MULTI-SENSOR TRACKING (MST)

MST AND ITS USE IN MOVE

What is Multi-Sensor Tracking Survey?

The Multi-Sensor Tracking (MST) survey was conducted by Ipsos for MOVE to measure audience movements using bespoke, wearable devices.

- Devices are carried by respondents for two weeks
- Passively records second-by-second location data
- Accuracy of approximately one meter
- GPS, accelerometers, gyroscopes, barometers, magnetometers

Ipsos has deployed the MST Survey in several countries, including the UK and France, to support Out of Home (OOH) audience measurement.

How is the MST Survey Collected?

- Tracked the travel behaviour of **5,000 respondents** across Australia over 14 days.
- Captured second-by-second movement as participants visited various Points of Interest (POIs) within each Statistical Area 1 (SA1), recording approximately **280,000 individual trips.**
- Resulted in around 200 million data points, delivering high level of spatial and temporal details, based on the second-by-second GPS tracking, including indoor detection and elevation changes. For example, the device detects when a respondent enters a shopping centre and moves between floors.
- This means tracking movements across any of the 60,000 travel zones across Australia. The travel zones are broken down into around **370,000 mesh blocks** for modelling intrazonal travel, **57** distinct **trip purposes** (e.g. visit a supermarket, go to the gym), hourly outputs, by day of the year.

How is the MST used in MOVE?

The output of the MST is then filtered and processed to be used in to train machine learning models that are used in Activity Based Model (measuring local trips) to accurately reflect real-world behaviour.

Since 2021, a monthly COVID tracker survey has been conducted to monitor any changes in audience behaviour following the MST.

The Value of MST in OOH Audience Measurement

High Precision Tracking

In combination with the second-by second GPS tracking, a recall survey was conducted at the end to confirm trip purposes, serving as a validation check and providing granular insights into participants' locations and movements.

Indoor and Outdoor Coverage

The MST device is designed to function effectively in various environments, including areas where GPS signals may be weak or unavailable, such as underground or indoor locations.

Comprehensive Sensor Suite

Incorporates multiple sensors to accurately determine position, movement, and orientation, enhancing the reliability of the data collected.

CENSUS DATA

CENSUS DATA AND ITS USE IN MOVE

What is the Census?

The Census of Population and Housing is Australia's largest statistical collection, conducted every five years by the Australian Bureau of Statistics (ABS). It aims to count every person and household in the country and captures key details such as:

- Where people live at Statistical Area 1 (SA1) level.
- Age, gender, and household structure
- Employment, education, and travel patterns

SA1 (Statistical Area Level 1) is a small geographic area defined by the Australian Bureau of Statistics for census and survey purposes. It usually represents about 200 to 800 people living in a neighbourhood-sized area. SA1s cover all of Australia without gaps, and many of them together build up larger areas like suburbs or regions used in data analysis.

Why is Census a Valuable Data Input?

National Coverage
Captures every household and person.

Granular Detail
Includes small-area data down to mesh blocks.

Reliable and Consistent
Produced by an independent national agency.

Publicly Accessible
Transparent and regularly updated every 5 years.

How do we use the Census in MOVE?

Census: The Census is a key source for creating MOVE's synthetic population. The Census is a key input in creating MOVE's synthetic population, a statistically representative model of all Australians aged 14 and over. MOVE currently uses data from the 2021 Census, with the next Census scheduled for 2026. Every five years, Census data is combined with additional information, such as income and Aboriginal and Torres Strait Islander status from the Government Household Travel Survey, to build this synthetic population. The 2026 Census will be incorporated in MOVE's next major audience update, subject to data availability and update timelines.

UPDATED EVERY 5 YEARS

1. Append additional Census variables (income, Aboriginal and Torres Strait Island status)
   - **Census Data** (SA1)
   - **Seed Population** (household travel surveys)
2. Run population simulation software to create a synthetic population representing of all Australians aged 14 and above
3. Sample 10% to use in the next stage of modelling audience movements

In Between Census Years: We re-weight the synthetic population to ABS Estimated Residential Populations (ERP) and OzTAM/Regional TAM universe estimates, then add Grocery Buyer variables using the Multi-Sensor Tracking Survey (MST) and TAM controls. This results in an updated synthetic population at SA1 and mesh block levels.

UPDATED ANNUALLY

1. Re-weight to match ABS ERP
   - Updated **ABS** Estimated Residential Populations (SA2)
2. Re-weight to match TAM
   - Updated **OZTAM/Regional TAM** Universe Estimates
3. Add Grocery Buyer variables
   - MST Survey + TAM control

Updated synthetic population (SA1/Mesh Block)

NATIONAL VISITOR SURVEY (NVS)

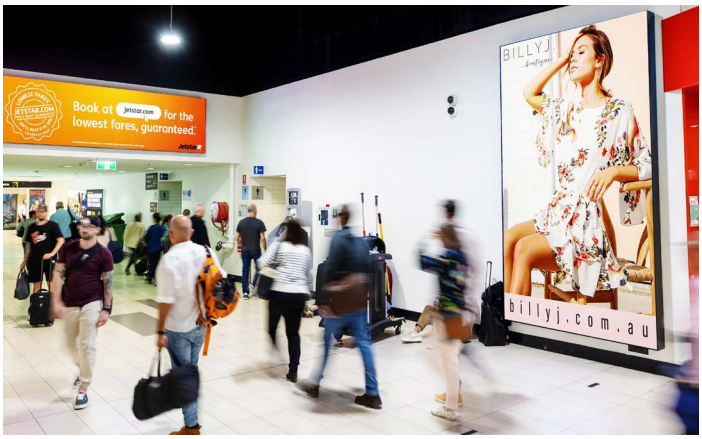
THE NVS AND ITS USE IN MOVE

What is the National Visitor Survey?

The National Visitor Survey (NVS) is a leading tourism data collection program in Australia, operated by Tourism Research Australia (TRA), part of the Australian Trade and Investment Commission (Austrade). It has been conducted monthly since 1998 and provides detailed and reliable insights into the travel behaviours of Australian residents. Data is released quarterly and annually.

How is the NVS Collected?

The NVS is conducted through telephone interviews (CATI) with a nationally representative sample of approximately 120,000 Australians each year. This ensures robust data across states, regions, and travel types.



MOVE uses mobile data to define airport catchment areas

How do we use the NVS in MOVE?

We use the NVS data in the Out of Market (OOM) model which is designed to predict how Australians travel within the country. This is the journey made from home to the destination place of stay, and then back again on the return trip. Where the trip is made by air, this requires consideration of which airports they use, and how they get to and from the airports at each end of the trip.

For modelling purposes, an out-of-market trip is deemed as an overnight stay (1+ nights) at least 40km from home, plus day trips by air. This definition aligns with the NVS.

Any long-distance day trips by car or public transport (e.g., to a beach 100km from home) are captured in the Activity Based Model (ABM) rather than the OOM model. Every time a respondent is in the ABM they are excluded from OOM and vice versa.

What does the NVS Capture?

The NVS captures comprehensive information about domestic travel, including:

- Trip purpose (e.g. holiday, business, visiting friends/family)
- Travel destinations within Australia
- Duration of stay and frequency of trips
- Modes of transport and types of accommodation used
- Spending patterns and travel activities

Why MOVE Uses the NVS

National Scope
Covers all states and territories.

High Frequency
Updated monthly, published quarterly.

Reliable Methodology
In operation for over 25 years.

Rich Behavioural Insights
Goes beyond movement to include motivation, expenditure and activity.

Trusted Source
TRA provides official tourism data for the Australian Government, widely used by policymakers, operators, and media.

INTERNATIONAL VISITOR SURVEY(IVS)

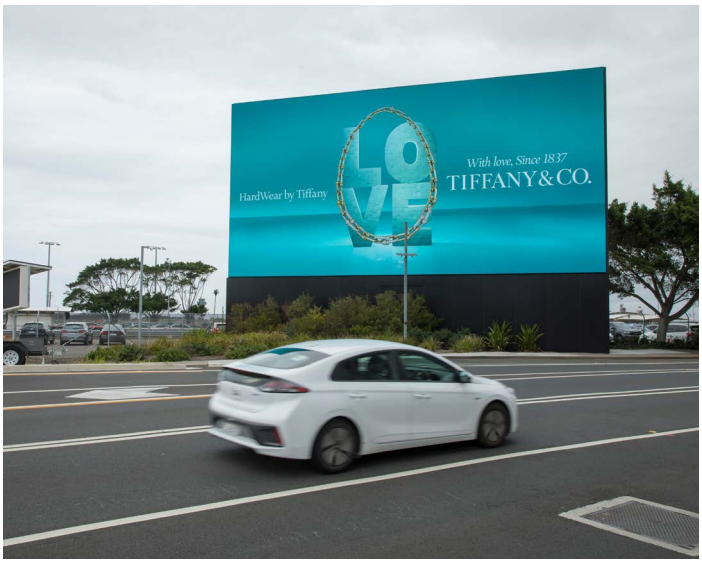
THE IVS AND ITS USE IN MOVE

What is the International Visitor Survey?

The International Visitor Survey (IVS) is a flagship tourism research program operated by Tourism Research Australia (TRA), a division of the Australian Trade and Investment Commission (Austrade). The IVS provides comprehensive data on international visitors coming to Australia - including their travel behaviours, spending, and experiences.
It has been running since 1979 and is a key source for understanding inbound tourism.

How is the IVS Collected?

The IVS is conducted via face-to-face interviews at major airports across Australia with departing international visitors. Around 40,000 interviews are conducted annually, ensuring coverage across all key markets and travel types. Data is released quarterly and annually.



How do we use the IVS in MOVE?

We use the IVS data in the Out of Market model to capture the travel made by international visitors to Australia. International visitors are classified as short-term international visitors to Australia. These are people whose main place of residence is overseas and can include Australian citizens who live overseas (i.e., expats returning to visit). We capture the journey they make from the international airport to their place of stay at the beginning of their journey, and vice versa at the conclusion of their visit to Australia.

What does the IVS Capture?

The NVS captures comprehensive information about domestic travel, including:

- Country of origin and demographics of international visitors
- Purpose of visit (holiday, education, business, etc.)
- Length of stay and locations visited in Australia
- Spending behaviour and travel activities
- Modes of transport and accommodation used

Why MOVE Uses the IVS

Rich Detail
Includes spending, motivations, and detailed itineraries.

Trusted and Official
Produced by the Australian Government.

Regular Updates
Quarterly and annual data releases.

Historical Continuity
Over 40 years of data collection.

Trusted Source
TRA provides official tourism data for the Australian Government, widely used by policymakers, operators, and media.

POPULATION SYNTHESIS

SAMPLE TO REPRESENT PEOPLE

What is Population Synthesis?

Population synthesis is the process of generating a detailed, statistically accurate representation of the population within a given area. It combines demographic, geographic and behavioural data to model individual "people" in a way that reflects real-world population patterns, without using personally identifiable information.

MOVE reconstructs this synthetic population by combining multiple data sources, creating one of the largest samples of its kind. The result represents more than 22 million Australians aged 14 and over. Each virtual person and household is assigned a range of demographic attributes, including age, gender, occupation, income, Main Grocery Buyer (MGB) status and home base at SA1 level.

Privacy Safe: MOVE builds its synthetic population in a privacy-safe manner. No real individuals are identified or exposed. The population characteristics and behaviours are modelled at an aggregate level, ensuring compliance with privacy regulations while still providing highly granular insight.

International Visitors: A separate synthetic population of international visitors is developed using the International Visitor Survey, conducted by Tourism Research Australia (TRA). Each year, the IVS samples around 40,000 departing short-term international travellers aged 15 and over who have visited Australia. The survey provides details such as port and mode of arrival, country of origin, age, gender, visit purpose, length of stay, quarter of arrival, life stage, total trip spend and travel party. Using this data, a synthetic population of more than 7 million international visitors is created with one-to-one representation. These audiences are then measured at their port of arrival, place of stay and port of departure.

Why it Matters?

Accurate OOH audience measurement starts with understanding who the audience is. This requires building a representative population foundation. There is no single data source in Australia that provides individual-level demographics and home locations for the entire population. To address this, MOVE reconstructs a virtual population by combining multiple data sources.

How is it Developed and Maintained?

Census Year: The Census is a key source in creating MOVE's synthetic population. The Census is a key input in creating MOVE's synthetic population, a statistically representative model of all Australians aged 14 and over. MOVE currently uses data from the 2021 Census, with the next Census scheduled for 2026.

Every five years, Census data is combined with additional information, such as income and Aboriginal and Torres Strait Islander status from the Government Household Travel Survey, to build this synthetic population. The 2026 Census will be incorporated in MOVE's next major audience update, subject to data availability and update timelines.

Between Census Updates: We re-weight the synthetic population to ABS Estimated Residential Populations (ERP) and OzTAM/Regional TAM universe estimates, then add Grocery Buyer variables using the Multi-Sensor Tracking Survey (MST) and TAM controls. This results in an updated synthetic population at SA1 and mesh block levels.

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3. Add Grocery Buyer variables
   - MST Survey + TAM control

✓ **Updated synthetic population** (SA1/Mesh Block)

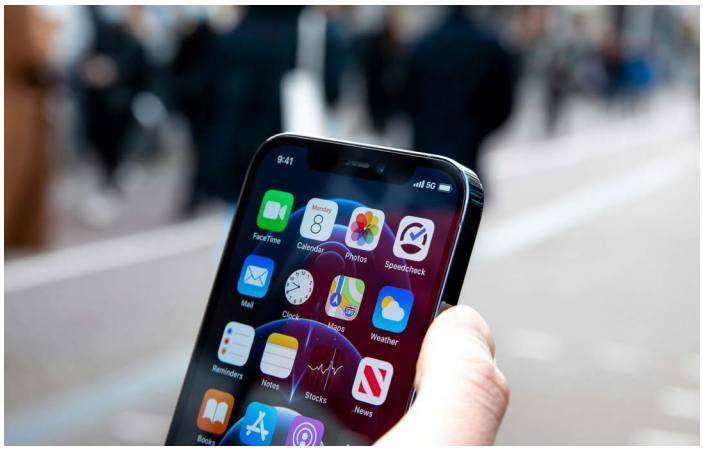
MOBILE DEVICE TRACKING DATA

MOBILE DEVICE DATA AND ITS USE IN MOVE

What is Mobile Data?

Mobile data refers to anonymised, location-based information collected from smartphones through GPS, apps, mobile networks, and Wi-Fi signals. This data provides a view of how people move through the real world in both urban and regional settings.

Privacy Safe: Data is fully anonymised and aggregated to protect individual identities. Use is governed by strict privacy laws, including Australia's Privacy Act and the Australian Privacy Principles (APPs).



How is the Mobile Data used in MOVE?

MOVE uses Near mobile data in various parts of its behaviour models and for calibration purposes. Near provides anonymised mobile location data sourced from smartphones via apps with location permissions. While mobile data as a standalone cannot provide detailed insights on travel behaviour, it proves valuable when layered with other validates sources and fills in gaps where data isn't easily available.

How the mobile data is not used and why?

MOVE uses mobile data to understand relative movement patterns, such as how location activity differs between weekdays and public holidays, rather than to quantify absolute volumes. This approach reflects the inherent variability of mobile datasets. App usage continually shifts, changing both the size and composition of the observable device pool. In addition, frequent device turnover across the population limits the ability to reliably track behaviour over time.

Place Based

- Relative size of a location versus other locations within format
- Time of day, day of week, visitation profiles
- Regular versus school holiday

Out of Market Model

- Airport catchment
- Airport time of day (departure from home)
- Out of Market car trip departure time

Truck Model

- Identifying truck drivers via attendance in multiple 'truck' locations (truck stops, warehouses, distribution centres)
- Truck driving behaviour for local and long-haul drivers

ABM Calibration

- SA2-SA2 relative demand
- SA2 reach - 30, 60, 90 days (the sample includes devices observed continuously across these days)

Pedestrian Model

- Pedestrian count volumes where none exist

Indoor Methodology

- Heatmaps for each indoor location