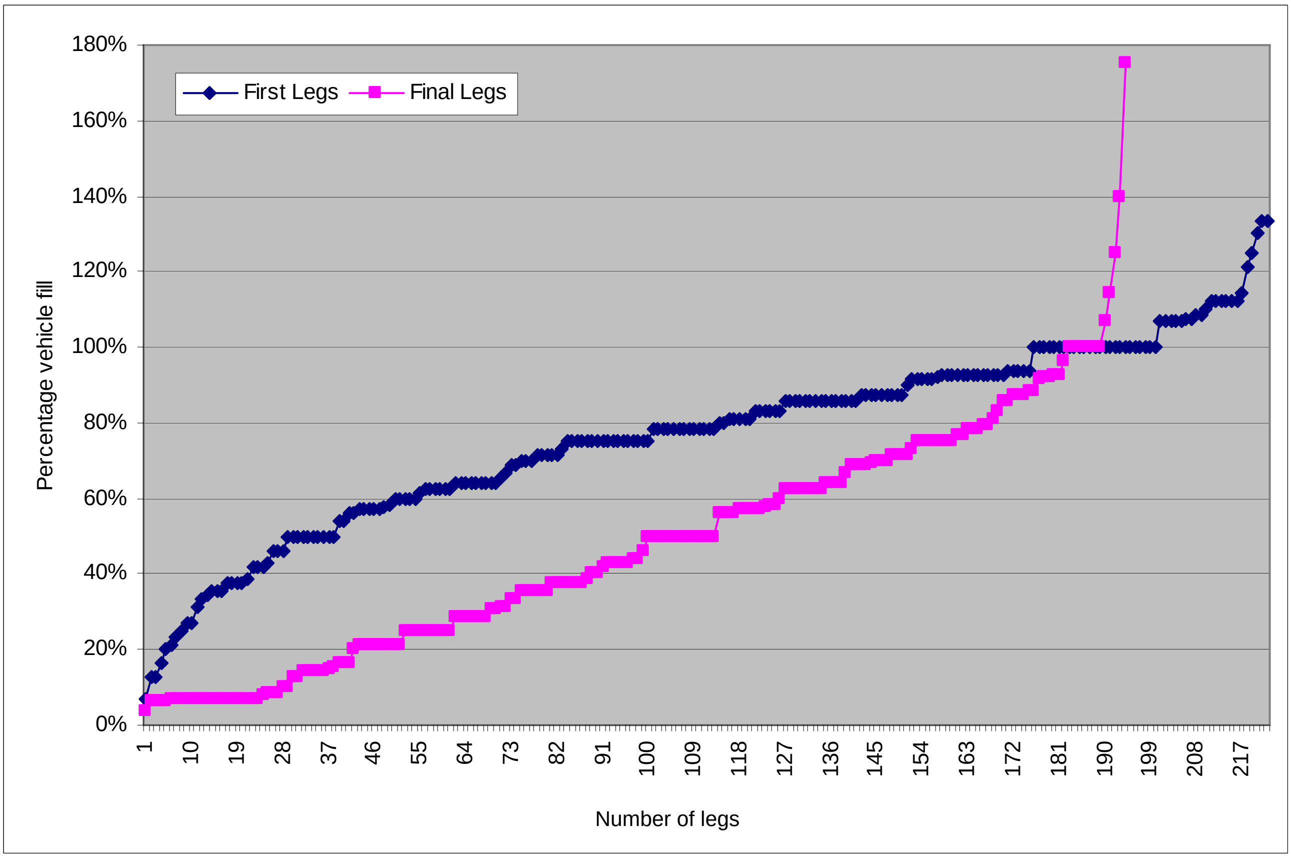

Figure 10 Distribution of individual vehicle utilisation by deck length on first and last legs

Because averages can hide substantial variations it is useful to see the individual leg utilisations. Figure 10 plots those records, which ordinarily would not exceed 100%. However, this is possible because some consignments can be double-stacked, giving the operator greater productivity. The ability to do this will not normally be visible to the operator until the consignments arrive from the hub, but where possible it will be easier on first, or outward, legs than for customer collections which contribute to the final leg utilisations. Knowledge of regular consignors and consignees make it possible to plan for this 'over-loading'.

5.2.3 Utilisation by vehicle type

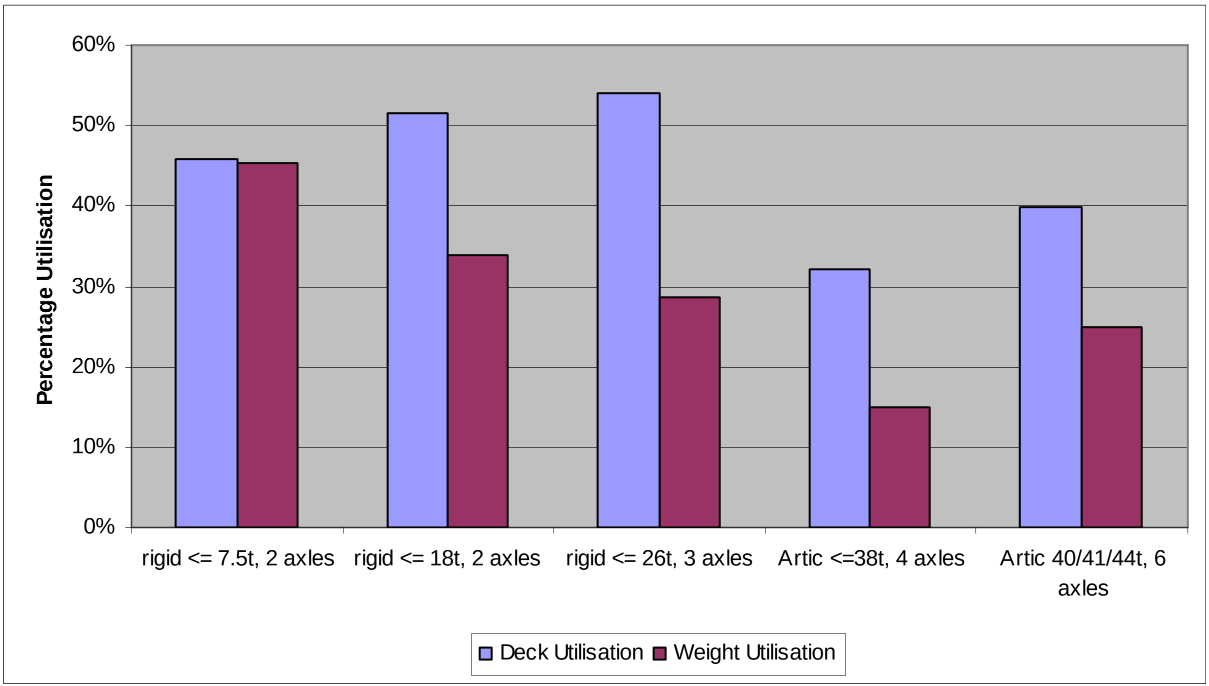

Figure 11 Utilisation by vehicle type across all fleets

Summarising the utilisation by vehicle type shows that rigid vehicles used for collection and delivery work were better utilised, in both weight and deck length (pallet capacity) measures. Generally, utilisation by deck length was greater than that by weight, supporting the view that most consignments are relatively low density. For rigid vehicles the deck length utilisation improves with vehicle size, as the weight utilisation reduces.

Overall both the average weight and deck length utilisations do not seem that efficient. In comparison with previous surveys in other sectors they are between 10 and 50% lower than the non-food retail averages by deck length and between 10 and 70% lower by weight. But this reflects the difference between multiple delivery routes of the pallet networks and mostly single delivery legs of the retail sector.

5.3 Empty Running

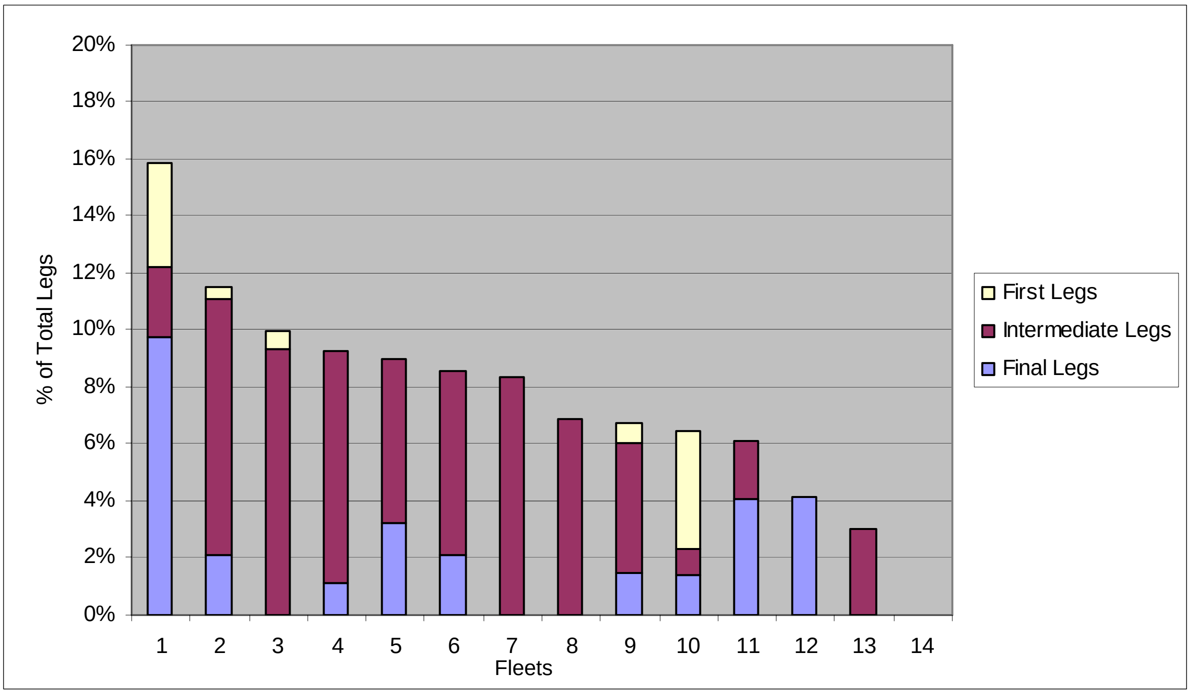

Figure 12 Empty running by legs

With deliveries and collections being made during the same vehicle trip, as far as is possible the number of empty legs run should be minimal. Across the survey fleet there is considerable variation.

Empty first legs result from a vehicle being sent out for a collection, intermediate legs will be between completion of deliveries and the start of collections, and final legs because a vehicle has not carried out any collections.

In total there were 181 empty legs, accounting for 8.05% of all legs travelled.

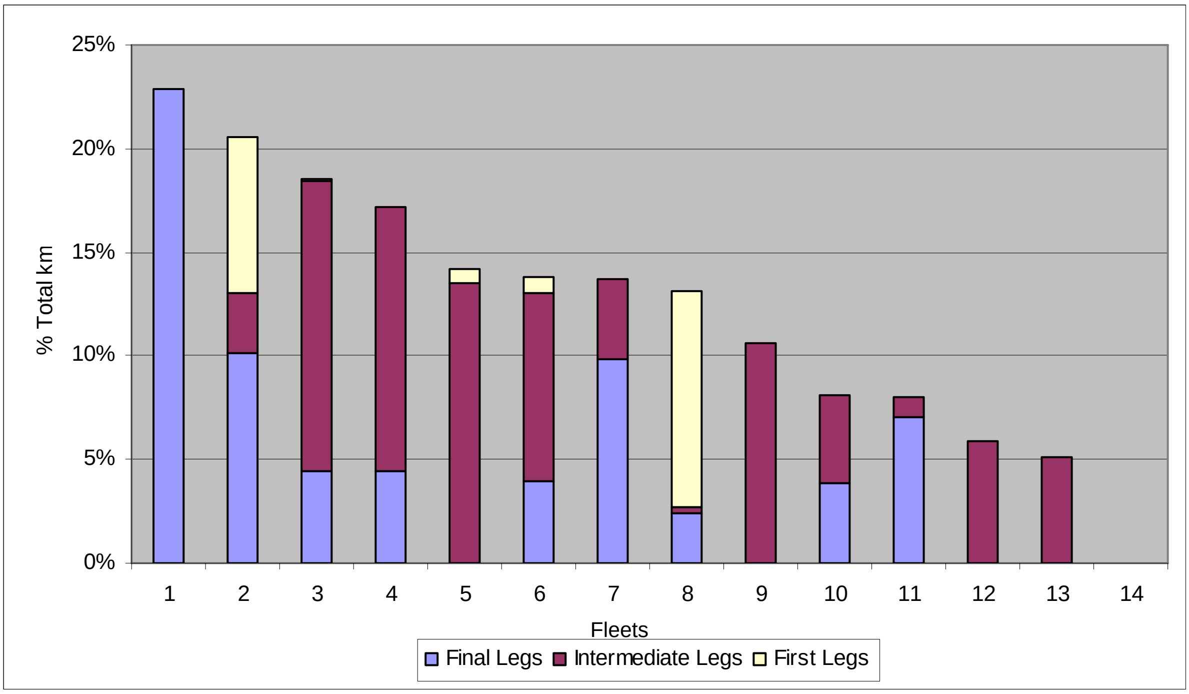

Figure 13 Empty running by kilometres

Empty kilometres run added up to 4,664 across all fleets, or 12.83% of total distance run, showing that empty legs, at 25.8 kilometres, were longer than the average for all legs, which was 16.43 kilometres.

5.4 Deviations From Schedule

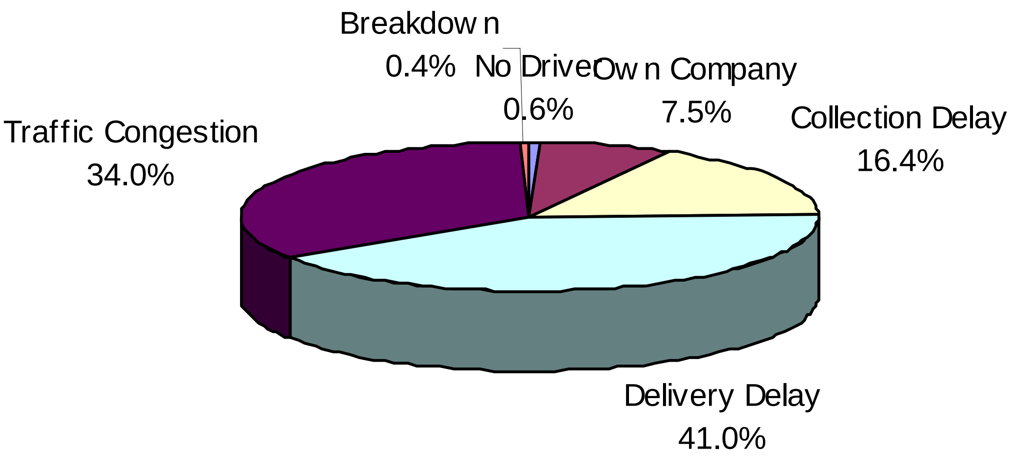

Figure 14 Delays by cause

Delays affected 833 legs, or 35.1%, but included 929 instances, giving an average of 1.1 delays per leg with a delay. Delays at delivery points or by traffic congestion accounted for 75% of this total. Figure 14 shows the percentage, by cause, of those legs that had a delay. The impact on each fleet is compared in Figure 15 below.

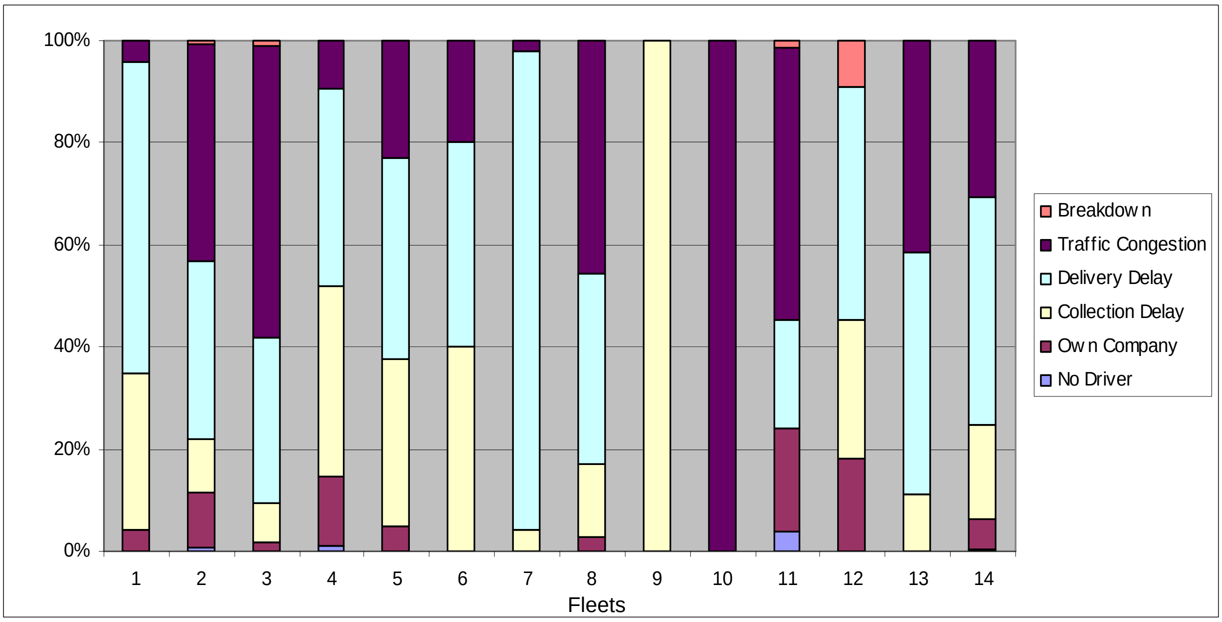

Figure 15 Causes of delay by fleet

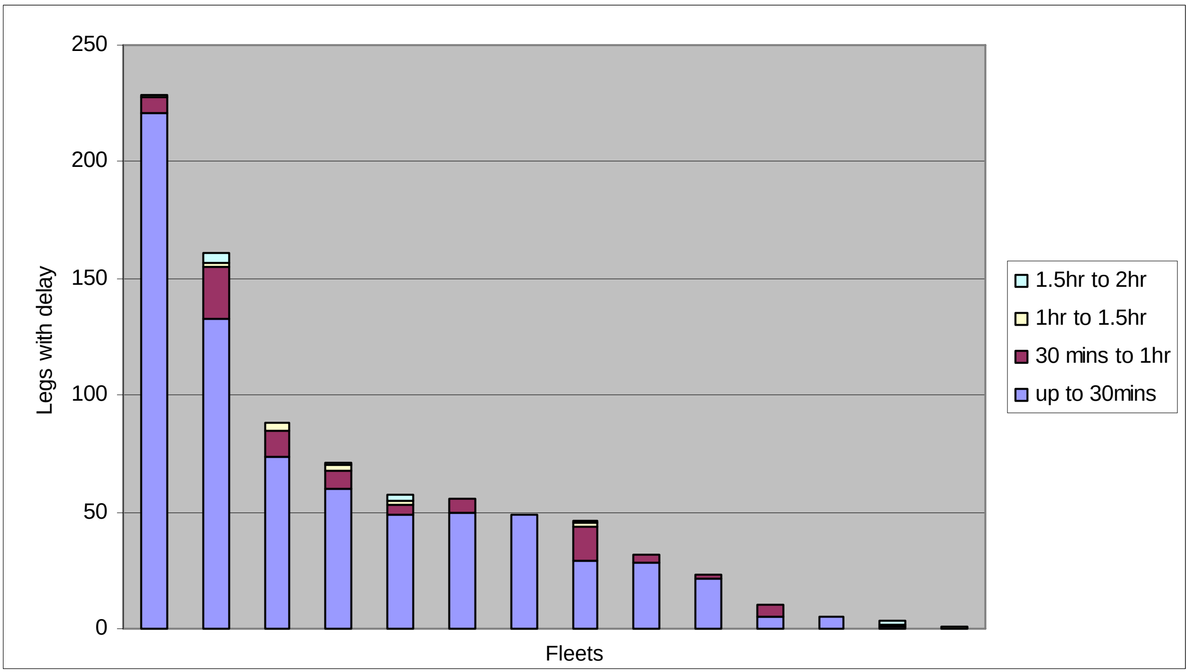

Figure 16 Length of delays in minutes

Looking at the delays by their length (Figure 16) 716, or 87%, were for 30 minutes or less, and the average, across all delays reported, was 16 minutes per leg. At a total of 250 hours and an average operating cost of £25 per hour, this is £6,250 of wasted expenditure by the operators within the 48 hours. This amounts to £6,886 per vehicle per annum if this level of delay is sustained, or a total of £812,500, for the sample fleet. Further detail is shown in Table 4.

	No driver	Own co.	Collection point	Delivery point	Congestion	Breakdown
Number of delays	6	70	152	381	316	4
Delays as % of all legs	0.26%	3.08%	6.69%	16.76%	13.9%	0.18%
Delays as % of delayed legs	0.6%	7.5%	16.4%	41.0%	34.0%	0.4%
Average delay, minutes.	24	22	23	16	11	68
Total delay, minutes.	142	1,541	3,522	5,983	3,530	270

Table 4 Causes of delay and time lost

Delivery point delays are a fact of life for most operators, although these are sometimes because of delays elsewhere. In the survey collection point delays equated to the same total time as traffic congestion. Taken with delivery delays, customers appear to be the cause of nearly half of the total delay time. Careful monitoring of who is responsible for the delays and when the delays occur may enable operators to manage the main contributors and improve their performance.

5.4.1 Delivery Windows

The survey measured the achievement of legs on time, against delivery time windows, where they existed, as shown in Table 5. Compared to many sectors the use of delivery windows is limited, at 23% of deliveries, which is close to the 20% average that most participants consider the norm. However, the service offered for many deliveries is ‘next day’, which in practice means by midday.

	Delivery legs	
	Number	**Per cent**
No time window	1,732	77.05
On time	431	19.17
Late	37	1.65
Early	48	2.14

Table 5 Achievement against delivery windows

5.4.2 Failed Deliveries

Very few delivery legs were classed as failures. The effect is shown in Table 6.

	Delivery legs	
	Number	**Per cent**
Refused full load	5	0.22
Refused part load	1	0.04
Load not ready	1	0.04
Other reason	4	0.18
TOTAL	11	0.48

Table 6 Failed delivery legs

5.5 Time Utilisation

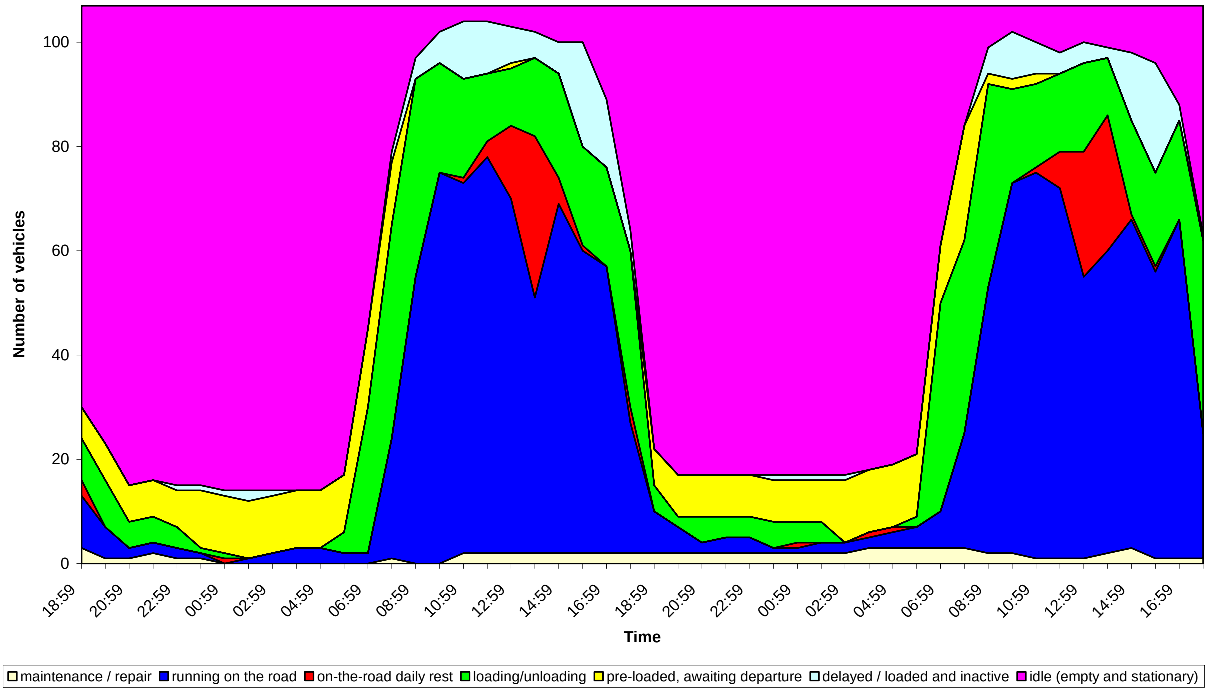

Figure 17 Summary of Hourly audit by individual vehicle

Most collection and delivery vehicles being 18 tonne gvw or less, they are not the optimum type for overnight trunk activity, and there are few, if any, deliveries to be made at night. This is highlighted in the chart in Figure 17, which shows a dominant period of use between 0700 and 2000 each day.

Summarising the various use categories, Figure 18 shows that 40% of all time was spent idle. Productive use (running on road, rest on the road and loading/unloading) accounted for only 49% of vehicle time. As networks generally work only a five day week, most of the week-end is also spent idle unless operators have additional uses and customers for their fleets.

The times of peak use are those when customers are working and want to receive their consignments. However, these are also the times of greatest traffic congestion and delays. For next day deliveries through national hub and spoke networks, it will not be possible to start the working day earlier than is shown.

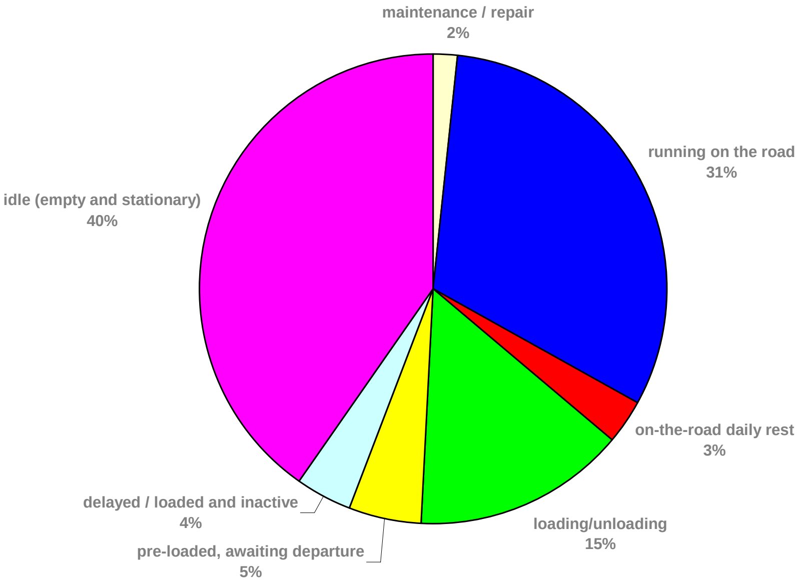

Figure 18 Summary of hourly audit, by category of use

Some operators do have work that keeps their fleets in productive use for much higher proportions of each day and this is reflected in Figure 19, which gives the category of use time for each fleet submitting data.

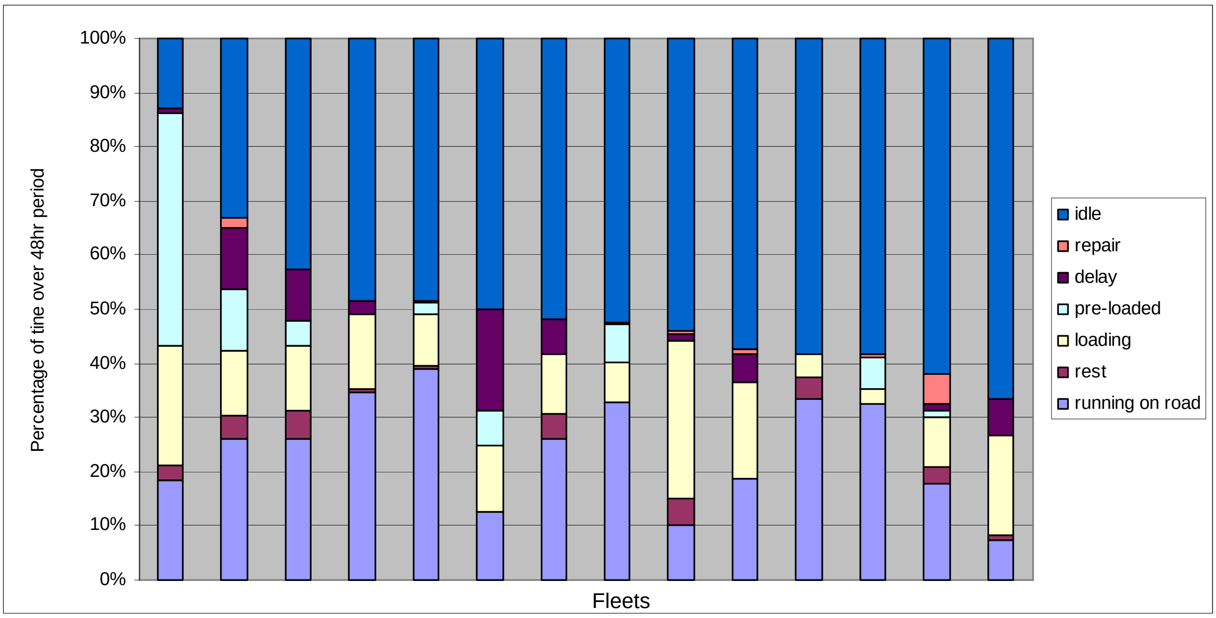

Figure 19 Time utilisation by fleet

5.6 Fuel Efficiency

5.6.1 Fuel consumption

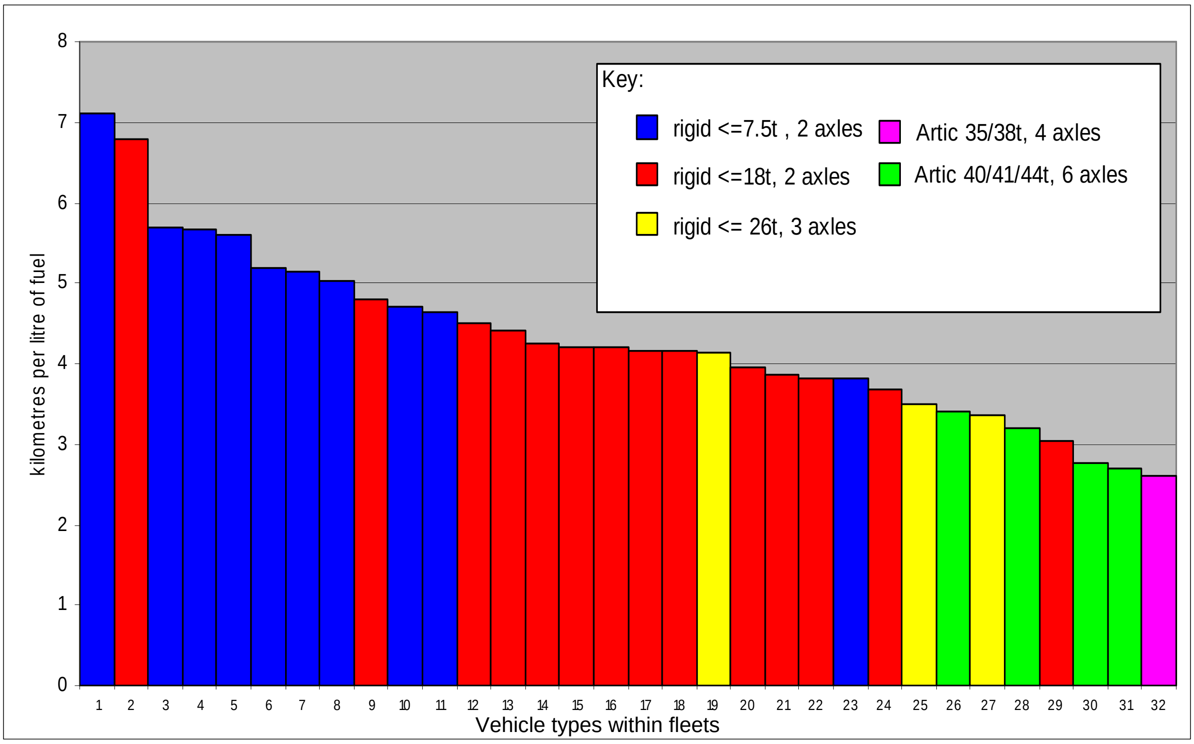

Figure 20 Fuel consumption by vehicle type within each fleet

Fuel consumption is affected by a wide range of influences. These include the operational weight of vehicle and load, the nature of the driving conditions and frequency of stops, driver technique, actual tyre pressures, the specification of the vehicle including air management and wheel rim sizes. It is also influenced by the importance given to it by managers through the practice of detailed measurement by driver, vehicle and trip. A simple consumption analysis by vehicle type within each fleet is shown in Figure 20.

The average result for each vehicle type, across all fleets operating them, is summarised in Figure 21. There are considerable variations within the most popular vehicle types and the relationship between average, minimum and maximum consumption for these can be seen in Table 7. Improving the fuel consumption provides the benefits of lower fuel costs and reduced atmospheric emissions. If a truck within the worst performing 18 tonne gvw fleet was able to improve to achieve the average consumption, for example, it would benefit by:-

- £3,084 per annum – based on 40,000 kilometres pa, fuel at 80p per litre, and consumption improving from 3.03 kpl to 4.28 kpl.
- 10.2 tonnes of CO_2 – based on reduced consumption of 3,855 litres, 35.6MJ/litre and 74.1gCO_2/MJ

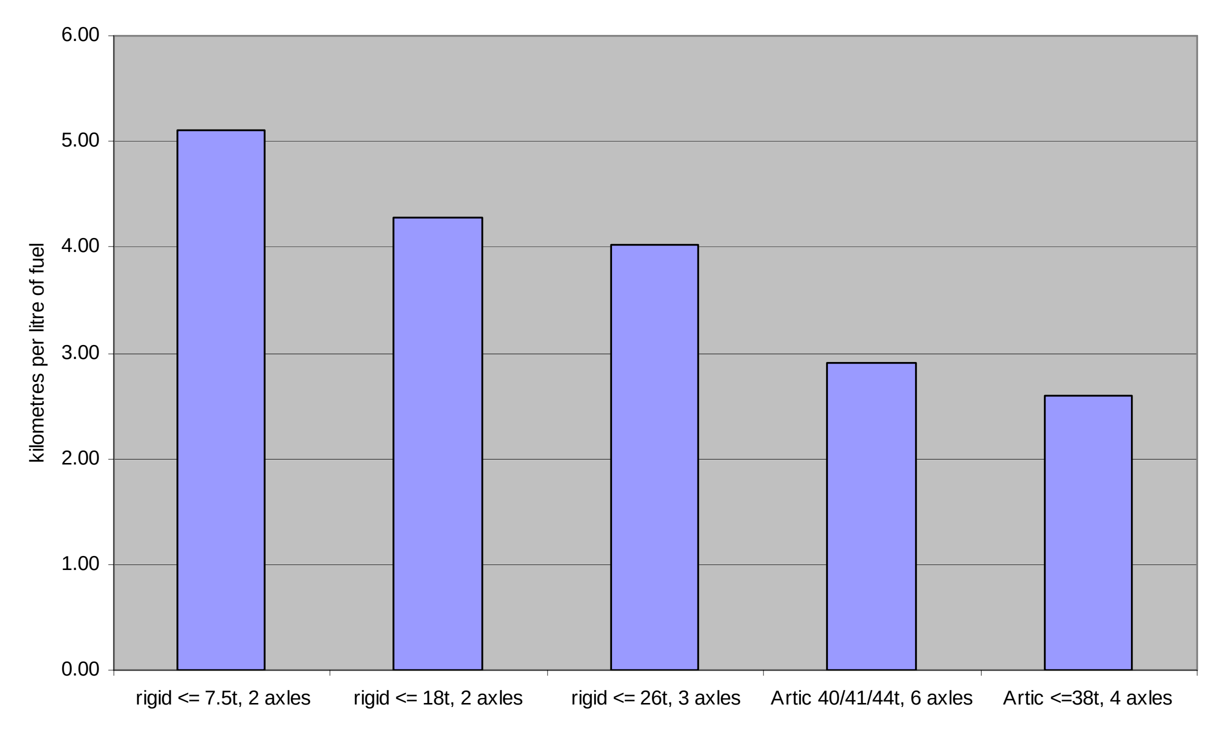

Figure 21 Fuel consumption summary by vehicle type

	Kilometres per litre		
Vehicle type	**Minimum**	**Average**	**Maximum**
7.5 tonne	3.82	5.11	7.1
18 tonne	3.03	4.28	6.79

Table 7 Summary of fuel consumption by vehicle type

This survey has been able to study the impact of fitting air management kit to vehicles. Where fitted this was to at least 25% of the fleet, but in 21 combinations of vehicle type and fleet this was 100%. The benefits in improved fuel consumption are demonstrated in Figure 22, although this may not be due solely to such fitting. The improvement ranged from 5.3 to 9.4%, which probably reflects the local delivery work performed by many vehicles in this sample. Higher improvement rates were seen in the trunking fleet. Using the same benefit calculation as previously the saving per vehicle in fuel costs would be £748 per annum and reduced CO_2 emissions of 2.47 tonnes per annum.

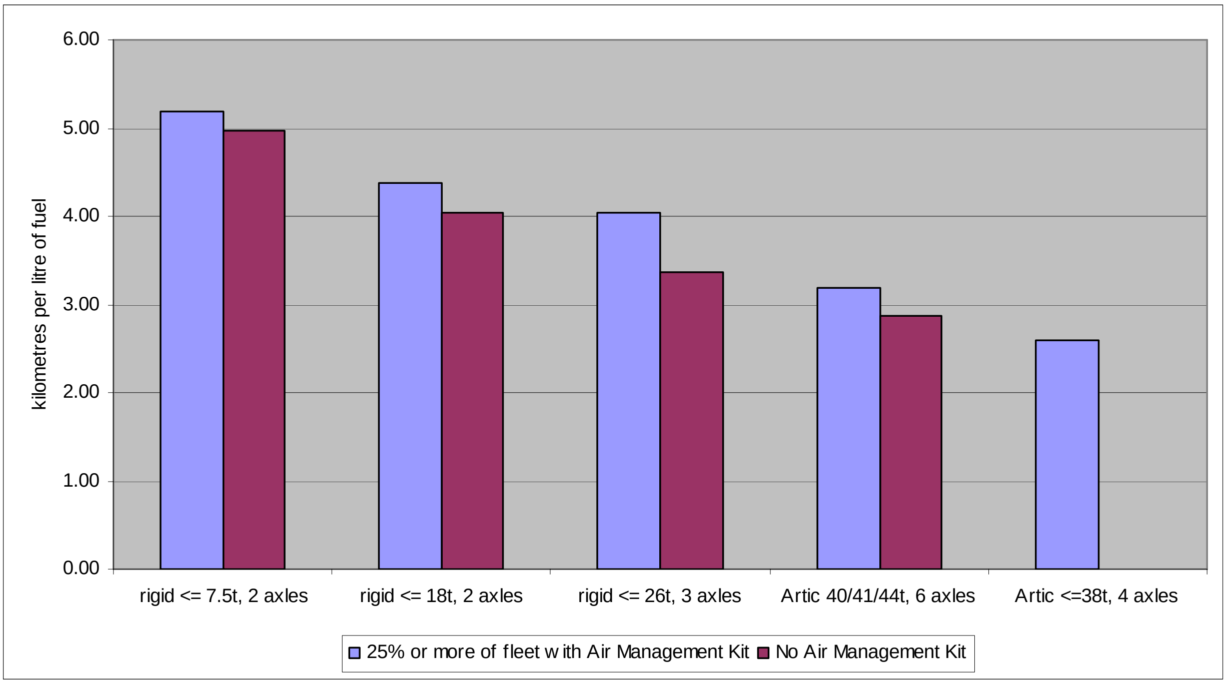

Figure 22 Fuel consumption by vehicle type – air management effect

5.6.2 Energy intensity

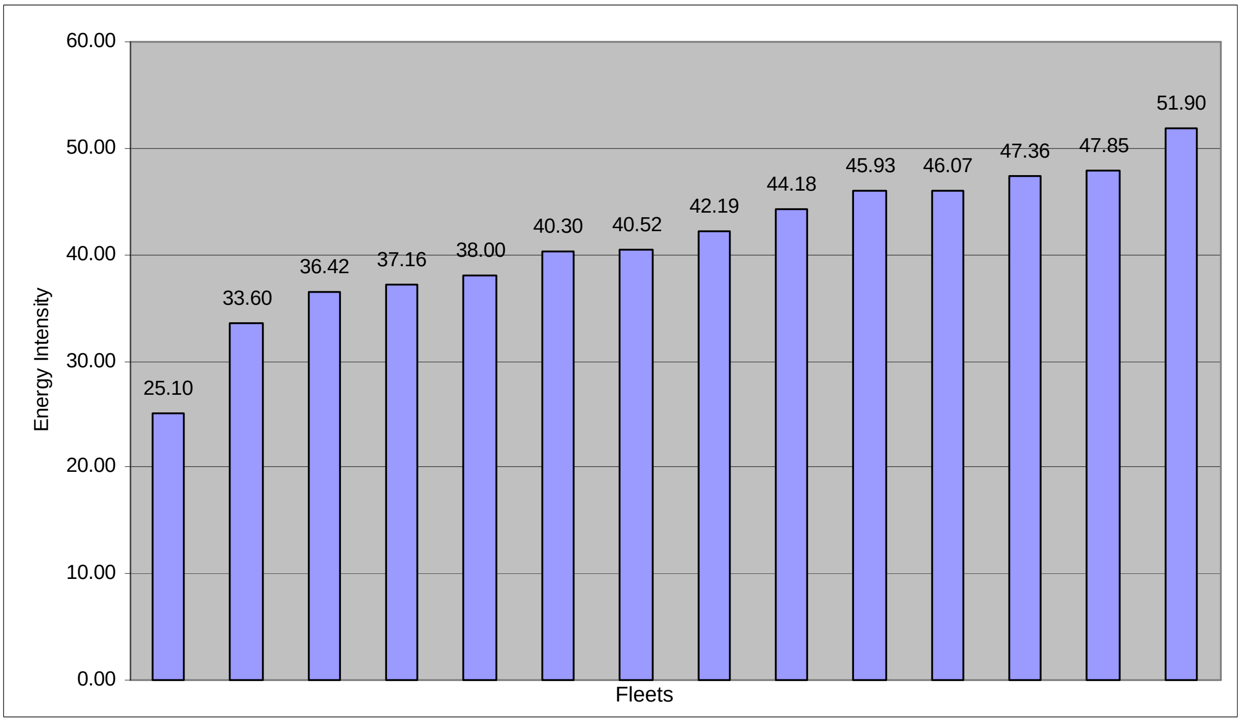

Figure 23 Energy intensity by vehicle fleet

Because fuel consumption based on kilometres per litre takes no account of the work being carried out while the fuel is being used, a measure of energy intensity was calculated. This takes account of the workload performed by the vehicle against the measured fuel consumption. It is based on the load moved and distance travelled, in this case pallets per kilometre, against the fuel consumed, per 100 millilitres. The results, in Figure 23, by individual fleet show that the best performing fleet gets twice as much ‘work’, per unit of fuel consumed as the worst performer. (The formula is shown in section 2.5.).

Given that it needs both good fuel consumption and low energy intensity to measure good performing operators, these two factors have been plotted against each other in a scatter diagram, Figure 24. The better results are those towards the top left hand corner. Lower results have worse fuel consumption and those to the right a worse load/distance rate for the fuel consumed.

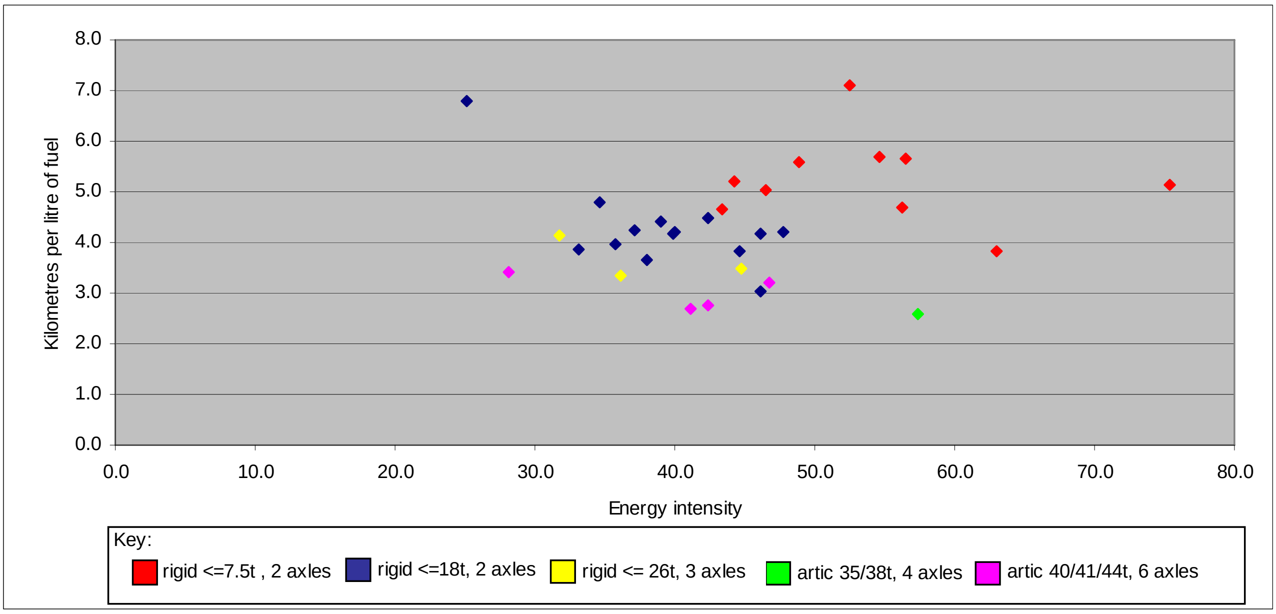

Figure 24 Relationship between fuel consumption rates and energy intensity

6. SURVEY RESULTS – TRUNKING

6.1 Summary Statistics

The overall statistics for the trunking activity are shown in Table 8.

Trunking survey data	
Vehicles	31
Trips	57
Legs	177
Average legs per trip	3.11
Total distance - kilometres	29,315
Average kilometres per leg	177
Average kilometres per trip	549
Pallets delivered	4,297
Pallets collected	2,474
Delivery only legs	74
Collection only legs	27
Collection and delivery legs	57
No collection or delivery legs	19

Table 8 Summary of survey statistics for trunk fleet

The trunk activity takes place during the evening and overnight, when consignments collected during a day are sent that night to the hub. Exceptions to this are economy consignments. If the scheduled trunk vehicles are full they can be delayed for 24 hours, or if sufficient consignments are available earlier they may be sent early to fit with other requirements of the vehicles. During the day many of these vehicles are used by their owners for other, non-pallet network work, and in some cases for delivery and collection activity for pallet network consignments.

All other work performed by these vehicles during the survey period was recorded to give a complete picture of each vehicle's activity.

6.1.1 Vehicle Types

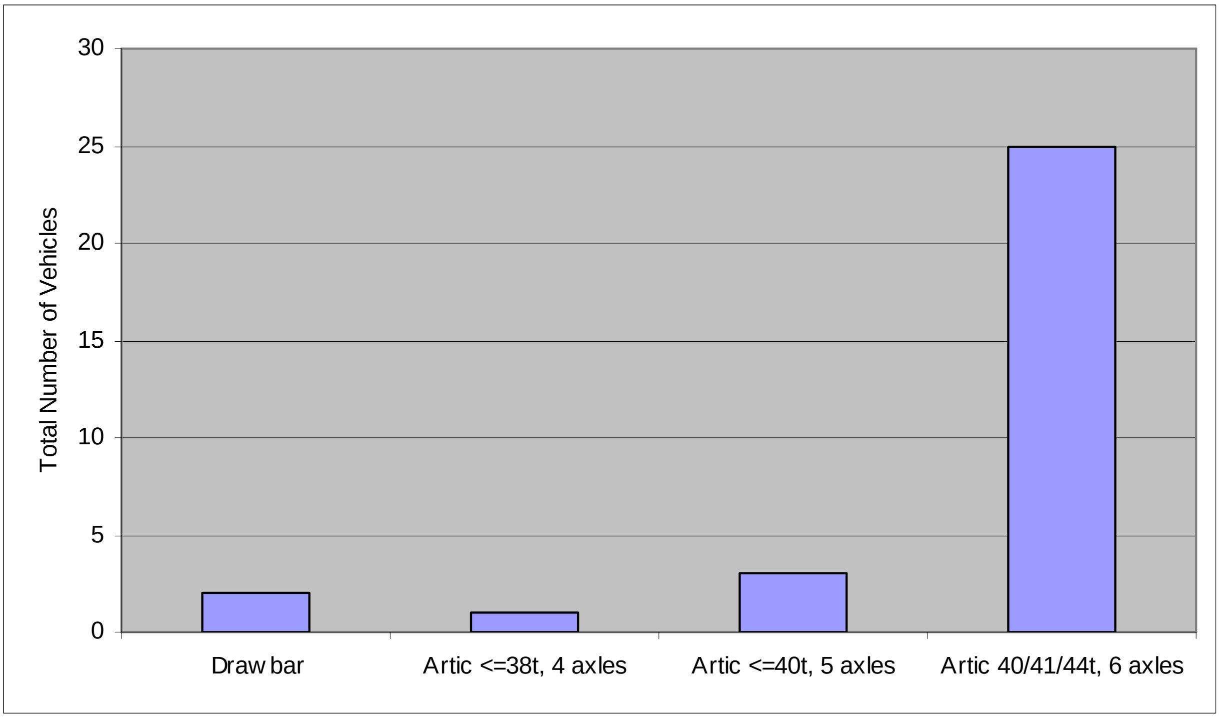

Figure 25 Number and type of vehicles

The dominant vehicle type is the 6-axle articulated combination up to 44 tonne gvw. All but three trailers were curtain-sided, as side loading is the method used at hubs, and increasingly, these are double-deck trailers. This is because consignments generally are relatively light per pallet space. As it is not good practice to double-stack pallets, each can be given a deck location, making them all equally accessible and protected. This may also facilitate cross-docking of urgent consignments at the hub, if there has been a delay and a critical trunk vehicle is scheduled to leave.

6.2 Vehicle Utilisation

6.2.1 Utilisation by weight

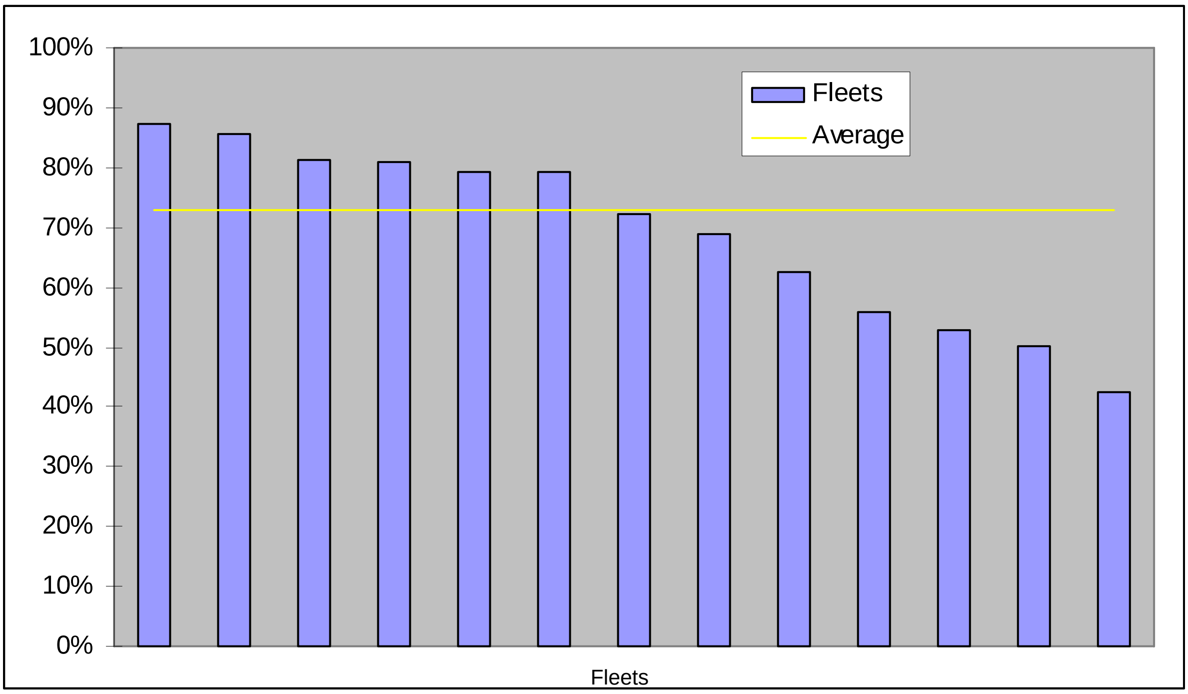

Figure 26 Vehicle utilisation by weight

For the trunks to and from hubs the utilisation of these trailers and vehicles will depend entirely on the flow of consignments collected by them, or received by their partner companies. The range of utilisations shown in Figure 26 has produced an average of 72.8%, which is considerably higher than was achieved in the surveys for food and non-food retail at 53% and 51% respectively. This is partly due to the higher use of double-deck trailers.

Selecting the first legs for analysis does not change the result by very much as the first and last legs generally reflect the two movements to and from the hubs. For many companies this would be a complete trip and fill a driver's shift.

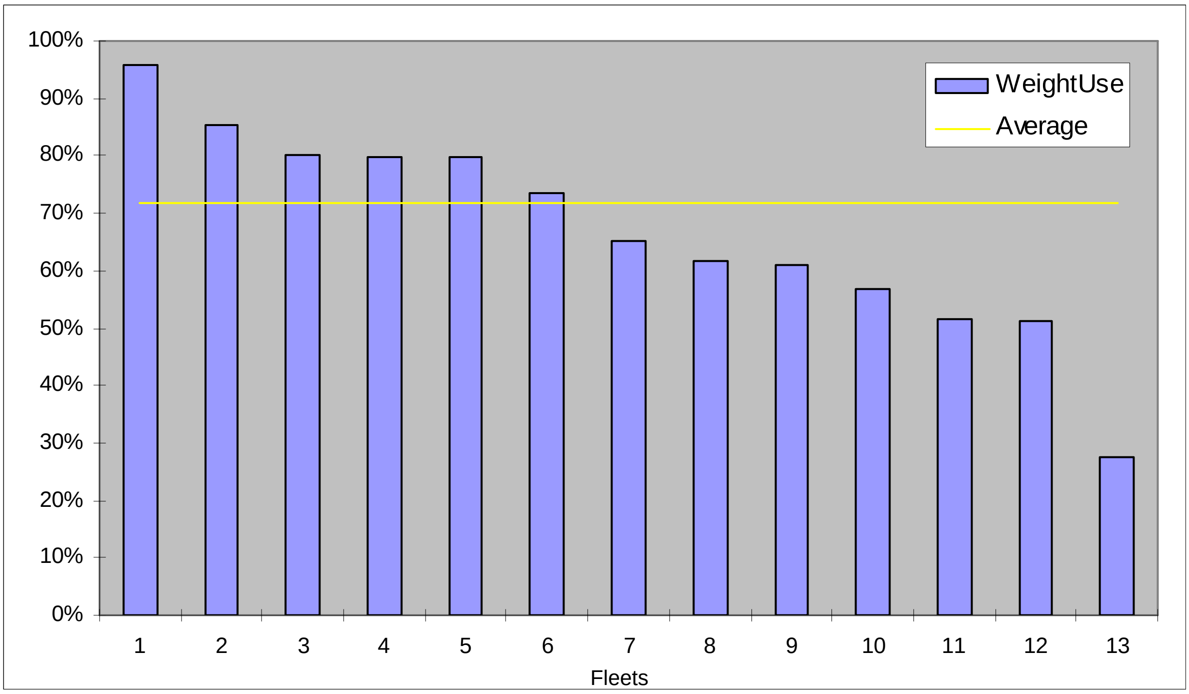

Figure 27 Vehicle utilisation by weight for first legs

To demonstrate the range of weight utilisations achieved, the chart in Figure 28 shows this for each recorded leg

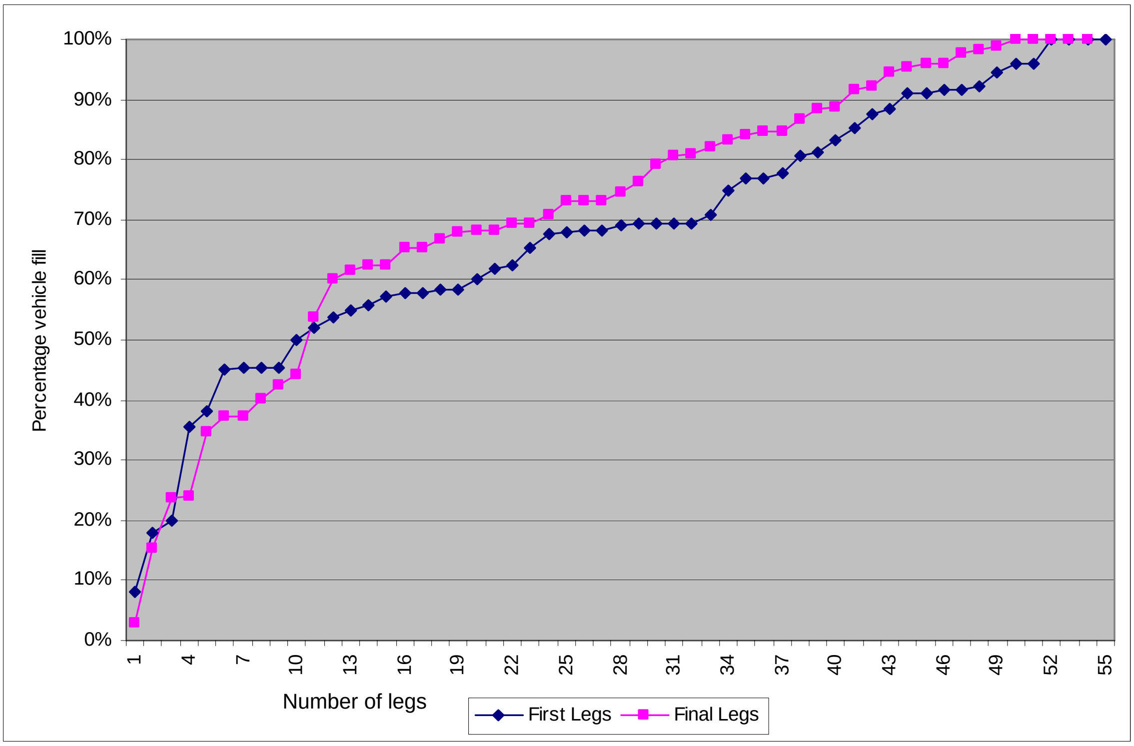

Figure 28 Distribution of vehicle utilisation by weight for first and last legs

6.2.2 Utilisation by deck length

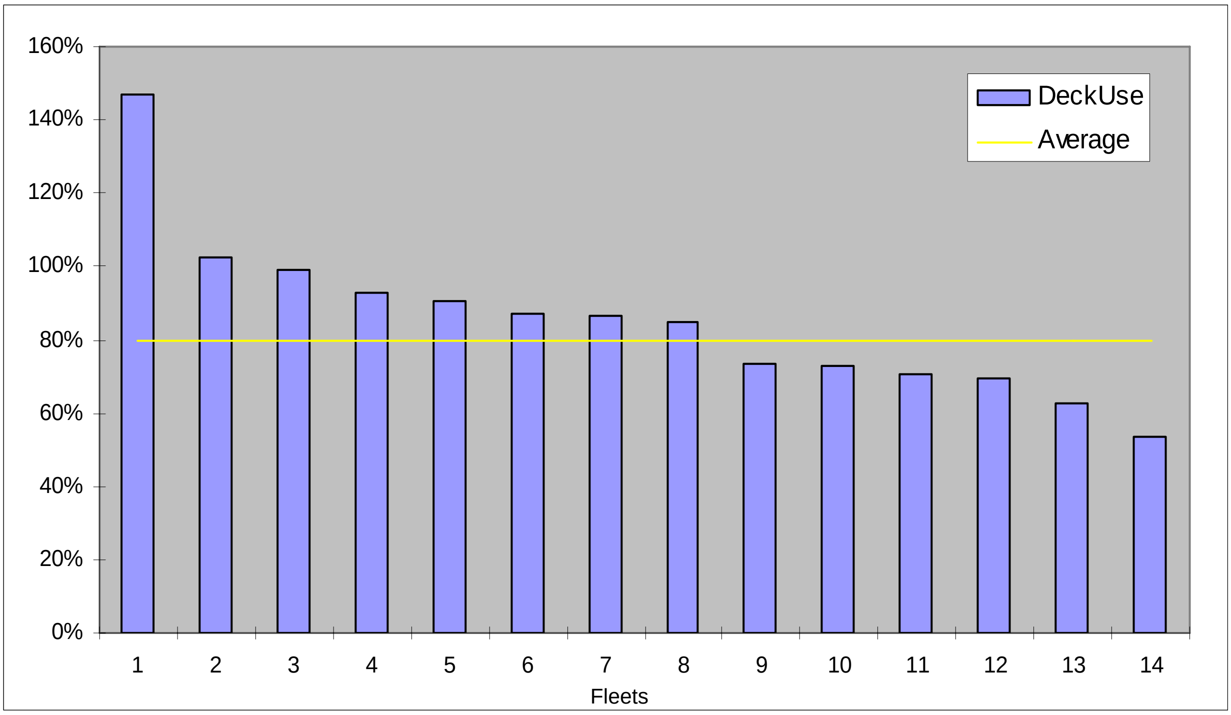

Figure 29 Vehicle utilisation by deck length

The average utilisation of deck length is 79.6%, which compares to 69% in the latest food retail survey and 74% in the non-food retail survey (both 2002). The fleet registering above 100% is due to their being able to double-stack pallets on single-deck trailers.

As for the weight utilisation, separating out the first and last legs to see if this gave higher utilisation figures makes little difference, as the vehicles trips are mostly of two legs, to and from the hub.

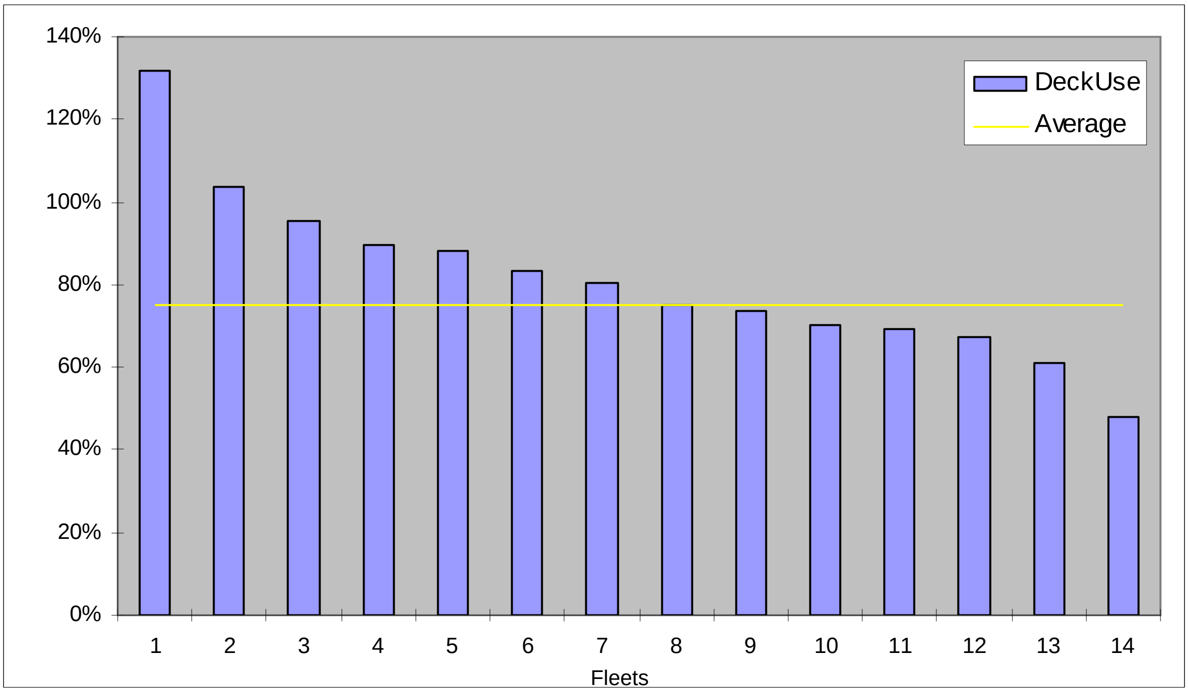

Figure 30 Vehicle utilisation by deck length for first and last legs

The range of individual leg utilisations by deck length is demonstrated in Figure 31.

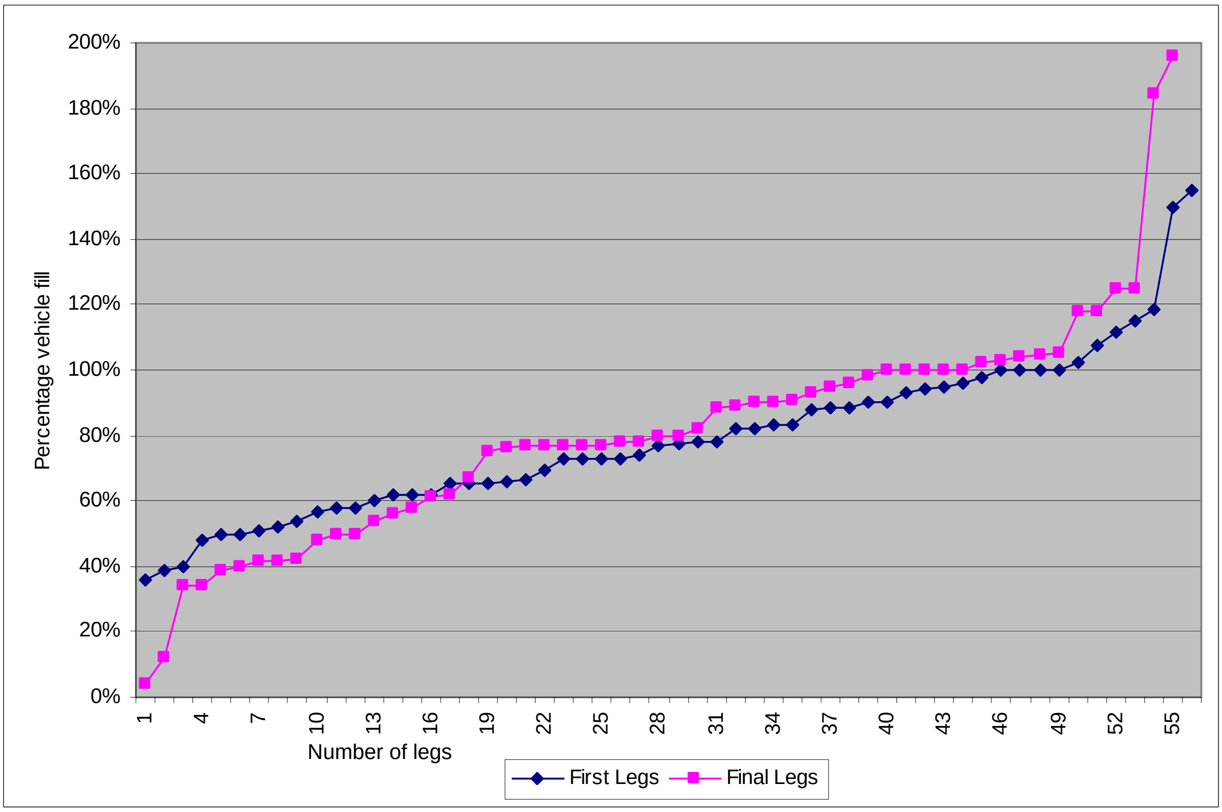

Figure 31 Distribution of vehicle utilisation by deck length for first and last legs

6.2.3 Utilisation by vehicle type

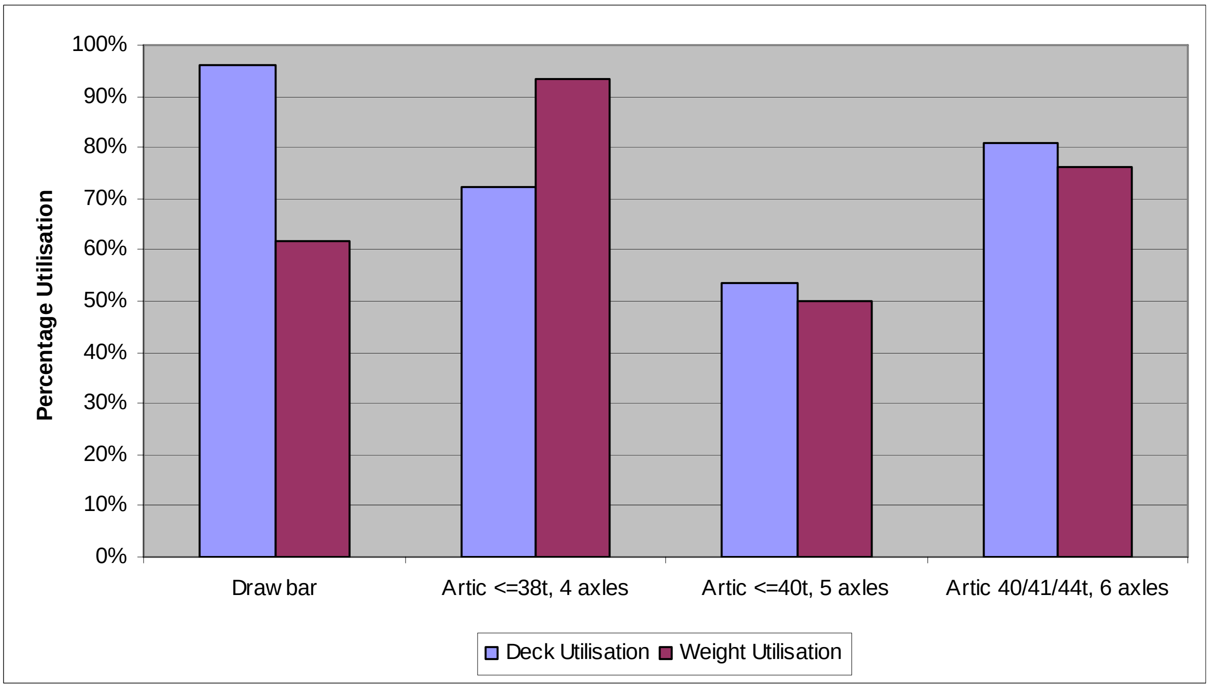

Figure 32 Utilisation by vehicle type across all fleets

Figure 32 shows that for most trips the consignments used space more than weight capacity. The 38 tonne gvw vehicle specification has a lower weight capacity but the same single deck capacity as other articulated vehicles, which explains partially its higher weight utilisation.

6.3 Empty Running

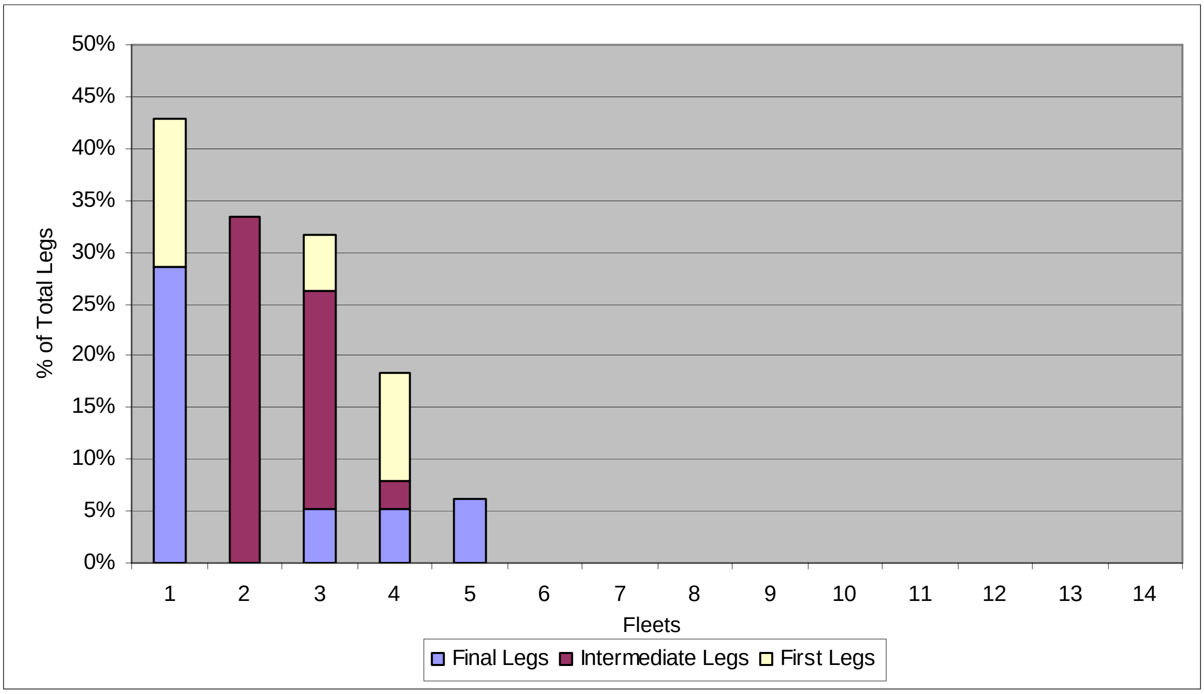

Figure 33 Empty running by legs

Trips to the hub would normally be loaded both ways and the utilisation of these will depend on the balance of consignments collected against those delivered. Where the imbalance is significant operators either allow for one leg to be run empty, or plan a one-way trip for pallet network consignments. The other leg(s) in the trip would be for other company work. Some of the empty running shown will have occurred during daytime operations, making deliveries and collections for pallet networks.

There were 24 empty legs (13.5%), totalling 1,315 kilometres (4.5%), giving an average empty leg of 55 kilometres, compared to an average across all legs of 154 kilometres. This compares well to empty legs of 26.4% for the UK truck fleet as a whole in 2001.

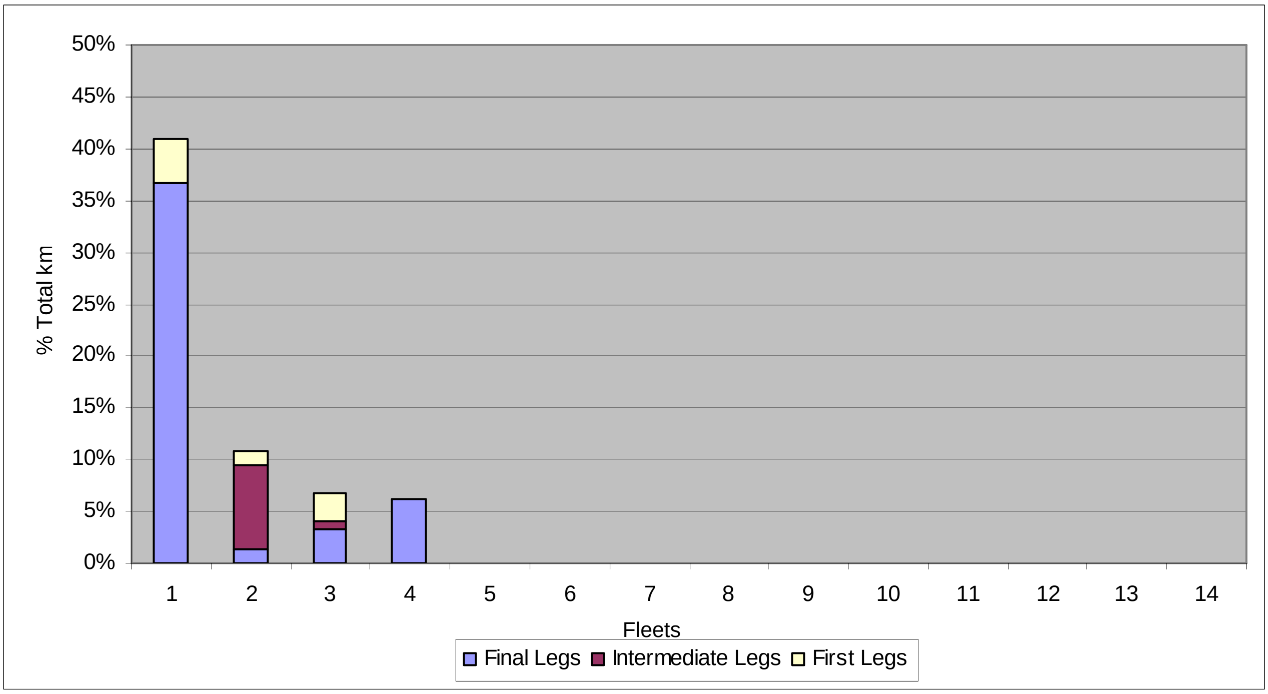

Figure 34 Empty running by kilometres

6.4 Deviations from Schedule

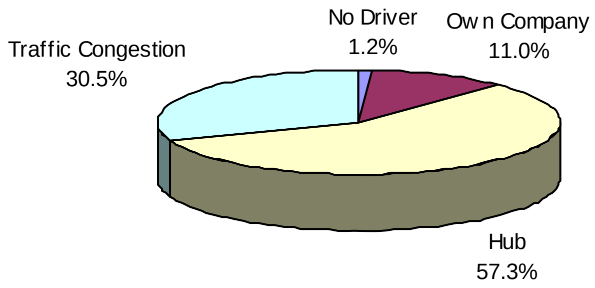

Figure 35 Delays by cause

A total of 82 instances of delays were reported, but across only 73 legs, giving a ratio of 1.2 delays per leg where there was a delay and 0.47 delays per leg across all legs run. The percentages in Figure 35 are of the total number of delays. Delays affected 44% of all legs, with an average length of 44.1 minutes. There was a total lost time of 60 hours, and at an estimated operating cost of £40 per hour this is £2,400 for the sample period, or £10,065 per vehicle per annum, giving a total of £312,000 for a full year.

The impact of these causes on individual fleets is shown in Figure 36.

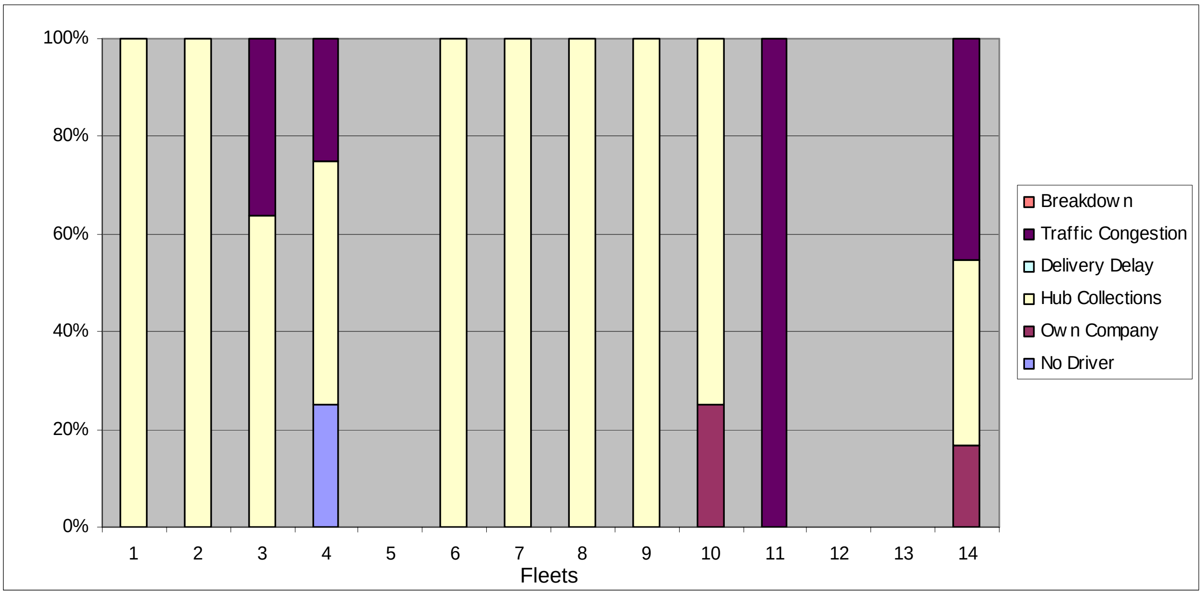

Figure 36 Causes of delay by fleet

More detail is given in Table 9 Causes of delay and time lost, and Figure 37, by length of delay by fleet. With 75% of reported delay time occurring at network hubs, these should be monitored for the benefit of both the network and the operators.

	No driver	Own co.	The Hub	Delivery point	Congestion	Breakdown
Number of delays	1	9	47	0	25	0
Delay as % of all legs	0.5%	4.8%	25.3%		13.4%	
Delay as % of delayed legs	1.2%	11.0%	57.3%		30.5%	
Average delay, minutes.	31	39	58		20	
Total delay, minutes.	31	352	2,736		505	

Table 9 Causes of delay and time lost

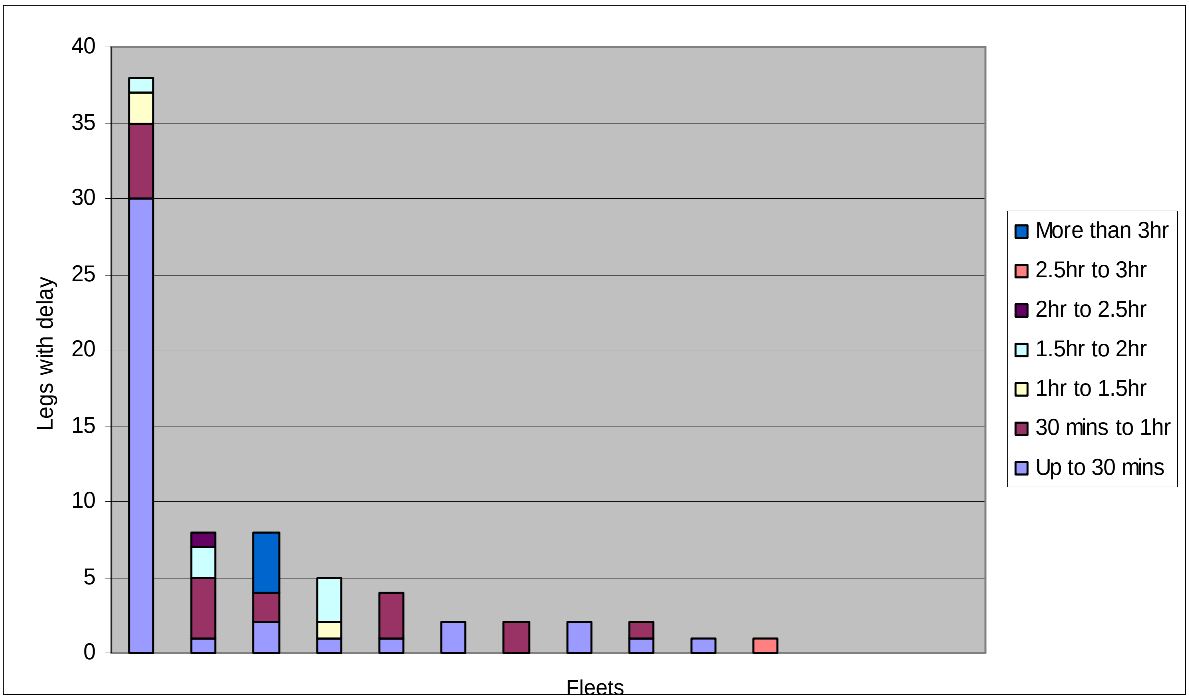

Figure 37 Length of delay in minutes

6.5 Time Utilisation

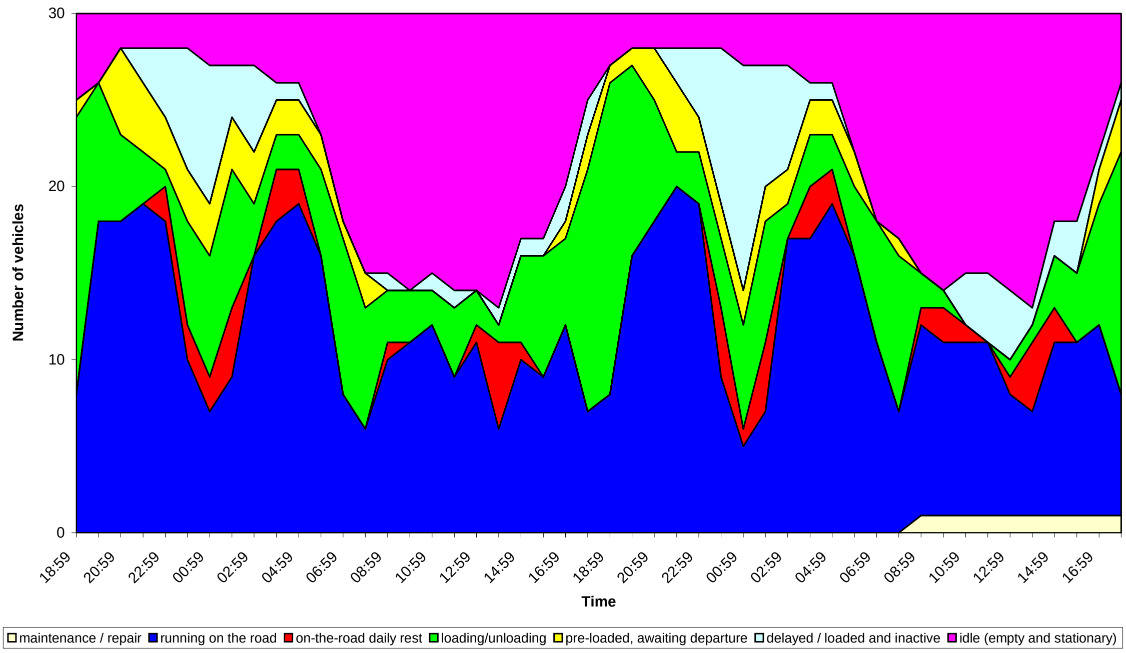

Figure 38 Hourly audit by individual vehicle

The chart in Figure 38 demonstrates a greater ability to use the trunk vehicle fleet throughout a 24 hour day, either for delivery and collection work during the day or on non-network activity This may involve standing trailers at customers' premises for loading throughout the day, although that does not appear to be the case during this survey period.

The summary by category of use in Figure 39 gives an idle time of 32% compared to 40% for the delivery and collection fleet. Across all vehicles in the 48 hour period vehicles were carrying out productive work for 57% of the time.

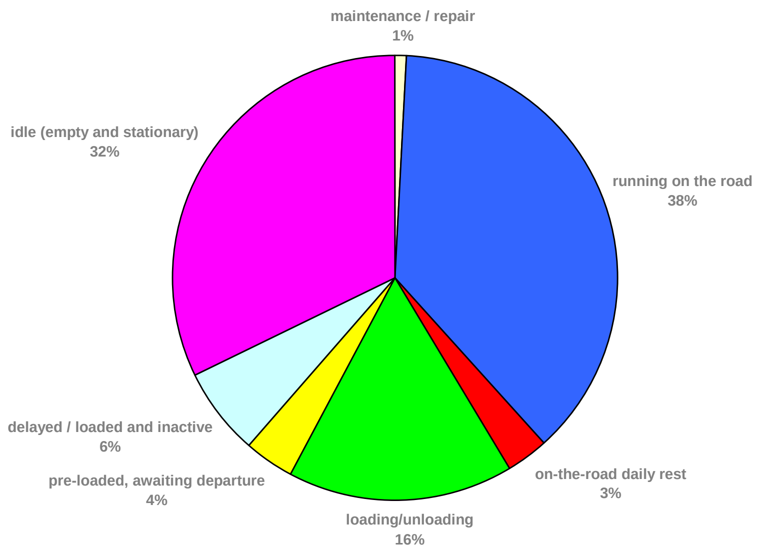

Figure 39 Summary of hourly audit, by category of use

For individual fleets the detail is shown in Figure 40, which shows idle time varying from 0% to 75%, or 40% if we ignore one extreme value. This highlights the fact that there are fleets that do not use all available hours even with night-trunking schedules.

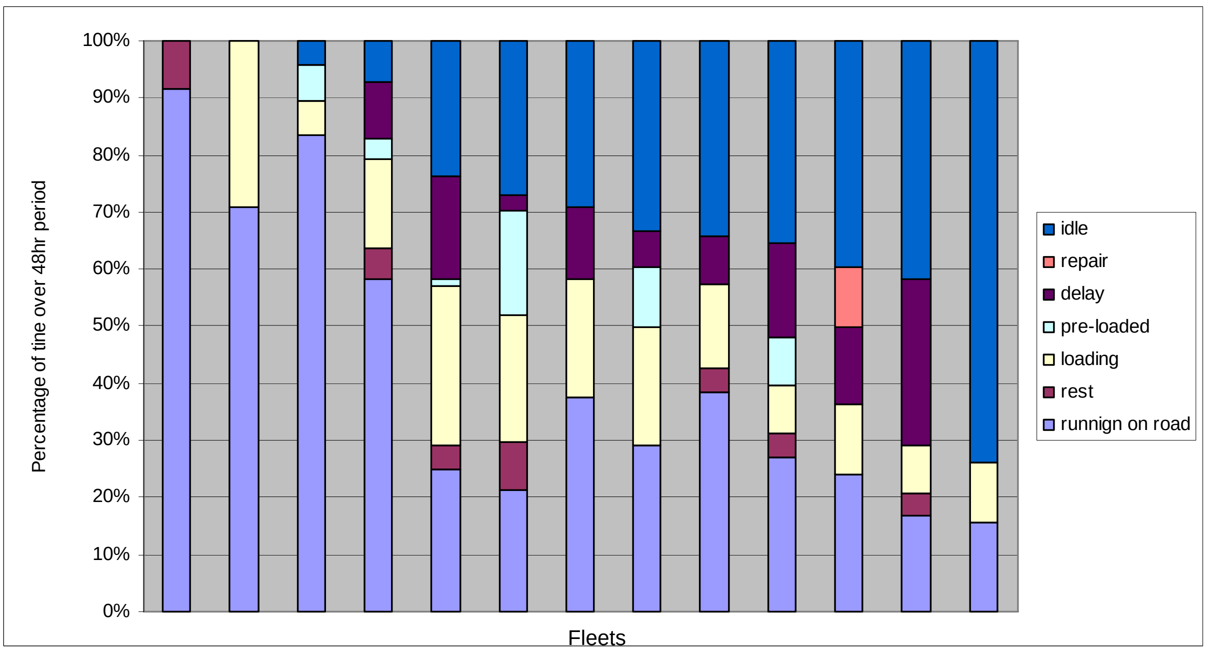

Figure 40 Time utilisation by fleet

6.6 Fuel Efficiency

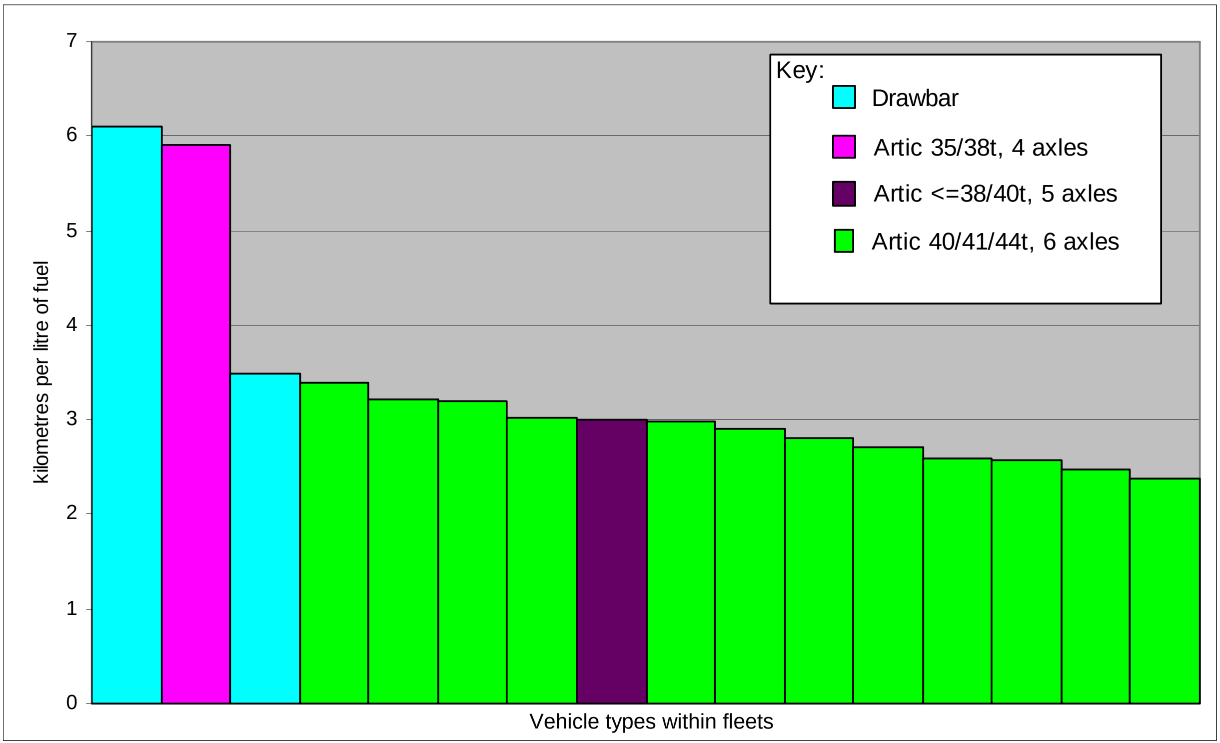

Figure 41 Fuel consumption by vehicle type and fleet

The average fuel consumption for the up to 44 tonne gvw fleets is 2.89 kilometres per litre (Figure 42), ranging from 2.37 to 3.4, as shown in Figure 41, which is a 43.5% improvement from the worst to the best. If the worst performer could move the same level as the best the it would accrue benefits of £12,271 in fuel cost savings (based on 120,000 kilometres per annum and fuel at 80p per litre) and 40.46 tonnes in reduced CO_2 emissions (based on 35.6MJ/litre and 74.1g/MJ), as well as a corresponding reduction in other damaging emissions.

The differences between various articulated vehicle types highlight the possibility of using lighter vehicles. The dimensions are similar but some costs will be less, including excise duty and initial capital cost. However, the higher weight capacity does give operators more flexibility, necessary if non-network activity is performed. The larger vehicles will also be better suited to pulling the physically larger multi-deck trailers, and may well have lower running costs because they are less stressed operationally.

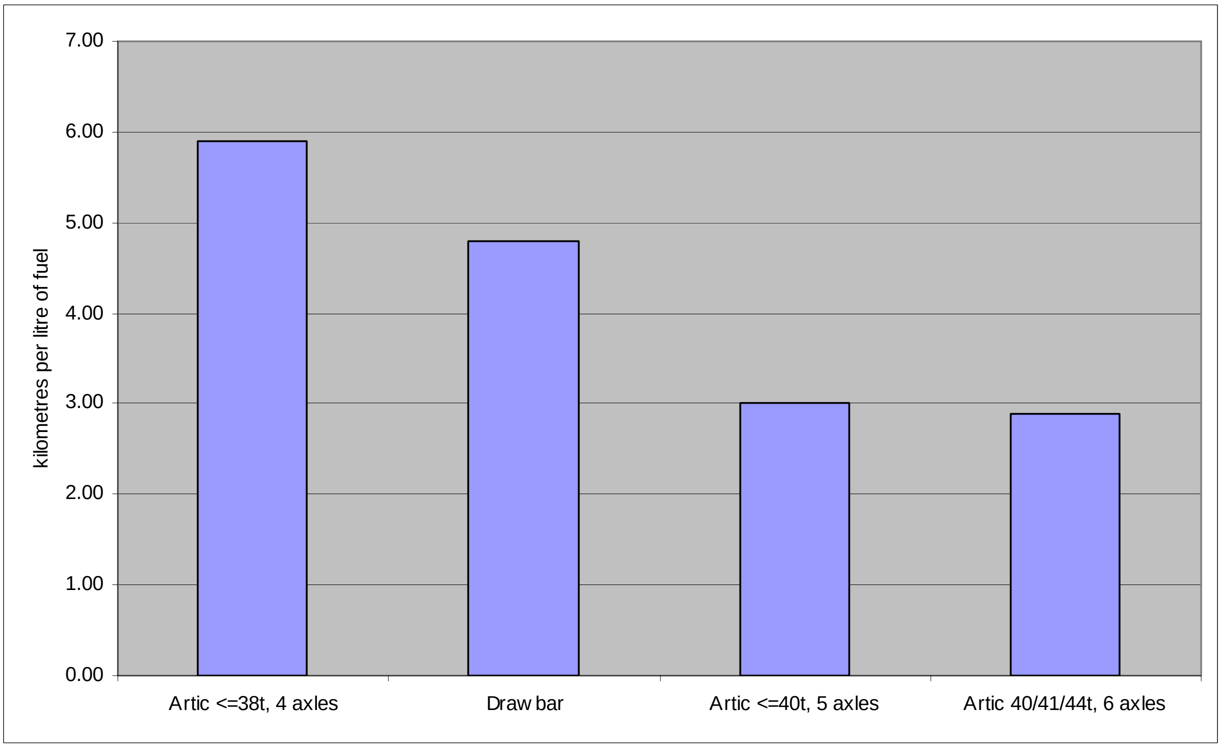

Figure 42 Fuel consumption summary by vehicle type

As described earlier, fuel consumption based on kilometres per litre takes no account of the work being carried out while the fuel is being used. A measure of energy intensity takes account of the workload performed by the vehicle against the measured fuel consumption. It is based on the load moved and distance travelled, in this case pallets per kilometre, against the fuel consumed, per 100 millilitres. The results by individual fleet show that the best performing fleet gets three times as much 'work', per unit of fuel consumed as the worst performer, as shown in Figure 43. This compares to an equivalent ratio of 2:1 for delivery and collection fleets.

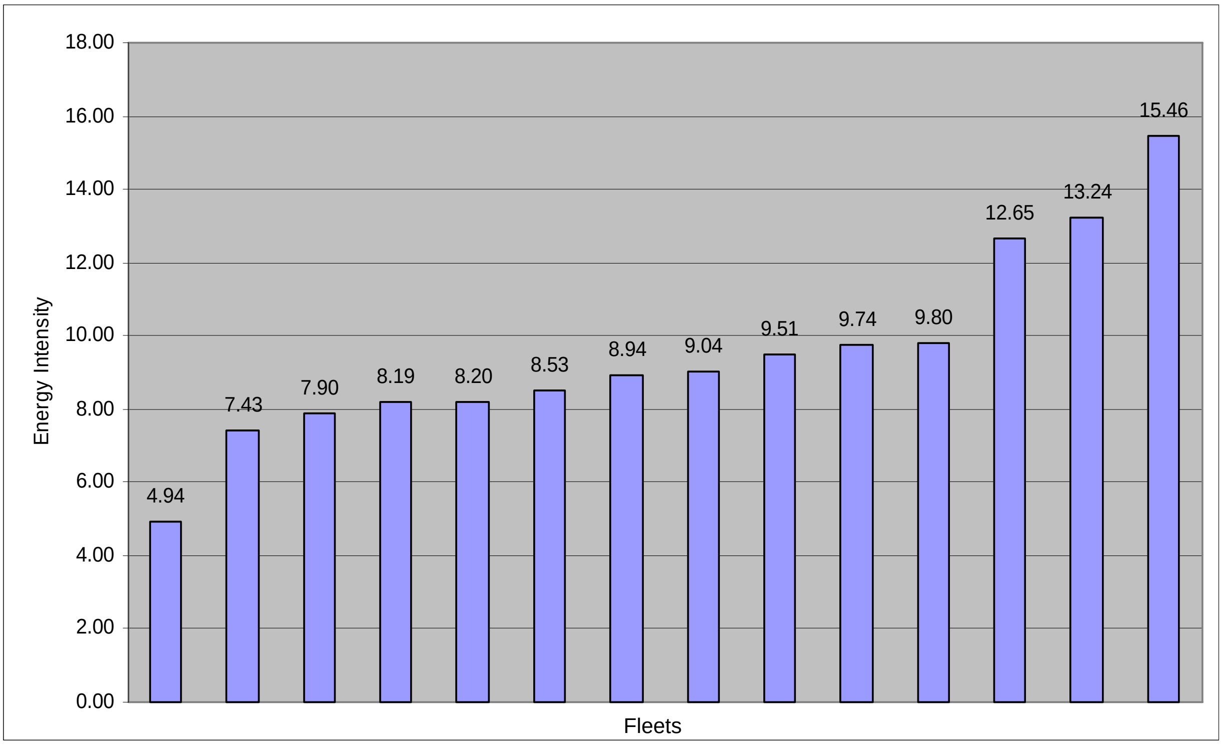

Figure 43 Energy intensity by vehicle fleet

7. FEEDBACK

All participating companies were sent a set of results that gave their own KPIs. These came directly from the data that they had collected. In addition a series of charts, together with descriptions and conclusions were circulated, using random numbers against each set of results to ensure their anonymity. Individual companies were told which set of results applied to their operations. They were all asked to provide feedback on the results, the data collection process and the actions they may take as a consequence of the results and comparisons. These are summarised on the following sections.

7.1 Data collection

Most participants commented that the collection process was very time-consuming, with the one reporting 2.5 days of effort. This is because many operators do not collect the required data as a matter of course. A number said they would not want to repeat the exercise, although they recognised the value of such data. In order to encourage operators to focus on these aspects of their fleets, and to get the benefit of doing so it is necessary to provide them with easier and simpler methods to do so.

Where operators invest in and employ suitable information technology they were able to provide the required information more easily. For example, a fleet that employed a Global Positioning Satellite system to track their vehicles was able to analyse existing reports, which then took 1.5 hours to input to the survey spreadsheet. In total they devoted 8 hours to the data collection. Others also reported that the collection was relatively easy.

Another company thought that the spreadsheet was difficult to use and suggested that a database would have made the task easier for them, requiring less understanding for the individuals performing the task.

7.2 Data availability

How operators view the collection process appears to depend on what they collect and use currently. For example, fuel consumption was recorded by some each day by vehicle and driver, in order to monitor the performance of both. One company noted that fuel consumption deteriorates as the replacement of fuel and air filters becomes due. Where fuel information was not recorded in such detail it was because of relatively short daily distances, so that filling the tank was not necessary.

A number said that they do not collect data at the level of detail required, and had to devise ways to do so. Adapting an existing driver run sheet, or using one specifically for this survey, got most people what they needed. Others realised that using a run sheet would have been beneficial. Data that was not routinely collected included the distance of each leg within a trip, the duration of time spent at each delivery or collection point. In planning one company used a 20 minute slot for each call, while another had a benchmark of 1 hour per delivery, to include the travelling. Consignment weights were sometimes difficult to obtain, although these should be provided by consignors. In practice it is rare for a pallet to be too heavy and no operators use this in their planning. The driver in planning is the number of pallets, and the service requirement for time of delivery.

One operator had all the data but it was in four different places, eg. tachograph, run sheet. As a result of the survey they have ensured that these are linked in a user-friendly way. Another has used the experience to help with the report specifications from a new software installation. Where data was more easily available in its basic form, it was not always easy to correlate various aspects. Using a database would have provided this functionality, and enabled more detailed analysis for some users. Because pallet networks provide a standard process to manage consignments certain information was available to everyone. However, where a vehicle trip included consignments that were outside the network, more than one operator found it difficult to provide the same data to complete the analysis.

7.3 Operations

Before discussing specific feedback on the results it is worth noting some points about how the various participants view their operations, as these sometimes constrain what they feel they can do to improve energy efficiency.

1. The percentage of throughput originating from the network ranged from 20% to over 50%.

2. Most operators reported that their vehicles started the day full in terms of number of pallets, and often over 2/3 full on return with collections. Some specific areas of the country did not generate much volume and so reduced the vehicle loading achieved. A known problem is that not all pallets that are advised to operators are actually received from their hub, for a variety of reasons. However, this is usually too late for a revision to delivery schedules and vehicles are under-utilised on specific trips.

3. The effectiveness of a vehicle's schedule was dependent on having clear traffic conditions, no customer hold-ups, and the service required on specific days. The need to fulfil next day deliveries meant that routes would often include longer legs in order to meet the higher priority consignments first.

4. Delays at customers arise in the main from difficult access, consignments not being ready and no mechanical handling equipment being available.

5. One operator had noted the trend to smaller and more frequent deliveries to regular customers, as a result of reduced stock-holding. This has also meant that they have to visit outlying areas on a daily basis, whereas they would prefer a nominated day schedule for these, dependent on throughput and customer numbers.

6. Because consignments for pallet distribution networks are not the only work that operators have, they have to ensure that the vehicle specifications will suit a variety of needs. This does mean that they do not always appear to be well utilised on network activity. Using vehicles with as large a cube as is practical for collection and delivery work seems to make sense for most operators. Trunk vehicles always seem to 'cube out' even when double-deck trailers are used.

7.4 Pallet network benefits

Each operator will belong to a network for their own reasons, but generally it will be to be more cost effective for their own consignments and to improve their own efficiency through additional deliveries within their home area. This was specifically stated by some, who see it as a good service offering to their own existing and new customers.

Others say that they have been able to reduce costs for their own customers, as a hub-based structure is more cost-effective than point to point deliveries. One company has stopped doing long-distance multi-delivery trips as a result of participating in a pallet network. Using night time trunk operations was estimated by another to gain them as much as one hour in three versus a day time movement, which provides certainty to their operation.

7.5 Results

The benchmarking that the results produced elicited various overall comments from participants including, 'where we expected to be', 'very useful to make the comparisons', 'did not show anything new', and a surprising ' not useful in day-to-day operations'. Some of this needs to be seen against the data that some operators do not have available and therefore do not use routinely. For some their daily benchmarks for success are each vehicle starting out full, and returning reasonably full (>50%), meeting all of their service obligations and delivering on time. If this produces sufficient profit for them they are happy with that.

One operator was happy that their trunking appeared to be efficient, while another noted that their collection and delivery fleet was used during the day only, implying that they could not do any better with this. Other notable views were that there was too much information to take in and action, or the information needed more careful analysis in order to understand what action to take.

In one case the participant said that the results confirmed their suspicion about their efficiency and would use them to instigate a further review. Another expressed an interest in finding out more about the benefits of specifying air management kit on vehicles.

Driving skills have an impact on fuel consumption rates and this was noted in one part of the country where the operator found staff quality to be less than that required. It had a direct influence on fuel consumption for him.

One operator specifically mentioned that the ability to use vehicles more efficiently was constrained by the need to meet service commitments.

7.6 Actions

Through their participation in the survey a number of operators have identified either actions that they can take to improve their efficiency, or aspects that they should look at more closely. The responses ranged from no changes to those who would be reviewing their performance in some detail. Some of the actions described were in place before the results were known, but arise from analysis of the same issues.

7.6.1 Fuel consumption

To improve fuel consumption rates there were examples of operators who:

- employ driver trainers to ensure that drivers are using the correct techniques;
- another who monitors individual vehicles for efficiency, and rotates them between routes and drivers in a controlled way;
- one who has recently started driver training to improve fuel consumption and reduce maintenance costs;
- in replacing their vehicles one company was considering contract maintenance as a way of keeping both costs and fuel use down.

7.6.2 Operations

A number of participants had made changes to how they operate in order to improve vehicle utilisation. These included:

- reorganising the trunk runs so that trips collect from multiple departure points;
- requested close monitoring of departure times from the network hub, rather than having to just manage the consequences;
- change from using under-utilised articulated trucks on collection and delivery work, operating these in other parts of the business, and reverting to rigid vehicles for local work;
- investigating how vehicles can be used throughout 24 hours to reduce the idle time incurred;
- evaluating the impact of delays on effectiveness;
- evaluating the current way drivers are utilised to increase their productivity.

7.6.3 Vehicle specification

Some operators pay close attention to the detail of the specification of their vehicle fleet.

- A number had established the benefit of fitting air management kit to vehicles, and one operator is fitting it to all new vehicles as the fleet is replaced. This is the result of its own trials that indicated at least 10% improvement in fuel consumption, with an expectation that this will be 15%.
- One operator had introduced a number of 3-axle rigid vehicles into their fleet in order to give them greater carrying capacity, both in terms of weight and number of pallets.
- Engine size had been shown to affect fuel consumption with benefit gained through specifying the next engine size above that normally sold by the manufacturer. On trunk runs this operator currently uses engines generating 420 bhp and achieves lower fuel consumption than with smaller engines previously specified. They are now evaluating 450/460 bhp engines.

- Another operator mentioned that they are now looking to upgrade the specification of their trunk vehicles.

- On-board computing was mentioned only once and considered to be too expensive to make it a paying investment.

7.6.4 Reporting and KPIs

There is support to continue monitoring a range of KPIs as a direct result of the experience and outcome of this survey, although a number of smaller operators do not see the need for this level of reporting and analysis. Network principals feel that it would beneficial for both these operators and the network service but their commercial relationship does not provide the scope for any insistence in this area.

- One participant in particular, would not change unless he had to do so as a requirement of his membership of a network.

- Another is to adapt his current reporting information system to produce a number of similar reports.

- One participant, who is new to the industry, reported that it helped him to identify a number of areas for investigation.

- The continued use of KPIs is dependent in some instances on them being easy to compile and interpret.

- But a number of participants thought that a sector-wide initiative would be beneficial, possibly in the form of a bench-marking club.

8. OPPORTUNITIES

There is a range of opportunities for all operators within the pallet network sector that are also available to all regional and small fleet operators. With up to ten networks currently competing in the sector, with an average of, say, 50 members/franchisees each that is 500 companies with some shared interest in similar performance measurement, including those indicators used in this survey. Many other fleet operators will have similar needs. From the analysis within this survey and the subsequent discussion with participants a number of opportunities have been identified, which fleet operators can pursue for themselves. Within networks these opportunities and experience could be shared if there are no commercial issues between the participating companies.

1. Measurement. There is scope to collect more detailed data about an operation. Clearly, this must not be too onerous and the reporting must be used or its credibility is lost. This includes fuel consumption by vehicle and driver, against the type of trips they are travelling.

2. Vehicle utilisation. Although pallet spaces are the controlling factor in this sector, it would be worthwhile monitoring cube and weight factors, as only then will it be seen how well vehicle capacities are actually being used.

3. Vehicle size. Whilst trunk vehicles seem to be well utilised in cube and pallet space terms, collection and delivery vehicles are limited by the maximum 14 pallets that most hold. This may suit the time available for a vehicle trip but there could be scope for some double-deck designs. The role of each vehicle and the need for flexibility are factors to be considered, as is the fact that many customers do not have their own mechanical handling equipment.

4. Vehicle specification. Consider key aspects of the vehicle such as engine size, fitment of air management kit, and, although not measured in this survey, aspects such as wheel rim diameter.

5. Driver training. With fuel still contributing up to a third of operating costs the importance of correct driving techniques must not be underestimated. A programme that monitors not only consumption against individual drivers, but also their driving techniques through observation or analysis of records such as tachographs will show up where improvements are possible.

6. Vehicle maintenance. Correctly maintained vehicles return better fuel consumption.

7. Telematics. It seems to be difficult for some fleet operators to justify the investment in telematics, but there is a large variation in what can be fitted. Potential users should make sure that they have identified all of the benefits they could gain, especially through correlating all the information available to them. In a pallet network there may be scope for fleets to cooperate in an investment programme. Alternatively, there could be some commercial gain through having installations that can also support the tracking of consignments and providing electronic signatures.

8. Service. Although customer service is a key commercial advantage, many operators will not know the profitability of servicing each customer. This is influenced by the distance they are from the previous delivery/collection point, how often they are serviced and the size of each consignment. These and other factors, such as turn-around times, will influence the utilisation of each vehicle. It may be possible to manage the service each customer receives, such as reducing the frequency of delivery in outlying districts. In extreme cases it may be more profitable to stop working with certain customers.

9. Vehicle scheduling. Those responsible for scheduling the vehicle fleet are usually very experienced operators, but as notifications of deliveries for the next day are received relatively late there could be some benefit in using vehicle scheduling software. This would give the scheduler the ability to try a number of different scenarios in a very short space of time, especially if linked to a download from the network hub. It could also aid performance monitoring. Clearly the benefits are greater for larger operations, but there are many applications to choose from, some of which are aimed at smaller fleets.