Office for National Statistics

Article

Travel and tourism review: final report

Final report of the travel and tourism review, including the findings of the review and the next steps for this work.

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1 . Overview

The Office for National Statistics (ONS) has conducted a review of travel and tourism statistics, aiming to:

- fully understand the needs of users of these statistics

- recommend how tourism statistics should be transformed, including responsibilities, approach, and data sources

- agree an implementation plan to deliver the transformation

The review began in response to recommendations from the Office for Statistics Regulation (OSR) compliance check into overseas travel and tourism statistics. It was also prompted by pausing the International Passenger Survey (IPS) because of the coronavirus (COVID-19) pandemic, and the ONS' decision to move away from the IPS as the primary source of data to compile migration estimates, instead focusing on producing administrative-based migration estimates.

The review proposes an approach to deliver more efficient, accurate and coherent travel and tourism statistics in the future. Introducing a long-term vision of using alternative data sources as the basis for delivering travel and tourism statistics, a hybrid approach is proposed comprising:

- alternative data sources, initially mobility data and financial transactions data, that will help to compile more granular estimates (in terms of geography and expenditure) that is not possible with survey data alone

- faster indicators of travel and tourism activity produced using statistical modelling with alternative data sources

- a passenger survey that collects data on departure from the UK only and is harmonised with the Civil Aviation Authority (CAA) Survey and the Northern Ireland Passenger Survey (NIPS), thereby allowing the combination of data from all sources into a single estimate for key variables

- a household survey that collects data from UK residents

This proposed approach was developed following extensive user engagement with both internal and external stakeholders. Alongside this, the ONS identified and researched alternative data sources, assessing their feasibility for use in the production of statistics, and considered how travel and tourism could be measured if development were to start from scratch. A public consultation was launched to gather opinions and feedback on the final vision for travel and tourism, which demonstrated broad support for this approach.

While the review proposes a vision for travel and tourism statistics, further work is now required to refine this vision into an implementation plan. As such, a high-level plan of intent has been developed, which includes a year-long period of detailed research followed by a two-year period of implementation. This plan is indicative at this stage and is subject to the findings of the detailed research and the availability of funding to deliver the implementation.

This review concluded at the end of March 2022.

2 . Current approach to measuring travel and tourism

Surveys

Currently, a number of different organisations are involved in the collection and production of travel and tourism statistics. The key official statistics on international tourism are produced by the Office for National Statistics (ONS), using the International Passenger Survey (IPS). Statistics on domestic tourism are produced by VisitEngland, Visit Wales and VisitScotland using the Great Britain Tourism Survey (GBTS) and the Great Britain Day Visit Survey (GBDVS).

Statistics on domestic travel are compiled using separate surveys. The Department for Transport (DfT) conducts the National Travel Survey (NTS) for England, the Northern Ireland Statistics and Research Agency (NISRA) conducts the Travel Survey for Northern Ireland (TSNI) and Transport Scotland publishes travel statistics based on the Scottish Household Survey (SHS). In addition, travel and tourism related statistics are collected and compiled by the Civil Aviation Authority (CAA), the Department for Digital, Culture, Media and Sport (DCMS) and the devolved administrations.

In March 2020, data collection for the IPS was paused because of the coronavirus (COVID-19) pandemic. This helped identify a key weakness with the current approach to data collection. The resulting lack of survey data was taken as an opportunity to bring forward plans to introduce the use of alternative data sources in the compilation of migration statistics (which were also based on the IPS). In addition, concerns have been raised about the extent to which existing international tourism statistics meet the needs of their users, resulting in a compliance check conducted by the Office for Statistics Regulation (OSR) in October 2019. Key issues reported by the OSR include timeliness, accuracy, and level of disaggregation as well as poor levels of user engagement.

The IPS was launched in 1961 as a regular sample survey of sea and air passengers travelling between the UK and continental Europe, and on longer air routes beyond European borders. It provided a regular source of expenditure data on the contribution made by tourists and other travellers to the UK balance of payments. Almost 20 years later, in 1980, the scope of the IPS was broadened to allow the survey to become the primary source of data on people migrating in and out of the UK. Except for the introduction of tablets to aid data collection in 2018, the survey is relatively unchanged, other than changes made to maintain the survey so that it is fit for purpose by, for example, conducting sample optimisation and updating weighting methodology.

For domestic travel and tourism, the main data sources used are the Great Britain Tourism Survey (GBTS) and the Great Britain Day Visits Survey (GBDVS), which measure the volume, value and profile of overnight and day trips taken by British residents to destinations in England, Scotland, Wales and Northern Ireland. While there have been changes to both coverage and methods, the GBTS has been running in some form since 1989. These two surveys are currently undergoing transformation with the aim of better meeting users' needs. GBTS and GBDVS data collection has been affected by the coronavirus (COVID-19) pandemic as travel restrictions meant that data collection had to be suspended. Fieldwork resumed in April 2021, with the release of data covering April to December 2021 currently planned for summer 2022.

Northern Ireland is included within the UK estimates of international travel and tourism produced by the ONS using the IPS, with passengers interviewed at Belfast International Airport. The Northern Ireland Statistics and Research Agency (NISRA) additionally compiles statistics based on its own passenger survey, the Northern Ireland Passenger Survey (NIPS). NIPS conducts face-to-face interviews with passengers leaving Northern Ireland via its seaports and airports. It collects data related to visits to both Northern Ireland and the Republic of Ireland. The NIPS design was initially based on the IPS, but subsequent reviews and methodological improvements introduced by NISRA have resulted in some divergence between the two surveys, although they do remain broadly similar.

Residents of Northern Ireland were previously included in the predecessor to GBTS, known as the United Kingdom Tourism Survey (UKTS). However, since January 2011, data on both domestic and international trips taken by residents of Northern Ireland have been collected using the Continuous Household Survey (CHS). The CHS has been run since 1983 and covers a range of topics including internet access, health and the environment.

The use of a passenger survey to measure foreign visitors to the UK is successful because, as an island nation, the majority of international visitors arrive to the UK via a sea, air or rail port. However, a passenger survey does not account for the arrival of visitors across the land border between the Republic of Ireland and Northern Ireland. In the case of the estimates of international travel and tourism produced by the ONS, movement across the Irish land border is estimated using pseudo records. These pseudo records are based on data from 2013, with the expenditure of foreign residents uplifted annually based on the change in the Consumer Price Index (CPI). NISRA has a separate approach to measuring the movement of foreign residents across the land border, currently utilising the Survey of Overseas Travellers conducted by Failte Ireland, as well as data from the Household Travel Survey conducted by the Central Statistics Office (CSO), Ireland. This difference in approach to the measurement of international inbound travel to Northern Ireland via the land border results in a lack of coherence, with estimates produced by the ONS for Northern Ireland appearing to be an underestimate.

Challenges and limitations

As the primary source of statistics on international travel and tourism, the IPS has changed relatively little since its inception in the 1960s. However, the user need for these statistics has changed significantly. While the IPS was established primarily as a source of data to feed into the Balance of Payments, these statistics are now used much more widely, in particular, for setting and monitoring travel and tourism policy and for tourism planning and analysis at a local level. As a result, and especially since tourism policy is devolved, the current IPS does not deliver the timeliness and geographical granularity that users require.

The coronavirus pandemic also highlighted a weakness in the mode of data collection used by the IPS. Since data are collected using face-to-face interviews in the major UK ports of entry and exit, the survey was paused for nine months from March 2020 to December 2020 for the safety of interviewers and to ensure compliance with COVID-19 regulations. This resulted in a lack of data on international travel and tourism at a time when users were keen to understand how the coronavirus pandemic had affected tourism.

Several different organisations are involved in the production of travel and tourism statistics. While there is no reason why a single organisation should take full responsibility for all travel and tourism statistics, the current approach does present some challenges around coherence. In particular, the statistics compiled by NISRA for Northern Ireland using the Northern Ireland Passenger Survey and Continuous Household Survey are not consistent with the Northern Ireland component of the IPS. The domestic and international trips taken by UK residents are measured separately; domestic trips are measured using a household survey and international trips are measured using a passenger survey. While the initial aims of the travel and tourism review focussed solely on improving the way in which international statistics were compiled using the IPS, it became apparent that UK international statistics should not be considered in isolation. As a result, the review also addresses issues of coherence as well as strategic oversight for travel and tourism as a whole.

Understanding user needs

During the [compliance check](#) conducted by OSR, it was reported that the ONS did not have sufficient knowledge of the users of international travel and tourism statistics. As a result, OSR concluded that the ONS were not able to assess all user requirements in terms of the quality of estimates or the outputs produced. The review began by identifying key users and their requirements.

A full list of travel and tourism topics was developed and key stakeholders were subsequently asked to review these topics to ensure there were not any gaps, and to provide evidence for individual user requirements. To evaluate the evidence gathered, a prioritisation matrix was developed, adapted from a similar model produced for the 2021 Census, to assess user requirements. The matrix includes a set of criteria: purpose, strength of impact, continuity with existing sources, and comparability with international data. Each of the criteria were given a scoring range and weight, which gave a value out of 100 for each topic. The scoring exercise was independently assessed by the ONS Good Practice Team to ensure the scores were objective, consistent and fair. The resulting list of prioritised topics was shared with both key and wider stakeholders for feedback.

Various stakeholder groups have been established to capture user needs and to engage with users throughout the review process. An expert panel was established to bring together key stakeholders to contribute knowledge and best practice as well as share updates on progress. A travel and tourism strategic group was also established to support and enable effective collaboration between the organisations. The strategic group plays a role in the production of statistics for travel and tourism, promotes coherence and efficiency, and ensures responsibilities lie in the right place. Lists of organisations included in the expert panel and strategic group are included in this publication (see [Section 13](#)). So that ideas and findings were communicated as broadly as possible and to seek feedback from a wide range of users, a mailing list was created and used to provide updates and invite users to webinars held at key points during the review. This mailing list is open to all.

Following the development of the proposed approach, a [public consultation](#) was launched to seek feedback from users on the proposal and to identify possible areas for improvement. The consultation was launched in October 2021 and ran for 11 weeks, closing on 21 December 2021. The consultation received 63 responses from a range of stakeholders including central and local government, businesses, academia and individuals.

Overall, 70 per cent of those who responded stated that they were either quite happy or very happy with the proposed approach. This provides support for continuation with the proposal. Feedback received included both enthusiasm and scepticism for alternative data sources, demonstrated a clear user need for increased granularity and more timely estimates, and raised concerns from users about the potential introduction of discontinuities. This feedback will be valuable as the proposed approach is further developed. The ONS published a [response to the public consultation](#) on 15 March 2022.

3 . Proposed approach for measuring travel and tourism

It is proposed that travel and tourism statistics are compiled using a hybrid method which maximises the use of alternative data sources in combination with surveys. This proposal represents a first key step towards a longer-term vision of using alternative data sources as the basis for travel and tourism statistics, as and when suitable data sources become available.

Under this hybrid approach, mobile collection data will be used to provide more granular estimates of the number of visits, with financial transactions data used to estimate expenditure at a more detailed geographical level than currently available. In all instances, alternative data sources will be received in an anonymised and aggregated form to address any privacy concerns. Alternative data sources will also be used with statistical models to produce faster indicators that will provide users with more timely estimates of travel and tourism.

The research conducted throughout the review shows that while alternative data sources show a lot of potential, it is unlikely to be possible to compile travel and tourism statistics solely using these sources. As well as the vast challenges associated with data acquisition, privacy and commercial sensitivity, the primary issue is around coverage. Without additional sources for benchmarking, changes in coverage could easily be interpreted as a change in, for example, the number of visitors or their expenditure. To address this, streamlined passenger and household surveys will be used to provide high-level estimates alongside alternative data sources.

The review has also concluded that it is not feasible to adequately compile these statistics solely using survey data. One of the key uses of these statistics is within the tourism industry - both in setting and monitoring policy and assessing the contribution of tourism to the economy. These users require very granular data, which, to provide at the required level of accuracy using a survey, would need a very large sample size. Increasing existing sample sizes to a level that could meet user needs is unlikely to be value for money or proportionate to the public need for these statistics.

Under the proposed approach, data for foreign visitors to the UK will be collected using a port-based passenger survey and the domestic and international travel of UK residents collected using a household survey. These surveys will be supplemented with alternative data to provide estimates from statistical models with greater granularity for geography and expenditure and also to develop faster indicators of travel and tourism.

4 . Proposed approach for alternative data sources

The coronavirus (COVID-19) pandemic, and the subsequent decision to temporarily suspend the International Passenger Survey (IPS) between March 2020 and December 2020, highlighted a key weakness in the collection of data using a face-to-face survey. In the absence of survey data, published official statistics were compiled entirely using alternative data sources including passenger counts and financial transactions data (as seen in Overseas travel and tourism, provisional: April to June 2020). As such, it was a key aim of this review to identify and investigate alternative data sources that have potential for use in the compilation of travel and tourism statistics to build on the experience gained during the coronavirus pandemic.

With the assistance of stakeholders, a large number of potential data sources were identified (as seen in the data sources section). Initial research and prioritisation of these data sources was conducted so that the review could focus only on the sources that appeared to have the most potential for the transformation of travel and tourism statistics. As a result, it is intended that additional data sources identified are considered further in the future and implemented within the approach set out above where appropriate.

Mobility data

Mobile connection data for two network providers, for both UK and foreign residents, have been explored throughout the review period. For foreign residents, anonymised and aggregated counts of SIM cards registered abroad, which have connected to the UK network, have been considered to represent inbound visitors. For UK residents, anonymised and aggregated counts of UK-registered SIM cards connected to a foreign network, weighted to the UK population, have been used to represent outbound visitors. For UK residents, the aggregate counts are provided as an expanded count, where the number of SIM cards detected has been weighted so that it represents the UK population. This weighting has been applied by the providers before aggregating the data. This expansion process is not applicable to the counts for foreign residents since the required population information is not available. The resulting estimates have been compared with the IPS and a good correlation has been found between the two sources. The results for one of these network providers has been published and the results for foreign visitors to the UK are shown in Figure 1.

Figure 1. Total number of foreign visitors to the UK from mobile and IPS survey data for 2019 to 2020

Figure 1. Total number of foreign visitors to the UK from mobile and IPS survey data for 2019 to 2020
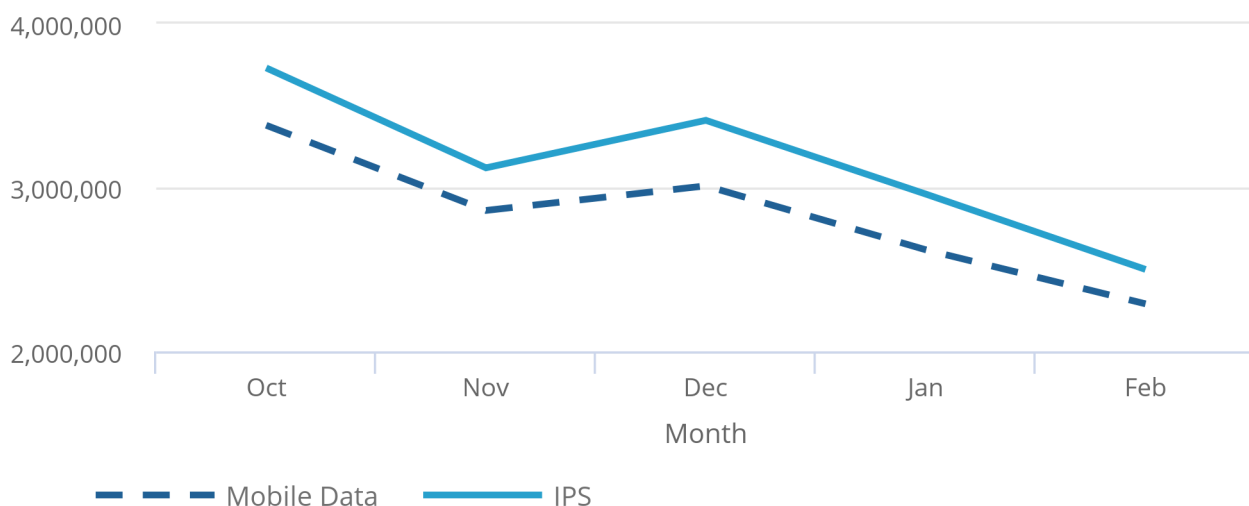
Source: Office for National Statistics

Mobility data has been considered primarily as a means of providing estimates of the number of visits with more accurate and detailed geographical breakdowns than would be possible with just survey data. In order to test the feasibility of this, small area estimation techniques were explored as part of the review to try to improve the accuracy of survey estimates of inbound tourism at the UK region level. This work aimed to apply a small area estimation model known as the Fay-Herriot model using data from both the IPS and mobile phone data. Small area estimation techniques are a way of using other data sources, in this case mobile phone data, to improve the quality of small area (or domain) estimates from a survey by assuming a statistical model can explain the relationship between data sources.

The Fay-Herriot model was used to estimate the IPS international passenger inflow counts at a region level using the mobile phone data as an auxiliary variable. The analysis was conducted on a cross-sectional basis, meaning that it used one quarter of data for the 12 UK regions. This approach was taken because of the lack of continuity in the time series for mobile phone data in the period of overlap with the IPS. As a result, the model does not account for this temporal aspect. It is also important to note that the two data sources differ in some definitions and the timing of collection and further research is required to assess the impact of these.

After fitting the model and performing diagnostics, the confidence intervals for region-level estimates of inbound tourism did not improve in any meaningful way. This could be attributed to the fact that, at the region level, sample sizes for the IPS are already relatively high and provide small variances so the regression component of the model that uses the mobile phone data as a predictor adds little. As a result, the direct survey estimates receive a larger weight in the model and so the quality of the outputs do not change substantially.

While the mobile phone data did not demonstrate an improvement of estimates at the UK region level, the data are able to provide inflow breakdowns at smaller geographies where small area estimation techniques are likely to make a greater difference. In addition to this, the survey estimates have larger sampling errors at lower-level geographies, which could allow the model to put more weight on the mobile phone estimates and perhaps improve the confidence intervals at that lower level. In order to assess the data and its usefulness at sub-region level, counts and variance estimates for the IPS are also required at the lower level for the Fay-Herriot model. Calculating these is a significant piece of work, and, as a result, could not be completed within the review timeframe. However, testing this approach at the local authority level is an important next step for this work.

One of the limitations of alternative data sources is that they do not cover the whole population and the level of coverage is likely to vary through time and by additional variables such as country of residence or destination. For example, mobile phone data will only cover visitors who travel with their mobile phone and the proportion of visitors who take their mobile with them when they travel is likely to change over time. If coverage were not accounted for, this could be interpreted as a change in the number of visitors when it is actually a change in mobile phone usage. As a result, additional information about coverage, for example, how many people do travel with their mobile phone or pay using a credit or debit card while in the UK, would be beneficial to inform the use of alternative data sources. Such ancillary information could be collected as part of the passenger or household surveys when data about actual trips taken are collected.

Financial transactions data

Initial work has been conducted to explore the use of financial transactions data within the production of estimates of travel and tourism expenditure. Of the data currently held by the ONS, the most appropriate data for use within travel and tourism is from credit and debit card transactions and point-of-sale terminals. Data that shows the value of transactions made using a UK-registered credit or debit card abroad can be used to give an estimate of outbound expenditure. Point-of-sale terminal data can show the value of transactions made in the UK using foreign registered cards, and so is an estimate of inbound expenditure. Like with mobility data, financial transactions data is not considered suitable to provide an overall estimate of expenditure because it does not provide complete coverage of all transactions, for example, transactions made using cash. Since the proportion of transactions made using a credit or debit card compared with other payment types is likely to vary through time, trends observed in the financial transactions data could be interpreted as trends in expenditure when, in reality, they represent changes in coverage.

Research conducted to date, based on a single provider of data, demonstrates that there is a correlation between financial transactions data and equivalent data from the IPS. However, because of the issues around privacy and the sensitivity required for financial transactions data, it has not yet been possible to publish this work. It is anticipated that the financial transactions data will be used in a similar way to the mobility data, using small area estimation to provide breakdowns of expenditure totals, based on the merchant category codes used within the source data. This has yet to be tested.

5 . Proposed approach for faster indicators

Currently, estimates of overseas travel and tourism are published on a monthly, quarterly and annual basis. The gap between the reference period covered by the release and the publication varies. The monthly release is published approximately 6 weeks after the reference month, the quarterly release is published approximately 3.5 months after the reference quarter, and the annual release is published approximately 4 months after the reference year. As demonstrated by the public consultation, users would like more timely estimates of travel and tourism, particularly given the seasonal nature of tourist activity.

One way to provide more timely estimates is to develop faster indicators based on alternative data sources and using statistical models. Research conducted during the review to develop a suitable statistical model for this purpose suggests the use of a state-space model. State-space models allow the combination of multiple time series data sources into a single framework, which can be used to produce smoothed estimates. They also allow likely errors to be incorporated, for example seasonality and sampling errors. State-space models were also used by the Office for National Statistics (ONS) for modelling migration flows during the coronavirus (COVID-19) pandemic.

Models have been produced using:

- International Passenger Survey (IPS) data for inbound (foreign residents' visits to the UK) and outbound (UK residents' visits abroad) tourism

- administrative data sources of counts of passengers arriving into and leaving the UK

- financial transactions data that includes the value and number of transactions made by both foreign residents in the UK and UK residents abroad

The feasibility work indicated that this kind of model has the potential to model the seasonality and relationships between the different sources of data.

In the future, state-space models could be developed using additional data sources including data on travel bookings and cancellations. It is anticipated that such data would give a very timely indication of likely travel trends. While attempts were made to acquire suitable data during the review, there was insufficient time available to complete the full data acquisition process.

In addition to the development of faster indicators of travel and tourism, it may also be possible to make changes to speed up the production of survey estimates. In the current IPS, one of the main factors affecting the timeliness is the time required for the delivery of passenger counts data that are used in the calibration of the survey results. Instead of waiting for the data, it may be possible to use nowcasting to estimate the most recent passenger counts and use these estimates for calibration. These provisional values could be revised as the actual passenger counts become available.

6 . Proposed approach for the passenger survey

Inbound travel and tourism will be measured using a port-based passenger survey that collects data from foreign residents as they leave the UK at the end of their visit. This survey will be based on the current methodology used by the International Passenger Survey (IPS) but, since its primary focus will be to measure inbound tourism only, the survey will not collect data from passengers on arrivals. To improve efficiency, coherence and accuracy, the passenger survey will be harmonised with both the Civil Aviation Authority (CAA) survey and the Northern Ireland Passenger Survey (NIPS). This change also gives the opportunity to review the methodology used by the IPS and identify improvements that could be included in the new passenger survey.

Harmonisation with CAA

The CAA survey collects information from passengers that helps to explain the decisions involved in their specific travel plan. Information collected includes:

- country of residence

- journey purpose

- full details around direct and indirect air services

- surface geographical breakdown

- surface transport breakdown

- key demographic indicators

The survey, which collects information from departing air passengers, has been running since 1968 and the information collected is used commercially to develop route networks but also at an institutional level to forecast air transport demand and support ongoing policy work.

While the CAA survey was established for a different primary purpose than the IPS, a comparison of the respective questionnaires has been carried out and a significant degree of overlap was found. This presents an opportunity to harmonise questions where necessary and seek to include CAA survey data within the official statistics, thereby potentially increasing accuracy for visits made via air transport. However, it is recognised that both surveys do have differences that need to be retained so that it would not be possible to fully harmonise the two questionnaires. As such, it is the intention that a key set of core questions are agreed, which can be harmonised so that variables collected by both surveys are done so on a comparable basis.

The IPS and CAA survey adopt slightly different approaches to the sampling of departing air passengers within a given airport or terminal. As part of the review, changing the sampling methods to make them consistent has not been considered. This could introduce additional discontinuities and present practical challenges if both surveys used the same methods in the same airports. However, the differences between the approaches must be taken into account when combining data from both surveys into a single estimate.

The IPS takes a two-stage approach, first selecting a fixed time period at selected ports (known as a shift), then selecting passengers based on a pre-determined sampling interval. The shifts are selected according to a series of marginal constraints, for example, whether it is morning or afternoon, the specific port of arrival or departure and whether passengers are arriving or departing, but not the day of the week, which is random and adjusted by post stratification. The shifts selected must meet a few additional constraints, such as not having a late shift one day followed by an early shift the following day for the same interview team. It is considered that the impact of these additional constraints is negligible so that the IPS sample of shifts is a probability sample. The second stage is the sampling from the flow of passengers as they move through a defined counting line in the airport. Every nth passenger is selected where n is usually fixed for each port but can be adjusted. It and has been variable throughout the coronavirus (COVID-19) pandemic as the rate of passenger flow has varied.

The CAA survey takes a three-stage approach, first selecting a shift (in a similar way to the IPS), then selecting flights within each shift and finally selecting passengers on each flight. For the second stage, flights are selected for each shift in such a way that all route and carrier combinations are covered over a defined period (with charter flights aggregated as a single carrier regardless of airline). In cases where all route and carrier combinations are not covered, any exclusions are represented by a dummy record so that they are included in the outputs. The third stage of the CAA survey involves sampling of passengers on departure for the selected flights, with a probability selection of one in n passengers at departure gates. N is always an odd integer to try to avoid the effect of couples passing through in order. As is the case for the IPS, this probability of selection can be changed.

To combine data from both surveys in a way that accounts for these differences in sampling methods, two approaches have been considered: joint estimation and joint calibration. Joint estimation combines the estimates from both surveys according to their sampling variances. Joint calibration takes the microdata from both surveys and weights them together using a single set of weights that accounts for the sample sizes of both surveys.

A joint estimation approach has been tested as part of the review based on data for Quarter Two (Apr to June) 2019 at London Heathrow airport. Since work to harmonise questions between the CAA departing passenger survey and the IPS is yet to be completed, joint estimation work was conducted using the estimate of the number of UK and foreign residents. Residency is already estimated on a comparable basis for both surveys. Sampling variances were calculated for the estimates produced by both surveys, accounting for the differences in sampling methodology, with the variance for the estimates produced using the CAA departing passengers survey found to be lower (see table 1 below). As a result, it appears that combining the CAA estimates with those from the IPS will deliver improved accuracy, although further work will be required to refine the sampling variance calculations and test the findings with additional variables and for additional airports.

Table 1. Estimates of foreign and UK residents from the IPS, the CAA departing passengers survey and the combined estimate (London Heathrow, Quarter 2 2019).

Residence	No of visitors ('000s) IPS estimate	Standard Error (IPS)	No of visitors ('000s) CAA estimate	Standard Error (CAA)	Joint estimate (IPS & CAA)
Foreign	2,646	57.2	2,943	33.6	2,722
UK	4,114	123.3	3,631	33.6	4,081

Source: ONS International Passenger Survey and Civil Aviation Authority departing passengers survey (London Heathrow, Quarter 2 2019)

It was not possible to fully test joint calibration during the review period. However, it is anticipated that this approach would yield a more accurate estimate than that produced using joint estimation. While joint calibration is likely to deliver greater accuracy, the additional work required to combine estimates from the microdata may mean that it is not practical for use in routine production of official statistics. This will need to be considered as part of the testing of the joint calibration approach.

Harmonisation with NIPS

The Northern Ireland Passenger Survey (NIPS), which is run by NISRA, was designed to measure overnight travel and tourism from visitors who reside outside of the island of Ireland. The survey methodology was based on that of the IPS, with the key difference that the NIPS is run on departures only and does not attempt to measure visits by residents of Northern Ireland. As a result, the introduction of a UK passenger survey that collects data on departure from the UK only will be consistent with the approach taken in Northern Ireland.

Currently the NIPS collects data from departing passengers leaving from airports (Belfast International, Belfast City and City of Derry) and seaports (Stena Cairnryan, Stena Liverpool and Larne) in Northern Ireland. The total sample size in 2019, including ineligible and refused responses, was 43,547. The IPS also operates in Northern Ireland but interviews passengers at Belfast International airport only. The total equivalent sample size for departing passengers in 2019 was 4,634. Despite the similarities between the NIPS and the IPS, there is currently no data sharing in place. Not only is this a missed opportunity to improve the quality of both surveys, but it also creates a lack of consistency between estimates of visitors to Northern Ireland as measured by NISRA compared with the estimate used within the UK figure produced by the ONS. The ONS does not publish a separate estimate for Northern Ireland.

The IPS imbalance

The IPS currently collects data on both departures from the UK and arrivals into the UK. In compiling estimates of travel and tourism, estimates are based on full interviews with visitors that are collected at the end of their visit. So, for foreign residents, full interviews are conducted on departures, as they leave the UK, but for UK residents, full interviews are conducted on arrivals, as they return home. Short interviews are also carried out at the start of a visit to establish where individuals are resident and how long they expect to stay in or leave the UK. Comparisons of interviews collected at the start and end of visits has shown an imbalance for certain nationals with more individuals recorded at the start of visits than at the end. Most notably, foreign nationals tend to be under-represented on departures, with particular countries, for example China, particularly under-represented. Also, UK residents are under-represented on arrivals as they return home from a foreign visit. The exact causes of these imbalances are unknown, but it is likely that they are a result of a tendency for lower response rates from residents of certain countries because of language barriers, cultural differences, and an artefact of passenger flows; for example, UK residents are more likely to move faster through the airport on arrivals than foreign residents.

Under the proposed approach, the data required to estimate the travel and tourism of UK residents will be collected using a household survey rather than a passenger survey. As a result, there should no longer be any concerns about the under-representation of UK residents in the estimates. Since a passenger survey will still run on departures, there is the opportunity to continue a short survey of UK residents at the start of their trip, which can be used alongside the household survey results. Further work will be required to determine how this benchmarking will be conducted in practice, but since estimates from both surveys will have known sampling errors, it may be possible to use joint estimation in a similar way to that investigated for the passenger survey.

A methodological change was introduced in early 2020 to improve the adjustment made to correct the under-representation of foreign residents in the IPS results. This adjustment was based on landing card data from the Home Office (for non-EEA nationals) and was also consistent with passenger counts collected by the CAA and the Department for Transport. Further research is required to review and develop this adjustment to ensure all foreign residents are well represented in estimates of travel and tourism compiled using a passenger survey. Additional datasets held by the Home Office, for example, Advance Passenger Information (API) and Exit Checks (which cover non-EEA nationals) will be investigated. Furthermore, if Electronic Travel Authorisations (ETAs) are developed in the future they are also likely to provide useful information for benchmarking and calibrating estimates.

Sample optimisation

Surveys are designed and optimised to provide reliable estimates at particular levels of geography and for particular variables. In line with its primary purpose to provide UK-level estimates of expenditure and its subsequent aim to provide estimates of UK migration, the IPS sample is designed to be representative of passengers travelling to and from the UK and is optimised to provide reliable estimates of migration and expenditure. User needs change through time so the way in which a survey is optimised may need to be reviewed. While the IPS was a primary source of information about migrants entering the UK, this is not a requirement of the future passenger survey because of plans for the transformation of population and migration statistics. Furthermore, the public consultation on the proposed approach for travel and tourism statistics demonstrated a clear user need for reliable statistics at least at UK nation and region-level (NUTS1). As a result, the prioritisation of variables used to optimise the new passenger survey should be reviewed. The prioritisation of estimates of foreign expenditure by UK nation and region may be a more appropriate target for optimisation.

Questionnaire design

When it was introduced, the IPS aimed to collect data in major UK ports without interrupting the flow of passengers. Since its inception, the number of questions asked on the survey has increased. An increased interview time is likely to result in respondent fatigue and increase the likelihood of incomplete interviews. It is recommended that the number of questions and the overall length of the survey be reviewed so that respondents are not unduly burdened or delayed.

7 . Proposed approach for the household survey

Under the proposed approach, outbound travel and tourism will be measured using a household survey where UK residents will be asked about any international trips they have taken over a set recall period.

This approach is consistent with that already taken in Northern Ireland, where international trips made by Northern Irish residents are recorded using the Continuous Household Survey. The collection of data using a household survey rather than a passenger survey also presents an opportunity to improve consistency between the measurement of international and domestic tourism of residents from Great Britain. The primary source of data on domestic trips made by residents from Great Britain is the Great Britain Tourism Survey (GBTS) and the Great Britain Day Visits Survey (GBDVS), which collects data from GB residents using an online survey. Adopting a similar approach for international visits will mean that international and domestic trips can be collected on a consistent basis. It will also bring the UK in line with the approach taken by other countries, for example, the National Travel Survey conducted by Statistics Canada and the Tourism Survey for Spanish Residents conducted by Instituto Nacional de Estadistica (INE).

Sample size

One of the key challenges associated with collecting tourism data from UK residents using a household survey is that not every household sampled will have taken an international trip within the specified recall period. Research conducted during the review has shown that the international trip count from a randomised household survey design is quite low. However, the research has also shown that a greater number of overnight domestic trips are taken each month, compared with overnight international trips. For a household survey to reach enough of the population of interest (those that have travelled abroad in the specified recall period), a greater sample size will be needed because of the large number of households responding with no international trip information.

A possible option worthy of exploration is to include a module to a pre-existing survey and then ask the household reference person (or all members of the household) whether anybody has taken an eligible trip, and if so, the necessary international travel questions will be asked. Alternatively, an option could be to try to target the population of interest (international travellers) by oversampling characteristics that are found to have a higher trip incidence.

Since the trip incidence for domestic trips is higher than it is for international trips, it will be more efficient to collect data for both international and domestic trips together rather than using separate surveys. To estimate the sample size that may be appropriate for such a survey, while maintaining the level of accuracy achieved by the IPS for international trips, several simulation studies were conducted using the IPS data from 2019. While the current level of accuracy achieved by the IPS has been used as a benchmark for this work, user engagement has suggested that the level of accuracy required for international travel of UK residents does not need to be as high as that for foreign residents visiting the UK. As a result, further user engagement should be conducted to determine the level of accuracy users require.

A key variable required to estimate the sample size is the proportion of individuals who have taken an international trip. In these studies, this proportion was estimated to range from 0.05, as observed by NISRA, to 0.14, as observed by VisitEngland. Both the CHS and the GBTS pilot asked for information about international trips made in the preceding four-week period before the coronavirus (COVID-19) pandemic.

The results of these simulations can be seen in Figure 2 and show that, assuming a trip incidence of 0.14, an achieved annual sample size of approximately 125,000 households would be required to produce estimates of spend with the same accuracy level as those produced using the IPS. However, the required achieved sample size would increase to around 325,000 households if the trip incidence was found to be 0.05.

Figure 2. Estimated annual household sample size and expected confidence interval for the total spend variable for UK residents' trips abroad with varying trip incidence rates

Figure 2. Estimated annual household sample size and expected confidence interval for the total spend variable for UK residents' trips abroad with varying trip incidence rates
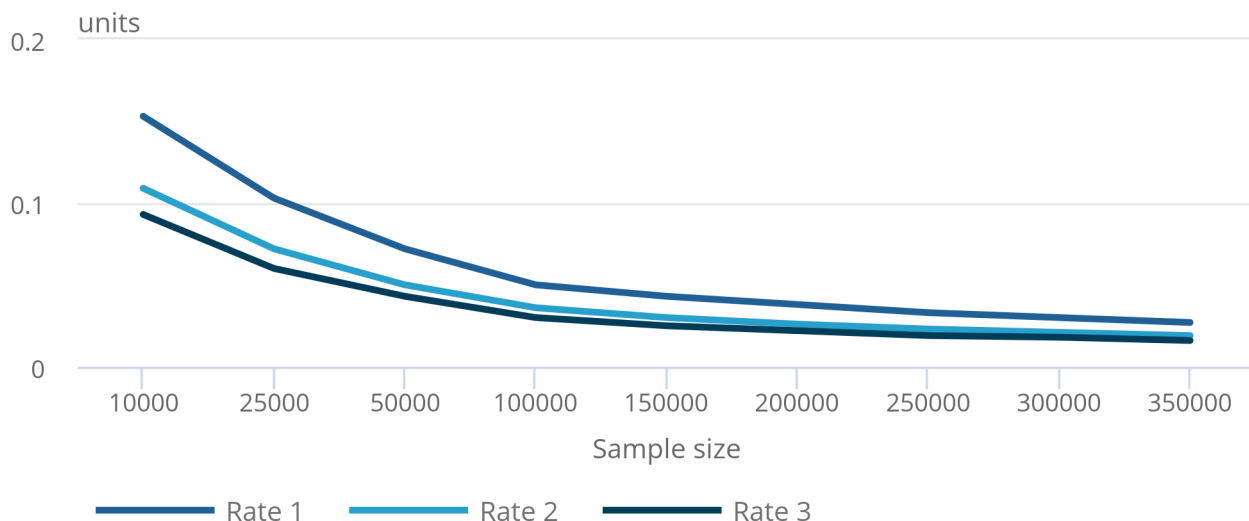
Source: Office for National Statistics

Notes:

1. The y-axis is the expected confidence interval (+/-) with a dashed black line representing the achieved relative confidence interval for the UK residents' spend variable using the IPS in 2019.

2. Rate 1 is 0.05, rate 2 is 0.1 and rate 3 is 0.14.

This is a simulation so may not accurately reflect the exact sample size required.

The simulations conducted to estimate sample size required a number of assumptions. Assumptions included were that:

- no individual takes multiple international trips within a single month

- business trips are conducted independently by members of the same household but all individuals in a single household would take the same tourist trips together

- the sampling unit is a household so that information on trips taken by all individuals within that household can be obtained

In addition, achieved sample sizes are used, and the issued sample would need to be larger to account for non-response. These assumptions will require further investigation, as well as decisions about the survey design, before final sample size calculations could be made.

Survey design options

Throughout the review, various options for the proposed household survey have been considered and have been narrowed down to three:

- include a module on international tourism on the existing GBTS/GBDVS

- include international tourism questions on the existing NTS

- establish a new household survey

The GBTS/GBDVS measure domestic overnight trips with a 4-week recall period and collects information for up to three recent trips. Day trips are also included with a 7-day recall period and a limit of three trips. In total, the survey recruits 95,000 panel members annually with 60,000 assigned to overnight trips and 35,000 to day trips. The data collection mode is via an online, vetted and incentivised panel with demographic quotas based on age, gender employment status, socio-economic status and area of residence.

The GBTS/GBDVS is a well-established and well-known survey for domestic tourism. Its content is well suited for the addition of an international module. This is also likely to be the most cost-effective option. However, an online panel design is more susceptible to self-selection bias, potentially leading to a lack of representation, and there may be issues related to incentivised online studies, such as fraudulent responses. It also presents challenges in terms of calculating standard errors since a quota sample may not meet the assumptions underlying the usual standard error calculations. VisitEngland, VisitScotland and Visit Wales, who coordinate GBTS/GBDVS, are aware of these risks and take steps to minimise them. For GBTS, following analysis to identify any bias in the sample, the only bias detected was the under-representation of individuals aged over 75 years. This has been corrected through the use of weighting the final estimates. In order to reduce self-selection bias, those selected are provided with minimal information about the survey when respondents are invited to respond. In addition, attempts are made to minimise fraudulent responses using digital fingerprinting technology and by checking panel members' IP addresses. In the case of GBTS, depending upon the sample size required, it may also be difficult to expand the size of the panel to a sufficient level to cater for the collection of international data, given the lower trip incidence for foreign visits. If this option was selected, the timing of the introduction of the new international questions would be limited by the renewal of the contract for the delivery of the survey, which currently is due to expire in December 2023.

The National Travel Survey (NTS) is a household survey used to collect data to monitor trends in the personal travel within Great Britain of English residents. It has been running in some form since the 1960s. It collects detailed information about demographics, travel mode, travel duration and general domestic travel patterns using face-to-face interviews and a 7-day travel diary; respondents are incentivised. The survey normally operates with an annual sample size of approximately 13,000 addresses, although this has varied during the coronavirus pandemic because of a temporary change in survey mode from face-to-face to telephone data collection. It is designed as a stratified, clustered, random sample of addresses, selecting postcode sectors as the primary sampling units and then selecting addresses from each postcode sector.

The NTS already collects some generic data related to the purpose and frequency of international travel, so the addition of further questions on international travel could be considered a good fit. Since the survey selects households using a random sample, there are no concerns around sample bias as there are for GBTS/GBDVS. However, the NTS currently collects data for households in England only. As a result, consideration will be required on an appropriate source of data for the rest of the UK. Since there is currently no travel survey that covers Wales, additional work would be required to ensure coverage of Welsh residents within the UK estimates. Furthermore, it may be challenging to fit additional questions on international travel and tourism within the existing NTS structure. The initial interview is already quite long (approximately 50 minutes) so the addition of further questions may cause excessive burden on respondents. Also, the existing travel diary asks respondents to record travel over a 7-day period which may be too short a time period to adequately capture international travel. Finally, while DfT do hope to increase the sample size of the NTS, it seems likely that a very large increase would be required to adequately represent the international travel of UK residents.

The development of a new survey would give the opportunity to be in full control of the questionnaire and sample design. This would minimise respondent burden and sample bias. It would also harmonise questions with existing surveys where appropriate, such as the passenger survey used to collect data on inbound tourism and the surveys used by Northern Ireland. Since it is likely to be more cost effective to collect data on both international and domestic travel and tourism using the same survey, the development of a new survey would also give the opportunity for the ONS to work collaboratively with others - namely VisitEngland, Visit Wales, VisitScotland and DfT - to improve efficiency, promote harmonisation and reduce any overlaps between surveys.

The fact that not all households sampled will have taken a trip within the defined recall period is a major challenge in the development of a new survey. There are options to help with this, which would reduce the required sample size, that have been considered during the review. The first is that the survey could be linked to an existing survey, for example the new ONS Labour Market Survey (LMS), where a filter question could be used to identify households who have taken an international or domestic trip. The second is that the sample could be made more efficient by oversampling regions where more international travel is expected, for example London, and using weights to account for this oversampling in the calculation of estimates.

8 . Irish land border

In the current international travel and tourism statistics, compiled by the ONS and based on the IPS, the movement of people across the land border between Northern Ireland and the Republic of Ireland is accounted for using pseudo records. This approach is required since it is not practical to directly interview people using a passenger survey at the land border. However, the current pseudo records are modelled and based on 2013 data and are believed to underrepresent the number of visitors entering and leaving the UK via the land border.

The Northern Ireland Statistics and Research Agency (NISRA) independently compiles estimates of foreign visitors to Northern Ireland, as well as the outbound travel of Northern Irish residents abroad, including movement across the land border. For visits across the land border made by residents of Northern Ireland, the main data source is NISRA's Continuous Household Survey. For visits to Northern Ireland made by foreign residents via the land border, the primary source of information is the Survey of Overseas Passengers conducted by Failte Ireland. This survey collects data via face-to-face interviews from passengers leaving the Republic of Ireland at air and sea ports. As part of the interview, passengers are asked if they have visited Northern Ireland and are shown a map to confirm the location of the border. Data are also used from the Household Travel Survey conducted by the Central Statistics Office (CSO) of the Republic of Ireland to capture any visits from Republic of Ireland across the land border to Northern Ireland. While these data sources do have some limitations (for example, the Survey of Overseas Passengers uses quota sampling, which could introduce bias and the Household Travel Survey does not identify the location of the land border to respondents), they are seen as preferable to the current approach taken by the ONS. Furthermore, there is no rationale for the two estimates to be inconsistent.

The CSO Ireland is currently developing a new passenger survey that will interview departing passengers as they leave the Republic of Ireland's air and sea ports. This survey design will be similar to that already used by the Northern Ireland Passenger Survey (NIPS) and the International Passenger Survey (IPS) and is anticipated to be a suitable source to capture the movement of foreign residents across the land border to Northern Ireland. NISRA intends to use this new survey in its estimates of visitors to Northern Ireland and it is recommended that the same change should be made to the UK estimates. However, the CSO have not been able to say when this survey data will be made available.

9 . Roles and responsibilities

Currently, a number of different departments and organisations are involved in the production of travel and tourism statistics. This results in duplication of effort and raises concerns about coherence, as well as being apparent that prioritisation of this topic is not the same across all organisations involved. Considering international practices, there is no clear trend for a country's National Statistics Institute (NSI) to take the lead on tourism statistics, so the UK approach, where the NSI leads on some travel and tourism statistics but not others, is not unusual. However, the UK does seem to be unusual in its approach to collecting international and domestic tourism data separately.

The review has identified a number of opportunities for collaboration that could improve the coherence and efficiency of these statistics. These include:

- working with the Civil Aviation Authority (CAA) to harmonise questions and share data to improve accuracy of a passenger survey that interviews air passengers only as they leave the UK

- working with VisitEngland, VisitScotland and Visit Wales and the Department of Transport (DfT) to develop a household survey that covers both international and domestic tourism of UK residents

- considering how coherence between statistics for Northern Ireland and those for Great Britain or the UK could be improved; currently the Northern Ireland Statistics and Research Agency (NISRA) conducts both the International Passenger Survey (IPS) and its own passenger survey in Northern Ireland

- considering who should be responsible for the publication of tourism outputs; currently both the Office for National Statistics (ONS) and Visit Britain publish international tourism statistics based on the IPS

- considering who should be responsible for data collection, linkage and storage; the ONS are leading on the [Integrated Data Service](#) (IDS) and DCMS/Visit Britain are working on a project under this to integrate tourism-related dat

- working more effectively together across all organisations to share experiences of working with alternative data sources

To support and establish an effective strategic and collaborative relationship between the organisations involved with travel and tourism statistics, a Travel and Tourism Strategic Group was established during the review. The aims of this group are to develop a shared vision for the future of international and domestic travel and tourism statistics, strategically drive forward travel and tourism-related data issues, facilitate collaboration between departments and consider where responsibilities for various products should lie.

10 . Further developments

Additional research

The review has set out a vision for travel and tourism statistics and has proposed a plan of intent. Further research is required before it is possible to produce a detailed plan of implementation. It is anticipated that this research work should be conducted during the 2022 to 2023 financial year to allow implementation to begin in 2023 to 2024. As it has been throughout the review, it is anticipated that this work will be in collaboration with other government departments and key stakeholders, with the Travel and Tourism Strategic Group providing oversight.

For the passenger survey, additional work is required to plan the implementation of a fully harmonised departures survey including:

- development and agreement of a core set of questions to be collected on both the Civil Aviation Authority (CAA) departing passengers survey and the departures-only International Passenger Survey (IPS)

- testing the joint calibration approach to combining survey estimates and a decision on whether joint estimation or joint calibration will be used to combine CAA departing passengers and departures-only IPS

- review the Northern Ireland Passenger Survey (NIPS) and departures-only IPS questionnaires and agree harmonised questions where necessary

- review departures-only IPS questionnaires to confirm all questions are necessary

To initiate a household survey that can measure outbound international travel and tourism of UK residents, future work includes:

- agreeing whether to develop a new survey or amend the existing Great Britain Tourism Survey (GBTS) or NTS and assess impact on contractual arrangements for existing survey delivery

- confirming required sample size and any strategies to make the sample more efficient (for example, linking to other surveys for filtering, or over sampling particular regions)

- determining the survey structure and design and testing the questionnaire, harmonising with other surveys including Northern Ireland's Continuous Household Survey and the departures-only IPS

For alternative data sources, additional work research required includes:

- testing small area estimation using mobility data at local authority level and determining lowest possible level of geographical breakdown

- investigating the use of small area estimation techniques using financial transactions data to provide breakdowns of expenditure-by-expenditure type and location

- gaining access to Home Office data and considering suitability of data for calibration of survey estimates

- determining what ancillary information would be useful to collect using surveys

For faster indicators, the next steps include:

- acquisitioning data for forward bookings of air, rail and sea transport and incorporating into a state-space model

- considering options for improving the timeliness of survey estimates, including nowcasting of the passenger counts used for calibration

User engagement

In addition to methodological work, the review has considered the need for improvements to user engagement and strategic oversight of travel and tourism statistics across government departments and organisations involved in the production of these statistics.

The Office for Statistics Regulation (OSR) [compliance check into overseas travel and tourism statistics](#) identified user engagement as a key area for improvement in the production of international travel and tourism statistics and, therefore, the Office for National Statistics (ONS) has focused on improving communication and engagement with stakeholders throughout the review. The ONS has worked closely with stakeholders to develop an understanding of the range of user needs and it is recommended that the stakeholder groups continue to meet periodically as research work is refined and the findings of this review are implemented. Furthermore, since user requirements are not static, there is a requirement to ensure that emerging user needs are captured as they occur. As part of the implementation of this review, a mechanism for ongoing identification of new user requirements should be established.

Plan of intent

To deliver the proposed changes to travel and tourism statistics, the ONS is currently considering a high-level plan.

- Over the next year we will focus on maturing our work on alternative data sources, explore harmonisation of IPS/CAA/NIPS and further develop plans for a HH survey.

- Within financial year 2023 to 2024, we envisage running a harmonised passenger survey, finalising our HH survey plans and agreeing a revised IPS and associated processing systems.

- We aim to have implemented our revised approach within 2024 to 2025.

The findings of the public consultation highlighted concerns from users that making changes to the data sources and methodology for travel and tourism statistics could introduce discontinuities into the time series. This is of particular concern for assessing tourism policy where international travel and tourism statistics are used as key performance indicators. In devising the current plan, it is anticipated that a parallel run approach in 2023 to 2024 would be used, but details for this will be finalised nearer the time.

This high-level plan is indicative at this stage and is subject to the findings of the continued detailed research and the continued availability of required funding. We are committed to continuing to engage closely with the users and stakeholders of the IPS and, in addition to our usual mechanisms, we will provide six monthly external updates on our progress and plans.

11 . Data sources

List of data sources considered by the review. Not all of these data sources have been acquired or investigated in full by the Office for National Statistics (ONS).

Visits data sources

- Civil Aviation Authority - passenger traffic counts

- Civil Aviation Authority - Departing Passenger Survey

- Eurostar - passenger traffic counts

- Department for Transport - passenger traffic counts

- Home Office, for example, advance passenger information (API)/travel document information (TDI), exit checks

- Mobile phone data

- Social media, for example, Facebook, Google

- Reciprocal statistics - collect from OECD/World Trade Organization/Eurostat

- Global Tourism Solutions (STEAM)

Spend data sources

- Financial transactions, for example, credit or debit cards or point of sale terminals

- Value added tax (VAT) reclaim

- Other transactions, for example, Apple Pay, Google Pay

- Transport providers - spend on tickets

Forward bookings data sources

- Forward keys

- Eurotunnel bookings

- Eurostar bookings

- OAG

- Air Travel Organiser's Licence (ATOL)

- Booking services, for example, Expedia

Accommodation data sources

- STR

- Accommodation providers

- AirDNA

- NISRA Occupancy Surveys (hotels, small services providers and self-catering)

Other data sources

- Seaports data

- Travel insurance

- Semaphore - Home Office

- Trade Associations

- Museum Associations

- Domestic Attractions Surveys

- Indestination Visitor Surveys

- Home Office Passenger Locator Form

- CCTV coverage at ports

- Visitor satisfaction

- Toll data

- Car rental

- Nsight

- Trip advisor

- Comparison sites - Trivago, Kayak, Skyscanner

12 . User requirements: prioritised list of topics

High priority

- Demographics (outbound): residence at UK level, nationality

- Demographics (inbound): residence by country, nationality

- About trip (outbound): cost of trip, purpose of visit, destination by country, mode of travel

- About trip (inbound): cost of trip, purpose of visit, nights spent in UK, mode of travel

- Other: domestic tourism

Mid-high priority

- Demographics (inbound): age, sex, residence by city (key markets)

- Demographics (outbound): residence at UK country, age, sex

- About trip (inbound): where visitors will reside, port travelled to and from, activities in UK

- About trip (outbound): nights spent abroad, multi-country travel

- About booking: bookings

- Other: types of accommodation

Mid-low priority

- Demographics (inbound): party type, accessibility, other demographics

- Demographics (outbound): residence by UK town

- About trip (inbound): mode and cost of transfer, attitudinal questions, previous visits to the UK, multi-country travel, day trips to part of the UK

- About booking: process of booking

- Other: Eurostar connections, cruises, airport procedures

Low priority

- Demographics (outbound): dual nationality, other demographics, party type

- About trip (inbound): reason for visiting location, cost of transfer to port, mode of transfer to port

- About trip (outbound): previous visits abroad, mode and cost of transfer, reason for choosing location, attitudinal questions

- About booking: locations and time of year for which people are searching

13 . Stakeholder group membership

List of organisations who have regularly attended the Travel and Tourism Expert Panel and Travel and Tourism Strategic Group meetings throughout the review.

Expert Panel

- Office for National Statistics (ONS)

- Northern Ireland Statistics and Research Agency (NISRA)

- Welsh Government / Visit Wales

- VisitScotland

- Scottish Government

- VisitEngland / VisitBritain

- Department for Transport

- Civil Aviation Authority (CAA)

- University of Southampton

Strategic Group

- Office for National Statistics (ONS)

- Northern Ireland Statistics and Research Agency (NISRA)

- Welsh Government / VisitWales

- VisitScotland

- Scottish Government

- VisitEngland / VisitBritain

- Department for Transport

- Department for Digital, Culture, Media and Sport (DCMS)

14 . Related links

[Travel and tourism review: October 2021](#)
Article | Released 05 October 2021
Update on progress on the travel and tourism statistics review, including proposed future approach and details of a user consultation.

[Proposed future approach to measure travel and tourism statistics](#)
Consultation | Released 15 March 2022
In October 2021, as part of its review of travel and tourism statistics, the Office for National Statistics (ONS) launched a consultation on a proposed approach for the future measurement of travel and tourism statistics. The consultation sought feedback on this proposed approach, which will be used to inform the recommendations of the review.

[Travel and tourism review: June 2021](#)
Article | Released 02 June 2021
Details of a review of travel and tourism statistics, including reasons for the review, progress so far and future developments.