

# Lecture 2.14

## 2.3 Origin-Destination Studies

# Roadside Interview Method (Direct Survey)

The Roadside Interview method involves stopping vehicles at designated survey stations along external cordon lines to directly interview drivers.

Survey teams record vehicle type, origin, destination, trip purpose, intermediate stops, and commodity payload for commercial vehicles.

- Conducted at external cordon stations crossing major highway entries/exits
- Sample rate: 10% to 20% of passing traffic stream
- Requires police support, warning signs, and safe pull-over bays to avoid traffic tailbacks
- Yields highly accurate direct data for external-internal and through trips

# License Plate Matching Method

The License Plate matching method positions observers (or Automated License Plate Recognition - ALPR cameras) at entry and exit stations across a study cordon.

Observers record vehicle registration numbers along with exact arrival timestamps at each station; matching plate records reveals travel paths and travel times.

- Zero traffic interruption; vehicles do not need to stop
- Observers record middle or last 4 digits of license plates with timestamps
- Computer algorithms match entry and exit plate records across stations
- Main limitation: Does not capture trip purpose or vehicle payload details

# Postcard / Questionnaire Return Method

In the Postcard survey method, prepaid return questionnaire cards are handed to drivers as they pass cordon stations or toll gates.

Drivers fill out trip origin, destination, and purpose details at their convenience and mail the card back to the highway department.

- Very low field labor requirement; fast distribution at toll plazas
- Main disadvantage: Low response rate (typically 10% to 25%)
- Response bias risk: Particular demographic groups may return cards at higher rates
- Requires statistical weighting to adjust for non-response bias

# Home Interview Survey Method

The Home Interview Survey is the most comprehensive O-D survey method for major urban transport planning.

Trained enumerators visit a statistically selected sample of households (e.g., 3% to 10%) within internal traffic zones to record all trips made by household members on the previous day.

- Collects complete multi-modal travel details (walking, bus, metro, car, 2-wheeler)
- Gathers household socio-economic data (income, car ownership, family size)
- Captures internal-internal urban trips missed by roadside cordon stations
- High cost and time intensive; requires skilled survey teams

# Tag / Sticker Method & Workplace Surveys

The Tag or Sticker method attaches color-coded adhesive tags to vehicle windshields at entry cordon points; observers at exit points record tag colors and exit times.

Workplace and Commercial Outlet Surveys distribute questionnaires at major employment centers, factories, or shopping malls to capture work and retail trips.

- Tag Method: Excellent for small compact areas and quick through-traffic checks
- Workplace Surveys: Targeted survey of high-density trip attraction hubs
- Commercial Fleet Surveys: Interviews logistics managers for freight movement
- Complements roadside cordon counts by detailing special generator trips

# Mobile Location Data and Passive Cellular O-D Tracking

Modern digital O-D studies utilize anonymized cellular tower handovers and mobile app location data to track urban trip matrices passively.

Big data analytics aggregate millions of daily trips continuously, replacing expensive manual home interview surveys with digital mobility metrics.

- Provides massive sample sizes (>20% of population mobility)
- Continuous 24/7/365 trip matrix tracking across seasons
- Drastically reduces field survey time and labor expenses
- Requires complex spatial algorithms to infer trip purpose and transport mode

# Data Compilation and Construction of O-D Matrix

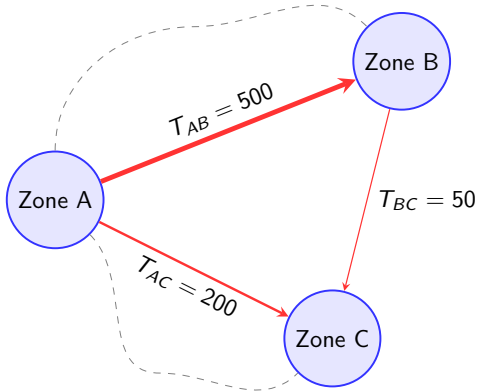
Raw O-D survey data is compiled into a two-dimensional grid table called the Origin-Destination Matrix (O-D Table).

The matrix rows represent origin zones (i), columns represent destination zones (j), and cell values ( $T_{ij}$ ) represent total trips from zone i to zone j.

| Origin Dest.    | Zone 1   | Zone 2   | Zone 3   | Total ( $P_i$ ) |
|-----------------|----------|----------|----------|-----------------|
| Zone 1          | $T_{11}$ | $T_{12}$ | $T_{13}$ | $P_1$           |
| Zone 2          | $T_{21}$ | $T_{22}$ | $T_{23}$ | $P_2$           |
| Zone 3          | $T_{31}$ | $T_{32}$ | $T_{33}$ | $P_3$           |
| Total ( $A_j$ ) | $A_1$    | $A_2$    | $A_3$    | $\sum T_{ij}$   |

# Desire Lines: Definition, Construction & Meaning

A Desire Line is a straight line drawn on a map connecting the origin of a trip to its destination, ignoring existing road network paths.



- Straight line vector drawn directly from Zone  $i$  centroid to Zone  $j$  centroid
- Width of desire line drawn proportional to trip volume ( $T_{ij}$ )

# Graphical Representation of Desire Lines

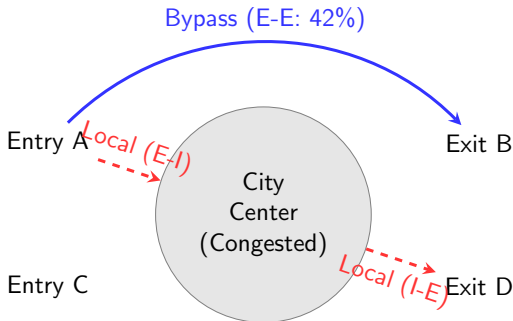
Desire line maps aggregate hundreds of zonal trip interchanges into visual desire corridors.

Thick bundles of desire lines crossing urban centers indicate demand for heavy mass transit corridors or elevated expressways.

- Desire lines plotted using automated GIS software tools
- Minor trip desire lines (< 100 trips/day) filtered out to avoid map clutter
- Through-traffic desire lines bypassing city center justify bypass routes
- Radial desire patterns indicate need for radial arterial expressways

# Practical Case Study: Urban Bypass Evaluation using O-D Data

An O-D survey reveals that 42% of total entry traffic consists of through vehicles (E-E trips) with neither origin nor destination in the city.



- Bypass route alignment designed directly along major E-E desire line vectors
- Substantial reduction in urban emissions and travel time for freight

# Summary & Key Takeaways

O-D survey methods include roadside interviews, license plate matching, home interviews, and passive cellular tracking.

O-D matrices and Desire Line diagrams provide the fundamental spatial evidence required to design bypasses, ring roads, and mass transit corridors.

- Roadside interviews capture external cordon trips; Home interviews capture internal urban trips
- O-D Matrix cell  $T_{ij}$  stores trip volume from Origin  $i$  to Destination  $j$
- Desire lines connect trip origins to destinations with line thickness proportional to volume
- Through traffic (E-E) desire line analysis determines urban bypass viability