Report
December 2023

Estimates of Station Usage 2022/23: Methodology Report

Office of Rail and Road
Our ref: 24384901
Client ref:

steer

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Introduction

This report explains the information contained within the Office of Rail and Road's (ORR) Estimates of Station Usage dataset ('Estimates of Station Usage 2022-23.xlsx', hereafter referred to as 'Station Usage dataset') and provides guidance on the methodology followed during the process of creating this dataset for the rail year 2022/23 (1st April 2022 to 31st March 2023). It also includes a summary of the validation checks undertaken as part of the production process.

The Station Usage dataset and associated reporting has been produced by Steer on behalf of the ORR.

The Station Usage dataset consists of estimates of the total number of journeys derived from passengers:

- Travelling from or to the station (entries & exits); and
- Interchanging at the station (interchanges).

Information is given for all the GB rail stations in England, Scotland, and Wales based on tickets sales data and are the most recent in a series produced for the ORR since 1997/98. The spreadsheet containing the estimates is in a similar format to those published in previous years.

The statistics on usage are necessarily estimates based on a methodology which utilises data on ticket sales. This is then supplemented with other data and adjusted to represent passenger movements more appropriately across the GB rail network. The methodology is reviewed annually and enhancements to the methodology are specified and implemented to address known issues. Often these enhancements utilise new sources of data that were not previously available.

Methodology

The Station Usage dataset is generated from the Origin Destination Matrix (ODM), a comprehensive matrix of rail flows between stations throughout Great Britain (GB). This is also produced by Steer and based largely on data produced for the MOIRA2.2 rail planning tool which itself is derived from LENNON, the rail industry's ticketing and revenue system. **This does place some limitations on the data of which users should be aware and these are detailed in this report.**

The MOIRA2.2 matrix provides an estimate of journeys on the GB rail network for the duration of a rail year (April 1st – March 31st). It includes all journeys associated with point to point flows and includes overlays ("infills") to reflect travel on Travelcards in the London area, Passenger Transport Executive (PTE) sponsored tickets in the major urban areas outside London and travel on some selected 'Rover/Ranger' products (e.g. Anglia Plus). The methodologies for the production of the PTE and 'Rover/Ranger' infills included in MOIRA2.2 were largely developed as part of Steer's work on the ODM.

The production of the ODM and the Station Usage dataset involves making a number of further adjustments to the MOIRA2.2 matrix to address known issues across the network that impact on the Station Usage estimates. The adjustments included in the Station Usage dataset include:

- Allocation of journeys associated with tickets sold to 'London Terminals' between those terminals;
- Allocation of journeys between individual stations within station groups outside central London. For example, where tickets are sold to/from 'Dorking BR' it is necessary to estimate how these journeys are distributed between Dorking West, Dorking (Main) and Dorking (Deepdene) stations;
- Allocation of demand between stations to account for specific known issues. For example, adjustments are made to account for situations where passengers buy season tickets from a station other than the one they generally travel from (which provides the passenger with additional flexibility).

Methodological Development

Consistency with past datasets is important to enable comparisons to be made over time. However, stakeholders have indicated that they are keen to see improvements, even where this reduces consistency with historical data, provided any changes are clearly explained.

In the 2022/23 Station Usage dataset the following methodological improvements were made:

- Updated application of 'Season ticket journey allocation' adjustments for flows to/from London and to/from Cardiff (see paragraphs 3.14 - 3.21);
- Allocation of journeys between selected station groups following implementation of recommendations from a programme of passenger count surveys at selected stations (see paragraphs 3.24 - 3.26);
- Update to concessionary demand methodology within the Greater Manchester PTE infill (see paragraphs 3.6 - 3.8);
- Updates to the distribution for the West Yorkshire PTE infill (see paragraphs 3.9 - 3.13);
- The inclusion of Caledonian Sleeper tickets (see paragraphs 3.22 - 3.23);
- Updated Heathrow station splits (see paragraph 3.27);
- Updated methodology for allocating tickets sold to/from London BR (see paragraphs 3.28 - 3.31);
- An adjustment to take account of split ticketing (see paragraphs 3.32 to 3.36); and
- An adjustment to the ODM to account for the overstatement of Elizabeth Line journeys (see paragraphs 3.37 to 3.41).

Limitations of the data

In the absence of a fully gated system or comprehensive count data, the use of ticket sales data (LENNON) as the primary source of the Station Usage dataset is the best approach available for estimating station usage. In particular, LENNON's national coverage makes it suitable as a basis for the production of National Statistics such as those reported by the ORR.

Nonetheless, this data does have weaknesses when utilised for this purpose and, although some of these are catered for in the methodology and the ORR continues to seek improvements to address identified issues, users of the Station Usage dataset should be aware of these acknowledged limitations and bear these in mind when using the data. The key limitations are outlined in Chapter 1 with more extensive discussion of some aspects of the limitations of the dataset included in Chapter 5.

1 Introduction

Overview

1.1 Steer was appointed by the Office of Rail and Road[1] (ORR) to produce the Estimates of Station Usage dataset for 2022/23, continuing the historic series that dates back to 1997/98. This report accompanies the Estimates of Station Usage dataset for 2022/23 and provides details of the process and outputs used to produce the statistics on behalf of the ORR. In the rest of this report the Estimates of Station Usage dataset is referred to as the "Station Usage dataset."

1.2 The Station Usage dataset is generated from the Origin Destination Matrix (ODM), a comprehensive matrix of rail flows throughout England, Scotland and Wales, also produced by Steer, and based on data produced for the MOIRA2.2 rail planning tool which itself is derived from LENNON, the rail industry's ticketing and revenue system.

1.3 Steer have provided the ORR with an MS Excel file containing entries, exits and interchanges made at stations throughout England, Scotland and Wales, for the rail year 1st April 2022 to 31st March 2023. For the entries and exits, figures are split into the three main categories of available ticket types (Full, Reduced, and Season).

1.4 The underlying methodology adopted by Steer in the production of the Station Usage data is consistent with that adopted by Resonate[2] in the production of the Station Usage dataset in the years prior to 2011/12. A number of updates to the methodology have been implemented by Steer over recent years which have been documented in this and previous annual reports. A summary of the methodological updates made by Steer is provided in the accompanying report, '*Station Usage & Origin Destination Matrix 2022/23: Historical Methodological Changes*'.

Use of the Station Usage dataset

1.5 When using the Station Usage dataset, it is important to be aware of:

- Methodological improvements made to the dataset over time which can impact consistency between years;
- Limitations of the data and specifically factors e.g. some ticket sales not being included, that may mean that demand on particular flows and at stations is underestimated or overestimated; and
- Factors which can affect reporting of entries and exits.

Methodological improvements to the dataset

1.6 Improvements to the dataset made in 2022/23 are set out in Chapter 3. A summary of improvements made over recent years are further detailed in the accompanying report, '*Station Usage & Origin Destination Matrix 2022/23: Historical Methodological Changes*'. The ORR continues to work with stakeholders and its own consultants to improve the robustness of the dataset by implementing methodological changes that demonstrate value and address acknowledged issues.

[1] The Office of Rail Regulation was renamed the Office of Rail and Road from 1st April 2015.

[2] Resonate were formerly known as 'DeltaRail' and changed their name in August 2016.

Limitations of the data

1.7 In the absence of a fully gated rail system that allows for the complete recording of station throughput, or comprehensive and robust count data, the use of LENNON ticket sales data as the primary source of the Station Usage dataset (as described in the following chapter) is the best available. Its national coverage makes it suitable as a basis for the production of National Statistics such as those reported by the ORR.

1.8 However, this data does have weaknesses when utilised for this purpose and, although some of these are catered for in the methodology, the user should be aware of these acknowledged limitations. The key limitations are outlined below with a more extensive discussion of some aspects of the limitations of the dataset included in Chapter 5.

- **Non-point to point tickets** – An overarching issue is the inherent difficulty and uncertainty associated with estimating the number of journeys undertaken on many rail products. Whilst this is, to some extent, a problem with all products (for example tickets which are bought but not used, or journeys broken enroute), it is a particular issue for the London Travelcard Area and Passenger Transport Executive (PTE)[3] areas, where tickets often have validity across a set number of zones, without needing to define specific stations. The Origin Destination Matrix (ODM) does include 'infills' that are estimated in order to account for journeys made on many of these products;
- **Concessionary travel** – Transport for London (TfL) and most PTEs subsidise some form of free travel for certain user groups, including those over a certain age, students, and those with disabilities. This creates a substantial additional element of demand which is very difficult to include in the ODM as information on the level and distribution of journeys associated with these free travel products is not recorded and will not even have point of sale information. The current approach to this in the ODM is to include this demand where data has been made available by TfL/PTEs which would generally be estimates based on surveys or digital ticket sales information;
- **Non-LENNON Sales** – A significant proportion of sales for rail travel are either not processed in LENNON (i.e. sold at non-railway sales points) or are included in LENNON in a format which requires additional processing and assumptions (i.e. are not associated with a station to station flow);
- **Group stations** – Many products are sold with the origin or destination as a group of stations (e.g. London Terminals, Manchester stations). Current industry data does not distinguish between the component stations and therefore a split between these stations must be estimated during the production of the ODM; and

[3] There are six metropolitan counties in England. These are Greater Manchester, Merseyside, South Yorkshire, Tyne and Wear, West Midlands, West Yorkshire. Formerly, each of these areas had a Passenger Transport Executive (PTE), which was a local government body with public transport responsibilities. They were accountable to Integrated Transport Authorities (ITAs), which were formerly known as Passenger Transport Authorities (PTAs) prior to 2008 and the Local Government Act 2008. Following enactment of the Local Democracy, Economic Development and Construction Act 2009, all Integrated Transport Authorities have now been reformed into Combined Authorities, some with a larger geographic coverage than the ITA they replace. Some Combined Authorities (Greater Manchester, Merseyside, North East, South Yorkshire) continue to have a free-standing transport executive, whilst in others (West Midlands and West Yorkshire) the transport executive has been incorporated within the Combined Authority. In Scotland the Strathclyde Partnership for Transport is the equivalent body covering the region of Strathclyde. For convenience, in this report we continue to refer to these seven areas as PTEs.

- **Ticketless travel** – Journeys associated with ticketless travel (i.e. journeys undertaken without an authority to travel) are not included in the datasets but, as with journeys made on other products excluded from the datasets, some journeys would be observed in passenger counts. This is likely to be an issue on some flows and in some areas where ticketless travel is significant. As more stations have become gated over time and rail operators focus on revenue protection activities this is likely to be less of an issue than in the past in contributing to a shortfall in journeys. There is a strong argument that it is inappropriate to include ticketless travel in the Station Usage dataset, as one of its core purposes is to support business cases for new investment, which would be distorted by the inclusion of these journeys.
- **Split ticketing** – The complexity of the fares system in GB rail has led to opportunities where a combination of shorter-distance tickets can be combined to provide a cheaper fare than the advertised price for the end-to-end journey. This is known within the industry as 'split ticketing' and, whilst there have been such opportunities for a number of years, prevalence increased towards the end of 2019/20. The split tickets are shown within LENNON as the individual journey components, and therefore within the base data indicate a greater number of shorter-distance journeys. This will suggest higher footfall at the intermediate stations where the tickets are 'split'. For the first time in 2022/23, an adjustment to the ODM (and by extension, Station Usage) has been developed to account for split ticketing – see section 3.32 for more details.

Factors which can affect reporting of entries and exits

1.9 There are numerous factors that can affect the reported level of usage at a station from year to year which could reflect local or more widespread trends or factors that have an impact on an individual or group of stations. Such factors should be considered by users of the statistics. Of particular note in the 2022/23 statistics:

- The continuing recovery of international travel since the onset of the pandemic (that had previously lagged behind due to travel restrictions).
- Significant timetable changes resulting in substantial increases or decreases in service levels on particular routes or at specific stations, such as the resumption of regular services post-pandemic at some rural stations on the Cambrian Coast Line in Wales.
- The impact of Infrastructure changes on recorded journeys. New and improved routes and changes in service patterns and new connections between stations can lead to increases in the number of recorded journeys and distribution across stations. The most significant example of this in 2022/23 was the opening of the Elizabeth Line.
- Industrial action can have an impact on train services and consequently on rail journeys that are undertaken. There has been ongoing industrial action since June 2022, affecting all operators at various points during 2022/23. The impact across the network has varied, with some disputes resolved within a few months whereas others are still ongoing in 2023/24.[4]
- Minor incidents can cause temporary line closures and impact rail usage.

[4] https://en.wikipedia.org/wiki/2022%E2%80%932023_United_Kingdom_railway_strikes

Adverse Weather and Consequential Impacts

1.10 Cases of extreme adverse weather may cause disruption to normal railway operations and can impact on travel patterns.

Major incidents

1.11 Major incidents affecting services such as those at Southall (1997), Ladbroke Grove (1999), Hatfield (2000), Grayrigg (2007) and Stonehaven (2020).

Gating Schemes

1.12 Installation of ticket gates can significantly affect not only the usage figures at that station, but also those at neighbouring stations. The gates help to ensure that customers purchase tickets, but customers may also alter their travel patterns to avoid gated stations. We would expect travel patterns to be most affected in the months following the installation of the gates.

Change in Service Pattern

1.13 Alterations in service frequency or stopping patterns would be expected to alter station usage figures. This is particularly apparent where a group of stations along a line show similar increases or decreases. Again, this can be a long-term trend.

1.14 In response to the COVID-19 pandemic, the majority of timetables were reduced to align with reduced passenger demand whilst enabling travel for key workers. Since then, timetables have been incrementally scaled up with more services added gradually and several major timetable changes have occurred to better reflect post-COVID demand patterns, with service levels still suppressed in some locations.

Ticket Issuing Facilities Changes or Product Changes

1.15 Some London stations have both underground and National Rail services operating. LENNON does not directly capture tickets sold by London Underground, only those sold by Train Operating Companies (TOCs).

1.16 Changes to on-train and station ticket sales, as well as product changes, can affect passengers' purchasing patterns at rail outlets thus affecting the Station Usage dataset. For example, the introduction of Oyster and contactless cards and, more recently, the extension of the geographical areas where they are valid can affect stations inside the Travelcard boundary in the London area.

Engineering Work

1.17 Engineering work can alter customers' travel patterns, either causing passengers to not travel, use an alternative mode or use an alternative rail route. The works can range from overnight possessions through to weekends, week-long or longer periods.

Advance tickets

1.18 Advance tickets can be sufficiently cheap to incentivise travellers to purchase a number of tickets but only use one dependent on how their circumstances change, creating an inflated number of trips in the ticket sales data. This can be particularly true for business travel and could overstate actual journeys (although in practice this is unlikely to commonly occur).

Tourism/Leisure

1.19 Stations near to tourist and leisure attractions may show significant changes in usage as a result of weather, promotions or other factors, which affect tourists' journeys. In 2022/23 a few stations saw decreases in usage resulting from previous upticks in usage due to increased leisure travel and staycations in previous years.

New/Special Stations

1.20 Some stations serve a particular activity or business. Some fluctuation in usage of such stations is reasonable. Such activities include:

- Sporting Events, e.g., Bordesley station in the West Midlands primarily serves St Andrew's stadium football matches (Birmingham City FC);
- Special Events, e.g., Birmingham International (for the National Exhibition Centre), Exhibition Centre (Glasgow) station (for the Scottish Exhibition and Conference Centre);
- Airports, where rail demand is closely linked to airport passenger numbers, e.g. Gatwick Airport, Stansted Airport and Southend Airport.

1.21 In addition, where there are new stations, ramp up effects can cause large demand increases over a number of years, for example at Worcestershire Parkway station.

1.22 This year (2022/23) saw the opening of 8 new stations: Barking Riverside, Bond Street (Elizabeth Line), Canary Wharf (Elizabeth Line), Custom House (Elizabeth Line), Inverness Airport, Reston, Tottenham Court Road (Elizabeth Line) and Woolwich (Elizabeth Line).

1.23 The opening of the Elizabeth Line's central section in May 2022 has transformed journey opportunities in London and also significantly impacted the ODM & Station Usage dataset. The Elizabeth Line is a National Rail service, and therefore the new stations and associated journeys appear in the MOIRA2.2 matrix. The journey volumes are high, with several of the stations immediately entering the top 10 busiest stations in 2022/23 and this signifies that there has been abstraction of journeys which would previously have been undertaken using TfL services (e.g. on the Central Line), and therefore would not have previously been present in the ODM (which only contains journeys undertaken on National Rail services).

1.24 Further detail regarding the Elizabeth Line, including an explanation of an issue of journeys overstatement and the methodological adjustment that has been developed to account for this issue is provided in Chapter 3.

Trend of Growth or Decline

1.25 For stations with a history of growth or decline, it is reasonable to expect this trend to continue. There are many possible reasons for these trends, such as demographic and employment changes (new developments in the vicinity), changes in rail service levels or new stations abstracting demand.

Errors in recording of Sales of Individual Ticket Types

1.26 Miscoding of ticket information entered into LENNON can alter the statistics, although this would not be reflecting an actual change in customers' journeys.

Changes in journeys per ticket

1.27 Sales of tickets are assumed to correspond to a number of journeys. In the case of Single and Return tickets the relationship is very clear but for period tickets, e.g. weekly/monthly/annual

seasons, there are a set of journey factors within the LENNON system that have remained fixed for a number of years. Whilst they were likely based on reasonable estimates of ticket usage historically, it could be argued that with lifestyle and working practice changes, e.g. greater flexible working, and ticketing arrangements that they are not as representative for today's market.

2 Methodological Overview

Introduction

2.1 All estimates of entries, exits and interchanges included in the Station Usage dataset are derived from the Origin Destination Matrix (ODM), also produced by Steer for the ORR. The ODM is in turn derived primarily from a matrix of journeys and revenue that is produced by Resonate for inclusion in MOIRA2.2.

2.2 The MOIRA2.2 matrix includes a comprehensive representation of travel on the GB rail network. The base data for the MOIRA2.2 demand matrix is LENNON ticket sales, with the addition of "infills" for London Travelcards, some specific tickets to/from airports and multi-modal and zonal products sponsored by PTEs. The current MOIRA2.2 matrix now includes some of the methodological enhancements that have been previously developed for inclusion in the ODM, for example a revised methodology for the PTE infills – see the accompanying report, '*Station Usage & Origin Destination Matrix 2022/23: Historical Methodological Changes*' – and the 'Other' infills relating to selected Rover and Ranger products.

Base Data

LENNON and MOIRA2.2

2.3 The underlying matrix of ticket sales and associated journeys and revenue used in MOIRA2.2 is derived from LENNON. It is based on an extract from LENNON, provided to Resonate by RDG, of total sales revenue and journeys for the year, broken down by flow (origin and destination National Location Code (NLC)), route code and product type (CTOT). However, as there are known omissions in this data in respect of TfL and PTE-sponsored tickets, and non-National Rail tickets on some airport services, there needs to be a "matrix infilling" exercise undertaken. This enables the estimation of a more complete origin-destination matrix and includes the associated journeys and revenue that either do not appear in the underlying matrix at all or are not sufficiently disaggregate.

2.4 There are three main cases:

- Tickets with non-geographical destinations, e.g. zonal products, Rovers;
- Tickets sold at some non-National Rail[5] outlets, e.g. newsagents; and
- Tickets which do not appear in LENNON at all. This includes some TOC tickets on airport flows and tickets for TOCs which fall outside the remit of the Rail Settlement Plan (RSP).

2.5 Certain tickets with destinations off the rail network are included in the MOIRA2.2 demand matrix, being mapped to the corresponding station. These 'rail links' usually include a third-party element, such as to a bus zone, or tourist/leisure attraction. The MOIRA2.2 demand matrix includes the journeys and the net revenue associated with such tickets.

[5] Not part of Rail Settlement Plan (RSP)

2.6 Data excluded from the MOIRA2.2 demand matrix is set out in Chapter 5.

Ticket Type Definitions

2.7 Within the base demand matrices, journeys and revenue have been sub-divided into the following four ticket types, each of which is further split by First & Standard Class:

- Full: all unrestricted (by time of day) single or return tickets, whether or not issued with a status discount (child, railcard etc);
- Reduced: all restricted single or return tickets, whether or not issued with a status discount (child, railcard etc), excluding train-specific tickets;
- Advance: all train-specific tickets; and
- Seasons: all tickets with unrestricted usage across a pre-specified number of days.

2.8 It should be noted that for the purposes of the Station Usage dataset, Advance products are included in the Reduced ticket category and First and Standard classes are combined.

Infills for London Travelcards, Major Urban Areas (PTE) & Airports

2.9 Infills are included within the MOIRA2.2 demand matrix to add in the missing journeys and revenue identified in paragraph 2.4 in three key areas:

- **Within London Travelcard area.** Whilst the underlying matrix includes an estimate of journeys made on Day Travelcards / Travelcard seasons purchased at National Rail stations, it does not include a significant number of National Rail trips made using Travelcards purchased at Tube stations, travel shops and newsagents. From 2015/16, a new methodology has been used to represent 'in-boundary' Travelcards based on TfL's Oyster Clicks Model (OCM) – see the accompanying report, 'Station Usage & Origin Destination Matrix 2022/23: Historical Methodological Changes', for more detail. Also, from 2015/16, the matrix has included journeys associated with Freedom Pass (these were previously added as an infill within the ODM).
- **Within PTE areas.** The underlying matrix excludes virtually all rail trips made on PTE-sponsored tickets, which are usually zonal and often multimodal. From 2015/16 the 'infills' representing these journeys in MOIRA2.2 have been based on a methodology originally developed for the ODM.
- **Trips to/from Airports.** The underlying matrix includes many trips to/from airports, but excludes some Heathrow Express journeys, and some tickets sold for Gatwick Express, Stansted Express and other airport operators. Demand to/from Heathrow airport (including Heathrow Express) was included for the first time in 2019/20.

2.10 There are also other ticket sales which are not included in the MOIRA2.2 demand matrix, but these are generally much less significant. It should also be noted that journeys with no associated ticket sales such as staff travel, and particularly fare evaders, are not included in the MOIRA2.2 demand matrix and therefore are not included in the ODM either.

2.11 The most significant "infills" are for the London Travelcard area (sales made by TfL), and for PTEs, since in both cases a substantial proportion of the rail journeys use multimodal travelcard-type tickets.

Origin Destination Matrix (ODM)

2.12 The MOIRA2.2 demand matrix is used as the starting point for the production of the ODM and as part of this process a number of adjustments and overlays are included which can be categorised as follows:

- Overlays (in addition to those already included in the MOIRA2.2 matrix relating to the London Travelcard Area and Airports – see paragraph 2.9)
    - PTE infills – although included in the MOIRA2.2 matrix these are developed as part of the work undertaken to produce the ODM and are provided to Resonate for inclusion in the MOIRA2.2 matrix. The methodology development work to produce the revised infills was undertaken between 2011/12 and 2014/15 and the methodology has remained largely unchanged in the current year's statistics.
    - Ranger/Rover infills – Methodological development was undertaken to include a representation of passenger flows on a selected number of Rover and Ranger products from 2011/12. Since 2015/16 this infill has also been included in the MOIRA2.2 matrix. The scope of this infill was reviewed during the production of the 2021/22 statistics to ensure all significant products are included.
- Adjustments:
    - Allocation of demand associated with tickets sold to 'London Terminals' between those terminals;
    - Allocation of demand between individual stations within station groups outside central London. For example, where tickets are sold to/from 'Dorking BR' it is necessary to estimate how these journeys are distributed between Dorking West, Dorking (Main) and Dorking (Deepdene) stations. To support this part of the methodology there is a programme of station counts that are undertaken periodically at selected stations;
    - Unknown destinations: Ticket sales do not always tell us where a passenger is travelling, for example where the Origin or Destination is a London Travelcard. Unknown destinations are converted into an estimate of the actual stations that passengers are travelling to. The full detail of this part of the methodology is provided in **Appendix A**;
    - Individual station adjustments: There are a number of cases where adjustments are made to selected stations to account for specific known issues:
        - Adjustments at a number of stations are made to reflect circumstances where there are significant numbers of season tickets sold at a particular station (where the passenger travels from) for travel to London or Cardiff that allow for travel to/from a different origin station to provide flexibility. This leads to a situation where station usage, as estimated by ticket sales, can be under- or over-estimated and journeys involving those stations needs to be adjusted to reflect actual usage. Since 2014/15, an adjustment (for London season tickets) has been made for selected stations where this issue has been identified. The Cardiff season ticket adjustment has been applied since 2020/21. Further details on these adjustments can be found in in the accompanying report, '*Station Usage & Origin Destination Matrix 2022/23: Historical Methodological Changes*'.
    - The 'Digby & Sowton' adjustment – described in the accompanying report, '*Station Usage & Origin Destination Matrix 2022/23: Historical Methodological*

Changes', and first included in the 2014/15 dataset – relates to journeys associated with a season ticket product for students which are being made to Exeter Central and Exeter St. David's on tickets with a recorded destination of Digby & Sowton.

- The inclusion of the portion of demand from Heathrow Express services that does not come through LENNON (and therefore is not included in the MOIRA2.2 matrix). More detail on this adjustment can be found in the 2019/20 section of the accompanying report '*Station Usage & Origin Destination Matrix 2022/23: Historical Methodological Changes*'. Since 2021/22 Heathrow has also supplied updated splits to better allocate demand between the 3 rail stations at the airport (see 3.27 for more information).
- The inclusion of tickets sold for Caledonian Sleeper services, which are not included in the MOIRA2.2 matrix. This adjustment was developed in 2020/21 and more detail is available in the accompanying report '*Station Usage & Origin Destination Matrix 2022/23: Historical Methodological Changes*'.
- An update to the London BR allocations process was developed in 2022/23 by using the data from the CAF file to replace older survey data. See section 3.28 for more information.
- A new methodological enhancement was developed in 2022/23 utilising RDG data to adjust the ODM to account for split ticketing which has been a known limitation of rail sales data for a number of years. See section 3.32 for more information.
- An adjustment was developed this year utilising TfL data to adjust the ODM to account for the overstatement of Elizabeth Line journeys in the MOIRA base matrix due an issue within LENNON. See section 3.37 for more information.

2.13 Further details relating to the overlays and adjustments outlined above can be found in Chapter 3 of this report, and in the accompanying report, '*Station Usage & Origin Destination Matrix 2022/23: Historical Methodological Changes*'.

Interchanges

2.14 In addition to entries and exits at stations an estimate of the number of people interchanging at each station is included in the dataset. This is obtained by combining the number of journeys made on each flow (from the ODM) with the information on passenger journeys taken from the Central Allocations File (CAF).

2.15 The CAF is an output of the ORCATS system which predicts passenger choices of rail route and train used and determines the allocation of passenger revenue between TOCs. Since ORCATS is a model, the CAF contains estimates rather than actual journeys. However, it is used throughout the rail industry, so it is an appropriate source of data to use for this purpose. Since CAFs are updated with the timetable, not with financial years, no CAF will match the ticket sales data exactly. The December 2022 CAF is used in the creation of the 2022/23 Station Usage dataset as the best representation for the options passengers have when making rail journeys involving interchanges.

2.16 It is worth noting that the December 2022 CAF does not contain the new Elizabeth Line central stations, nor take into account the new journey options involving the central section. This is because the rail industry agreed to delay the inclusion of the new Elizabeth Line section in ORCATS, as the impact of this significant change on revenue allocations required

thorough testing prior to implementation. It is anticipated that the same exclusions won't apply in future CAFs.

2.17 The CAF contains:

- Origin and destination;
- Route alternatives for each origin and destination, including all interchange points;
- Ticket type data; and
- For each flow, the proportion of passengers who choose to travel on each route alternative as calculated by the ORCATS model.

2.18 An overview of the ORCATS allocation process can be found in in **Appendix B**.

3 Methodological Changes in 2022/23

Introduction

3.1 Consistency with past datasets is important to enable comparisons to be made over time. Nonetheless, stakeholders have indicated that they are keen to see improvements, even where this reduces consistency with historic data, provided any changes are clearly explained. Steer has worked with the ORR to scope and implement methodological enhancements to address identified issues and utilise new data as it is made available whether this is from primary data collection (e.g. passenger counts at stations), or industry systems such as TfL's Oyster Clicks Model (OCM).

3.2 The methodological changes made in the 2022/23 dataset relate to:

- **PTE infills:** updates to the methodology for calculating the infills for West Yorkshire (updated distribution of infill demand based on MCard data) and Greater Manchester (updated methodology for calculating concessionary demand using more recent data sources);
- **Season ticket journey adjustments:** update to adjustments for a number of stations to account for situations where passengers buy season tickets for travel to/from a station other than the one they generally travel from, in order to allow additional flexibility (for season tickets to/from London and to/from Cardiff);
- **Inclusion of Caledonian Sleeper tickets:** this year Caledonian Sleeper tickets (which were previously excluded from the MOIRA2.2 base matrix) were incorporated into the ODM and estimates of station usage as per the methodology developed in 2020/21 when these tickets were first included in the ODM;
- **Demand allocation at Group Stations:** allocations of demand across individual stations within station groups based on passenger counts;
- **Updated Heathrow station splits:** demand splits for the 3 rail stations at Heathrow Airport were supplied by Heathrow (based on gateline data) to enable more accurate allocation of demand;
- **London BR allocations:** an updated methodology was used to allocate tickets sold to/from London BR to the appropriate station using the CAF file (replacing older survey data);
- **Split ticketing:** a new methodological enhancement was developed this year utilising RDG data to adjust the ODM to account for split ticketing which has been a known limitation of rail sales data for a number of years; and
- **Elizabeth Line:** a new adjustment was developed this year utilising TfL data to adjust the ODM to account for the overstatement of Elizabeth Line journeys in the MOIRA base matrix due to an issue within LENNON.

3.3 The changes made to improve the dataset are explained in the rest of this chapter, together with quantification of their impact.

PTE Infill Changes

3.4 Each year, PTE infills are prepared by Steer (West Midlands) and Mott MacDonald (Greater Manchester, Merseyside, South Yorkshire, Tyne and Wear, West Yorkshire, Strathclyde).

3.5 These infills are subject to annual improvements, which normally represent a simple update, but some years contain a step change in the methodology.

Greater Manchester – update to concessionary demand methodology

3.6 In the 2022/23 dataset, the methodology for calculating concessionary demand in the Greater Manchester region has been updated. A new data source was available (rail surveys undertaken in August 2023) which covered all ticket types (including concessions on radial Manchester rail routes). This data can be used to estimate the proportion of concessions across all other ticket types – this in turn can then be used to update the assumptions used to uplift the Greater Manchester infill (non-concessionary demand) to account for concessionary travel that would otherwise not be covered by the ticket purchase data.

3.7 This update is also an improvement to overall demand estimates because the previous assumption was derived from surveys conducted in March 2017 i.e., pre-pandemic. It is likely that the amount of concessionary travel has changed between 2017 and 2023, due to general changes to travel patterns and as older passengers have tended to return to rail travel more slowly following the pandemic.

3.8 The new data suggests that 6% of all ticket types are concessions (compared to 13% previously). This methodology change accounts for a decrease of **0.75m** journeys (1.5m entries & exits) in the Greater Manchester PTE area in 2022/23, which equates to a 2.3% decrease in total entries and exits across the Greater Manchester PTE area (inclusive of RSP tickets).

West Yorkshire– updated distribution

3.9 In 2020/21, a new distribution was used for allocating the journeys on West Yorkshire PTE products to specific flows. 2019/20 MCard smartcard data was used, replacing the out-of-date 2013/14 WYCA fares survey data. The MCard data covers 80% of passengers travelling to 80% of stations and is more suited to demand modelling. It consists of raw tap-in/tap-out data covering all time periods and contains 15,000 smartcards, specified by PTE ticket type, which are assigned to an origin station based on postcode.

3.10 In 2021/22 this MCard distribution was updated by using 2021/22 data (replacing the pre-pandemic 2019/20 data), better reflecting post-pandemic travel patterns. The sample size was also greater than the 2019/20 data, covering a full year rather than one week.

3.11 In 2022/23 this MCard distribution was updated again by using 2022/23 data, to best reflect the most recent travel patterns, including continue post-pandemic recovery. This data covers the whole year with the same sample size as 2021/22.

3.12 As per the previous years, the new distribution was evaluated for each station, with a threshold set to adjust a small number of anomalous results using ratios based on the distribution used in previous years and RSP (LENNON) data.

3.13 This methodology change does not affect the total number of journeys included in the infill, but it does impact their distribution across the network. The main conclusion is that recovery is continuing post-pandemic in line with wider trends, with just a few stations experiencing decreases in usage year-on-year due to changes in service provision (Denby Dale) and engineering works (Dewsbury, Huddersfield).

Season ticket journey adjustments

London

3.14 In the production of previous years' statistics, adjustments were made to account for passengers who buy season tickets for travel to/from a station other than the one they

generally travel from, providing additional travel flexibility. This issue, and the previous adjustments, are described in detail in the accompanying report, '*Station Usage & Origin Destination Matrix 2022/23: Historical Methodological Changes*'.

3.15 In some areas, multiple stations have identically priced season tickets to London. As a result, London season tickets are generally sold as being from the furthest station, regardless of the actual origin of travel, giving the passenger additional flexibility for no increase in fare. This means that the ticket sales data shows that there are more people travelling to/from this station than is the case.

3.16 LENNON sales data was used to estimate the number of tickets where the issuing office (the location at which the season ticket is obtained by the customer) was at a branch line station, but the ticket origin showed a station further along the line. For the ten flows with the highest absolute number of ticket journeys being issued from stations different to the ticket origin, it was assumed that the true origin of the journeys was the issuing location, and not the recorded origin.

3.17 For the production of the 2022/23 statistics, the analysis underpinning this reallocation was updated with 2022/23 LENNON data. Table 3-1 shows the scale of the adjustments.

Table 3-1: Summary of London season ticket adjustments in 2022/23

Station TLC	Station Name	Station Group	Adjusted Entries & Exits	Total Entries & Exits
SOV	Southend Victoria	Southend Victoria Branch	-162,910	1,261,540
HOC	Hockley	Southend Victoria Branch	54,131	770,184
RLG	Rayleigh	Southend Victoria Branch	78,641	1,332,392
RFD	Rochford	Southend Victoria Branch	30,138	574,674
OXF	Oxford	Oxford/Didcot Parkway	-59,123	6,581,606
DID	Didcot Parkway	Oxford/Didcot Parkway	59,123	2,329,704
UCK	Uckfield	Uckfield	-26,426	200,272
BXD	Buxted	Uckfield	4,488	92,856
COH	Crowborough	Uckfield	21,937	227,138
REI	Reigate	Reigate/Redhill	-23,878	1,004,608
RDH	Redhill	Reigate/Redhill	23,878	2,711,640
GLM	Gillingham (Kent)	Medway	-32,716	2,120,460
CTM	Chatham	Medway	12,779	2,010,328
RTR	Rochester	Medway	7,232	1,783,662
SOO	Strood (Kent)	Medway	12,704	990,098
BTR	Braintree	Braintree	-13,901	524,782
WTM	Witham	Braintree	13,901	1,617,780
EGR	East Grinstead	East Grinstead/Lingfield	-10,530	888,748
LFD	Lingfield	East Grinstead/Lingfield	10,530	353,316
GTW	Gatwick Airport	Gatwick Airport/Horley	-35,664	16,507,980
HOR	Horley	Gatwick Airport/Horley	35,664	1,033,666
RTR	Rochester	Rochester/Strood	-8,461	1,783,662
SOO	Strood (Kent)	Rochester/Strood	8,461	990,098
SOC	Southend Central	Southend Central Branch	-6,452	2,041,420
WCF	Westcliff	Southend Central Branch	6,452	920,720

Cardiff

3.18 In the stakeholder feedback and consultation as part of the production of the 2019/20 estimates of station usage, Transport for Wales (TfW) highlighted that there were several

end-of-line or end-of-fare-zone stations that potentially have over-estimates of season ticket usage and corresponding under-estimates at preceding stations.

3.19 This is the same issue that the adjustment described above addresses for season ticket flows to/from London, so an equivalent methodology was developed for season ticket flows to/from Cardiff during the production of the 2020/21 estimates of station usage, with LENNON sales data being used to estimate the number of tickets where the issuing office is different to the origin station on the season ticket.

3.20 For the production of the 2022/23 statistics, the analysis underpinning this reallocation was updated with 2022/23 LENNON data. Table 3-2 shows the scale of the adjustments.

Table 3-2: Summary of Cardiff season ticket adjustments in 2022/23

Station TLC	Station Name	Station Group	Adjusted Entries & Exits	Total Entries & Exits
PPD	Pontypridd	Pontypridd/Trefforest	-7,921	536,050
TRF	Trefforest	Pontypridd/Trefforest	7,921	554,112
BYI	Barry Island	Barry	-17,845	367,594
BRY	Barry	Barry	8,121	452,024
BYD	Barry Docks	Barry	1,560	219,792
CAD	Cadoxton	Barry	8,164	258,164
ABE	Aber	Aber/Caerphilly	-2,093	103,976
CPH	Caerphilly	Aber/Caerphilly	2,093	524,900
SRR	Sarn	Sarn/Bridgend	-1,196	46,410
BGN	Bridgend	Sarn/Bridgend	1,196	1,133,284
LNB	Llanbradach	Llanbradach/Caerphilly	-992	49,924
CPH	Caerphilly	Aber/Caerphilly	992	524,900
TDU	Tondu	Tondu/Bridgend	-761	39,936
BGN	Bridgend	Tondu/Bridgend	761	1,133,284
RDR	Radyr	Radyr/Llandaf	-865	331,870
LLN	LLandaf	Radyr/Llandaf	865	316,534
HNG	Hengoed	Hengoed/Ystrad Mynach	-692	105,904
YSM	Ystrad Mynach	Hengoed/Ystrad Mynach	692	198,824
TRB	Treherbert	Treherbert/Pontypridd	-676	121,196
PPD	Pontypridd	Treherbert/Pontypridd	676	536,050
SWA	Swansea	Swansea/Neath/Port Talbot	-1,431	1,883,574
NTH	Neath	Swansea/Neath/Port Talbot	563	666,058
PTA	Port Talbot Parkway	Swansea/Neath/Port Talbot	868	471,848
PGM	Pengam	Pengam/Caerphilly	-813	189,282
CPH	Caerphilly	Pengam/Caerphilly	813	524,900
TRY	Treorchy	Treorchy/Pontypridd	-442	83,404
PPD	Pontypridd	Treorchy/Pontypridd	442	536,050
MST	Maesteg	Maesteg/Bridgend	-885	142,286
BGN	Bridgend	Maesteg/Bridgend	885	1,133,284
POR	Porth	Porth/Trefforest	-533	151,692
TRF	Trefforest	Porth/Trefforest	533	554,112
TAF	Taffs Well	Taffs Well/Radyr	-662	164,682
RDR	Radyr	Taffs Well/Radyr	662	331,870

3.21 This adjustment leads to a significant impact (>2%) at 3 of these stations (Barry Island, Sarn and Cadoxton).

Inclusion of Caledonian Sleeper tickets

3.22 MOIRA2.2 does not model overnight (sleeper) services, and therefore dedicated sleeper products are not included in the MOIRA2.2 base matrix used as the starting point for the estimates of station usage. The volume of tickets excluded from the MOIRA2.2 base matrix has increased in recent years, as the Caledonian Sleeper TOC has moved towards more 'all inclusive' tickets which include travel and accommodation (and can therefore be identified as sleeper tickets and removed from the matrix) rather than 'sleeper supplements' (which have no journeys assigned to them in LENNON) used in conjunction with tickets valid on daytime trains (which have no way of being identified as being used on sleeper services).

3.23 Therefore, in the processing of the 2020/21 statistics, an extra LENNON query was used to extract such Caledonian Sleeper tickets and these were incorporated into the statistics. For the production of the 2022/23 statistics, this analysis was updated with 2022/23 LENNON data. This resulted in the addition of c. 198.5k journeys (397k entries and exits), with the vast majority at London Euston and stations in Scotland, as show in Table 3-3 below.

Table 3-3: Summary of additional Caledonian Sleeper entries and exits in 2022/23

Station TLC	Station Name	Total Entries & Exits	Entries & Exits Added	% Impact
EUS	London Euston	31,318,408	191,837	0.6%
EDB	Edinburgh	18,212,628	55,261	0.3%
GLC	Glasgow Central	20,767,954	42,929	0.2%
INV	Inverness	974,808	39,189	4.0%
FTW	Fort William	145,564	22,960	15.8%
ABD	Aberdeen	1,961,414	12,393	0.6%
AVM	Aviemore	112,090	4,385	3.9%
CRE	Crewe	2,922,754	3,490	0.1%
DEE	Dundee	1,453,560	2,967	0.2%
PTH	Perth	695,276	1,772	0.3%
LEU	Leuchars (For St. Andrews)	461,204	1,496	0.3%
PIT	Pitlochry	105,586	1,341	1.3%
WFJ	Watford Junction	5,536,096	1,076	0.0%
STG	Stirling	1,927,190	1,052	0.1%
PRE	Preston (Lancs)	4,236,536	1,039	0.0%
CNR	Crianlarich	13,370	965	7.2%
KGX	London Kings Cross	23,287,414	915	0.0%
DKD	Dunkeld & Birnam	38,416	828	2.2%
STN	Stonehaven	359,880	818	0.2%
GLE	Gleneagles	76,370	734	1.0%
HLU	Helensburgh Upper	9,320	693	7.4%
CAR	Carlisle	1,801,198	691	0.0%
MTH	Motherwell	699,220	689	0.1%
MTS	Montrose	243,796	671	0.3%
CRR	Corrour	14,108	670	4.7%
DBL	Dunblane	360,418	558	0.2%
Other stations (<500 E&Es added each)		n/a	5,210	n/a

Demand allocation at Group Stations (retained from previous years)

3.24 To validate and improve the allocation of journeys to/from stations within groups (e.g. Dorking BR), passenger counts are routinely carried out at selected group stations on the

network. The most recent counts were carried out at a number of stations during Autumn 2022, with the following groups having their splits updated:

- Dorking BR
- Bootle BR
- Newark BR
- Wakefield BR
- Pontefract BR

3.25 These Autumn 2022 counts were used both to validate existing data, and to create or update station group counts splits, with five sets of station counts splits updated. The proportion of journeys split between stations based on routine counts are shown in Table 3-4 below, which were implemented in the production of the 2022/23 estimates of station usage.

Table 3-4: Count-based adjustments to 2022/23 statistics

Station Name	Station Group	Proportions	Year Undertaken
Colchester	COLCHESTER BR	85%	2013/14
Colchester Town	COLCHESTER BR	15%	2013/14
Bedford	BEDFORD BR	96%	2014/15
Bedford St Johns	BEDFORD BR	4%	2014/15
Farnborough (Main)	FARNBOROUGH BR	82%	2013/14
Farnborough North	FARNBOROUGH BR	18%	2013/14
Maidstone Barracks	MAIDSTONE BR	11%	2013/14
Maidstone East	MAIDSTONE BR	55%	2013/14
Maidstone West	MAIDSTONE BR	34%	2013/14
Portsmouth & Southsea	PORTSMOUTH BR	49%	2014/15
Portsmouth Harbour	PORTSMOUTH BR	51%	2014/15
Canterbury East	CANTERBURY BR	30%	2014/15
Canterbury West	CANTERBURY BR	70%	2014/15
Falkirk Grahamston	FALKIRK BR	44%	2014/15
Falkirk High	FALKIRK BR	56%	2014/15
Helensburgh Central	HELENSBURGH BR	98%	2014/15
Helensburgh Upper	HELENSBURGH BR	2%	2014/15
Southend Central	SOUTHEND BR	46%	2015/16
Southend Victoria	SOUTHEND BR	28%	2015/16
Southend East	SOUTHEND BR	26%	2015/16
Wigan North Western	WIGAN BR	52%	2015/16
Wigan Wallgate	WIGAN BR	48%	2015/16
Folkestone Central	FOLKESTONE BR	57%	2018/19
Folkestone West	FOLKESTONE BR	43%	2018/19

Station Name	Station Group	Proportions	Year Undertaken
Hertford East	HERTFORD BR	51%	2018/19
Hertford North	HERTFORD BR	49%	2018/19
Guildford	GUILDFORD BR	88%	2018/19
London Road (Guildford)	GUILDFORD BR	12%	2018/19
Worcester Foregate Street	WORCESTER BR	77%	2019/20
Worcester Shrub Hill	WORCESTER BR	23%	2019/20
Dorchester South	DORCHESTER BR	83%	2019/20
Dorchester West	DORCHESTER BR	17%	2019/20
Warrington Bank Quay	WARRINGTON BR	51%	2019/20
Warrington Central	WARRINGTON BR	49%	2019/20
Edenbridge (Kent)	EDENBRIDGE BR	35%	2019/20
Edenbridge Town	EDENBRIDGE BR	65%	2019/20
Deansgate	MANCHESTER BR	3%	2019/20
Manchester Oxford Road	MANCHESTER BR	13%	2019/20
Manchester Piccadilly	MANCHESTER BR	65%	2019/20
Manchester Victoria	MANCHESTER BR	19%	2019/20
Dorking (Deepdene)	DORKING BR	37%	2022/23
Dorking (Main)	DORKING BR	60%	2022/23
Dorking West	DORKING BR	3%	2022/23
Bootle New Strand	BOOTLE BR	56%	2022/23
Bootle Oriel Road	BOOTLE BR	44%	2022/23
Newark Castle	NEWARK BR	36%	2022/23
Newark North Gate	NEWARK BR	64%	2022/23
Wakefield Westgate	WAKEFIELD BR	79%	2022/23
Wakefield Kirkgate	WAKEFIELD BR	21%	2022/23
Pontefract Monkhill*	PONTEFRACT BR*	70%	2022/23
Pontefract Tanshelf*	PONTEFRACT BR*	30%	2022/23

3.26 *For the Pontefract station group, when the station counts were conducted in October 2022, there were no rail services at Pontefract Baghill (Northern had been forced to scale back services at this low usage station due to COVID-19-related staff absences). Therefore, no passengers were counted at this station, and a % split is not applied to reallocate demand at this station. This station is the smallest and least used out of the three Pontefract stations (accounting for only 4% of total demand to stations within the Pontefract BR station group in 2021/22). Therefore, it is unlikely to have an impact on the split of demand between the other two stations, with the counts results providing a good estimation of the demand split between them.

Updated Heathrow Station splits

3.27 To improve the allocation of demand between the 3 rail stations within Heathrow Airport (Terminals 2&3, Terminal 4 and Terminal 5) data was supplied by Heathrow. This data replaces the derived splits from LENNON data (see Appendix A, category 2) and is based on gateline data collected by Heathrow. This is a more accurate representation of the split of passenger usage at the 3 Heathrow rail stations, as it is derived from actual passenger movements rather than sales data. These updated splits were first included in the 2021/22 estimates of station usage and updated splits were supplied by Heathrow for use in the 2022/23 estimates.

London BR Allocations

3.28 One of the steps in allocating tickets that do not have a specified station origin or destination (see Category 3 in the Appendix) is to allocate flows that have 'London BR' as an origin or destination to an appropriate London station. In previous years, this has been done by utilising survey data from the 2001 London Area Travelcard Survey (LATS) which was a comprehensive survey of travel in London, but is now limited by the fact that more recent infrastructure and service upgrades have altered demand patterns. For example, while many allocations to central London stations will be similar to when the LATS took place, some will have changed significantly (e.g., due to the impacts of the Thameslink Programme[6]).

3.29 A further limitation of the LATS data is that it was originally based on survey responses from travelcard users, and therefore there are some small allocations to stations outside of central London, reflecting its original use for allocating travelcard data. This does not fully reflect permissible travel using tickets to London BR.

3.30 For these reasons, a methodological enhancement was developed to utilise the data contained in the Central Allocations File (CAF) which is already used for producing the interchanges estimates in the Station Usage dataset. The CAF contains information on the proportion of passengers modelled to choose each possible route between station pairs, and also disaggregates by ticket type. It is also updated for each timetable change, so can take into account future service changes, thus future-proofing this new methodology.

3.31 This methodology change does not affect the total number of journeys, but it does impact their distribution across London stations. Stations which have experienced significant changes (>2%) due to this methodological enhancement are presented in Table 3-5 below. The impact of large schemes can be clearly seen in the stations with significant changes, and the removal of the Travelcard survey destinations where stations are not actually part of London BR can be seen in the stations with significant decreases.

Table 3-5: Stations with significant changes resulting from the London BR Allocation update.

TLC	Station Name	Impact	Notes
CST	Lonon Cannon Street	-22%	Impacts of Thameslink Programme
KGX	London Kings Cross	-19%	Impacts of Thameslink Programme
CHX	London Charing Cross	-15%	Impacts of Thameslink Programme
TOM	Tottenham Hale	-12%	Travelcard survey destination

[6] **https://www.networkrail.co.uk/running-the-railway/railway-upgrade-plan/key-projects/thameslink-programme/**

VIC	London Victoria	-11%	Impacts of Thameslink Programme
WAE	London Waterloo East	-9%	Impacts of Thameslink Programme
FPK	Finsbury Park	-8%	Travelcard survey destination
VXH	Vauxhall	-3%	
FST	London Fenchurch Street	-3%	
ZFD	Farringdon	+5%	Impacts of Thameslink Programme
LBG	London Bridge	+11%	Impacts of Thameslink Programme
STP	London St Pancras International	+18%	Impacts of Thameslink Programme
CTK	City Thameslink	+31%	Impacts of Thameslink Programme
BFR	London Blackfriars	+53%	Impacts of Thameslink Programme

Split Ticketing

3.32 Split ticketing has been a known limitation of rail industry data for many years. The complexity of the fares system in GB rail has led to opportunities where a combination of shorter-distance tickets can be combined to provide a cheaper fare than the advertised price for the end-to-end journey.

3.33 This is known within the industry as 'split ticketing' and, whilst there have been such opportunities for a number of years, prevalence increased towards the end of 2019/20. The split tickets are shown within LENNON as the individual journey components, and therefore within the base data indicate a greater number of shorter-distance journeys. This will suggest higher footfall at the intermediate stations where the tickets are 'split'. For the first time in 2022/23, an adjustment to the ODM has been developed to account for split ticketing.

3.34 The Rail Delivery Group (RDG) has developed an algorithm that can identify split ticketing in LENNON data and agreed to share the outputs and data extracts for use in developing this adjustment. The RDG data was used to estimate annual split journeys by flow in 2022/23 and therefore indicate the number of journeys on each flow that should be removed from the ODM due to split ticketing.

3.35 The data also enabled the 'correct' journey to be reinstated after this removal. For example, for a journey on flow A<>C with a split at B, the first step is to remove the A<>B and B<>C legs, and the second step is to replace with a journey on A<>C. This is because it is only the split at B that is creating artificial demand – LENNON has recorded 2 journeys (1 on each of A<>B and B<>C) but this was 1 journey on A<>C.

3.36 The split ticketing adjustment results in a net reduction of journeys in the ODM (due to the removal of artificial demand generated by split ticketing) of **18.6m** journeys (37.2m entries & exits) which equates to a c. 1.5% reduction in total entries and exits across the ODM.

Elizabeth Line

3.37 The opening of the 'central core' of the Elizabeth Line (previously known as Crossrail) in May 2022 has had a significant impact on the station usage dataset. This is a rail line with very high passenger usage, and therefore several of the stations served by the Elizabeth Line appear towards the top of the list of most used stations in 2022/23.

3.38 However, a complexity caused by the opening of the Elizabeth Line is that an existing issue within LENNON was highly exacerbated on the new flows involving Elizabeth Line stations. This is because one of the steps in LENNON is limited to integer journey inputs, however, the Elizabeth Line has generated a large number of route options for each flow, each with a decimal allocation of journeys. This leads to a 'rounding' up of the journeys on the affected flows, ultimately resulting in a significant overstatement of journeys on flows involving the Elizabeth Line in LENNON (and therefore also in the MOIRA2.2 base matrix).

3.39 Through discussions with industry colleagues at RDG, DfT, TfL and GBRTT, an alternative data source was provided by TfL. This data is a modelled number of daily journeys on the Elizabeth Line by flow, but based on TfL's tap data. Therefore, this was the best candidate for use in generating an adjustment to avoid significant overstatements of demand in the ODM and station usage dataset.

3.40 The TfL taps data was compared with appropriate LENNON data extracts in order to generate adjustment factors for each flow (based on the different estimates of journeys in the two data sources), which were then applied to the rail legs of the LENNON flows. This enabled a calculation of how many journeys were likely overstated in LENNON (and therefore MOIRA) and enabled the ODM flows to be adjusted appropriately to remove the effects of this overstatement.

3.41 The Elizabeth Line adjustment results in a net reduction of journeys in the ODM (due to the removal of the overstated Elizabeth Line journeys generated by the LENNON issue) of **29.5m** journeys (58.9m entries & exits) which equates to a c. 2.3% reduction in total entries and exits across the ODM.

4 Validation

Introduction

4.1 Checks undertaken on the Station Usage dataset encompass a number of elements, including:

- Investigation of large increases and decreases for individual stations;
- Checks at different geographical levels; and
- Validation against other data sources.

Data Checks

Large increases and decreases

4.2 Table 4.1 shows the 10 stations with the largest percentage increases in total usage in 2022/23 when compared with 2021/22.

Table 4.1: Top 10 increases (vs 2021/22)

Station Name	2022/23 Entries & Exits	2021/22 Entries & Exits	Change	Reason
Llandanwg	3,860	464	731.9%	Significant increase in service provision in 2022/23 vs 2021/22.
Sugar Loaf	398	76	423.7%	The absolute increase in journeys is small.
Abererch	2,040	396	415.2%	Significant increase in service provision in 2022/23 vs 2021/22.
Tygwyn	1,052	224	369.6%	Significant increase in service provision in 2022/23 vs 2021/22.
Perry Barr	139,376	30,362	359.0%	This station reopened in May 2022 (after being closed since May 2021).
Farringdon	31,459,904	6,865,228	358.2%	The opening of the Elizabeth Line has caused a large increase in rail usage at this station.
Okehampton	228,272	54,904	315.8%	Significant increase in service provision in 2022/23 vs 2021/22 after services resumed at this station in November 2021.
Soham	55,518	14,196	291.1%	This station opened in December 2021, so was not open for a significant portion of 2021/22.
Llanbedr	9,782	2,596	276.8%	Significant increase in service provision since in 2022/23 vs 2021/22.

Station Name	2022/23 Entries & Exits	2021/22 Entries & Exits	Change	Reason
Heathrow Terminals 2 & 3 (Rail Station Only)	4,392,712	1,267,508	246.6%	Continued recovery in international travel and the opening of the Elizabeth Line.

4.3 Table 4-2 shows the 10 stations with the largest percentage decreases in total usage in 2022/23 when compared with 2021/22.

Table 4-2: Top 10 decreases in 2022/23 (vs 2021/22)

Station Name	2022/23 Entries & Exits	2021/22 Entries & Exits	Change	Reason
Stanlow & Thornton	0	44	-100.0%	Since 3 February 2022 the station has been temporarily closed due to safety concerns of the footbridge which is the only entry point to the station.
Teesside Airport	2	42	-95.2%	While remaining officially open, the station has seen its service suspended since May 2022 with the one operational platform condemned as unsafe.
Althorpe	1,408	4,488	-68.6%	Significant decrease in service provision in 2022/23 vs 2021/22.
Crowle	5,770	13,796	-58.2%	Significant decrease in service provision in 2022/23 vs 2021/22.
Eastrington	1,660	3,844	-56.8%	No specific reason noted.
Pensarn (Gwynedd)	1,414	3,248	-56.5%	No specific reason noted.
Brigg	288	632	-54.4%	The absolute decrease in journeys is small.
Barrow Haven	478	790	-39.5%	The absolute decrease in journeys is small and there was a month-long closure in 2022.
Ince & Elton (Cheshire)	130	202	-35.6%	The absolute decrease in journeys is small.
Doleham	550	848	-35.1%	The absolute decrease in journeys is small.

4.4 Whilst reasons for large changes at some stations are specific to that station, in many instances there are groups of stations where there is a common cause for the changes seen. We have identified a number of reasons that affect multiple stations in the 2022/23 statistics, and these are described in the following sections.

Changes in methodology

4.5 These changes relate to methodological updates rather than changes to the underlying demand (see Chapter 3 for detail).

The COVID-19 pandemic

4.6 The COVID-19 pandemic and associated lockdowns have had a profound impact on the trends in station usage across recent years, with restrictions on travel and activities, working from home, service changes and staycations amongst the factors that have impacted rail travel.

4.7 There has been a further recovery of station usage this year, reflecting a year of no travel restrictions and more stable travel patterns. This recovery over the past couple of years has dominated the trends in usage at the majority of stations.

Growth or decline trend

4.8 These stations are those that consistently experience strong growth or decline in usage year on year. These can be due to a variety of exogenous and endogenous reasons.

Line specific trend

4.9 Consistent growth and decline has been observed on some lines. This can be due to service changes or potentially changes to ticketing (and therefore recording of journeys).

Local factors

4.10 Demand at some stations is strongly linked to demand for nearby airports, industrial/employment sites, or new housing developments. Furthermore, if multiple stations are available nearby, passengers may switch to an alternative nearby station.

Weather disruption

4.11 These relate to impacts of weather-related disruption, including landslips and floods that caused line closures. These impacts can be negative (reduced usage due to disruption), or positive (usage bounce-back following end of disruption).

Rail operator disruption

4.12 These impacts relate to operator issues, for example poor performance or reduced timetable offering.

Industrial action disruption

4.13 These impacts relate to industrial action, typically causing a reduction in usage on affected networks (and growth observed in areas with less industrial action than in previous years). There has been a significant amount of industrial action during 2022/23 across all operators at various points during the year.

Timetable change

4.14 These relate to improvements to journey opportunities or quality or a reduction of service frequency and subsequent falls in usage.

Facility change

4.15 These relate to improvements to the passenger environment (e.g. improved rolling stock or stations).

Fluctuating usage at small stations

4.16 Small stations are often flagged due to the high percentage change implied by a small change in absolute usage.

Validation against alternative data sources

Comparison with ORR journey data on the ORR data portal

4.17 The ORR produces passenger journey data by sector and TOC and makes this available on the ORR website via its data portal and as a National Statistics release[7]. This dataset shows an increase in overall journeys from 2021/22 to 2022/23 of 39.9% at the national level for all operators. The ODM shows an increase of 37.4% over the same period.

Comparison with Network Rail footfall data

4.18 Network Rail have provided gateline footfall data for 17 of their managed stations for the past three years, which provide a good basis for comparison with the Station Usage dataset. This data is based on infra-red sensors mounted above station gatelines and differentiates between passengers accessing platforms and the station concourse, hence it is a robust comparison against the Station Usage dataset's LENNON ticket sales methodology. Network Rail also publish concourse data at their managed stations, although this is a less useful comparator for the Station Usage dataset, as it includes non-passenger users of the stations.

4.19 In Table 4-3 below the absolute footfall figures for 2022/23 are shown for Network Rail data and station usage estimates, plus the year-on-year % change for each data source. The majority of stations align reasonably well, and where there are discrepancies some explanations are provided.

Table 4-3: Comparison of Network Rail gateline footfall data with Estimates of Station Usage in 2022/23

Station	NR Footfall	Estimates of Station Usage	NR Change from 2122	SU Change from 2122	Commentary
Birmingham New Street	45,278,661	30,726,280	27.7%	35.5%	
Bristol Temple Meads	8,136,947	9,291,680	37.2%	40.2%	
Cannon Street	8,661,353	6,723,216	14.8%	-4.3%	SU contains impact of the London BR allocations methodological enhancement (see 3.28)
Charing Cross	18,880,197	16,191,196	16.5%	2.9%	SU contains impact of the London BR allocations methodological enhancement (see 3.28)
Edinburgh Waverley	17,061,220	18,212,628	24.9%	33.7%	

[7] Passenger Rail Usage, available at: **https://dataportal.orr.gov.uk/**

Euston	35,664,636	31,318,408	22.5%	35.6%	There is an additional circulatory route at Euston that has no NR sensors
Glasgow Central	17,830,773	20,767,954	24.7%	35.5%	
Guildford	6,642,429	5,284,714	19.2%	23.4%	
Kings Cross	16,172,097	23,287,414	33.7%	13.7%	SU contains impact of the London BR allocations methodological enhancement (see 3.28)
Leeds	16,467,942	23,964,156	32.6%	24.4%	
Liverpool Lime Street	10,820,852	11,101,930	0.7%	6.1%	
Liverpool Street	50,060,523	80,448,194	30.1%	150.1%	Some sensors offline (data is patched), plus impact of Elizabeth Line – SU contains the EL footfall which won't be picked up on NR sensors
Manchester Piccadilly	27,475,058	23,558,364	24.5%	20.3%	
Paddington	45,541,062	59,182,926	47.5%	147.9%	Impact of Elizabeth Line – SU contains the EL footfall which won't be picked up on NR sensors
Reading	17,880,696	12,400,988	35.3%	40.6%	
Victoria	40,799,132	45,563,972	1.9%	23.9%	Victoria had many sensors off during station upgrade works
Waterloo	61,154,845	57,789,780	31.5%	39.5%	

5 Station Usage Dataset Limitations

Introduction

5.1 This section summarises potential limitations which may result in differences between observed station usage and that estimated by the methodology above.

Limitations

Limitations of the LENNON data

5.2 The LENNON database captures ticket sales for the entire GB rail network from many different input machines. It is consequently a very large dataset. With all large data sources there will always be input errors resulting in a certain amount of invalid data. Generally, such errors will be small, and are more likely to occur in the journeys rather than revenue fields.

5.3 Checks are performed on the data when the MOIRA2.2 demand matrix is compiled, but due to the size and complexity of the dataset it is not possible to validate each and every entry.

5.4 We have used similar information extensively for the last ten years or more, and have found the data to be reliable, particularly when examining the data at an aggregated level.

5.5 There are a number of areas where we know that LENNON does not capture the data correctly, or instances where it is not possible to derive passenger journeys from ticket sales data. These areas are expanded upon below.

Known Problems of Data Capture

5.6 The data in LENNON from which the ODM is derived is based on ticket transactions. In order for the data to be included in the ODM it must include an origin station and a destination station. However, if this is not the case then the data will automatically be excluded.

5.7 Human error at the point the ticket sale is entered into the system will also produce invalid data in LENNON.

Travelcards

5.8 As Travelcards are for multi-modal travel they allow the purchaser to make journeys on the rail system and on other modes. Equally, tickets purchased elsewhere on the local transport system will be valid for rail travel. Therefore, LENNON gives only a partial picture of the rail travel in conurbation areas, such as: London, Birmingham, Glasgow, Leeds, Liverpool, Manchester, Newcastle and Sheffield.

5.9 The ODM contains reasonably robust estimates of journeys within London and other conurbation areas where travelcards are widely used. An infill for London Travelcards has been included in the ODM since 2006/07, and an infill for PTE tickets is included from 2008/09. Both these infills have been subject to methodological enhancements in recent years.

Return and Single Journey Tickets

5.10 On certain routes the cost of a return ticket is similar to that of a single ticket. This leads to the cheaper return ticket being purchased even though the passenger may not make/has no intention of making the return journey by rail. This results in two journeys being recorded instead of one.

Multiple Tickets

5.11 It is possible to buy special cheaper tickets between certain stations for example under a promotion by one of the train companies. In these cases, a local ticket may be bought to gain access to a main station and a second ticket bought for the rest of the journey. This results in two journeys being recorded in the ODM and will not accurately represent the journey undertaken.

Split Ticketing

5.12 The complexity of the fares system in GB rail has led to opportunities where a combination of shorter-distance tickets can be combined to provide a cheaper fare than the advertised price for the end-to-end journey. This is known within the industry as 'split ticketing' and, whilst there have been such opportunities for a number of years, prevalence increased towards the end of 2019/20. The split tickets are shown within LENNON as the individual journey components, and therefore within the base data indicate a greater number of shorter-distance journeys. This will suggest higher footfall at the intermediate stations where the tickets are 'split'. For the first time in 2022/23, an adjustment to the ODM has been developed to account for split ticketing – see section 3.32 for more details.

Rail Staff Passes

5.13 Prior to the privatisation of the rail network, British Rail employees and their families were eligible for various levels of free or reduced rate rail travel. When the various rail companies were converted to private companies, this benefit often continued.

5.14 Their usage may be significant on certain routes, for example on those out of Derby due to large concentration of companies in Derby relating to British Rail both pre and post privatisation.

Ticketless Travel

5.15 On every route on the network there will always be passengers who travel without purchasing a ticket. This is referred to as ticketless travel. As LENNON data is derived from ticket transactions it cannot reflect this travel.

5.16 Anecdotally, there is a risk that ticketless travel may have increased during the COVID-19 pandemic as there were fewer on-board ticket inspectors and fewer visible station staff. This may have led to an increase in people's propensity to avoid buying a (valid) ticket.

Other Rail Systems

5.17 There are a number of rail systems in operation in the country that are not covered by LENNON. Eurostar revenue and journeys data are not available for inclusion in the ODM and station usage estimates.

Journey Factors

5.18 Ticket transactions are converted into an estimate of the number of journeys made by applying a series of ticket type journey factors. Single and return tickets unambiguously translate into one and two journeys respectively, for season tickets, the factors used represent a rough historic estimate as set out in Table 5-1.

5.19 Ticket periods of other lengths are converted to a number of journeys using a proportion of the monthly journey factor.

5.20 Therefore, the journeys data in the ODM represents an assumed number of journeys made based on the ticket type sold and the above journey factors. In particular it should be noted that the journeys data has not been cross-checked against other data sources of the actual number of journeys made on the network.

Table 5-1: Journey Factors used in LENNON

Description	Journeys Per Issue
Single Journey Ticket	1
Return Journey Ticket	2
Return Journey 2 Persons	4
3 Day Return/ 6 Single Journeys	6
4 Day Return/ 8 Single Journeys	8
5 Day Return/ 10 Single Journeys	10
6 Day Return	12
5 Day Single	5
1.5 Journeys	1.5
Weekly Ticket	10.3
10 Day Return/ 20 Single Journeys	20
2 Weekly Ticket	22
Seasons-Variable Periods	***
Monthly Ticket	45[8]
Not Used	0
3 Monthly Tickets	135[6]
Not Used	0
6 Monthly Tickets	270[6]
Summary Group Codes	***
Annual Ticket	480[6]
8 Day Ticket	22
22 Day Ticket	44
14 Day Ticket	30
50 Journeys	50
10 Weeks	103

[8] These are average values based on an aggregation of daily values which can vary throughout the year

Data Excluded from Station Usage Dataset

5.21 Some of the LENNON data has been excluded from the MOIRA2.2 Demand Matrix, and subsequently from the ODM.

5.22 All products that are classified into the 'miscellaneous' ticket pot are excluded. These products are:

- Car Parking;
- Railcard Sales;
- Penalty/Excess Fares;
- Seat Reservations;
- Sleeper Supplements.

5.23 Also excluded from the analysis were all the flows that had either an Origin or Destination that did not represent a geographical location (these are mainly "I codes"), e.g.

- Rover and Ranger Tickets (except those included in the 'Other' Infill in 2011/12 and subsequent years);
- BritRail Tickets;
- Gate passes usually used by staff;
- Passenger Charter Discounts;
- Headquarters Input Items, other than those which can be identified as TfL or PTE.

5.24 Finally, for flows that have either Origin or Destination as a Private Settlement Code some are included, and some are excluded.

- PTE tickets and TfL sold London Travelcard records from LENNON are removed and replaced with an estimate of all rail travel using these tickets via 'infill's to the MOIRA2.2 demand matrix.
- PlusBus – all significant flows have been included since 2007/08 and minor flows are excluded.
- Attractions – the rail element of the significant flows have been included since 2007/08, which include:
    - Bluewater Shopping Centre;
    - Alton Towers;
    - Whipsnade Zoo;
    - Chatsworth House.

5.25 All other flows involving Private Settlement are excluded, e.g. Irish Stations.

Appendices

A Methodology: Tickets with Unknown Origins or Destinations

A.1 Ticket sales do not always tell us where a passenger is travelling. Ticket sales can be divided into the seven categories listed in table below. Ticket sales data has been converted into an estimate of the actual stations that passengers are travelling from/to.

A.2 The processing of ticket sales data is undertaken in the creation of the MOIRA2.2 demand matrix, and then subsequently in the creation of the ODM. For each of the flow categories, the table below states where the flow is processed: MOIRA2.2 or ODM.

Table A.1: Categorisation of ticket sales in LENNON

Flow Category	Description	Processing
Category 1	Origin and Destination Stations Known	No processing required
Category 2	Origin or Destination a Group Station (excl. London BR)	ODM
Category 3	Origin or Destination is London Terminals	ODM
Category 4	Origin or Destination a London Travelcard including Zone 1	MOIRA2.2 Demand Matrix
Category 5	Origin or Destination a London Travelcard excluding Zone 1	MOIRA2.2 Demand Matrix
Category 6	Origin or Destination a London Travelcard Boundary Zone	MOIRA2.2 Demand Matrix
Category 7	Non-National Rail Stations	MOIRA2.2 Demand Matrix

A.3 In the descriptions below any reference to the methodology used prior to 2011/12 is drawn from documentation produced by Resonate when they were the ORR's consultants producing these statistics. From 2011/12 onwards a number of changes have been made in the methodology in order to better represent the distribution of demand between Group Stations (Category 2) by using passenger count data as described in chapter 3 of this report.

Category 1 – Origin and Destination Stations known

A.4 Both the origin and destination were known stations so no further processing is required for such flows.

Category 2a – Origin or Destination a Group with all Stations having a Ticket Office

A.5 In 2005/06 all origins or destinations that were a group station (with the exception of London BR) were changed to the major station within the group. For example, all ticket sales to or from Reading BR were recoded to Reading.

A.6 In 2006/07 the ODM was based on the journeys from ticket sales to the individual stations within a group. We assumed that passengers travelling to the stations in a group would act in the same way as passengers travelling from the stations in that group. It was believed that this was, in general, a valid assumption to make, and no bias would be introduced into the journey figures.

A.7 From 2007/08 onwards this process is still used where all stations in the group have ticket offices, so that the relative flows from the individual stations are credible.

A.8 For example, in 2006/07 the journeys between stations in the 'Manchester BR' group and Crewe and vice-versa are shown by the column "jnys" in the table below. First the proportion of journeys from each of the individual Manchester stations to Crewe is determined, as shown in column "%split."

A.9 Then these proportions are applied to both the 'Manchester BR to Crewe' and 'Crewe to Manchester BR' flows, giving the breakdowns to individual stations shown in column 'BR portion'. These are added to the base values to give "Total Journeys", before the 'Manchester BR to Crewe' and 'Crewe to Manchester BR' flows are deleted, to avoid double counting. The slight discrepancy between the 'Grand Totals' is due to rounding error.

Table A.2: Example of breaking down journeys to/from a BR group of stations

Orig	Dest	Origin Name	Destination Name	Jnys	%Split	BR portion	Total Jnys
2963	1243	DEANSGATE	CREWE	83	0.32%	85	168
2966	1243	MANCH OXF RD	CREWE	5,464	21.03%	5,580	11,044
2968	1243	MANCH PICC	CREWE	19,733	75.95%	20,152	39,885
2970	1243	MANCH VICT	CREWE	700	2.69%	714	1,414
0438	1243	MANCH BR	CREWE	26,533		Remove	
1243	2963	CREWE	DEANSGATE	207		1,478	1,685
1243	2966	CREWE	MANCH OXF RD	2,262		97,287	99,549
1243	2968	CREWE	MANCH PICC	8,017		351,349	359,366
1243	2970	CREWE	MANCH VICT	343		12,464	12,807
1243	0438	CREWE	MANCH BR	462,578		Remove	
		Grand Total:	525,920			525,918	

A.10 The above methodology has been applied to all flows with more than 1,000 journeys in total, based on sales data, leaving the individual group stations (i.e. not including the 'BR Group NLC to destination' flow). For the smaller flows an average split is applied based on the flow with more than 1,000 journeys.

A.11 Since 2011/12 a number of station passenger counts have been undertaken at individual stations within some of the BR station groups in order to support a revision to how the total demand is split between the individual stations. Since 2012/13 progressively more station groups have a count-based methodology for apportioning total demand amongst its member stations. In the 2022/23 Station Usage dataset the following Group Stations use passenger counts to calculate the split between individual stations:

- Bedford BR (Bedford, Bedford St Johns);
- Bootle BR (Bootle New Strand, Bootle Oriel Road);
- Canterbury BR (Canterbury East, Canterbury West);
- Colchester BR (Colchester, Colchester Town);
- Dorchester BR (Dorchester South, Dorchester West)
- Dorking BR (Dorking (Deepdene), Dorking (Main), Dorking West);
- Edenbridge BR (Edenbridge (Kent), Edenbridge Town);
- Falkirk BR (Falkirk Grahamston, Falkirk High);
- Farnborough BR (Farnborough Main, Farnborough North);
- Folkestone BR (Folkestone Central, Folkestone West);
- Guildford BR (Guildford, London Road (Guildford));
- Heathrow BR (Heathrow Terminals 2&3 (Rail Station Only), Heathrow Terminal 4 (Rail Station Only), Heathrow Terminal 5 (Rail Station Only)) – (annual data supplied by Heathrow since 2021/22);
- Helensburgh BR (Helensburgh Central, Helensburgh Upper);
- Hertford BR (Hertford East, Hertford North);
- Maidstone BR (Maidstone Barracks, Maidstone East, Maidstone West);
- Manchester BR (Manchester Piccadilly, Manchester Victoria, Manchester Oxford Road, Deansgate);
- Newark BR (Newark Castle, Newark North Gate);
- Pontefract BR (Pontefract Monkhill, Pontefract Tanshelf);
- Portsmouth BR (Portsmouth Harbour, Portsmouth & Southsea);
- Southend BR (Southend Central, Southend East, Southend Victoria);
- Wakefield BR (Wakefield Kirkgate, Wakefield Westgate);
- Warrington BR (Warrington Central, Warrington Bank Quay);
- Wigan BR (Wigan North Western, Wigan Wallgate); and
- Worcester BR (Worcester Foregate Street, Worcester Shrub Hill);

Category 2b – Origin or Destination a Group with some Stations Having no Ticket Office

A.12 For this class of stations the above process breaks down because the proportion of journeys **to** the group stations with no ticket offices will tend to be estimated as zero because the sales **from** those stations are necessarily zero. For these groups bespoke methodology has tended to be used based on the best available data. This year entries and exits for the majority of stations in this group have been obtained by apportioning total station group entries and exits using count data.

A.13 For the remaining stations splits between stations have been fixed at an origin and destination and route code level at the proportions estimated in the 2010/11 dataset.

Category 3 – Origin or Destination is London BR

A.14 This category contained all flows that had London BR as either the origin or destination. In order to assign an appropriate London station on flows where either the origin or destination is London BR (NLC=1072), allocations data from the Central Allocations File (CAF) was used. This was a methodology change in 2022/23 (replacing the previous methodology that used responses from the 2001 LATS survey to allocate the London BR demand).

A.15 The CAF contains information on the proportion of passengers modelled to choose each possible route between station pairs, and also disaggregates by ticket type, and is also updated for each timetable change, so can take into account future service changes. This enabled the journeys to be assigned to appropriate London terminal stations.

A.16 For example, if the flow was from Ashford International to London BR, we used our processing of the CAF data to generate the percentage spilt between the alternative London termini for passengers starting at Ashford International. From this we apportioned the exits between London Bridge, London Charing Cross, London Victoria and other London termini.

A.17 Where there is not data in the CAF to allocate journeys from a station to London BR (only a handful of very minor flows), a similar process with the Non London Groups methodology was applied.

Category 4 – Origin or Destination a London Travelcard including Zone 1

A.18 In previous years all origins and destinations that were London Travelcard Zones that include Zone 1 were converted to 'London BR' under the assumption that they will travel to the same stations as point-to-point passengers and then transfer to another mode. However the processing of Travelcards is now undertaken during the production of the MOIRA2.2 demand matrix.

Category 5 – Origin or Destination a London Travelcard excluding Zone 1

A.19 This category contained all Travelcards that did not include Zone 1, for example Zone R2345 London.

A.20 For flows with origin or destination a London Travelcard (excluding zone 1) we use a set of assumptions based on survey responses from the 2001 LATS. They use the starting station to work out which stations it is possible for the passenger to be travelling to, and also give the proportion of passengers travelling to each of these stations. This is based on the assumption that a passenger holding a Zones 2-6 Travelcard would travel as far as Zone 2.

A.21 This processing is undertaken during the production of the MOIRA2.2 demand matrix.

Category 6 – Origin or Destination a Boundary Zone

A.22 All origins and destinations that were a London Travelcard Boundary Zone were converted to 'London Travelcard including Zone 1' under the assumption that a passenger travelling from or to a Boundary Zone will hold a Travelcard that includes Zone 1. The methodology set out above for Category 3 was then applied.

A.23 This processing is undertaken during the production of the MOIRA2.2 demand matrix.

Category 7 – Non-National Rail Stations

A.24 This final category contains all those flows in the original ticket sales data that do not fall into one of the above categories. Refer to chapter 5 for a detailed description of this data and what has been included and excluded from the ODM.

This processing is undertaken during the production of the MOIRA2.2 demand matrix.

B Interchanges - Overview of the ORCATS allocation process

B.1 This appendix gives an outline of the Central Allocations File (CAF), which is used in producing the interchange figures, and the ORCATS process which is used to create the CAF.

B.2 Most of the train tickets that are sold are inter-available – the customer has a choice of routes and operators. For example, when a customer buys a ticket to travel from Leicester to Leeds, that customer may travel on various combinations of East Midlands Railway, London North Eastern Railway, CrossCountry and Northern Trains, and may interchange at Doncaster, Sheffield, Derby or Nottingham. LENNON captures the sale of the ticket, but unless the ticket has stringent route restrictions, the route actually taken by the customer is not recorded.

B.3 The route taken by any particular customer may never be known, but some route options are more attractive than others. The customer is more likely to choose a faster, more frequent service than a slower, less frequent one. This likelihood can be translated into the proportions of customers choosing each route option, on a particular flow. (A 'flow' represents all journeys from a given origin station to a given destination station, irrespective of the route taken.) The revenue received from all customers on that flow should be split between different operators to reflect the proportion of customers which each operator carried.

B.4 ORCATS was developed to model the choice made by the customers, and to allow revenue to be split between operators. It applies passenger choice modelling to the train timetable, to determine the relative attractiveness of different route alternatives. It then weights the results by journey mileage.

B.5 For any given timetable, ORCATS works out the possible routes between each origin and destination and calculates the percentage of the passengers that are expected to choose each route based on the services in that timetable.

B.6 The output from ORCATS is the CAF. This lists the proportion of journeys on each flow (or origin-destination pair) estimated to be made by each route alternative. For journeys involving interchanges, each leg of the journey is listed. By combining this information with the ODM data, which contains journeys for all flows, the number of interchanges occurring at individual stations has been estimated.

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