

# Standardising DRT metrics to compare fleet performance

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## Abstract

Demand Responsive Transport (DRT) schemes operate in many different areas in the UK. This paper suggests a set of standard metrics to help compare scheme performance for different designs and different contexts.

To find a set of metrics appropriate to DRT, we considered the data set out in the DfT Rural Mobility Fund Interim Report<sup>1</sup> and the data available to DRT services using tools provided by Padam Mobility. In order to help contextualise these schemes within the bus network and national travel patterns, we cross reference these with existing metrics for bus use and journey data from the UK Department for Transport Annual Bus Statistics<sup>2</sup> and the National Travel Survey<sup>3</sup>. This provides context to the metrics for DRT.

The worked example suggests that the DRT schemes was launched in an extremely poorly served area with a long standing public transport deficit. From this low baseline, the DRT use is impressive and has increased bus use. The cost of provision across the area is estimated at less than £10 per head of population per year.

Whilst the metrics can be used to compare the performance of different DRT schemes, there are real disparities between the detail available for fixed and DRT services which suggests that more granular data for fixed line services is required to better benchmark services.

## Background

In the UK, bus statistics are collected annually and reported in the following categories:

- Passenger journeys and percentage of concessionary travel
- Passenger boardings by time of day
- Bus use by local authority
- Passenger journeys per head of population in different authorities
- Mileage of routes measured in bus service vehicle miles
- The percentage of supported bus services the percentage that are commercially run
- The vehicle specification, including vehicle details such as their facilities (charging, wireless, CCTV), accessibility, ticketing (ITSO, contactless etc), location data (for information systems), audio visual information, and fuel/emissions standards
- Fleet – the overall numbers of buses and the age of the fleet
- Fares
- Operating costs
- Drivers, numbers, pay, hours, age, disability awareness training
- Punctuality of buses that run to timetable (or meet the advertised frequency of ‘every x minutes’)

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<sup>1</sup> <https://www.gov.uk/government/publications/rural-mobility-fund-evaluation-interim-report>

<sup>2</sup> <https://www.gov.uk/government/statistics/annual-bus-statistics-year-ending-march-2023/annual-bus-statistics-year-ending-march-2023>

<sup>3</sup> <https://www.gov.uk/government/statistics/national-travel-survey-2022/national-travel-survey-2022-notes-and-definitions>

- Passenger satisfaction (derived from the Transport Focus Bus User Weekly Survey and the TfL Customer Satisfaction Survey)

In addition the DfT National Travel Survey provides a picture of

- Average trips, miles and minutes of bus use plus reasons for travel
- Frequency and length of trips
- Characteristics of bus users – car ownership, disability / mobility difficulty, household income

The DfT National Travel Survey also collects sets of statistics on travel by four different classifications which describes the number of trips and distances travelled with modes of transport in:

- Rural Village, Hamlet and Isolated Dwellings
- Rural Towns and Fringes
- Urban Cities and Towns
- Urban Conurbations

The DfT Rural Mobility Fund Interim Report collected additional data on DRT scheme performance. Although it was not possible to collect this for all schemes it aimed to include:

- Operational data
  - number of vehicles
  - operating hours and days
  - number of miles
  - running without passengers etc
- Usage data
  - passengers by month including passengers on concessionary
  - fares
  - unfulfilled bookings
  - average journey length
  - key destinations etc.
- Passenger demographics
  - age and gender of users
- Financial data
  - Revenue
  - public subsidy
- Marketing and promotional activities
- Any changes to DRT scheme

In addition, the report contextualised these schemes by looking at:

- Residential populations served – size of populations, density
- Area served (size, urban rural description)
- Feeder vs within zone services
- Door-to-door / corner to corner
- Fare structure (mileage, zonal, fixed)
- How journeys can be booked (app, website, call centre)

It also provided tabulated data for each scheme comprising:

- Settlement structure
- Population
- Area (sq km)

- Population density (person/sq km)
- Feeder locations served external to operating zone
- Service model (C to C v D to D)
- Number of vehicles
- Size of vehicles
- Days of operation per week
- Hours of operation

And detailed some of the functionality of the schemes such as:

- Integration with other modes eg bus and train stations
- Integrated ticketing with other bus services
- Maximum and minimum time bookings could be made in advance
- Ticketing options and discounts (adult, children and young people, older people, disabled people, other, £2 fare cap)

The report also looked at the following set of usage data for the schemes:

- Percentage of bookings over different methods
- Actual range of booking times before use
- Average journey lengths (distance and minutes and miles per hour)
- Vehicle utilisation rates (measured in terms of average daily distance travelled per vehicle with passengers). This set of metrics also calculated the total miles with passengers and total miles without passengers or the average monthly distance with and without carrying passengers. In the DfT review this is called the 'empty running ratio'.
- Unfulfilled journey bookings
- Number of passengers per revenue hour
- Revenue per passenger

### Additional Metrics

We propose to augment these metrics with additional calculations that take into account the size of the scheme and provision of services in relation to the population size, density and dispersal of the population, to enable the benefits to areas of DRT to be more fully captured.

### Rationale

Whilst per passenger costs are useful and have been used to compare schemes they need to be contextualised. One baseline is the overall availability of public transport to the population living in the area. Where people have no other access to public transport, the availability of DRT has a much higher value to the population. We look at the provision of buses per 100km<sup>2</sup> and also the bus per head of population to give a broad picture of transport availability and the extent to which DRT augments it.

Some features will also affect the efficiency of a scheme. DRT schemes covering a large area with a small number of vehicles often struggle to get high numbers of passengers per vehicle hour and therefore find it difficult to reduce costs per passenger.

For this reason our additional metrics can be described in three groups; capacity indicators, utilisation indicators and indicators which describe the relationship between the capacity and the area covered. In addition, we look at the Annual Bus Survey metrics for the area – the number of vehicle service miles, the trips per person and the ratio between service miles and trips per person. These metrics will help benchmark system designs and models for different locations, population types and densities.

### Capacity indicators

These metrics are intended to help understand how much of the overall capacity of the scheme is utilised. They could be used for insight into when additional capacity is needed as well as into the efficiency of the services. Different schemes will have differences in shift structure and operational hours, and use different vehicle sizes. In order to be able to compare schemes without introducing anomalies due to vehicle size and operational differences we propose capacity indicators of:

- Total vehicle hours per week - in order to reduce variations which may be due to shift structure and operational hours
- Total seat hours per week - this will help to comparison between schemes with different capacities enabled by vehicle size

### Utilisation indicators

These can be calculated for monthly periods or more granular periods (weeks and days) to show fluctuations in usage - both busy and under utilised periods.

- Passengers per vehicle hour - this can be calculated by dividing number of passengers by vehicle hours for the period.
- Passengers per seat hour - this can be calculated by dividing the number of passengers by seat hours for the period.

### Additional metrics

These metrics are intended to identify whether an area is well served by DRT (or indeed bus) as it could prove a useful piece of context if we compare different areas. It could potentially compare the efficiency of schemes (achieving good grouping even with a small number of seats and vehicles in a large area is very efficient). The DfT has a 'bus use per head of population' metric which could be contextualised with bus provision per head of population and by area.

- Vehicles (or vehicle seat hours) per km<sup>2</sup> served
- Vehicles (or vehicle seat hours) per population served
- Passengers per revenue hour (revenue hour is equal to vehicle hour)

### Conclusion

The worked example below highlights that fixed line bus data is not available to the same degree of granularity as DRT data. Whilst it hints at provision and provides averages across England, it conceals some deep disparities. It's possible, for instance, to count the fixed line buses traversing the iTravel area but not to map and count them for the whole of Cheshire West. Equally we can see the vehicle capacity availability for DRT but not for buses as a whole, which makes the average loading as a percentage of capacity for the total fleet impossible to calculate and compare.

It does, however, demonstrate the paucity of provision into which the DRT scheme was launched, and, whilst showing an improvement, it also shows that the number of vehicles in the area in no way matches the average for the authority or indeed for England as a whole.

One of the gaps in data is that it does not provide a benchmark for the cost of bus provision against which to compare the cost of DRT, either on a per passenger or per head of population basis. We can, however, calculate the cost per head of population and per km<sup>2</sup> (per annum) of making public transport available area wide.

**Appendix 1** is our Standard Metrics proposal

**Appendix 2** is an example of how these metrics may be applied to an existing scheme in Cheshire.

## Standard Metrics Proposal

### General scheme details

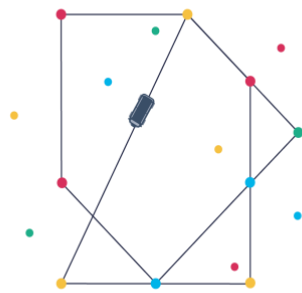
For each scheme we set out a standard set of metrics to describe a general outline of the scheme. The labels ABS, NTS and RMFIR relate to the other reports in which these metrics are used, and relate to the Annual Bus Statistics, the National Travel Survey and the Rural Mobility Fund Interim Report respectively. Additional metrics are labelled AD.

- Place name: Although this should be simple, the different structures applicable in rural areas mean that this could refer to the local authority, key towns or villages or parishes. It is hard to standardise but indicative place names provide useful information.
- Area covered (km<sup>2</sup>) [RMFIR]
- Population covered: There are five relevant population metrics
  - The total population of the area intended to be served by the scheme (ie lying within the bounds of the DRT area) [RMFIR]
  - The population density of the area [RMFIR]
  - The typical residential population actually served by the scheme [AD]. This can be calculated as population within the area of the scheme, however it's important to note that different scheme designs have implications for the populations served. Services running 'door to door' would generally serve the whole population (deducting any exclusions). Other designs and models specifically exclude certain trips (and therefore certain populations). For instance where there are feeder models or 'key hub' stops. This means that the population within a rural area is able to use the service to access the key hub stops within larger towns, however the rest of the town is excluded (because alternative provision is available). For these designs and models we suggest the population covered should be calculated as those persons living within walking distance of a virtual bus stop. Service designs can and do evolve with additional virtual stops added on request so this should be reviewed from time to time.
  - The proportion of the population served by the DRT (the population within the area who can access it). [AD]
  - The population served by the DRT scheme who do not otherwise have access to public transport at least once per hour [AD]
- Type of area [RMFIR]: for these metrics this is defined using the UK definition in the National Travel Survey
  - Urban  
Urban areas are the connected built up areas identified by Ordnance Survey mapping that have resident populations above 10,000 people (2011 Census).
  - Rural  
Rural areas are those areas that are not urban, for example consisting of settlements below 10,000 people or are open countryside.
- Vehicle details [ABS / RMFIR]: As provided by operator
- Days and hours of operation [RMFIR]: As provided by service
- Service model description [RMFIR]: There are several different models of DRT which may be door to door, corner to corner (all street corners deemed suitable are pick up or drop off points) or between 'virtual bus stops'.  
These models may be further configured in a number of different ways, including 'free floating' in which all possible stops are served in any combination; 'feeder' services which carry people between points within a defined area and a point or points outside it (often interchanges with

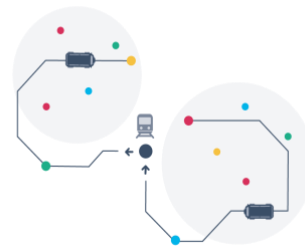
other modes). Other variations include 'on-demand fixed line' where the bus travels along a fixed corridor but only picks up people who have booked at the times booked; 'virtual line' where the bus largely follows a fixed line route during certain hours so that passengers can anticipate the service but diverts to pick up people just off the route who have booked. Services can be configured to be multi-zone with rules governing the areas they can travel between or divergent where a multi-vehicle service can take people to or from a key hub to a variety of destinations in different directions .

The options largely conform to the following diagrams:

free floating



feeder



fixed line

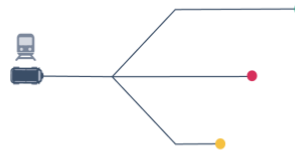
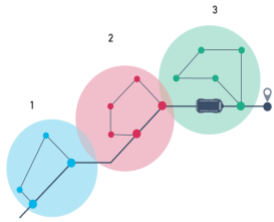


virtual line



multizones

divergent



- Booking description [RMFIR]: This includes the method of booking (app, online, call-centre) and the minimum and maximum time before travel to indicate whether the service facilitates pre-booking or real-time booking.
- Ticketing description: This includes:
  - types of ticketing used for the service (on board or pre-booked),
  - fares [ABS],
  - fare structure [RMFIR] (are they mileage based or zonal)
  - how the service fares relate to local ticketing prices eg more/less or a standard fare [AD]
  - acceptance of concessionary passes and discounts [RMFIR]
  - integration with other modes and other bus services [RMFIR].

#### Passenger details

This is intended to give an idea of passenger volumes and profiles and the kinds of trips being made.

- Total number of passenger trips [ABS] [RMFIR]
- % trips by booking method [RMFIR]
- Passenger types (full fare, concessionary - young person, older person, disability) [ABS] [RMFIR]
- Actual range of booking times before trip [RMFIR]
- Average booking time before trip [AD]
- Boarding by time of day in hourly units eg 7-8am, 8-9am etc (this will indicate when the service is busy and to what extent peak and off peak patterns apply and enable comparison with timetabled services).[ABS]
- Average journey length (km) [RMFIR]
- Average journey time (mins) [RMFIR]
- % of unfulfilled journey bookings [RMFIR] - where someone has booked but is not picked up (this is an indicator that can show if a service is difficult to use or whether it is being misused - there are some more granular information available as passengers are asked their reasons for no-shows however full understanding of each service has to be done using follow up communications)
- Total number of unique individuals using the service (all time / per year / per month) [AD – although this enables comparison with ABS data about bus use over population]
- Average trips per passenger and the range this covers. We suggest tabulating the number of people using the service 1-5 trips per month, 5-19 trips per month and more than 20 trips per month. This indicates how regularly the service is used and how much it is relied on by passengers. [AD]



- Passenger satisfaction measures [ABS] [RMFIR]- these are generally collected by the technology platform however additional customer surveys can be used to augment this. The ratings should be analysed for all time / per year / per month to understand any variations which might be due to operations.

#### Operational details

These are details for outlining the operational conditions and efficiency.

- Fleet details [ABS] [RMFIR]
- Number of drivers / working hours required or shift structure [ABS]
- Actual mileage per month [RMFIR]
  - time not moving, empty running and with passengers
  - mileage empty running and with passengers

#### Contract details

This is intended to capture the relationships between the organisation, bus operator and technology provider. It helps capture details about operations collected in the ABS.

- Contracting authority or organisation
- Operator
- How the three parties relate contractually

#### Capacity indicators

These metrics are intended to help understand the overall capacity of the scheme and how full it is. They could be used for insight into when additional capacity is needed as well as into the efficiency of the services.

- Total vehicle hours per week - in order to capture differences in shift structure and operational hours [AD]
- Total seat hours per week - this will help to capture the different capacities enabled by vehicle size [AD]

#### Utilisation indicators

These can be calculated for monthly periods or more granular periods (weeks and days) to show fluctuations in usage - both busy and under utilised periods

- Passengers per vehicle hour - this can be calculated by dividing number of passengers by vehicle hours for the period. [AD]
- Passengers per seat hour - this can be calculated by dividing the number of passengers by seat hours for the period. [AD]

#### Relational metrics

These metrics are intended to identify whether an area is well served by DRT (or indeed bus) as it could prove a useful piece of context if we compare different areas. It could potentially compare the efficiency of schemes (achieving good grouping even with low provision is very efficient). The DfT has a 'bus use per head of population' metric which could be contextualised with bus provision per head of population and by area.

- Vehicles (or vehicle seat hours) per km<sup>2</sup> [AD]
- Vehicles (or vehicle seat hours) per per head or per 10,000 population [AD]
- Passengers per revenue hour (= vehicle hour) [AD]

#### Costs

The combined metrics can be used to calculate:

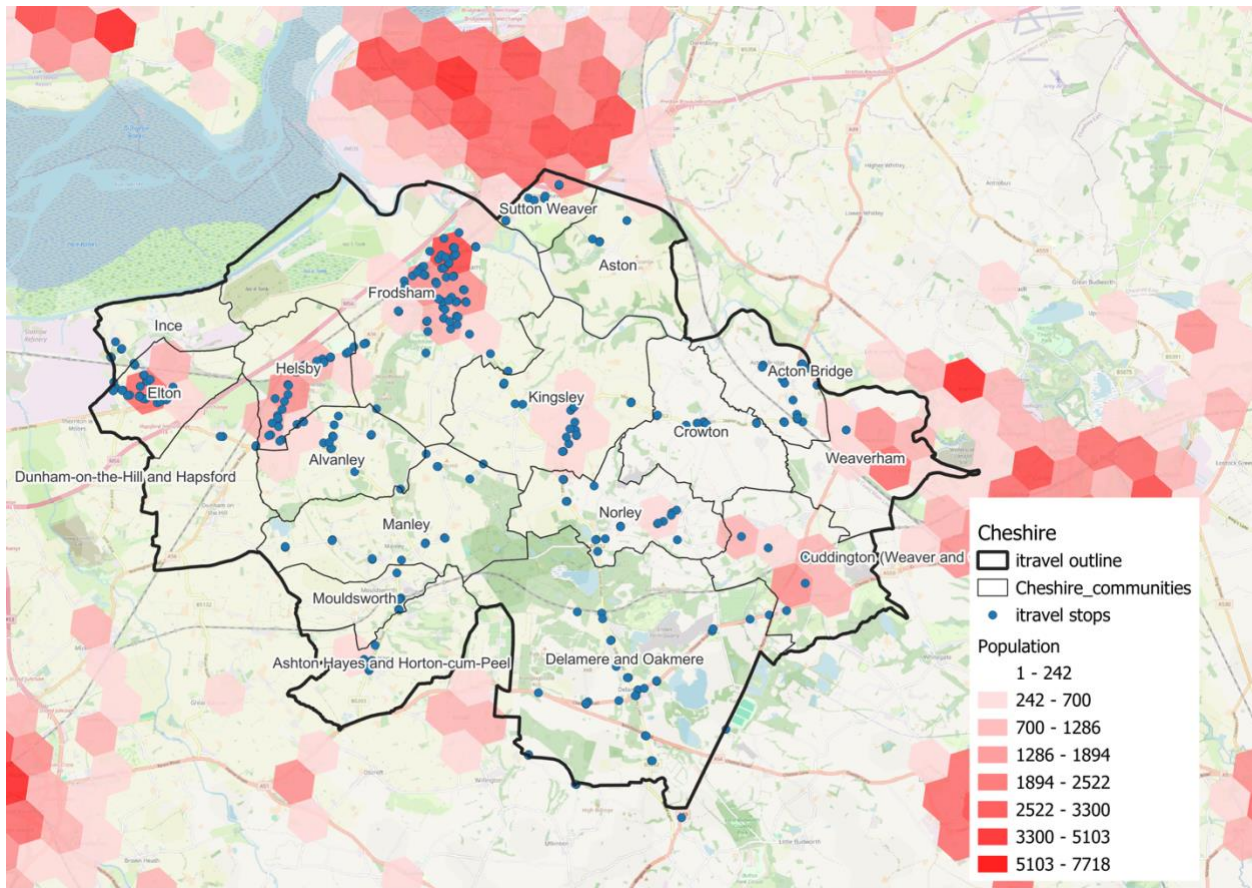
- cost per passenger trip
- cost of provision per population
- cost of provision per km<sup>2</sup>.

These can be used to benchmark against the existing bus network which is tracked in the Annual Bus Survey statistics.

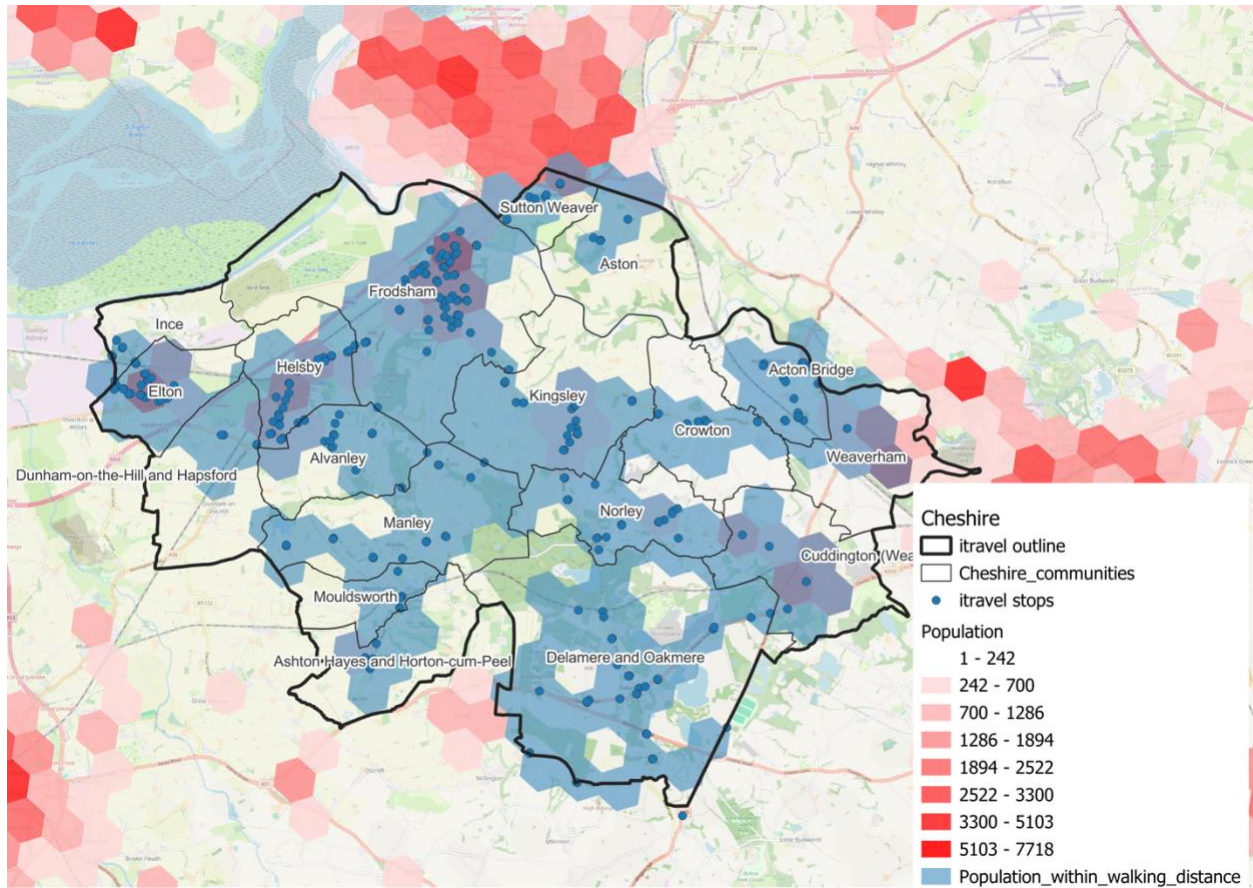
Worked example:

Place name: Cheshire West

Area: The area covered is 150km<sup>2</sup>  
The total population within the DRT area is 47258 and of that population the service is currently designed to cover 38,725 people (just over 80% of the population).  
The approximate population density is 315 people per km<sup>2</sup> – slightly less than the total population density for the whole authority of 388 people per km<sup>2</sup> <sup>4</sup>.  
This is a rural area – no settlement has more than 10,000 residents



<sup>4</sup> <https://www.ons.gov.uk/census/maps/choropleth/population/population-density/population-density/persons-per-square-kilometre?lad=E06000050>



### Service details

- 2 x 14 seat minibuses
- Monday – Friday 7am to 7pm (125 hours per week)
- The service design is free floating between virtual stops and is designed around links to stations.
- Booking is by app, online and by call centre and the service can be booked between 10 minutes and 30 days before travel.
- Fares are a standard with £2 single journey within the designated zone (supported by UK government £2 fare scheme in 2023-24) and half fare for young people up to the age of 19. English National Concessionary pass holders travel free.

### Passenger details

Total number of passenger trips	12,404 to end May 2024 Most recent full month May 2024 : 1462
% of trips by booking method	Website : 5-9% Call centre : 15-20% App : 70-80%
Passenger types (full fare, concessionary – young person, older, disability)	£2 fare, 50% fare for young people upto age of 19, ENC pass holders free
Actual range of booking times before trip (may 2024)	Hours between booking-search between 10 minutes and 718 hours (almost 30 days)

	<p>Average : 68.9 hours (2.87 days)  Median (mid point of data) : 14.8 hours  Mode (most frequent) : 0.3 hours (about 20 minutes)</p>																												
Boarding by time of day	<p>The most popular boarding hour is between 0800 and 0900, followed by 1500 to 1600 (table to April 2024)</p> <table border="1"> <thead> <tr> <th>Time (hours)</th> <th>Count of Actual Pickups (all time) in that hour</th> </tr> </thead> <tbody> <tr><td>6</td><td>20</td></tr> <tr><td>7</td><td>492</td></tr> <tr><td>8</td><td><b>780</b></td></tr> <tr><td>9</td><td>481</td></tr> <tr><td>10</td><td>475</td></tr> <tr><td>11</td><td>510</td></tr> <tr><td>12</td><td>423</td></tr> <tr><td>13</td><td>460</td></tr> <tr><td>14</td><td>449</td></tr> <tr><td>15</td><td><b>685</b></td></tr> <tr><td>16</td><td>527</td></tr> <tr><td>17</td><td>526</td></tr> <tr><td>18</td><td>392</td></tr> </tbody> </table>	Time (hours)	Count of Actual Pickups (all time) in that hour	6	20	7	492	8	<b>780</b>	9	481	10	475	11	510	12	423	13	460	14	449	15	<b>685</b>	16	527	17	526	18	392
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Average journey length (km)	5.95 miles (9.52 km) (May 2024)																												
Average journey time (mins)	11.73 minutes (March 2024)																												
% of no shows	<p>In May 2024  4.7% of bookings (90 people) were absent at the point of pick up  19.8% (380 people) cancelled their bookings  <i>These people are not included in the trip data.</i></p>																												
Total number of individuals using vehicle (all time/yr/month)	<p>In May 2024: 212 individual users  All time individual users 785</p>																												
Average trips per passenger and range	<p>On average 5.76 trips per passenger (May 2024)  Breaking down to:  9 passengers making more than 20 trips per month, in fact 353 regular trips  49 passengers making 5-20 trips per month (a total of 614 trips)  154 passengers making less than 5 trips per month totalling 495 trips</p>																												
Passenger satisfaction measures	May 2024 99.08% of ratings are 5/5																												

Operational details

Fleet details	2 x 14 seater vehicles
Number of drivers / working hours required	variable
Actual mileage per month	May 2024 6,800 miles

Percentage time not moving, empty running and with passengers	Parked 26% Empty 39% Loaded 35%
Percentage mileage empty running and with passengers	Extra distance 15.3% (operational reasons) Transit distance 34.8% (travelling empty to pick up) Loaded distance 49.9% (with passengers) Data from March 2024

**Contract details**

The Local Authority has contracted Stagecoach to operate the service and provide customer service with Padam Mobility providing the technology platform.

**Capacity indicators**

These metrics are intended to help understand the overall capacity of the scheme and how full it is. They could be used for insight into when additional capacity is needed as well as into the efficiency of the services.

- Total vehicle hours per week - in order to capture differences in shift structure and operational hours [AD] 125
- Total seat hours per week - this will help to capture the different capacities enabled by vehicle size [AD] 3500

**Utilisation indicators**

These can be calculated for monthly periods or more granular periods (weeks and days) to show fluctuations in usage - both busy and under utilised periods

- Passengers per vehicle hour – reached a high point of 3.27 in March 2024, for May 2024 (1462 passengers over 500 vehicle hours) is 2.92. [AD]
- Passengers per seat hour – (1462 passengers over 7000 vehicle seat hours). [AD] 0.21

**Relational metrics**

These metrics are intended to identify whether an area is well served by DRT (or indeed bus) as it could prove a useful piece of context if we compare different areas. It could potentially compare the efficiency of schemes (achieving good grouping even with low provision is very efficient). The DfT has a ‘bus use per head of population’ metric which could be contextualised with bus provision per head of population and by area.

- Vehicles capacity per km<sup>2</sup> [AD]
  - 2 vehicles for 150km<sup>2</sup> is 0.01 vehicle per km<sup>2</sup> equivalent to just over 1 vehicle per 100km<sup>2</sup>
  - 0.19 seats per km<sup>2</sup>
  - 0.83 vehicle seat hours per week per km<sup>2</sup>
- Vehicle mileage per km<sup>2</sup>
  - The iTravel service would expect to travel about 82,000 miles – 547 vehicle miles per km<sup>2</sup> – over the year. There is some relation between miles traveled and passenger numbers
- Vehicle capacity per 10,000 population [AD]
  - 0.52 vehicles per 10,000 population / 1 bus per 23,629 people
  - 32.28 vehicle seat hours per week per 10,000 population

#### Within context

Cheshire West and Chester is an area where bus use is below average - people made 6.4 million passenger journeys, on average 17.9 passenger journeys per person per year (against an average of 40 for the North West as a whole and 36 for England outside London).

The calculations point to extremely uneven provision of buses even within this area. On average there is one bus per 2,268 people in England outside London – however iTravel was launched in an area previously served by 4 vehicles running along the northern edge of the area and equivalent to 1 bus per 11,815. iTravel increased the vehicle numbers to 6 – equivalent to one bus per 7,876 people. The total number of bus vehicles for Cheshire West and Chester as a whole is not available for comparison.

The cost for serving 80% of the population within the 150km<sup>2</sup> iTravel area can be estimated from the grant provision - £1.075 million over 3 years. This implies an approximate cost per km<sup>2</sup> of £2,389 per annum and £9.25 per head of population served (within walking distance of a virtual stop) or £7.58 per head of total area population (assuming the DRT stops could be adjusted to cover additional requests). The reported cost per passenger carried fell dramatically from the start to around £10 per passenger. Comparison with fixed lines is, however, difficult.