

# ANALYSIS AND OPTIMIZATION OF PUBLIC TRANSPORT NETWORKS

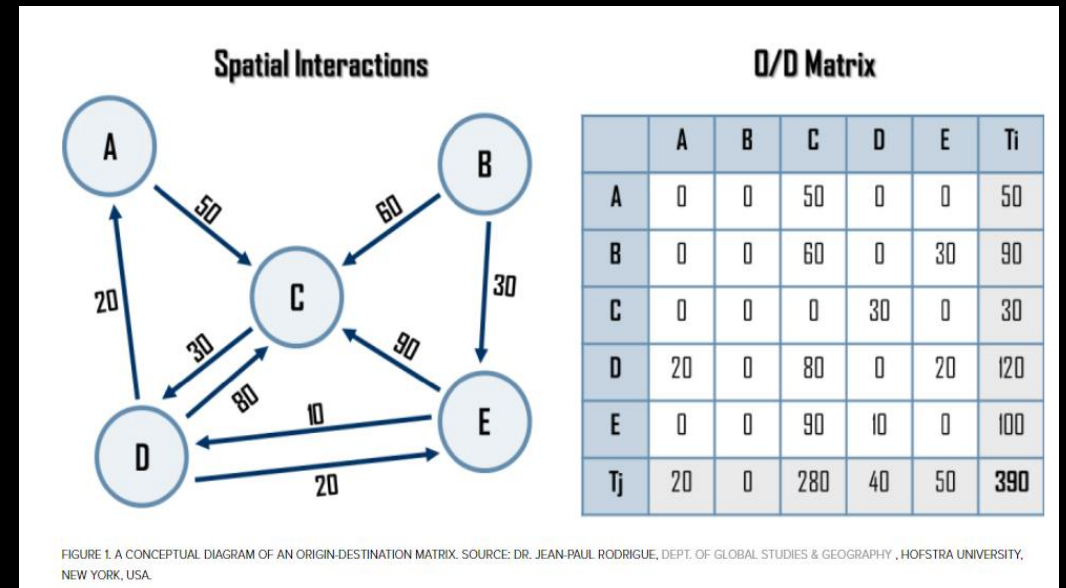
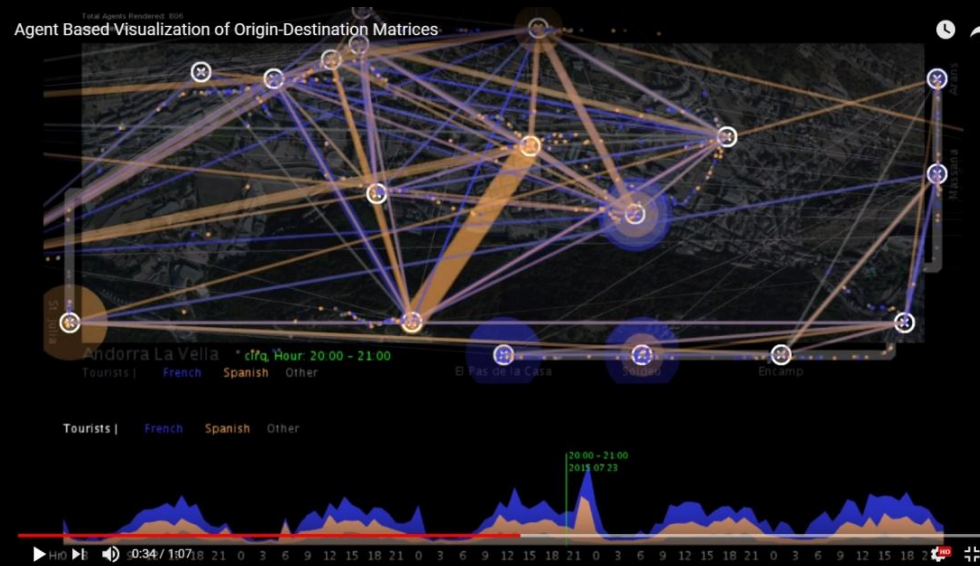


This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement number 778764

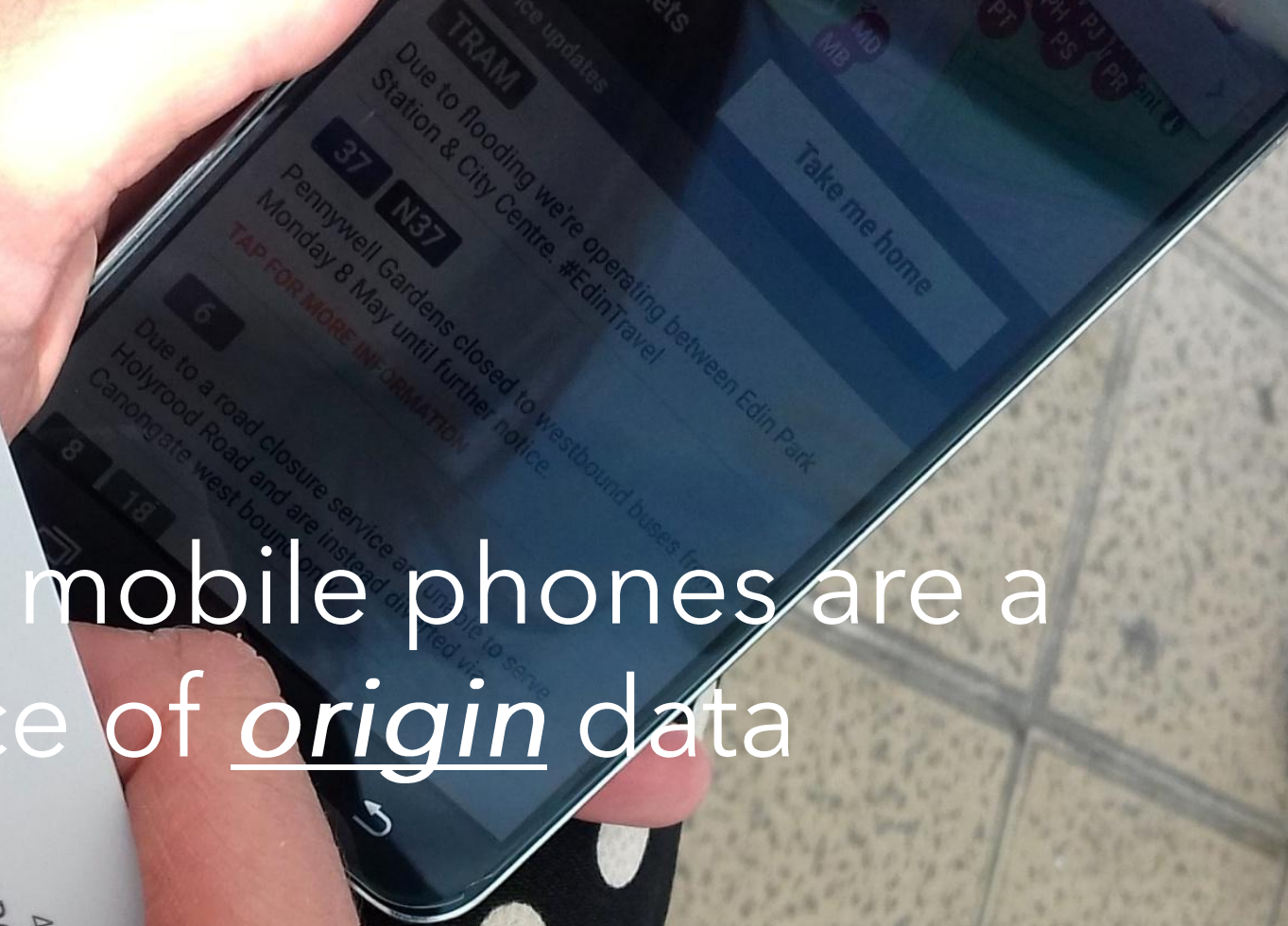


Big Data analysis Platform  
Passenger mobility and public transport usage

# OD matrices are essential elements in transport planning and analytics



Smart cards and mobile phones are a good source of origin data



What about destination?

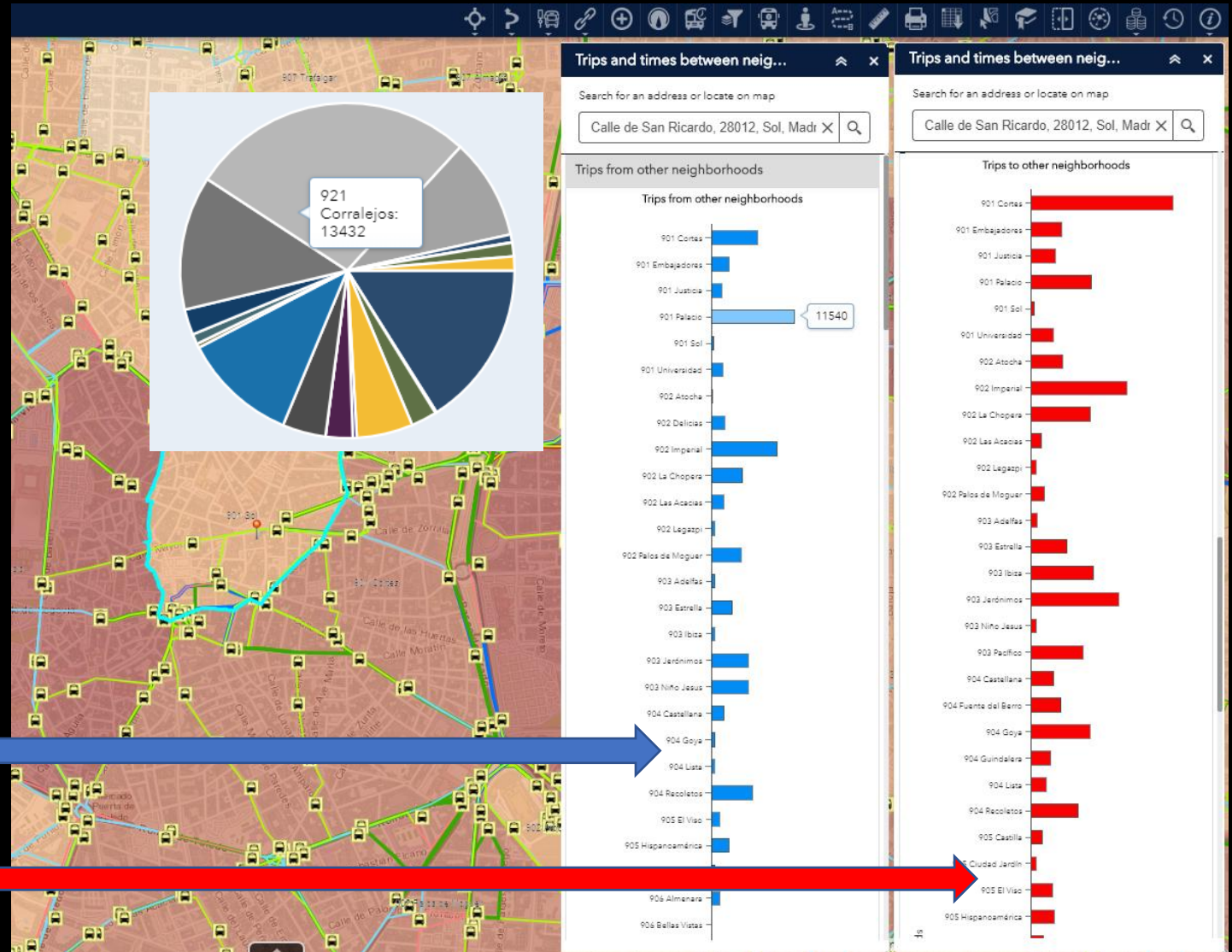


Using just smart card and spatial data,  
SIADe infers up to **90% of**  
**passenger destinations** with  
**> 95% accuracy**

# OD matrix generation

- > 95% accuracy, using smart card data
- Creates OD matrices by bus stop, summarized into zones (by neighbourhood, census sections, etc.)
- Multimodal / concessions  
e.g. Trips **from** Sol (Madrid)

e.g. Trips **to** Sol (Madrid)



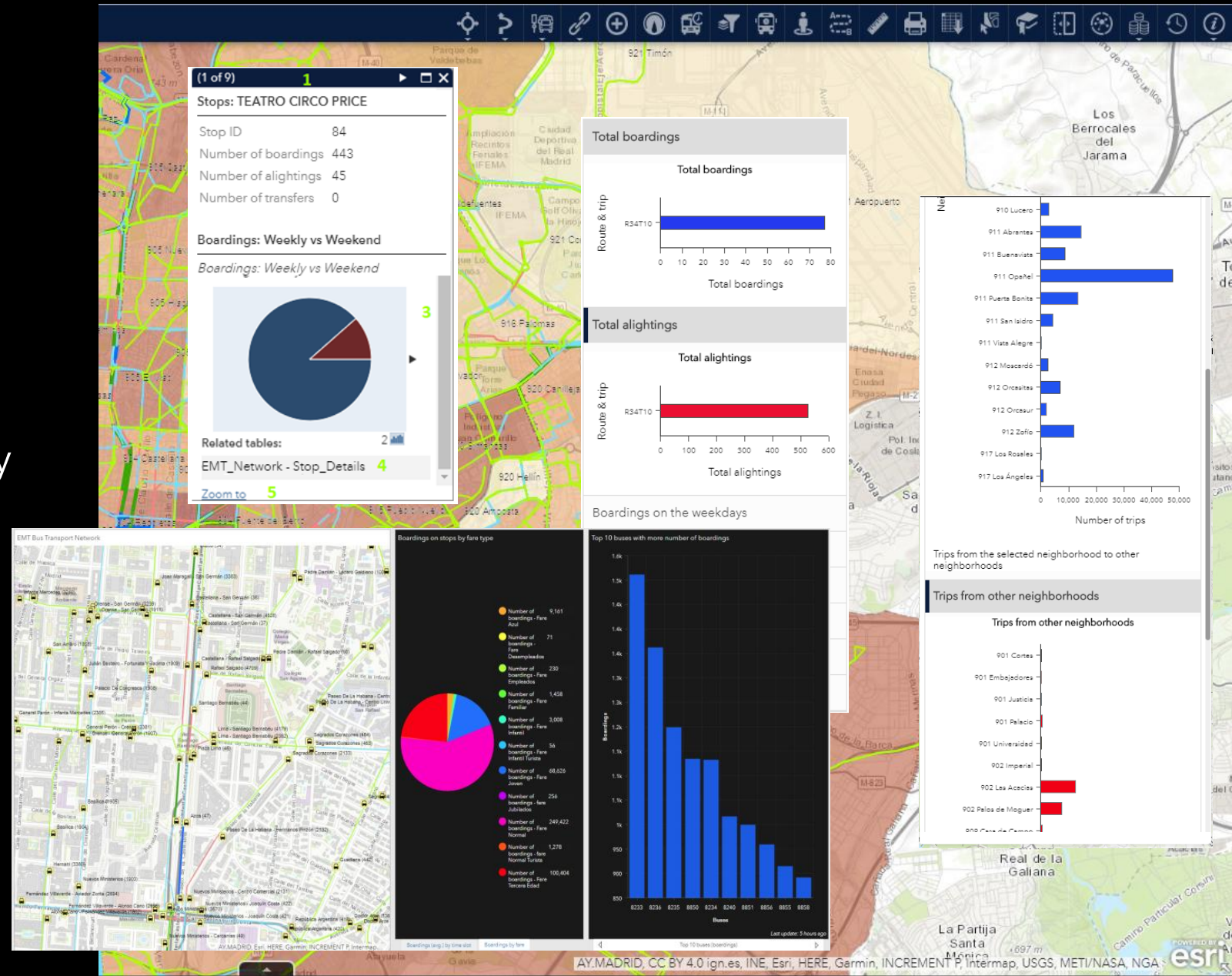
Result: full knowledge about population's mobility patterns and network usage

# OD matrix exploitation

- Comprehensive set of analytic tools relative to routes, stops, sections, fare types, days, hours, population, etc.
- Complex analysis is possible by using a friendly SQL query builder.

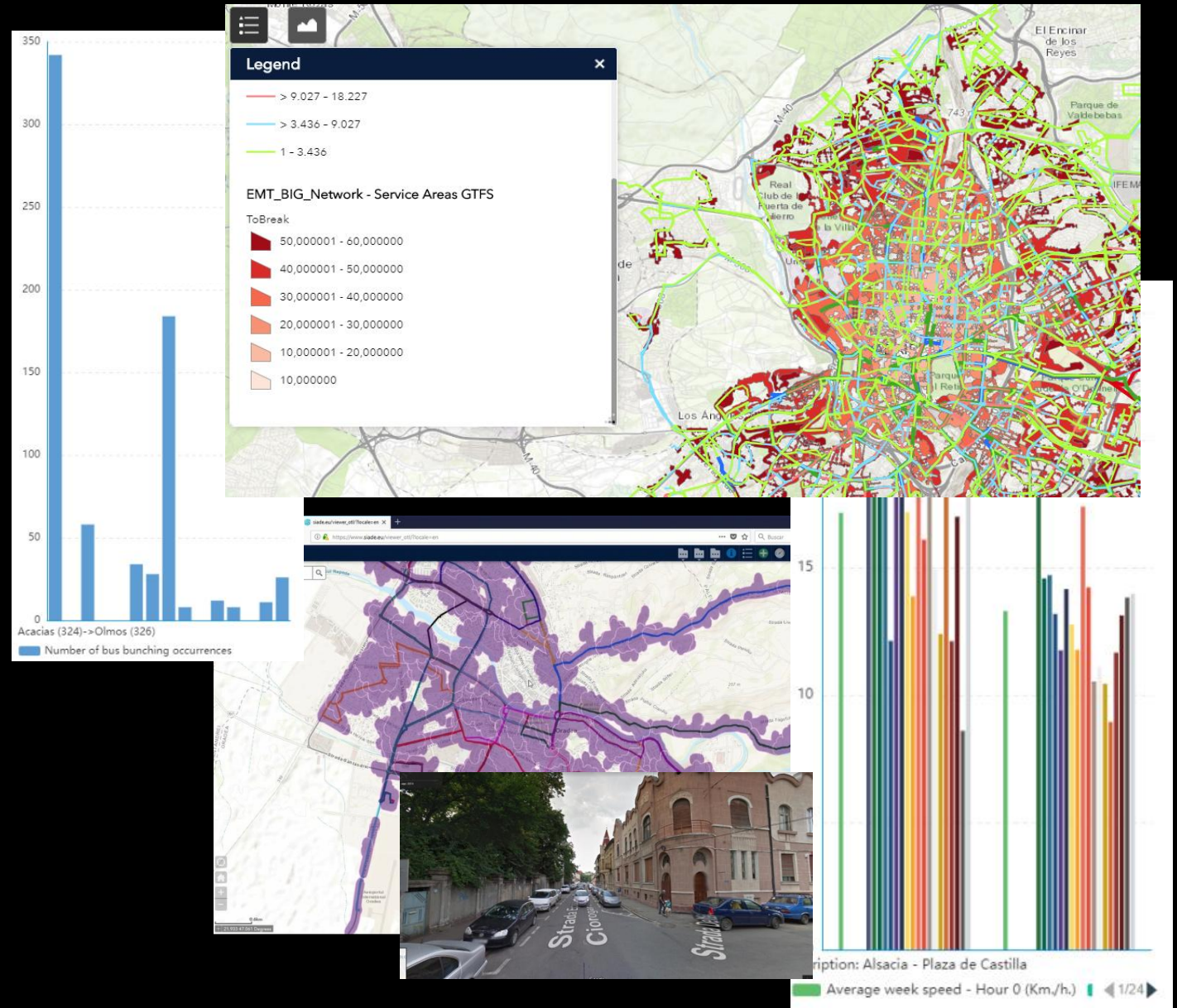
- Information is displayed:

- Map viewer
- Dashboard



# Transport network analysis

- Occupancy by route and section
- Suggested number of minimum buses needed by route, trip and time zone
- Speed / time per day, hour and route
- Temporal evolution of transport-related variables (Big Data)
- Street View connection
- Bus Bunching
- By using routing services:
  - Isochrone maps
  - Service coverage

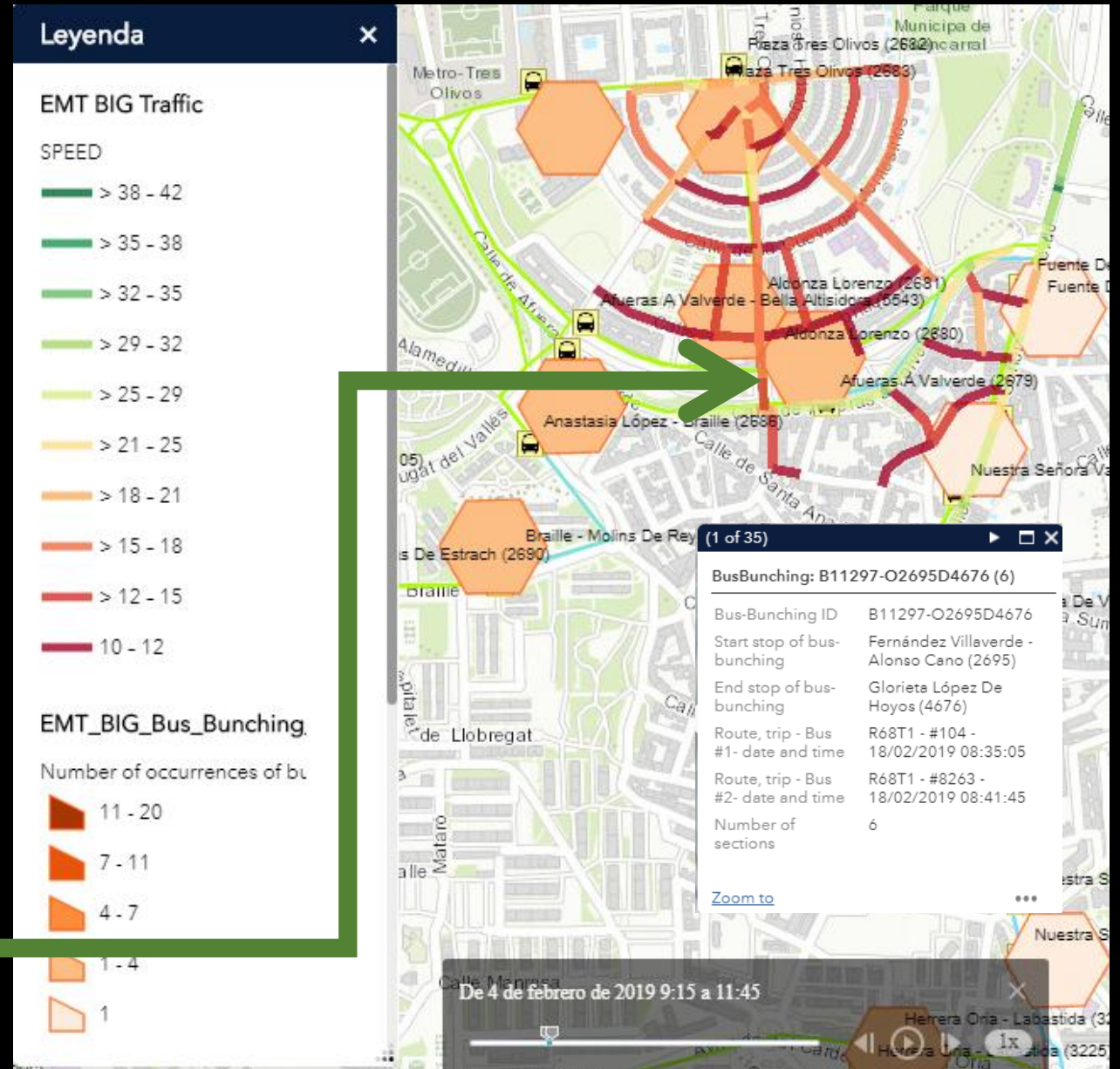


Result: network optimisation

# Bus bunching

- Graphical and alphanumerical display of bus bunching occurrences.
- Historical analysis
- Cross-analysis with other layers (e.g. traffic data)
- Analysis between buses operating the same route or different buses in overlapping routes.

*Relationships between bus bunching-traffic*



# Import/export

- Data export (CSV, Geodatabase, KML, SHP)
- Advanced SQL data selection
- Local and web services import (CSV, SHP, GPX, GeoJSON, WMS, KML, GeoRSS)

The screenshot displays a GIS application interface with a map of a city area. Overlaid on the map is a data table titled "EMT\_Network - Sections". The table has columns for "Number of boardings", "Number of alightings", and "Number of boardings - Weekdays". A context menu is open over the table, showing options like "Show selected records", "Filter", and "Export all to CSV".

Section	Number of boardings	Number of alightings	Number of boardings - Weekdays
R14T2	2766	1429	2516
R27T2	5163	2760	4686
R40T2	600	600	600

Other visible elements include:

- Execute SQL query** dialog: Shows a query named "Query about stops" for the "EMT\_BIG\_Network" service. The field "Daily use" is selected, and the SQL expression is "daily\_use < 15".
- Add Data** dialog: Shows options to add data from a file or URL. The "File" tab is selected, and options for "SHARE FILE", "CSV", "GPX", and "GeoJSON" are visible.
- Add Data** dialog: Shows a list of data types to import, including "An ArcGIS Server Web Service", "A WMS OGC Web Service", "A KML File", "A GeoRSS File", and "A CSV File".

Result: interoperability with other systems

# Advanced queries: spatial analysis

- Aggregate Points
- Calculate Density
- Choose Best Facilities
- Create Buffers
- Create Drive-Time Areas
- Derive New Locations
- Extract Data
- Hot Spots
- Join Features
- Plan Routes
- Summarize Nearby

The screenshot displays a GIS application interface with several key components:

- Legend:** Shows 'EMT\_BIG\_Network - [QUERY] EMT\_BIG\_Network - Stop Details Statistics' with 'Daily use' categories (13.01 - 14, 10.01 - 13, 7.01 - 10, 4.01 - 7, 1 - 4) and 'EMT\_Network - Sections' with 'Total boardings' categories (> 60.680 - 102.724, > 33.251 - 60.680).
- Execute SQL query:** A dialog box for running queries. Fields include 'Name of query' (i.e. Query about stops), 'Select service' (EMT\_BIG\_Network), 'Select layer' (Stop Details Statistics), and 'Select field' (Daily use). It also features a 'Select features with operator' section with buttons for LIKE, BETWEEN, AND, OR, NOT, IS, IN, NULL, =, >, <, >=, and <=.
- Analysis Panel:** A sidebar titled 'Analysis' containing a list of tools: 'Aggregate Points', 'Calculate Density', 'Choose Best Facilities', 'Create Buffers', 'Create Drive-Time Areas', and 'Derive New Locations'. Each tool has a small icon and a help button.
- Data Table:** A table titled 'VT\_BIG\_OD\_BOARDINGS-EMT\_BIG\_OD\_BOARDINGS(2)' with columns: Route\_ID, Direction, Vehicle\_ID, Stop\_start\_ID, Stop\_end\_ID, Fare\_ID, Number\_of\_trans, Number\_of\_stops, Hour\_of\_day, Day\_of\_week, and Daily\_travel\_ID. The first row shows: 21, 2, 5294, 767, 671, 4097, 2, 15, 7, 2, 0.
- Map Views:** Multiple map panes showing different data layers: a network of red and blue lines, a map with green dots, a map with purple and blue shaded areas, and a map with a grid of green dots.

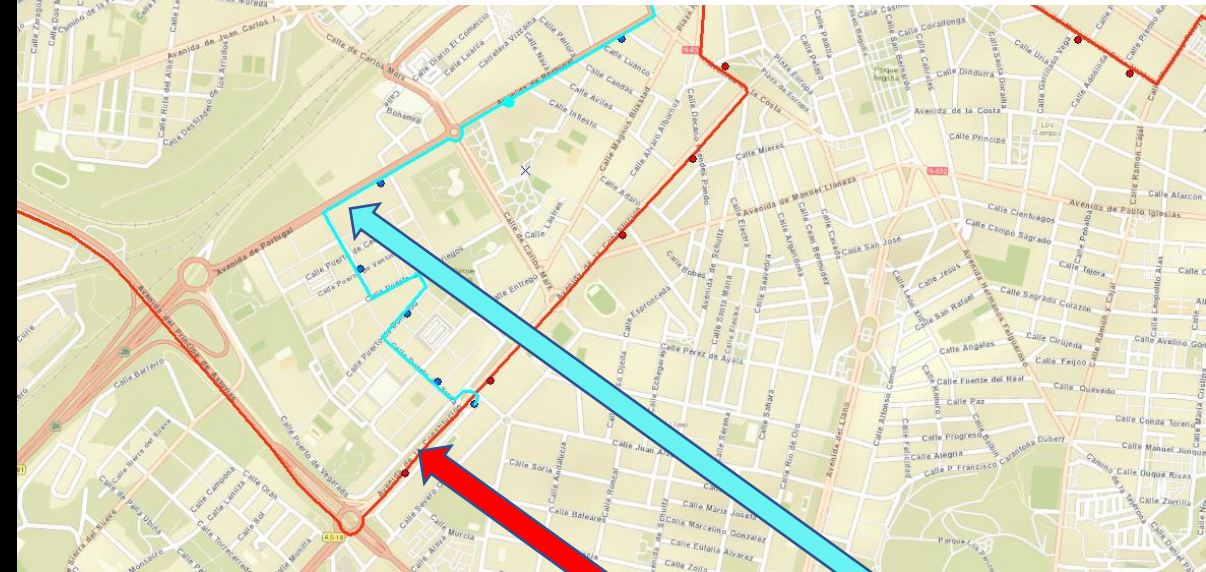
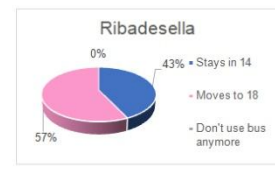
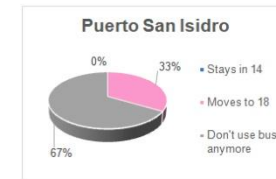
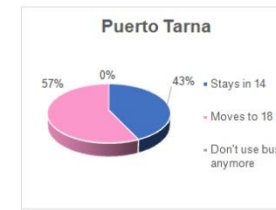
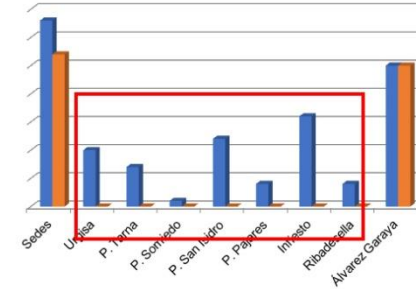
# Simulator

- Calculates new passenger flows after potential network changes (frequency, stops, routes, etc.)
- Results have been tested with real data (before and after network changes).
- Fast execution (i.e. **Madrid: 5 min**)
- High coincidence between real/simulated datasets: **93%**

**Result: decision making based on real information**

Results from simulator per bus stop:

Red rectangle highlights altered bus stops



Former route L14

New L14



# SIADE in action

Introduction to SIADE: [https://youtu.be/bPOylj\\_3Kec](https://youtu.be/bPOylj_3Kec)

Isochrone maps: <https://youtu.be/UY4GqKxsovE>

Bus bunching + traffic data: <https://youtu.be/aAY3w4DB-Pc>

Simulator + query builder: [https://youtu.be/79ob\\_XxTlyw](https://youtu.be/79ob_XxTlyw)

ANALYSIS  
AND OPTIMIZATION OF  
PUBLIC TRANSPORT  
NETWORKS



This project has received funding from  
the European Union's Horizon 2020  
research and innovation programme  
under Grant Agreement number  
778764





Partners/Collaborators:



# Contact

[www.SIADE.eu](http://www.SIADE.eu)  
info@siade.eu

**Headquarters:**  
Adosinda 11, 1C  
33202 Gijón - Spain  
+34 984 05 06 07

3BSR Tower, 13th Floor.  
9 Masada St.,  
Bnei Brak 5120109 Israel  
+972-3-9360211

