Rail Passenger Customer Experience Survey – Pilot

Weighting guide

3 May 2024

CONTENTS

1. Introduction

In summer 2022, the rail industry commissioned a method review with the objective to identify the optimal methodological approach to deliver an ongoing customer experience survey amongst rail passengers in Britain.

Field trials were conducted from April to June 2023 with the top methodologies that emerged from the method review. A method recommendation report was produced with detailed findings from the trials and a recommended approach for the pilot, as well as the future continuous survey.

Following the method review field trials further tests in the field and the pilot were conducted as follows:

1. Response rate experiments in September and October 2023 to measure further approaches of how the response rate could be improved. These included:
    a. Removing instruction to complete at end of journey.
    b. Shorter 5-6 minute survey.
    c. User experience (UX) modifications.
    d. Completion incentive.
2. Pilot plus a soft launch of the pilot to run the survey as intended in the future.
    a. The smaller soft launch was conducted during rail period 9 in 2023 and comprised of 39 shifts with 828 completed questionnaires.
    b. The pilot was run during rail period 10 2023/24 but was slightly extended beyond the rail period to make up for no fieldwork taking place during a few days over Christmas and the New Year and for some disruptions; in the pilot we conducted 368 shifts with 7,753 valid completed questionnaires across all Train operating companies (TOCs) in Britain.
3. Short survey trials in February 2024 to test further questionnaire modifications (a shorter modulated questionnaire of 8-9 minutes); this comprised of 15 shifts that were selected from the pilot survey based upon their higher footfall. The fieldwork compared how the modified shorter questionnaire compared to the longer 'standard' questionnaire by comparing the equivalent shifts from the pilot i.e. does the modified questionnaire have any positive impact on response rate?

For the response rate experiments and the short survey trials, separate standalone reports have been published.

The following document presents the weighting guide for the pilot under bullet 2. This guide summarises how the weighting was applied in the pilot, and the approach was decided upon from the method review field trials. For more information, this can be found in a separate technical report and weighting guide from the field trials. A separate pilot report and technical report have been published for the pilot, both containing a summary of the weighting guide.

2. Weighting context

Data from the pilot needed to be weighted to ensure it reflects the overall profile of rail journeys made on the network by TOC and journey characteristics within each TOC. This ensures that the reported data reflects the profile of rail journeys made during the sample period.

Weighting for the pilot was proposed to be similar to the weighting of the field trials. In summary, weighing has been applied to the following categories for each TOC:

1. Dayparts.

The sampling process generates totals of estimated number of passengers for each TOC by section of the week that the train is travelling, also known as dayparts, so this can be used for weighting the data. These sections of the week are split by Saturday, Sunday, and the weekdays are split into peak AM (06:00 hrs - 08:59 hrs), peak PM *(16:00 hrs to 18:59)*, late (19:00 hrs onwards until 23:59 hrs) and off-peak hours (09:00 hrs to 15:59 hrs or times recorded between 0:01 hrs to 05:59 hrs). MOIRA data is used to generate the dayparts figures. A brief description of MOIRA is shown at Annex D.

2. Station size bands (from MOIRA).

MOIRA data has been used to estimate the number of passengers boarding trains at each station for each TOC. The stations for each TOC are then sorted into descending order of passenger numbers. The stations that generate the first 25% of passenger journeys go into size band 1, those that generate from 25-50% go into size band 2, 50-75% into size band 3 and 75-100% into size band 4.

3. Passenger journey volume.

Passenger volumes on routes (from LENNON plus factors for certain TOCs to estimate ticket sales made outside the LENNON system). This is generated for the sampling before fieldwork and can then be used for the weighting exercise following fieldwork

4. Age and gender.

Age and gender of passengers taken from the footfall count data captured during fieldwork.

3. Weighting approach

In this section we provide more detail on the process used and the actual weights applied.

3.1 Data ruled out when deriving the weighting

Data on ticket type and journey purpose has not been used to create initial weights. There are several reasons for this:

- There is no official industry data on journey purpose by TOC.
- A significant proportion of respondents cannot recall their ticket type and being able to map these survey respondents with no ticket types to the population data for ticket types effects the accuracy of the weighting regime. The proportion of those not recalling their ticket type or the ticket type not being included in LENNON was 21% before weighting in the pilot survey. However, the percentage of ticket transactions that were not assigned to a specific ticket type in LENNON is very small (less than 1%). Therefore, if we were to weight the survey results for ticket type according to the ticket types on the LENNON system (as the population of ticket transactions), it would mean the 21% of the 'Other/don't know' responses from the survey data would be significantly higher than the 1% of unassigned tickets and would need to be severely downweighted. This would significantly reduce weighting efficiency and the effective sample available for analysis.
- LENNON data includes refunds which may appear in a different rail period (RP) from the one where the ticket was originally sold.

Our aim was that the random sampling approach we have used to select stations and trains for sampling and weighting by daypart, station size band and demographics would yield the correct ticket type profile. We have compared the profile with that from the LENNON analysis and do not recommend using ticket type as a weight in the survey, which is explained later in this document.

3.2 Weights used

Analysis of the field trials data, as identified in the tables in Annex A, showed that the key satisfaction measures do vary by day of week and time of day, by size of station and by demographics. This was done by manually examining the variations and identifying the most prominent for each possible weighting element. Weights have therefore been applied for each TOC using the following:

- Dayparts (different dayparts for weekdays, Saturday, Sunday).
- Station size bands.

- Passenger journey volume.
- Age and gender.

Journey purpose shows similar variation in overall satisfaction to other weighting actors, and for some metrics (such as punctuality, frequency of services and value for money) patterns of satisfaction with commuters and business users had far lower satisfaction than was seen in other weighting factors (see Annex A). However, there is limited accurate data on journey purpose in order to be able to weight the sample accurately. The use of proxy data such as ticket type has been considered above and in later analysis.

3.3 Data sources used to estimate the target population

The following data sources have been used to create estimates of the target population:

- Data from MOIRA, a passenger demand forecasting model, from November 2023 (used to estimate station size bands).
- The Rail Delivery Group (RDG) electronic timetable for the pilot period (used to estimate passenger numbers by daypart).
- LENNON (Latest Earnings Networked Nationally Overnight) data for the pilot period (used to estimate total passenger numbers for each TOC and to verify the ticket type categorisation used in the pilot survey)
- Age and gender data from the footfall counts.

3.4 How to produce the target population figures

3.4.1 Day of week and time of day profiles

The daypart and station size band profiles are produced as part of the sample selection process for the rail period or time of fieldwork. For daypart weights, BVA BDRC's rail sampling process takes the train services file (from the RDG electronic timetables) and calculates weights based on the passenger volumes from MOIRA appended to each train service, determining passenger volumes for each daypart for each TOC in a CSV file. This was done in Python.

MOIRA has been used to provide targets for each TOC by weekday/weekend and time of day. We have therefore constructed the following dayparts so that weighting counters any over or under sampling:

- Weekday - morning peak (trains starting between 06:00 and 08:59).
- Weekday - evening peak (trains starting between 16:00 and 18:59).
- Weekday - late (trains starting from 19:00 onwards).

- Weekday - other (off-peak – starting before 06:00 and between 09:00 and 15:59).
- Saturday.
- Sunday.

When the sample for each rail (RP) period is produced, MOIRA estimates of passenger numbers are appended to the data for each train service that runs during the RP. If the train service exists in MOIRA, the passenger numbers are directly appended; if the train service does not exist in MOIRA, models are used to estimate the number of passengers using that train.

It should be noted that the factors used in MOIRA to estimate the numbers boarding and alighting a train service at each station are based upon patterns of travel that existed before the COVID pandemic. These will not reflect current travel patterns and comparison with other sources suggests that MOIRA does overstate peak hour travel. There is an urgent need to update MOIRA data to reflect travelling behaviour but until this is done, we recommend using the existing data.

3.4.2 Station size band profiles

Weighting for each TOC also includes station size bands for each TOC to ensure that any bias towards larger stations is corrected. This mirrors the approach used in NRPS (National Rail Passenger Survey). We have therefore divided the stations for each TOC into roughly four equal bands after sorting by number of passengers. So, when stations are ranked into decreasing passenger numbers, the first quartile contains the stations that take the first 25% of passengers, the next quartile the stations that generate from 25% up to 50% and so on. The top one or two stations are in band 1, the next largest in band 2 and a larger group of smaller stations in band 3 and especially small ones in band 4. The quartiles will not be exactly 25% of passenger volume each but they do define groups of stations with the estimate proportion of passengers that those stations represent.

The BVA BDRC's rail sampling program outputs a file with a record for each station stop a service makes; the record also contains the TOC running the service. This data is analysed to generate a station by TOC matrix where the cells contain the estimated number of passengers boarding train services at each station for each TOC.

3.4.3 Estimated number of passenger journeys

We need to remain aware that LENNON data does not include all ticket sales and this is particularly a problem for certain TOCs (London Overground, Merseyrail, Heathrow Express and indeed any other TOC where substantial numbers of tickets are sold outside the channels that LENNON incorporates for example local retail outlets and directly from a Passenger Transport Executive).

Up to date estimates of the passenger numbers for each TOC can thus be provided by LENNON and applying a factor to take account of ticket sales not covered by the national ticketing system. The factors are only used for those TOCs where ticket sales are made outside the LENNON system. The factors are derived by dividing the ORR data for each TOC (which do include ticket sales outside LENNON) with the LENNON data for the same time period.

The number of passenger journeys for each TOC in the pilot is thus calculated as follows:

- The DfT undertakes an analysis of LENNON data which provides the total number of estimated passenger journeys derived from tickets included in LENNON.
- For some TOCs, a factor is applied to estimate the number of journeys made by tickets sold outside the LENNON system. The factor was calculated by comparing ORR data for the last published period with LENNON data for the same period.

3.4.4 Age and gender profiles

Early data for the field trials (manually comparing completed questionnaires to footfall data) suggests that there is no great response bias by age but there is by gender. The difference in profile between footfall and survey is as follows:

Table 1: Demographic profile comparison footfall vs. respondents

		Footfall	Respondents	Ratio
	16-24	15.77%	18.21%	87%
	25-44	44.93%	43.08%	104%
Age	45-64	26.52%	29.09%	91%
	65+	12.71%	9.15%	139%
	Other	0.06%	0.48%	13%
	Male	53.22%	46.08%	116%
Gender	Female	46.56%	52.12%	89%
	Other	0.07%	0.75%	10%
	DK	0.15%	1.05%	14%

The survey respondents slightly overrepresent 16-24 year olds and underrepresent those aged 65+. Males are underrepresented and females overrepresented. The footfall and survey profiles for each TOC are shown in Annex B.

We have therefore weighted data demographically by age group and gender from the footfall counts. This weighting is undertaken for each TOC. The age and gender distribution for each TOC comes from the observational counts undertaken as part of the pilot sampling plan. At random points during the fieldworker's shift, a message pops up on their tablet, asking them to suspend recruiting respondents for a period and conduct footfall count to profile passengers on the train or station by age and gender instead (see technical report for more detail). The fieldworker's tablet loads a tool which enables the passenger counts to be undertaken.

3.4.5 Other issues

It should be borne in mind that any extra variable used in the weighting process reduces the effective sample size, sometimes dramatically, if the sample profile is significantly different from the universe profile. This is particularly the case when looking at national data, as TOCs are sampled disproportionately to ensure each TOC has a robust sample size.

3.5 How to produce the sample distribution figures

The profiles of passengers for each TOC are produced by analysing the survey dataset to determine the proportion of respondents in each TOC, based on the variable for the TOC of the train the passenger was recruited on. The proportion of these respondents and how they are distributed across each of the following four factors provides the sampling profile:

- Passenger journey volume (the proportion of respondents for each TOC in the overall sample).
- Dayparts (different dayparts for weekdays, Saturday, Sunday) (from the variable indicating the departure time of the train the passenger used).
- Station size bands (from the variable indicating station where the passenger boarded; issues can occur due to different spellings between the Journey Picker Tool, and the RDG timetable and particularly if the passenger has to write in a station name).
- Age and gender (from age and gender variables for the TOC).

3.6 Description of the weight method used

Using Quantum, a software for for statistical analysis and survey reporting, rim weighting was used for each TOC, using the daypart, station size band and age and gender profiles. To generate national estimates TOCs are weighted to the estimated number of passenger journeys in the Rail Period being analysed, ensuring that at a national level the weighted sample is representative of passenger journeys. To achieve this national figure, the data of the number of respondents for each TOC is scaled up to estimated passenger journeys for that TOC in Rail Period 10 so the weights for each respondent have a weighting factor combined with a grossing factor.

3.7 How to deal with very small or large weights

Weighting factors are produced for category within each of the four variables (daypart, station size band, age group, gender) for each TOC. The full weighting matrix can be found in the appendix. These will help identify any characteristics that are over or under represented in the survey.

Table 2: Gender profile comparison weighted vs. unweighted

Q6: Thinking about this train that you travelled on between [pipe: dDeparture] station and [pipe: dArrival] station, please select the train company that operated this service. by Q96: Please indicate your gender?

	Weight			Unweighted proportions			Difference		
	Male	Female	NET Other	Male	Female	Net Other	Male	Female	Net Other
Avanti West Coast	51.5%	48.5%	0.0%	47.0%	49.7%	3.4%	4.5%	-1.2%	-3.3%
c2c	55.8%	43.5%	0.7%	47.1%	49.0%	3.8%	8.7%	-5.5%	-3.1%
Chiltern Railways	47.1%	52.8%	0.1%	45.0%	54.1%	0.9%	2.1%	-1.2%	-0.9%
CrossCountry	49.1%	50.8%	0.0%	37.8%	60.6%	1.6%	11.4%	-9.8%	-1.5%
Elizabeth line	55.2%	44.7%	0.0%	47.8%	50.9%	1.2%	7.4%	-6.2%	-1.2%
EMR - East Midlands Railway	62.6%	37.4%	0.1%	49.5%	50.0%	0.5%	13.0%	-12.6%	-0.4%
Grand Central	39.6%	60.4%	0.0%	23.1%	76.9%	0.0%	16.5%	-16.5%	0.0%
Great Western Railway	51.2%	48.8%	0.0%	48.8%	49.5%	1.7%	2.3%	-0.7%	-1.7%
Greater Anglia	56.1%	43.8%	0.0%	46.0%	50.9%	3.2%	10.1%	-7.0%	-3.1%
Heathrow Express	50.3%	49.7%	0.0%	53.8%	46.2%	0.0%	-3.6%	3.6%	0.0%
Hull Trains	51.0%	49.0%	0.0%	56.3%	43.7%	0.0%	-5.3%	5.3%	0.0%
London North Eastern Railway	53.9%	46.0%	0.1%	46.0%	52.3%	1.7%	7.9%	-6.2%	-1.7%
London Overground	55.1%	44.9%	0.1%	40.4%	56.8%	2.8%	14.7%	-12.0%	-2.7%
Lumo	46.2%	53.8%	0.1%	35.1%	63.6%	1.3%	11.1%	-9.9%	-1.2%
Merseyrail	46.1%	53.8%	0.1%	42.9%	55.9%	1.2%	3.3%	-2.1%	-1.2%
Northern	47.3%	52.6%	0.0%	45.0%	53.5%	1.4%	2.3%	-0.9%	-1.4%
ScotRail	52.6%	47.4%	0.1%	45.1%	53.8%	1.1%	7.5%	-6.5%	-1.0%
South Western Railway	54.3%	45.6%	0.1%	47.0%	51.3%	1.7%	7.3%	-5.7%	-1.6%
Southeastern	59.4%	40.6%	0.0%	44.9%	54.1%	1.0%	14.5%	-13.5%	-1.0%
Southern / Gatwick Express	52.0%	47.9%	0.0%	43.2%	54.8%	2.0%	8.8%	-6.9%	-1.9%
Thameslink / Great Northern	55.7%	44.2%	0.0%	49.2%	49.2%	1.5%	6.5%	-5.0%	-1.5%
TransPennine Express	47.0%	52.9%	0.0%	37.3%	60.5%	2.2%	9.7%	-7.5%	-2.1%
Transport for Wales Rail	51.6%	48.3%	0.0%	48.1%	46.7%	5.2%	3.5%	1.7%	-5.1%
West Midlands Trains	54.2%	45.8%	0.0%	48.3%	50.2%	1.5%	5.9%	-4.4%	-1.5%

Some TOCs will have high weights due to the need to upweight that TOC in generating national estimates. This is a natural consequence of imposing maximum sample sizes for any individual TOC and in particular ensuring adequate sample sizes for the smaller TOCs.

A weighting efficiency can be calculated for each TOC, which reflects the difference between the survey and target population profile. The weighting efficiency is a measure of how much weighting has stretched the data and the impact of this on effective sample size. For example, if a survey has one respondent with a very large weight, the effective sample size will be very low as the impact of this one respondent on the results is large and any variation in results for that respondent would impact substantially on the overall results.

The exact formula for the effective sample size is:

(Sum of weights) squared divided by (sum of weights squared)

$$n_{\text{eff}} = \frac{\left(\sum_{i=1}^{n} w_i\right)^2}{\sum_{i=1}^{n} w_i^2}$$

The weighting efficiency is the effective sample size divided by the actual sample size. The effective sample size should always be used to calculate confidence intervals (rather than the actual sample size).

We need to investigate any TOC where its weighting efficiency falls below 50%. The range of weights and the weighting efficiency for each TOC are shown in Annex C. In some cases, the weighting efficiency is affected by applying weights to small base sizes; in such cases, adjacent cells can be merged to improve the efficiency. For example, there may be few trains in a daypart and merging that daypart with an adjacent one. This was applied several times in analysing the pilot survey data.

An overall weighting efficiency can also be produced and to a large extent this will reflect the deliberate over and under sampling of individual TOCs.

3.8 How to apply weights to the survey data and analysis

A derived weight is created for each respondent and appended to each respondent's case as a variable so that it can be applied as weight in analyses in statistical software. This ensures that the weighted profile matches that of all passengers in RP10.

The only time the weights might not be used is for analyses that the sampling plan was not designed to deliver e.g. for time periods shorter than a rail period (the time period which the sampling plan was based) and subsequently where the sample profile achieved diverges significantly from the sampling frame.

3.9 Why not to weight by ticket type

To look at ticket type analyses, we need to have a common definition of ticket types across a number of data sources, principally LENNON (which generates the universe data) and the survey questionnaire (which obviously generates the sample data). Annex E shows a mapping which has been used to convert the detailed ticket types on LENNON to a reduced ticket type categorisation, which is used by the ORR statistics on ticket types and passenger volumes, where data is published annually.

The table below compares the reduced ticket type categorisation from LENNON with that published by the ORR. Both sets of data relate to the year from April 2022 to March 2023. As noted earlier, LENNON does not include some ticket sales which the ORR does include.

Table 3: Ticket type comparison ORR vs. LENNON

	Profile ORR	Profile LENNON
Franchised ordinary ticket Advance	6.77%	6.31%
Franchised ordinary ticket Anytime or Peak	31.94%	32.23%
Franchised ordinary ticket Off Peak	46.11%	46.65%
Franchised ordinary ticket Other	0.55%	0.40%
Franchised Season ticket	14.62%	14.41%
Total	100.00%	100.00%

As can be seen, the profiles match very well, giving confidence that using the LENNON data does generate an accurate profile for other periods. The same mapping has been applied to LENNON data from RP10. Survey data for the same reduced ticket type categorisation has been produced using the mapping shown at Annex F. The comparison is outlined in table 4.

Table 4: Ticket type comparison ORR vs. LENNON

	Profile LENNON	Profile survey
Advance	6.77%	10.93%
Anytime or Peak	31.94%	36.26%
Off Peak	46.11%	37.91%
Season ticket	14.62%	8.16%
Other/Don't Know	0.55%	6.74%
	100.00%	100.00%

Comparing the ticket type distribution from LENNON with that from the survey, it emerges that the "Other/Don't Know" is higher in the survey but that is as expected as it's a survey issue with some people not recalling the ticket type they used. The survey overstates Advance and Anytime/Peak categories and understates Off peak and Season categories, suggesting that response rates for these two categories might be lower than others.

In our view weighting should only be used for variables where there is robust universe data and where the variable has the same categories in the survey and the population. Age, gender, day of week, time of day, station size all meets these objectives but ticket type does not.

First there are a number of don't know responses in the survey (21%) which cannot be reliably allocated to a ticket type and so these respondents cannot have a weight generated. This will lead to significant down weighting of this group which would impact weighting efficiency significantly. There are other issues with universe data where the LENNON system itself uses a number of estimates to create passenger journey numbers (e.g. in converting a season ticket sale to a number of journeys), bringing into question the robustness of the ticket type data at this level of granularity. These methodological challenges suggest that weighting on the currently available data could potentially distort that final data set by as much as any differences that might be resolved. Therefore, we do not recommend weighting by ticket type despite the differences between the survey profile and that of LENNON for some categories.

4. Step by step weighting and issues encountered

Responses included in the pilot were collected during RP10 and to a smaller extent during RP11. Responses from the soft launch collected during RP9 were not included.

4.1 Data cleaning

The survey data required some cleaning so that the different weighting criteria could be applied:

- Age and gender (Q95 and Q96) – this required little cleaning and for the analysis the codes "prefer another term", "other" and "prefer not to say" were combined into one code.
- TOC – this derived from Q6 and was based on the journey picker tool (JPT). Respondents who could not return their journey details using the Journey Picker tool had to enter the TOC manually creating an issue because the TOC was not always correct which then had to be manually corrected using information on the journey provided by respondents (date, time, origin and destination stations).
- Departure station – this was based on the information from the JPT, or where that failed manual entry, and checked manually if any inconsistences arose (e.g. the station was not used by that TOC).
- Date and time – this was also based on the information from the JPT, or where that failed manual entry, and checked manually if any inconsistences arose (e.g. the station was not used by that TOC).

To ensure we could weight the data on the factors mentioned previously we had to create some additional variables:

- Day parts – this was used by creating a new variable based on the departure time and date from the JPT (dplanneddepartureBack) or manually entered data on the journey. Based on the date of the travel we were able to automatically assign a day of the week:
    - Weekday - morning peak (trains starting between 06:00 and 08:59).
    - Weekday - evening peak (trains starting between 16:00 and 18:59).
    - Weekday - late (trains starting from 19:00 onwards.)
    - Weekday - other (between 09:00 and 15:59; no shifts to be conducted prior to 06:00).
    - Saturday.
    - Sunday.

- Station category – for this we had to create a new variable based on the departure station and the TOC at Q6 (as per the station size band document – generated based on ORR data). When doing this it was noted that in many cases, when the respondent failed the JPT, an incorrect TOC or station had been given which led to the station category to fail. The entry had to be checked manually by reading the manually entered free text response and amending the surveys.

  This step also highlighted that a new station opened during the fieldwork period and there were respondents who used this station as their departure station. The station in question is East Linton which was missing from the database because the station opened on 13 December 2023 (during fieldwork) which created a twofold issue:

  - It was not in the JPT so respondents failed the journey selection.
  - There was no station size category for this station. Station category 4 was applied.

The weighting criteria are shown in Table 5 below.

4.2 Weighting process

The entire dataset was weighted on all weighting criteria at once. This resulted in the following weighting efficiency:

- Rim Weighting Efficiency 20.3 %.
- Maximum Respondent Rim Weight: 80.068612.
- Minimum Respondent Rim Weight: 0.000000.

20% overall is a low weighting efficiency, so this needed to be improved. Some of the low weighting efficiency comes from upweighting the larger TOCs and downweighting the smaller TOCs, where minimum sample size targets were initially set to ensure a minimum level of analysis was possible. We therefore decided to apply the weight in two stages:

1. Weighting each TOC by the weighting variables listed earlier.
2. Then weight the weighted dataset to be representative overall by grossing each TOC up to its estimated number of passenger journeys in RP10.

This allowed us to understand the weighting efficiency by TOC and subsequently we could identify those with a low weighting efficiency. Results for each TOC are outlined in table 5.

Table 5: Weighting efficiency by TOC after first round of weighting

Train Operating Company	Rim Weighting Efficiency	Maximum Respondent Rim Weight	Minimum Respondent Rim Weight
Avanti West Coast	38.30%	13.218622	0.004494
c2c	46.70%	7.674783	0.002439
Chiltern Railways	39.70%	12.397812	0.014167
CrossCountry	58.70%	5.061273	0.00534
East Midlands Railway	40.20%	8.275074	0.107849
Elizabeth Line	31.20%	18.58103	0.01016
Hull Trains	49.50%	5.989612	0.006619
Transpennine Express	22.80%	18.667295	0.001845
Grand Central	28.10%	9.125999	0.000068
Great Western Railway	58.60%	6.770173	0.013266
Greater Anglia	66.50%	4.503638	0.004443
Southern/Gatwick Express	65.20%	5.623243	0.009502
Thameslink /Great Northern	68.70%	4.26	0.002136
Heathrow Express	29.90%	5.131116	0.004365
LNER - London Northeastern Railway	61.10%	4.556147	0.020341
London Overground	42.80%	7.417202	0.004396
Lumo	50.40%	4.56103	0.038488
Merseyrail	58.60%	8.51669	0.004677
Northern Rail	34.70%	9.020101	0.00391
Scotrail	35.20%	9.054767	0.045551
South Western Railway	66.30%	5.583813	0.002666
Southeastern	57.40%	5.866059	0.031829
Transport For Wales	16.50%	17.836545	0.000013
London Northwestern	48.60%	4.682975	0
West Midlands Railway	65.00%	7.751833	0.007437

Based on these results the focus was on TOCs that had an overall efficiency below 50%. Weighted and unweighted data tables were generated on the different weighting criteria. This helped understand where large upweights/downweights were created. This analysis revealed that a key issue with the overall weight was the fact that we needed to upweight certain TOCs considerably, e.g. Elizabeth line and London Overground due to their relatively small sample compared to actual passenger journeys.

Table 6: Difference between weighted and unweighted TOC usage after first round of weighting

Q6: Thinking about this train that you travelled on between [pipe: dDeparture] station and [pipe: dArrival] station, please select the train company that operated this service.

	Difference between weighted and unweighted
Elizabeth line	13.8%
London Overground	6.4%
Thameslink / Great Northern	-2.9%
South Western Railway	1.8%
Southeastern	2.1%
Southern / Gatwick Express	0.9%
Northern	1.6%
ScotRail	3.9%
Great Western Railway	-3.6%
Greater Anglia	-0.8%
West Midlands Trains	-7.4%
c2c	-0.7%
CrossCountry	-0.5%
Merseyrail	-0.2%
Avanti West Coast	-2.5%
EMR - East Midlands Railway	-1.1%
Transport for Wales Rail	-0.1%
TransPennine Express	-2.7%
Chiltern Railways	-2.8%
London North Eastern Railway	-2.4%
Heathrow Express	-0.4%
Grand Central	-0.4%
Lumo	-0.9%
Hull Trains	-1.1%

This is not something that can be corrected at the weighting stage because it is linked to the sampling approach and the individual response rate per TOC. To ensure we get a better overall weight efficiency the sampling approach needs to be reviewed, and more shifts need to be conducted for the larger TOCs (and fewer for the smaller ones). At regional or national level, the drop in weighting efficiency is an inevitable result of upweighting some TOCs substantially.

To improve the TOC level weighting efficiency, other weighting criteria was looked at to see how this could be improved further (i.e. combining some weighting criteria together).

We did three rounds of reweighting.

In round 1, the focus was on the following TOCs:

- Avanti West Coast
- c2c
- Chiltern Railway
- East Midlands Railway
- Elizabeth line
- Grand Central
- Heathrow Express
- Hull Trains
- London Overground
- Northern
- ScotRail
- TransPennine Express
- Transport for Wales
- West Midlands Trains

We combined some cells across daypart, age and station category to improve their weighting efficiency and achieved the following improvements.

For example, for Hull Trains, the initial weighting efficiency was 49.5%. We merged station category 2 and 3. As a result the weighting efficiency jumped to 75.9%. This is illustrated in table 7 below where it is also highlighted TOCs whose weighting efficiency was below 50% after the second round of weighting.

Table 7: Weighting efficiency and maximum and minimum individual weights by TOC after second round of weighting.

Train Operating Company	Rim Weighting Efficiency		Maximum Respondent Rim Weight		Minimum Respondent Rim Weight	
	Original	Revised	Original	Revised	Original	Revised
Avanti West Coast	38.30%	44.50%	13.21862	11.63778	0.004494	0.010815
c2c	46.70%	77.80%	7.674783	3.514529	0.002439	0.002188
Chiltern Railways	39.70%	51.30%	12.39781	4.674767	0.014167	0.01686
East Midlands Railway	40.20%	56.70%	8.275074	6.78091	0.107849	0.107775
Elizabeth Line	31.20%	41.70%	18.58103	14.2143	0.01016	0.0146
Hull Trains	49.50%	75.90%	5.989612	5.293954	0.006619	0.562168
Transpennine Express	22.80%	82.90%	18.6673	3.823867	0.001845	0.017008
Grand Central	28.10%	27.90%	9.125999	9.125999	0.000068	0.200534
Heathrow Express	29.90%	69.90%	5.131116	3.062686	0.004365	0.031188
London Overground	42.80%	83.40%	7.417202	2.621827	0.004396	0.003345
Northern Rail	34.70%	46.90%	9.020101	6.860408	0.00391	0.00996
Scotrail	35.20%	41.40%	9.054767	9.781638	0.045551	0.045578
Transport For Wales	16.50%	39.30%	17.83655	9.708694	0.000013	0.000749

Based on these results, we decided that those TOCS with less than 50% weighting efficiency and those around 50% but with upweights greater than six needed improving and we combined further the same three variables:

Station size bands are merged when there are either no sample data in a particular size band or where the sample sizes are very small, leading to unstable weights. For example, for Avanti West Coast (VT) we merged station size 1-2 and 3-4. This boosted the weighting efficiency from 44.5% to 72.9%.

Table 8: Weighting efficiency by TOC and minimum and maximum individual weights after third round of weighting (TOCs highlighted whose weighting efficiency was below 50% after the third round of weighting)

Train Operating Company	Rim Weighting Efficiency		Maximum Respondent Rim Weight		Minimum Respondent Rim Weight	
	Original	Revised	Original	Revised	Original	Revised
Avanti West Coast	38.30%	72.90%	13.218622	3.054194	0.004494	0.010174
East Midlands Railway	40.20%	83.10%	8.275074	2.669566	0.107849	0.107962
Elizabeth Line	31.20%	58.90%	18.58103	4.000147	0.01016	0.016714
Grand Central	28.10%	28.90%	9.125999	9.125999	0.000068	0.277649
Great Western Railway	58.60%	67.50%	6.770173	5.291788	0.013266	0.007799
Merseyrail	58.60%	60.00%	8.51669	8.544082	0.004677	0.006715
Northern Rail	34.70%	84.50%	9.020101	2.437869	0.00391	0.007356
Scotrail	35.20%	62.60%	9.054767	3.968826	0.045551	0.045493
Transport For Wales	16.50%	40.30%	17.836545	11.842812	0.000013	0.001526
London Northwestern	48.60%	54.10%	4.682975	4.169456	0	0

A final round of weighing was then applied to a few remaining TOCs to improve weighting efficiency further, again combining some levels in some variables for those TOCs. And it was decided not to weight Grand Central due to its low base size (any weight on 37 respondents is too much weight).

The final weighting efficiency for the TOCs are outlined in table 9.

Table 9: Final Weighting efficiency by TOC after fourth round of weighting

Train Operating Company	Rim Weighting Efficiency		Maximum Respondent Rim Weight		Minimum Respondent Rim Weight	
	Original	Revised	Original	Revised	Original	Revised
Avanti West Coast	38.30%	72.90%	13.21862	3.054194	0.004494	0.010174
c2c	46.70%	46.70%	7.674783	7.674783	0.002439	0.002439
Chiltern Railways	39.70%	39.70%	12.39781	12.39781	0.014167	0.014167
CrossCountry	58.70%	58.70%	5.061273	5.061273	0.00534	0.00534
East Midlands Railway	40.20%	83.10%	8.275074	2.669566	0.107849	0.107962
Elizabeth Line	31.20%	58.90%	18.58103	4.000147	0.01016	0.016714
Hull Trains	49.50%	49.50%	5.989612	5.989612	0.006619	0.006619
Transpennine Express	22.80%	22.80%	18.6673	18.6673	0.001845	0.001845
Grand Central	28.10%		9.125999		0.000068	
Great Western Railway	58.60%	67.50%	6.770173	5.291788	0.013266	0.007799
Greater Anglia	66.50%	66.50%	4.503638	4.503638	0.004443	0.004443
Southern/Gatwick Express	65.20%	65.20%	5.623243	5.623243	0.009502	0.009502
Thameslink /Great Northern	68.70%	68.70%	4.26	4.26	0.002136	0.002136
Heathrow Express	29.90%	29.90%	5.131116	5.131116	0.004365	0.004365
LNER - London Northeastern Railway	61.10%	61.10%	4.556147	4.556147	0.020341	0.020341
London Overground	42.80%	42.80%	7.417202	7.417202	0.004396	0.004396
Lumo	50.40%	50.40%	4.56103	4.56103	0.038488	0.038488
Merseyrail	58.60%	66.80%	8.51669	8.524319	0.004677	0.005776
Northern Rail	34.70%	84.50%	9.020101	2.437869	0.00391	0.007356
Scotrail	35.20%	62.60%	9.054767	3.968826	0.045551	0.045493
South Western Railway	66.30%	66.30%	5.583813	5.583813	0.002666	0.002666
Southeastern	57.40%	57.40%	5.866059	5.866059	0.031829	0.031829
Transport For Wales	16.50%	39.30%	17.83655	9.708694	0.000013	0.000749
London Northwestern	48.60%	54.10%	4.682975	4.169456	0	0
West Midlands Railway	65.00%	65.00%	7.751833	7.751833	0.007437	0.007437

At an overall level this last round of weighting generated the following efficiency for the overall data set:

- **Rim Weighting Efficiency 53.6 %.**
- **Maximum Respondent Rim Weight: 4.284166.**
- **Minimum Respondent Rim Weight: 0.061978.**
- **Final maximum with pre/post weighting: 17.137307.**
- **Final minimum with pre/post weighting: 0.000000.**

As a min weight of 0 is unusual and not preferable (it means one or more respondent are virtually removed from the database), we investigated the reason. It was because some respondents for West Midlands Trains did not give their age or gender. As a result the weighting excluded them. We considered applying a default 1% for all TOCs for those answering "others/prefer not to say,".

However, this approach meant that we arbitrarily forced the size of this segment. After some thoughts and discussions with stakeholders we agreed that this was not the best approach and that those respondents should be left unweighted in those categories.

We therefore updated the weighting criteria to take into account the natural fall out of these categories.

Table 10: Natural fall out of Don't know/Other/Prefer not to say for the survey per TOC

	I identify in another way + Prefer not to say + Don't know/not sure	Male	Female	Don't know/not sure + Prefer not to say	16-34	35-64	65+
Avanti West Coast	3.3%	49.8%	46.9%	0.0%	43.6%	44.7%	11.7%
c2c	3.7%	54.8%	41.5%	1.0%	41.1%	47.3%	10.6%
Chiltern Railways	0.9%	46.7%	52.4%	0.3%	49.1%	42.2%	8.4%
CrossCountry	1.6%	48.4%	50.0%	1.1%	47.9%	36.7%	14.3%
East Midlands Railway	0.5%	62.3%	37.2%	0.5%	34.2%	42.9%	22.4%
Elizabeth Line	1.2%	54.6%	44.2%	0.0%	47.6%	42.9%	9.5%

	I identify in another way + Prefer not to say + Don't know/not sure	Male	Female	Don't know/not sure + Prefer not to say	16-34	35-64	65+
First Hull Trains	0.0%	51.0%	49.0%	0.0%	35.1%	53.6%	11.3%
First Transpennine Express	2.1%	46.0%	51.9%	0.0%	41.1%	43.9%	15.0%
Grand Central	0.0%	44.7%	55.3%	0.0%	23.9%	52.7%	23.4%
Great Western Railway	1.7%	50.2%	48.1%	0.5%	45.3%	39.1%	15.2%
Greater Anglia	3.2%	54.4%	42.5%	0.7%	35.8%	50.6%	12.8%
GTR - SOUTHERN & GATWICK EXPRESS	2.0%	51.0%	47.0%	0.4%	47.1%	42.7%	9.9%
GTR- THAMESLINK & GREAT NORTHERN	1.5%	54.9%	43.6%	0.9%	37.0%	52.6%	9.5%
Heathrow Express	0.0%	50.5%	49.5%	1.9%	47.6%	43.8%	6.7%
LNER	1.7%	53.0%	45.3%	0.0%	37.0%	44.8%	18.1%
London Overground	2.7%	53.6%	43.7%	1.2%	46.2%	41.3%	11.3%
Lumo	1.3%	45.6%	53.1%	0.0%	60.6%	38.6%	0.8%
Merseyrail Electrics	1.2%	45.6%	53.2%	1.9%	30.2%	35.6%	32.4%
Northern Rail	1.4%	46.7%	51.9%	0.6%	36.5%	44.9%	18.1%
Scotrail	1.1%	52.0%	46.9%	0.0%	41.9%	38.8%	19.2%

	I identify in another way + Prefer not to say + Don't know/not sure	Male	Female	Don't know/not sure + Prefer not to say	16-34	35-64	65+
South Western Railway	1.6%	53.4%	45.0%	0.2%	42.0%	45.8%	12.0%
Southeastern	1.0%	58.8%	40.2%	0.5%	33.7%	49.4%	16.4%
Transport for Wales	4.9%	48.8%	46.3%	0.0%	50.2%	39.3%	10.5%
WMT - London Northwestern	1.4%	54.2%	44.4%	0.5%	40.5%	48.2%	10.9%
WMT - West Midlands Railway	1.5%	53.3%	45.2%	0.5%	41.6%	43.6%	14.4%

We then recalculated the weights to rebase them to take into account the 'Don't know/Other Prefer not to say'. This resulted in the following overall weighting efficiency (which subsequently did not change much from phase 3):

- **Rim Weighting Efficiency 53.6%**
- **Maximum Respondent Rim Weight: 4.285839.**
- **Minimum Respondent Rim Weight: 0.062002.**
- **Final maximum with pre/post weighting: 17.439937.**
- **Final minimum with pre/post weighting: 0.004051.**

5. Considerations for future surveys

For future surveys we recommend taking the following points into consideration.

- Designing the sample so that over and under sampling dayparts and station size bands are reduced to improve the weighting efficiency and reduce the need for multiple iterations. Some consideration should be given to increasing the sample size for TOCs that have been substantially upweighted which would be informed by the prioritisation of analysis at TOC, National and Regional levels.
- Stations in the data did not appear in the station size band list for their TOC. Some of these were new stations, some were due to errors in data provided by respondents when they could not get the JPT to work for them. There were also some stations generated by the JPT that did not (and should not) appear in the station size band database e.g. London Eurostar. The addition of stations to the database this time round should reduce the number of station mismatches that occur when the weighting is run. New stations are known about, so should be added to the station database and the sampling tool (that also generate the station bands) as soon as they become operational.
- Some mismatches with stations occur due to station names being spelled differently between various data sources e.g. ORR, RDG timetable, JPT all have different spellings of some stations. If another wave takes place, a comprehensive lookup table should be created which allows station names from one source to be "translated" to a common name.

6. Quality standards & accreditation

We are ISO 20252:2019 and ISO 27001:2013 certified, the recognised international quality standards for market research and information security.

- All work will be carried out in conformity to these standards, the MRS Code of Conduct, GDPR, the UK's Data Protection Act, and all other relevant industry codes, legal and ethical requirements.
- Adherence to the standard is independently audited once per year.
- Where subcontractors are used by BVA BDRC, they are assessed to ensure any outsourced parts of the research are conducted in adherence with these same standards.

7. Other details

Images within this proposal have been sourced via Getty Images through subscription / Flaticon / logos from Wikipedia and Wikimedia.

Appendix

Annex A – Factors affecting satisfaction from field trials data

In the tables below cells shade green had a notably higher percentage of respondents who were satisfied across various metrics of satisfaction than for other categories in that variable. Cells shaded red had a notably lower percentage of respondents who were satisfied for that category compared to other within that variable.

The questions used as satisfaction categories were:

- Overall, taking everything into consideration, how satisfied or dissatisfied were you with your train journey from <<departure station>> to <<arrival station>>?
- Thinking about the entire journey you made between <<departure station>> and <<arrival station>> how satisfied or dissatisfied were you with the following?
    - The overall punctuality of this service
    - The frequency of trains running on this route
    - The overall value for money of the journey you made

Table 11: Percentage of respondents reporting either 'fairly satisfied' or 'very satisfied' by day of the week

day of week (Monday=1)	Overall satisfaction	The overall punctuality of this service	The frequency of trains running on this route	The overall value for money of the journey you made
Mon	88%	82%	74%	64%
Tues	87%	83%	72%	62%
Weds	86%	82%	72%	63%
Thurs	87%	83%	74%	62%
Fri	85%	81%	72%	59%
Sat	85%	84%	79%	68%
Sun	88%	85%	76%	71%
Total	87%	83%	74%	63%

Table 12: Percentage of respondents reporting either 'fairly satisfied' or 'very satisfied' by hour of departure

Hour of departure	Overall satisfaction	The overall punctuality of this service	The frequency of trains running on this route	The overall value for money of the journey you made
0	88%	85%	81%	67%
1	89%	81%	73%	65%
2	85%	82%	72%	58%
3	82%	79%	71%	60%
4	91%	83%	77%	67%
5	88%	85%	75%	69%
6	82%	74%	68%	58%
7	81%	86%	70%	71%
8	88%	86%	70%	56%
9	89%	87%	74%	63%
10	88%	85%	72%	62%
11	88%	84%	74%	63%
12	90%	88%	79%	70%
13	82%	85%	77%	67%
14	88%	83%	74%	68%
15	87%	81%	76%	65%
16	86%	78%	74%	59%
17	86%	88%	78%	66%
18	87%	85%	79%	66%
19	87%	76%	79%	69%
20	81%	72%	61%	61%
21	83%	79%	64%	66%
22	88%	85%	77%	66%
23	88%	82%	73%	62%
Total	87%	83%	74%	63%

Table 13: Percentage of respondents reporting either 'fairly satisfied' or 'very satisfied' by purpose of journey

Summary journey purpose	Overall satisfaction	The overall punctuality of this service	The frequency of trains running on this route	The overall value for money of the journey you made
Unknown	50%	50%	63%	25%
Commuter	84%	76%	65%	51%
Business	86%	84%	76%	58%
Leisure	89%	87%	80%	73%
Other	85%	81%	74%	69%
Total	87%	83%	74%	63%

Table 14: Percentage of respondents reporting either 'fairly satisfied' or 'very satisfied' by gender

gender	Overall satisfaction	The overall punctuality of this service	The frequency of trains running on this route	The overall value for money of the journey you made
Male	84%	81%	74%	61%
Female	89%	85%	75%	66%
Another way	82%	73%	62%	53%
Not answered	72%	64%	58%	40%
total	87%	83%	74%	63%

Table 15: Percentage of respondents reporting either 'fairly satisfied' or 'very satisfied' by age group

Summary age groups	Overall satisfaction	The overall punctuality of this service	The frequency of trains running on this route	The overall value for money of the journey you made
Not answered	100%	100%	67%	100%
16-34	85%	80%	71%	59%
35-54	87%	83%	73%	60%
55-64	86%	85%	75%	70%
65+	90%	87%	82%	81%
Other	81%	71%	60%	57%
Total	87%	83%	74%	63%

Table 16: Percentage of respondents reporting either 'fairly satisfied' or 'very satisfied' by daypart

daypart	Overall satisfaction	The overall punctuality of this service	The frequency of trains running on this route	The overall value for money of the journey you made
weekday - morning peak	86%	83%	68%	58%
weekday - evening peak	87%	83%	77%	63%
weekday - late	87%	80%	69%	60%
weekday - other	87%	83%	75%	64%
Saturday	85%	84%	79%	68%
Sunday	88%	85%	76%	71%
Total	87%	83%	74%	63%

Annex B – Footfall and survey profiles of age and gender

Table 17 : Profile of age and gender by TOCs in footfall counts – weighted

Weighted									
	Age					Gender			
TOC	16-24	25-44	45-64	65+	Other	Male	Female	Other	DK
Avanti West Coast	18.11%	42.35%	29.00%	10.54%	0.00%	49.88%	48.75%	0.02%	1.36%
c2c	17.98%	47.98%	23.78%	10.21%	0.05%	53.29%	46.08%	0.58%	0.05%
Chiltern Railway	14.00%	50.45%	26.81%	7.82%	0.92%	46.64%	52.45%	0.04%	0.87%
CrossCountry	25.10%	38.09%	24.80%	11.96%	0.05%	44.63%	54.27%	1.07%	0.03%
East Midlands Railway	17.57%	34.15%	32.10%	16.18%	0.00%	58.46%	40.84%	0.04%	0.65%
Elizabeth line	15.53%	58.83%	17.42%	8.22%	0.00%	59.15%	40.71%	0.00%	0.14%
Gatwick Express	20.24%	39.27%	39.29%	1.20%	0.00%	60.61%	39.35%	0.00%	0.05%
Grand Central	2.62%	46.10%	33.22%	18.07%	0.00%	41.36%	58.64%	0.00%	0.00%
Great Northern	11.71%	42.74%	31.75%	13.78%	0.02%	52.70%	47.25%	0.00%	0.06%
Great Western Railway	18.14%	44.56%	21.60%	15.63%	0.06%	49.09%	50.87%	0.03%	0.02%
Greater Anglia	13.05%	43.26%	31.72%	11.92%	0.06%	57.36%	42.34%	0.02%	0.28%
Heathrow Express	4.54%	56.81%	37.62%	0.97%	0.06%	51.87%	48.13%	0.00%	0.00%
Hull Trains	7.12%	30.13%	39.05%	23.70%	0.00%	62.67%	37.33%	0.00%	0.00%
LNER	16.09%	36.19%	31.15%	16.57%	0.00%	50.52%	49.43%	0.05%	0.00%
London Northwestern Railway	12.00%	52.00%	32.00%	4.00%	0.00%	56.00%	42.00%	2.00%	0.00%
London Overground	15.65%	51.14%	21.42%	11.78%	0.01%	55.99%	43.96%	0.02%	0.03%
Lumo	21.42%	57.70%	18.82%	2.07%	0.00%	40.57%	59.42%	0.01%	0.00%
Merseyrail	14.99%	26.07%	24.47%	34.43%	0.04%	45.85%	54.09%	0.00%	0.06%
Northern	17.34%	36.68%	26.88%	19.02%	0.07%	44.34%	55.60%	0.01%	0.05%
ScotRail	13.64%	43.50%	30.13%	12.73%	0.00%	59.75%	40.19%	0.00%	0.06%
South Western Railways	14.48%	43.18%	30.11%	12.22%	0.00%	53.67%	46.33%	0.00%	0.00%
Southeastern	11.84%	43.21%	29.24%	15.65%	0.06%	59.28%	40.67%	0.04%	0.01%
Southern	14.32%	52.80%	21.64%	11.20%	0.03%	47.75%	52.21%	0.02%	0.02%
Thameslink	11.89%	48.63%	30.47%	8.93%	0.08%	57.48%	42.27%	0.03%	0.21%
TransPennine Express	22.54%	25.46%	38.00%	14.00%	0.00%	45.30%	53.84%	0.04%	0.82%
Transport for Wales	32.55%	35.95%	22.54%	8.96%	0.00%	51.95%	46.80%	0.62%	0.64%
West Midlands Trains	18.69%	39.80%	29.13%	12.35%	0.03%	54.03%	45.94%	0.02%	0.01%
Grand Total	**15.77%**	**44.93%**	**26.52%**	**12.71%**	**0.06%**	**53.22%**	**46.56%**	**0.07%**	**0.15%**

Table 18: Profile of age and gender by TOCS in footfall counts– unweighted

Unweighted									
	Age					Gender			
TOC	16-24	25-44	45-64	65+	Other	Male	Female	Other	DK
Avanti West Coast	16.97%	43.64%	29.70%	9.70%	0.00%	47.58%	48.48%	1.21%	2.73%
c2c	15.77%	49.55%	29.28%	4.50%	0.90%	45.95%	50.45%	0.45%	3.15%
Chiltern Railway	18.90%	49.09%	27.44%	3.96%	0.61%	45.43%	53.35%	0.61%	0.61%
CrossCountry	25.89%	37.95%	23.21%	12.05%	0.89%	37.05%	60.71%	1.34%	0.89%
East Midlands Railway	22.84%	33.62%	33.62%	9.91%	0.00%	49.14%	50.00%	0.43%	0.43%
Elizabeth line	20.83%	54.51%	16.67%	7.99%	0.00%	48.26%	50.35%	0.00%	1.39%
Gatwick Express	18.92%	39.19%	40.54%	1.35%	0.00%	48.65%	50.00%	0.00%	1.35%
Grand Central	10.26%	48.72%	30.77%	10.26%	0.00%	33.33%	66.67%	0.00%	0.00%
Great Northern	12.58%	39.74%	33.77%	12.58%	1.32%	45.36%	52.32%	0.00%	2.32%
Great Western Railway	22.70%	45.24%	22.70%	8.89%	0.48%	47.14%	51.43%	0.95%	0.48%
Greater Anglia	17.20%	43.12%	29.82%	9.17%	0.69%	47.71%	49.31%	1.38%	1.61%
Heathrow Express	3.77%	49.06%	43.40%	1.89%	1.89%	52.83%	47.17%	0.00%	0.00%
Hull Trains	13.79%	37.07%	37.93%	11.21%	0.00%	59.48%	40.52%	0.00%	0.00%
LNER	17.96%	38.38%	32.39%	11.27%	0.00%	45.77%	52.46%	1.76%	0.00%
London Northwestern Railway	12.00%	52.00%	32.00%	4.00%	0.00%	56.00%	42.00%	2.00%	0.00%
London Overground	13.76%	51.01%	26.51%	7.72%	1.01%	40.60%	56.71%	0.67%	2.01%
Lumo	16.67%	47.50%	30.83%	5.00%	0.00%	35.83%	63.33%	0.83%	0.00%
Merseyrail	19.86%	28.77%	30.82%	19.18%	1.37%	42.47%	56.16%	0.00%	1.37%
Northern	25.14%	38.73%	27.46%	8.09%	0.58%	43.64%	54.91%	0.29%	1.16%
ScotRail	18.63%	44.12%	31.37%	5.88%	0.00%	44.12%	54.90%	0.00%	0.98%
South Western Railways	11.24%	42.13%	35.39%	11.24%	0.00%	47.00%	51.50%	0.56%	0.94%
Southeastern	13.47%	44.04%	31.61%	10.36%	0.52%	45.85%	53.11%	0.78%	0.26%
Southern	13.94%	48.53%	29.22%	8.04%	0.27%	41.55%	56.84%	0.54%	1.07%
Thameslink	13.13%	45.25%	30.92%	10.02%	0.69%	51.81%	46.80%	0.69%	0.69%
TransPennine Express	25.93%	37.96%	27.78%	8.33%	0.00%	37.04%	60.49%	1.23%	1.23%
Transport for Wales	27.71%	43.98%	18.07%	10.24%	0.00%	48.80%	45.78%	1.81%	3.61%
West Midlands Trains	24.85%	40.96%	26.72%	7.12%	0.35%	48.42%	50.06%	1.17%	0.35%
(blank)	15.08%	40.12%	32.06%	11.71%	1.02%	47.00%	51.68%	0.29%	1.02%
Grand Total	18.21%	43.08%	29.09%	9.15%	0.48%	46.08%	52.12%	0.75%	1.05%

Table 19 – Ratio of weighted and unweighted footfall counts in each age group and gender categories in each TOC

Weighted/unweighted									
	Age					Gender			
TOC	16-24	25-44	45-64	65+	Other	Male	Female	Other	DK
Avanti West Coast	107%	97%	98%	109%		105%	101%	1%	50%
c2c	114%	97%	81%	227%	6%	116%	91%	130%	1%
Chiltern Railway	74%	103%	98%	197%	150%	103%	98%	6%	142%
CrossCountry	97%	100%	107%	99%	5%	120%	89%	80%	3%
East Midlands Railway	77%	102%	95%	163%		119%	82%	10%	152%
Elizabeth line	75%	108%	105%	103%		123%	81%		10%
Gatwick Express	107%	100%	97%	89%		125%	79%		3%
Grand Central	26%	95%	108%	176%		124%	88%		
Great Northern	93%	108%	94%	110%	2%	116%	90%		2%
Great Western Railway	80%	99%	95%	176%	12%	104%	99%	3%	4%
Greater Anglia	76%	100%	106%	130%	8%	120%	86%	1%	17%
Heathrow Express	120%	116%	87%	51%	3%	98%	102%		
Hull Trains	52%	81%	103%	212%		105%	92%		
LNER	90%	94%	96%	147%		110%	94%	3%	
London Northwestern Railway	100%	100%	100%	100%		100%	100%	100%	
London Overground	114%	100%	81%	153%	1%	138%	78%	4%	1%
Lumo	128%	121%	61%	41%		113%	94%	1%	
Merseyrail	75%	91%	79%	180%	3%	108%	96%		4%
Northern	69%	95%	98%	235%	11%	102%	101%	2%	4%
ScotRail	73%	99%	96%	216%		135%	73%		6%
South Western Railways	129%	102%	85%	109%		114%	90%	0%	0%
Southeastern	88%	98%	93%	151%	12%	129%	77%	5%	5%
Southern	103%	109%	74%	139%	12%	115%	92%	4%	2%
Thameslink	91%	107%	99%	89%	11%	111%	90%	4%	31%
TransPennine Express	87%	67%	137%	168%		122%	89%	4%	66%
Transport for Wales	117%	82%	125%	88%		106%	102%	34%	18%
West Midlands Trains	75%	97%	109%	173%	9%	112%	92%	1%	3%
(blank)	109%	90%	96%	139%	24%	99%	104%	2%	16%
Grand Total	87%	104%	91%	139%	13%	116%	89%	10%	14%

Annex C – Weighting efficiency data for each TOC

TOC Weighting characteristics

Train Operating Company	Rim Weighting Efficiency	Maximum Respondent Rim Weight	Minimum Respondent Rim Weight
Avanti West Coast	72.90%	3.054194	0.010174
c2c	46.70%	7.674783	0.002439
Chiltern Railways	39.70%	12.397812	0.014167
CrossCountry	58.70%	5.061273	0.00534
East Midlands Railway	83.10%	2.669566	0.107962
Elizabeth Line	58.90%	4.000147	0.016714
Hull Trains	49.50%	5.989612	0.006619
Transpennine Express	22.80%	18.667295	0.001845
Grand Central	28.90%	9.125999	0.277649
Great Western Railway	67.50%	5.291788	0.007799
Greater Anglia	66.50%	4.503638	0.004443
Southern/Gatwick Express	65.20%	5.623243	0.009502
Thameslink /Great Northern	68.70%	4.26	0.002136
Heathrow Express	29.90%	5.131116	0.004365
LNER - London Northeastern Railway	61.10%	4.556147	0.020341
London Overground	42.80%	7.417202	0.004396
Lumo	50.40%	4.56103	0.038488
Merseyrail	66.80%	8.524319	0.005776
Northern Rail	84.50%	2.437869	0.007356
Scotrail	62.60%	3.968826	0.045493
South Western Railway	66.30%	5.583813	0.002666
Southeastern	57.40%	5.866059	0.031829
Transport For Wales	39.30%	9.708694	0.000749
London Northwestern	54.10%	4.169456	0
West Midlands Railway	65.00%	7.751833	0.007437

Annex D – Brief description of MOIRA

MOIRA

The linking of demand with supply, represented through measures of the capacity and quality of the network, is a fundamental part of most transport models. This process enables policymakers to understand the impact of congestion or crowding, which, if capacity is not increased while demand grows, will inhibit the growth in demand. In addition, forecasts are often used to estimate the impact on demand, revenues and rail-user benefits of changes to the services specified in the base case, to inform decision-makers about the case for investment in capacity.

The supply side of the rail network is represented through the MOIRA model, which is composed of the base year and future year timetables, with any options for change set up in a separate future year timetable. The timetable includes data on train capacities. The model allocates passengers travelling between the origins and destinations identified in LENNON in both the base year and the future year flows, forecast through the PDFH elasticities in combination with the EDGE forecasts, to the trains operated in the timetable.

MOIRA includes a feedback loop whereby an increase in crowding both suppresses overall demand and encourages rail users to switch to less-crowded trains despite the inconvenience of having to change their schedules. An option which increases capacity will result in passengers reverting to their preferred schedule as well as an overall increase in demand.

MOIRA is also used to show the effects on demand of changes in journey time and in other attributes of the journey. These effects are expressed in the model in units of generalised journey time (GJT), with each attribute being valued in relation to what its equivalent would be if taken in terms of additional travel time.

MOIRA includes a representation of passengers' preferred departure times and can thus show the effect on demand of changes in the timetable.

Annex E – Mapping of LENNON ticket types

Ticket type from LENNON	Mapped ticket category
APEX SINGLE/RETURN	Advance
BRITRAIL/CONTINENTAL	Other
CAR PARKING	Other
CHEAP DAY SINGLE	Reduced (Off-Peak)
EXCESS/PENALTY FARES	Other
FIRST ADVANCE PURCHASE	Advance
FIRST CHEAP DAY RTN/DAY TRVLCARD	Reduced (Off-Peak)
FIRST REDUCED	Reduced (Off-Peak)
FIRST RETURN	Full (Anytime/Peak)
FIRST SEASONS 180-359 DAYS VB2B	Season
FIRST SEASONS 91-180 DAYS VB2A	Season
FIRST SEASONS ANNUAL	Season
FIRST SEASONS UP TO 90 DAYS VB1	Season
FIRST SEASONS WEEKLY	Season
FIRST SINGLE	Full (Anytime/Peak)
INCLUSIVE TOURS	Other
MISCELLANEOUS	Other
NON PASSENGER/RAIL TRAVEL	Other
NON SPECIFIC SPG	Other
OTHER ADVANCE PURCHASE SGL/RTN	Advance
OTHER REDUCED SINGLE/RETURN	Reduced (Off-Peak)
RAILCARD SALES	Other
REFUNDS BY FLOW ORDINARY	Full (Anytime/Peak)
REFUNDS BY FLOW SEASONS	Season
ROVER TICKETS	Reduced (Off-Peak)
SAVER	Reduced (Off-Peak)
SLEEPER SUPPLEMENT	Other
STANDARD FLEXI SEASON	Season
STANDARD RETURN	Full (Anytime/Peak)
STANDARD SINGLE	Full (Anytime/Peak)
STD CHEAP DAY RTN/DAY TRVLCARD	Reduced (Off-Peak)
STD SEASONS 180-359 DAYS VB2B	Season
STD SEASONS 91-180 DAYS VB2A	Season
STD SEASONS ANNUAL	Season
STD SEASONS UP TO 90 DAYS VB1	Season
STD SEASONS WEEKLY	Season
SUPERSAVER	Reduced (Off-Peak)

Annex F – Mapping of survey data

Ticket type from survey	mapped
Advance	Advance
Anytime single/return	Full (Anytime/Peak)
Day Travelcard	Map to Ticket
Pay As You Go (e.g. using a contactless bank, Oyster or pre-paid card)/ contactless	Map to Ticket
Freedom Pass	Reduced (Off-Peak)
Off-Peak or Super Off-Peak (single or return)	Reduced (Off-Peak)
Special Promotion Ticket i.e. Rover Ticket	Reduced (Off-Peak)
Annual Season Ticket	Season
Flexi Season Ticket	Season
Monthly Season Ticket	Season
Weekly Season Ticket	Season
Don’t know/not sure	Other/ Don't know
Other (please specify)	Other/ Don't know
Travelled without a ticket	Other/ Don't know