

Connectivity Travel Time Indicators: England, 2011 data (experimental)



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Summary

These new experimental statistics present travel time data and indicators to measure connectivity from each area of England to transport destinations – major airports, stations, and road junctions – by car and by public transport.

This document introduces the travel time dataset, which is effectively the result of a large number of journey planner queries, and illustrates ways in which it can be used.

The level of detail available makes the dataset useful for visualising travel time patterns at national and local level.

There are also various summary measures of transport connectivity, including:

- **Travel time indicators** (average travel times, travel time to nearest)
- Indicators measuring **access to destinations** (e.g. catchment populations)
- Indicators counting **number of destinations** within given travel times of each area



Note: this map is described on page 9

Request for feedback

We are publishing these experimental statistics, to assess whether they and/or the underlying dataset are useful. Feedback on potential uses and methodology used can be provided via our [online form](#) or by contacting the team directly via the details above.

Although this release relates to transport destinations, similar statistics could be produced for other destinations subject to user interest.

Underlying data

Detailed [statistical data tables](#) containing these indicators are published alongside this release.

The full underlying dataset, which allows users to produce their own analyses, is published at data.gov.uk.

In this publication

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About these statistics

These statistics are calculated from the results of journey time modelling which uses a snapshot of data from public transport timetables and road network information to estimate the minimum travel time from each small area (origin) to each specified destination (e.g. airports). This methodology extends that used for the established accessibility statistics to consider longer journeys to more strategic destinations.

Introduction

DfT has published the results of journey time modelling algorithms for many years in the annual [accessibility statistics](#), which measure access from small areas (origins) to a range of key services (destinations) and are widely used for local service planning by local authorities.

These *connectivity* statistics are constructed in a very similar way, but with a focus on longer journeys to access fewer, more strategically significant destinations. This release focuses on access to the transport network itself, by looking at access to transport gateways, but the approach offers scope to extend to a wide range of other destination sets.

This document aims to illustrate potential uses of the statistics, rather than presenting a comprehensive analysis of the data. Therefore it contains a high level summary of the results and some illustrative examples.

We are publishing these results as experimental statistics¹ for the purposes of user consultation, to assess the potential value of producing further statistics of this nature. The results of any feedback from potential users will feed into a wider review of the accessibility statistics, which will be published alongside those statistics in September. We would particularly welcome any comments on:

- Usefulness of the raw dataset
- Usefulness of aggregate statistics and tables
- Any other destination sets of interest
- Methodological details

We anticipate that much of the value in these statistics will come from analysis of the underlying dataset, which we are publishing alongside this release in as much detail as possible including travel times for each (small area) origin and destination pair.

Why we've produced these statistics

Potential uses are illustrated

We are seeking any feedback via our [online form](#)

Get the dataset <http://data.gov.uk/dataset/connectivity-travel-time-data>

Overview of the statistics

Calculation

In summary, the figures presented are the results of journey time modelling which uses information on road network and traffic speeds, and public transport timetables to find representative travel times between each small area origin (Lower Super Output Area, LSOA) and each selected destination.

Figures are calculated for different time periods. In this release analysis has been restricted to journeys during the morning peak (defined as the period 7am to 10am) to illustrate the data, though statistics for the evening peak and inter-peak period are also available in the underlying dataset.

Overview of how the statistics have been compiled

More details on page 11, and in separate [technical documentation](#)

¹ Experimental statistics are defined in the Code of Practice for Official Statistics as new official statistics undergoing evaluation. They are published in order to involve users and stakeholders in their development and as a means to build in quality at an early stage.

Indicators

The modelling produces a representative travel time for each origin to each destination. From these times, it is possible to calculate a range of indicators, at various levels of geography. In this release we present:

- *Travel time indicators*: these present the average travel time from origins to destinations, to give an estimate of actual travel times. Averages for higher levels of geography can be calculated from the raw data by weighting together results for each LSOA in proportion to the LSOA population.
- *'Access to destination' indicators*: these provide a measure of the number/percentage of people able to access particular destinations (e.g. Heathrow airport) or types of destination (e.g. any airport) within a given time. A number of different measures are presented.
- *'Number of destination' indicators*: These count the number of destinations of a certain type (e.g. airports) within a given travel time of an origin area

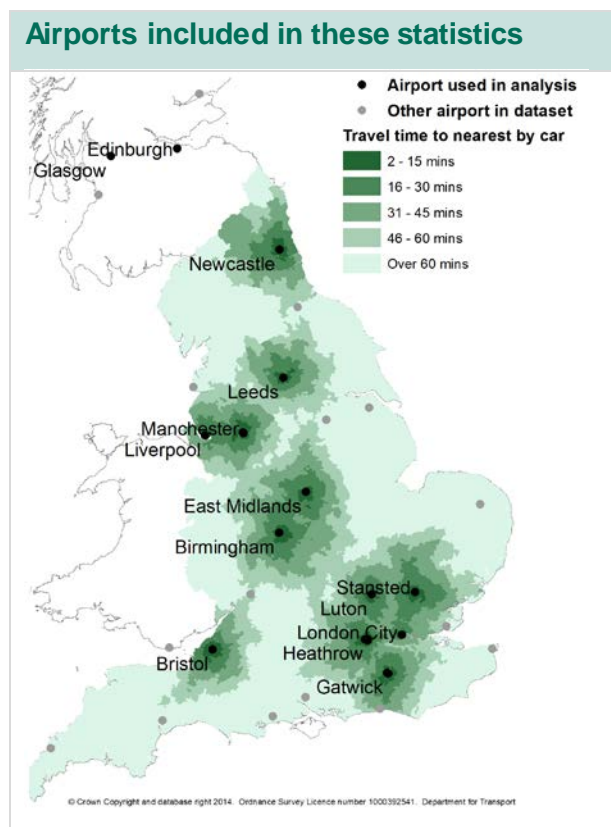
Destinations covered

These statistics are based on a dataset of travel times from small area origins in England to selected destinations. For this initial release the destinations we have focussed on are the key transport hubs as outlined below, though the same methods can be applied to a range of other destinations and we welcome any interest in extensions to other types.

Note that some destinations in Scotland and Wales are included where they may be realistic options for some people living in England.

Airports

- The 15 largest airports in Great Britain (by terminal passenger numbers²) are covered in these statistics.
- However, the underlying dataset includes 32 British airports (all except those in the Scottish highlands and islands, and some heliports)
- For the larger airports (Heathrow, Gatwick and Manchester) different terminals are included as separate destinations, though for some analyses these are aggregated.



Data for each of these types of indicator is in the [data tables](#)

Other destinations of interest? Please let us know via our online [feedback form](#).

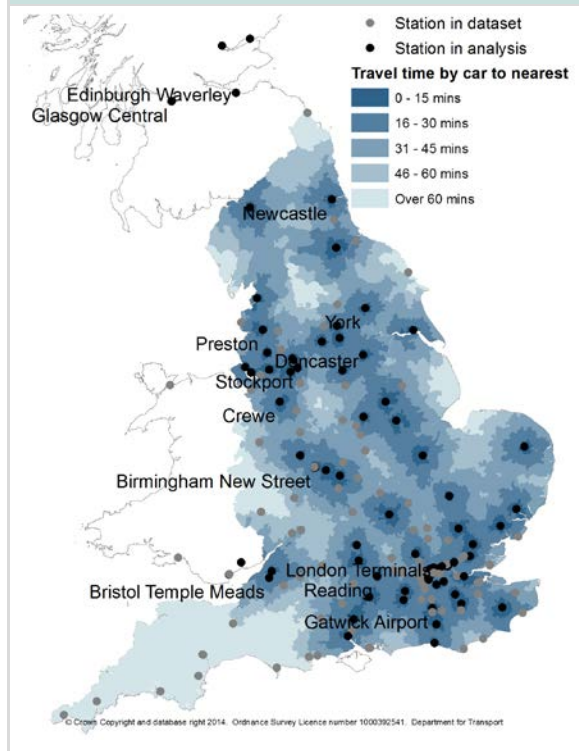
The maps here show the destinations included, with illustrative travel times (from every small area to the nearest destination within the set)

² Based on Civil Aviation Authority statistics for 2011; refer to metadata table for details

Rail stations

- These statistics cover stations in Great Britain classified by Network Rail as category A (28 national hubs) or B (60 regional interchanges).
- The major London terminals are sometimes considered as a single station for analysis purposes.
- The underlying dataset contains 183 stations, in categories A, B and C ('important feeder' stations) as defined by Network Rail.

Rail stations included

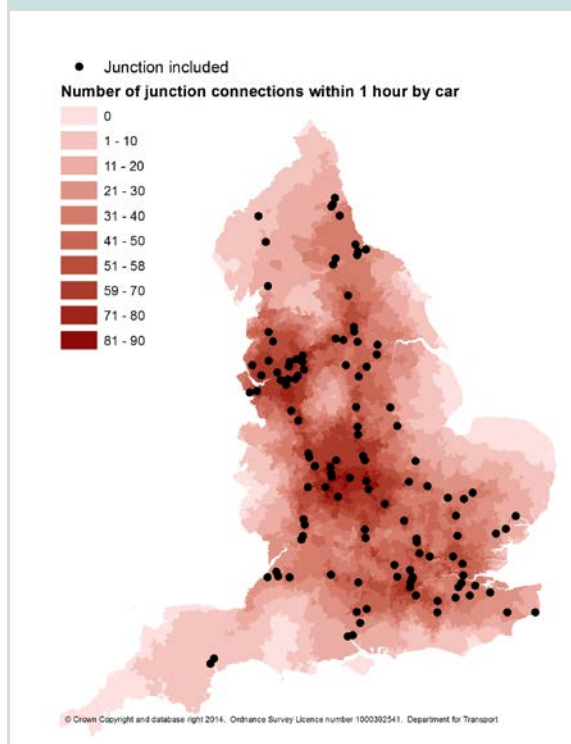


We've selected a subset of destinations (e.g. larger stations) for presentation in maps and tables, but the underlying dataset on data.gov.uk has a larger number.

Road junctions

- The statistics in this release are based on 122 road junctions on the 'Strategic National Corridors'³ which intersect with the Strategic Road Network of motorways and major A roads managed by the Highways Agency.
- The dataset contains a larger dataset of nearly 500 junctions on the strategic national corridors intersected with the Primary Route Network of roads which are used for transport on a regional or county level.

Road junctions included



Further information

A full list of destinations covered and metadata is available in the [technical documentation](#)

³ In 2009 fourteen Strategic National Corridors (SNCs) were identified by the Department for Transport - recognising the economic importance of routes linking the largest English cities with the busiest ports and airports in England. Further details are available via www.gov.uk

Average travel time indicators

The dataset for these statistics consists of a large number of estimated travel times between small area origins (broadly, neighbourhoods) and specified destinations, for travel by:

- road: times reflect both the road network and average car speeds derived from GPS data, so reflect patterns of congestion to some extent.
- public transport/walking: times are based on scheduled timetables, with assumptions about walking to/from stops and stations, and waiting times.

An advantage of indicators based on these travel times, such as travel time to the nearest destination of a given type, is that they are generally easy to interpret.

Some points to note are that:

- The level of detail in the origin data (over 30,000 small areas) allows a picture of travel times to be shown, on a consistent basis across the whole of England.
- Although these statistics currently only cover travel to transport hub destinations, these can sometimes be used as approximations for other types of destination. For example, the rail stations may be a suitable proxy for many large town or city centres. Similarly, ports are often close to road junctions or rail stations. Used in this way, these statistics provide an 'off the shelf' dataset which may be adaptable for different purposes.
- The modelling shows whether a connection exists and does not represent the actual volume of journeys made, which will depend on factors other than travel time alone. Also, each destination is weighted equally, which does not account for the fact that travel to some destinations may be more useful than to others.

At the national level, summary statistics can be calculated from the data, for example average travel times to nearest airport, station or road junction (where nearest means the shortest travel time).

This section illustrates how the travel time data can be used, with some examples

An advantage is there's a lot of consistent data readily available 'off the shelf' – see data.gov.uk for the full raw dataset of travel times

National level summary statistics can be produced from the data e.g.

The average travel time to one of the 15 largest British airports is around 48 minutes by car

Average travel times to selected transport destinations⁴, AM peak 2011 [based on data in tables CON0111, CON0211 and CON0311]

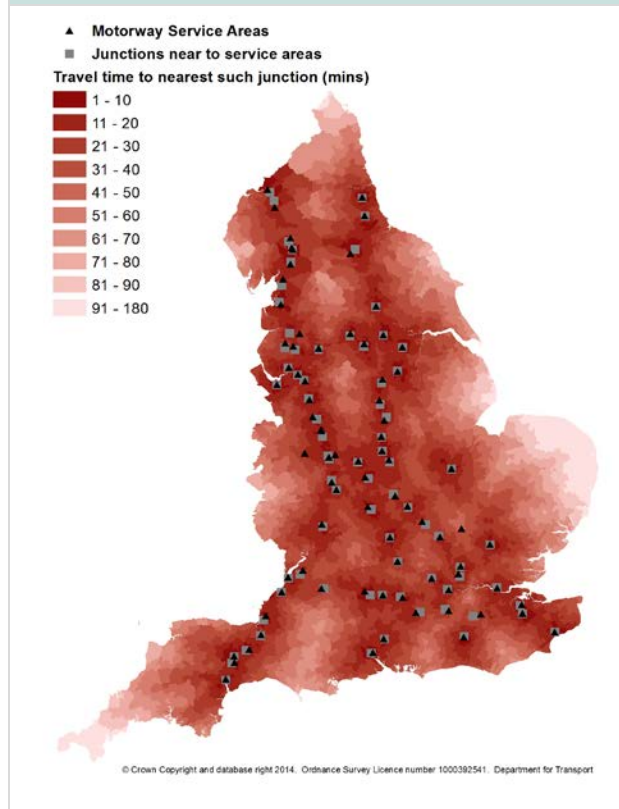
	By car	By public transport/walking
Nearest 'large' airport	48 mins	114 mins
Nearest 'national hub' or 'regional interchange' rail station	43 mins	55 mins
Nearest 'major' road junction	25 mins	not applicable

⁴ Destinations are as defined in the preceding section. Figures are the population weighted average of the travel times for each LSOA. Where a travel time could not be calculated at LSOA level (typically for longer journeys by public transport), a value of 360 minutes was used.

The detail available in the dataset supports visualisation of travel time patterns. As an example, this map shows estimated travel times by car to a subset of the road junctions which are located near to motorway service areas – this gives a fairly good approximation to service areas without performing a new calculation.

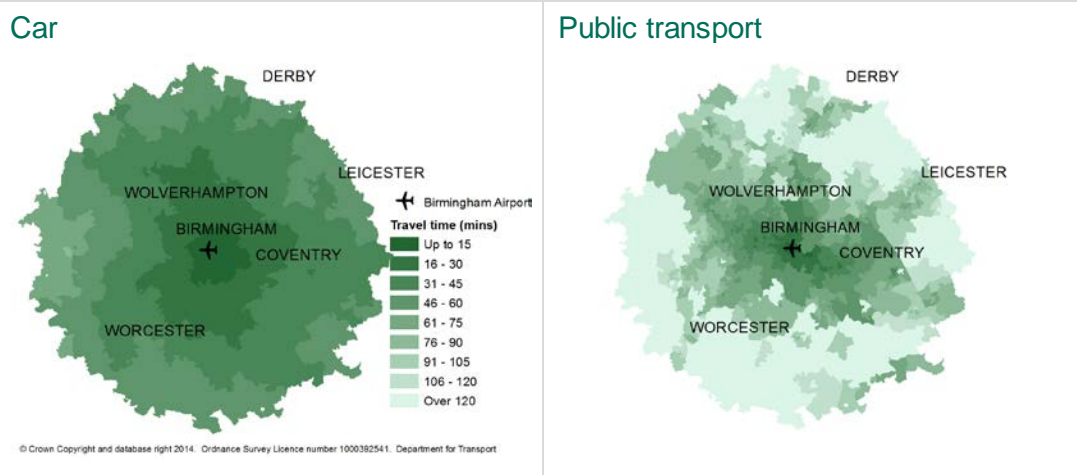
This might be useful, if, for example, the use of service stations as sites for electric car charging points was of interest – the map could highlight areas where provision is less good (and the underlying data enables summary statistics to be calculated).

Travel times to nearest of selected junctions, by car: AM peak 2011



The level of detail in the dataset means that it can also be used to illustrate travel time patterns at a more localised level. As an example, the maps below show travel time to Birmingham airport from the surrounding area by car, and by public transport/walking. Equivalent maps can be produced for other destinations, allowing a visual comparison of travel times.

Travel times to Birmingham Airport, by car and by public transport: AM peak 2011. Note that the maps are both based on the same colour scale



The data allows **visualisation** of patterns on a consistent basis at **national level**.

This approach could be applied to other types of destination, to support a range of analyses and may be useful in operational planning. If you have any interest please let us know by completing our [feedback form](#)

Travel times to **specific destinations** can be mapped and compared

Related data tables:

Travel time data is available for different destinations in the following tables:

- Airports:
CON0101
(local authority level)
CON0111
(LSOA level)
- Stations:
CON0201 and
CON0211
- Junctions:
CON0301 and
CON0311

Access to destination indicators

In addition to calculation of average travel times, the raw travel time data can be aggregated to produce a variety of indicators which measure transport connectivity.

For example, indicators described below relate to *access to destinations*. These can provide simple summary statistics, to allow comparison of destinations or of origin areas, at different levels of geography⁵.

Population of England within an hour of selected transport destinations⁶, AM peak 2011 [tables CON0103, CON0203, CON0303]

	By car	By public transport/walking
Nearest 'large' airport	74%	31%
Nearest 'national hub' or 'regional interchange' rail station	95%	77%
Nearest 'major' road junction	96%	not applicable

Comparing destinations: catchment population measures

The graphic shows the number of people within an hour's travel of selected major rail stations (i.e. the catchment population for the stations, based on travel times). As these stations are typically within the city centre, this acts as a proxy for travel to the associated cities, which may be more useful e.g. if linked to other data such as number of employment opportunities.

Population living within an hour's travel of major stations, AM peak [table CON0202]:

Leeds
4.9m by car ; **2.3m** by public transport

Sheffield
4.2m by car ; **1.6m** by PT

Manchester (Piccadilly)
5.6m by car ; **2.8m** by PT

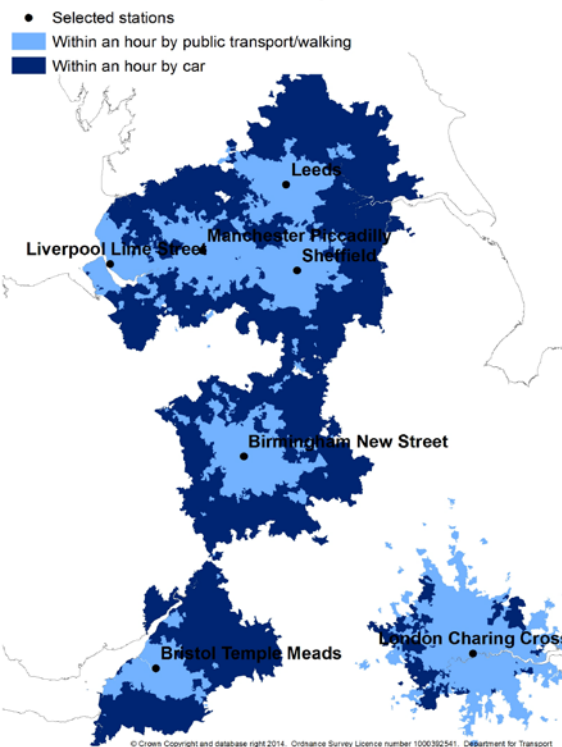
Liverpool (Lime Street)
4.0m by car ; **1.8m** by PT

Birmingham (New Street)
5.1m by car ; **3.4m** by PT

Bristol (Temple Meads)
2.2m by car ; **1.1m** by PT

London (Charing Cross)
7.8m by car ; **8.7m** by PT

Travel time catchments for selected rail stations (as proxies for city centres)



This section describes some summary indicators that can be calculated from the [raw travel time data](#)

National travel time catchment populations can be estimated e.g.

5 million people live within an hour of Birmingham New Street station (in Birmingham city centre) by car

These are indicators based on specified travel time thresholds; the data tables also include some other time thresholds.

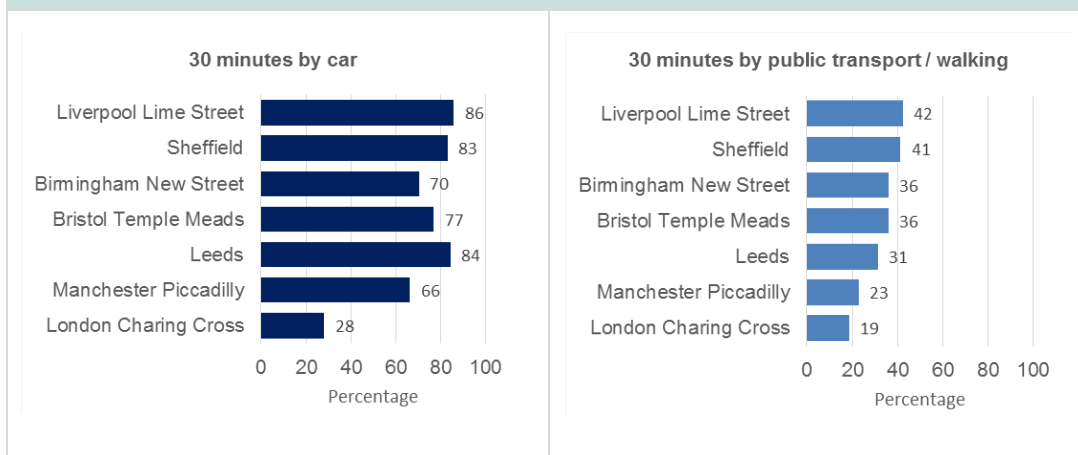
Any feedback on the usefulness or otherwise of these indicators, and the method used, can be provided via our [feedback form](#)

⁵ These are broadly analogous to the destination indicators presented in the DfT accessibility statistics

⁶ Destinations are as defined in the preceding section.

The above catchments will obviously reflect the size of the local population, as well as the transport links available. An alternative approach is to compare the proportion of people living within a given distance of a destination who are able to reach it within a given time – as an example, the chart compares selected rail stations in this way, for travel by public transport and car.

Percentage of 20km catchment population able to reach selected stations within 30 minutes: AM peak, 2011 [table CON0202]



Local area connectivity measures can also be defined e.g.

70% of people living within 20km of Birmingham New Street station can get there in half an hour by car

Related data tables:

Indicators comparing destinations:
 Airports: **CON0102**
 Stations: **CON0202**
 Junctions: **CON0302**

Summary statistics comparing areas, e.g.

Comparing areas: access to destinations

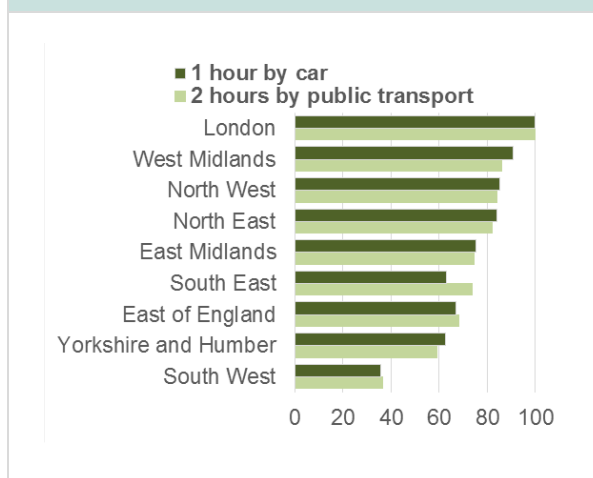
Different areas of the country can also be compared by calculating the proportion of their resident population able to access particular types of destination within a specified time, providing a simple summary measure of connectivity of population to the selected destinations at an aggregate level.

For example, the chart compares travel to airports at regional level. Note that in this case the results are likely to reflect the location of the destinations considered (15 selected airports), more than availability of transport connections. As all of the destinations included are considered as equally important the results can be sensitive to the criteria used for selection.

Additionally, the results will depend on the travel time cut-offs chosen.

Figures for other travel time thresholds, different levels of geography (e.g. local authority) and different destinations (major stations and road junctions) are available in the data tables. In addition, the underlying data is available from data.gov.uk to allow users to explore alternatives.

Percentage of population within specified travel time of a 'large' airport: AM peak, 2011 [table CON0103]



91% of the population of the West Midlands are within an hour by car of one of the 15 largest British airports, compared with 36% of people living in the South West

Related data tables:

Indicators comparing areas based on specified times:
 Airports: **CON0103**
 Stations: **CON0203**
 Junctions: **CON0303**

An alternative approach is to weight the destinations; this allows the relative “importance” of different destinations to be compared, and is not sensitive to specified cut off times required for the above indicators.

For example, we have defined indicators which weight airports by the number of destinations served per week (i.e. a measure of size) and display, for each origin, a value which reflects both size of airport and travel time, with bigger airports and shorter travel time given a bigger weighting (and a darker shading on the map)⁷.

Weighted indicators which account for the importance of destinations can also be defined

These measures can be used to illustrate **national** patterns of connectivity

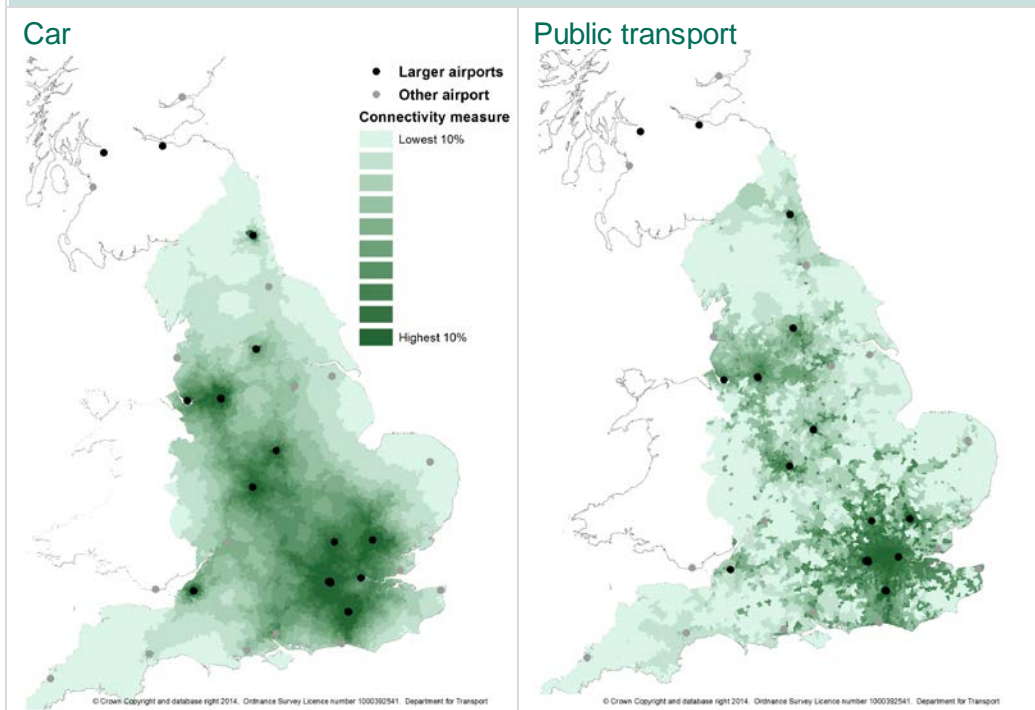
As the units for these weighted measures do not have an obvious natural interpretation, the maps show the relative pattern, highlighting ‘hot’ and ‘cold’ spots of connectivity using percentiles.

These measures can also be analysed at **local area** level

Related data tables:

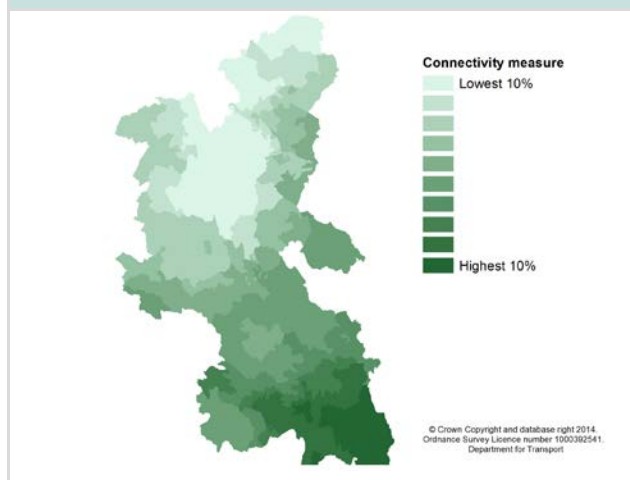
Indicators comparing areas based on weighted travel times:
 Airports: **CON0104**
 Stations: **CON0204**
 Junctions: **CON0304**

Weighted indicator for travel to airports, by car and by public transport: AM peak 2011. Note that the two maps are on different colour scales, to highlight the relatively well and less well connected areas for each mode.



This approach shows relative ‘hot’ and ‘cold’ spots of connectivity. Again, the level of detail available means that this can be analysed at detailed levels of geography, as shown in the map, which shows the areas of highest and lowest connectivity within Buckinghamshire only.

Weighted indicator for travel to airports, by car, Buckinghamshire: AM peak 2011



⁷ For airports with more than one terminal (Heathrow, Gatwick and Manchester) an overall weight is calculated. Refer to the technical guidance notes for further details of how these indicators are calculated.

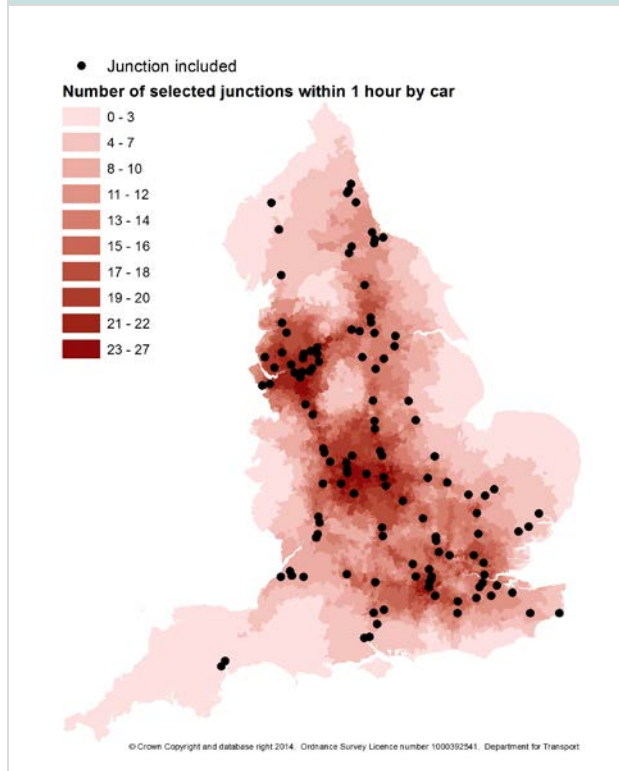
'Number of available destination' indicators

Another type of indicator measuring connectivity that can be produced from the dataset is to measure the *number of destinations* of a particular type available to the resident population within a given travel time⁸.

For example, the map shows the number of junctions (of the 122 major road junctions analysed) available within an hour's travel by car from every small area (LSOA) within England.

Figures for other times, and for other types of destination, are available in the data tables.

Number of junctions available within an hour by car: AM peak 2011



Indicators comparing number of destinations available

Related data tables:

'Number of destination' indicators:

Airports: **CON0105**
Stations: **CON0205**
Junctions: **CON0305**

⁸ These are analogous to the 'origin indicators' in the DfT accessibility statistics

Potential uses of these statistics

We are publishing these experimental statistics to assess the potential value of producing further statistics of this nature, and we welcome any feedback. Possible uses might include:

- As a high level measure of access to the strategic transport network in England, with the potential to track changes over time.
- Use in commercial applications, for example in websites showing characteristics of different areas.
- Use in operational planning e.g. assessing where to locate services based on transport connections.
- As an explanatory variable in economic analyses, e.g. of the factors affecting economic growth at a local level, which may add to the understanding of local area economic performance
- In contributing to development of the strategic case for transport projects, or assessment of bids for funding (e.g. to illustrate existing connectivity problems, or as a sense check on whether proposals address them).
- A source of information on travel times which may offer scope for validating other model results, such as those used for transport appraisal (although it is not expected that existing models based on generalised costs would be replaced).

Related data

These statistics are based on a dataset of travel times from origins to destinations, and in essence represents the results of a large number of 'journey planner' type queries run on a consistent basis. For more bespoke data, the [Transport Direct batch journey planner](#) can provide alternative results, and other software is available that can produce this type of result.

These statistics are a development of the established [DfT accessibility statistics](#). These are currently being reviewed and any user feedback on them is also welcome.

Overview of methodology

The following provides brief details of the methodology used to produce the statistics, with a fuller description available in the separate [technical documentation](#).

Data sources. The key data sources for these statistics are:

- Origins – 180,000 Census output areas, collapsed to a population-weighted centroid (however these are aggregated to Lower Super Output Area (LSOA) level for reporting)
- Destinations – locations of airports, stations and road junctions (as described earlier)
- Transport network – the Ordnance Survey Integrated Transport Network layer of roads and footpaths is used. For car journeys, average speeds are derived from a sample of actual speeds which is used for the DfT congestion statistics. For public transport, timetable data from the 2011 National Public Transport Data Repository is used.

Calculation. In summary, the process by which the statistics are produced is as follows:

- Select origins (output areas) and destination sets of interest
- Run an algorithm to calculate travel times for a number of representative journeys between every origin and destination pair for a given time period, using the relevant transport network data – this results in a single 'average' time for each pair. This algorithm is broadly the same as that used to produce the DfT accessibility statistics.
- Construct various indicators by aggregating the raw travel times.

Strengths and weaknesses of these statistics

The travel times will be affected by a number of factors:

- the number and location of destinations included
- road / travel factors (public transport timetables, road layout and congestion)
- model assumptions
- data quality

In particular, comparisons between different types of destinations, and between areas within specific destinations, are likely to be largely affected by the number and distribution of the selected destinations.

These statistics readily provide a large dataset of travel times from small area origins to a range of destinations, based on a nationally consistent method and covering the whole of England. A range of different indicators can be constructed from the underlying data. Much of the value of the data is in the small area data which allows levels of connectivity to be compared.

To date, only figures for 2011 are available, which means that at present these statistics are suitable only for comparing across areas, not over time. However, subject to user feedback, updates could be produced.

It should be kept in mind that these statistics represent the outcomes of algorithms which rely on the quality of the input data, and involve a number of assumptions, though this is more likely to impact on shorter journeys and less likely to invalidate broad patterns of connectivity. However, the patterns of connectivity shown are likely to be sensitive to the destinations chosen, which involves subjective judgement.

The contractor carried out a range of sense checks on the model outputs, for example using mapping to plot the closest destination for each origin. Further high level sense checks were carried out by DfT prior to publication of the statistics.

Finally, these figures provide estimates of 'actual' travel times and indicate possible connections – they do not provide any measure of how likely it is that people would be able to achieve the minimum times in practice, and how many people would choose to make the connection in that way. Other factors relevant to that choice, notably cost, are not captured by these results. These statistics should therefore be considered as most useful in supplementing other evidence in building up a picture of relative levels of connectivity across an area of interest, and possibly highlighting features of interest for further study.

Further information on the data sources, calculation methodology and strengths and weaknesses of these statistics can be found in the separate [technical documentation](#).

National Statistics

These figures are *outside* the scope of National Statistics. However, as experimental official statistics they are produced in line with the Code of Practice for Official Statistics.

For details of ministers and officials who receive pre-release access to these statistics up to 24 hours before release: <https://www.gov.uk/government/organisations/department-for-transport/>

Further development and future releases

We intend to review these statistics alongside the establish accessibility statistics, taking account of feedback from users. We will publish further information on the DfT statistics website later in 2014.

Any feedback you are able to provide will be used to help plan the future production of related statistics, making the best use of resources available. Please use our [feedback form](#) to provide any comments.