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HOW TO USE TECHNOLOGY TO UNDERSTAND HUMAN MOBILITY IN CITIES?

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Dynamic Transportation Systems



- Sustainable transport planning requires a **deep understanding on human mobility behavior**
 - How is traffic motivated?
 - How is the infrastructure used?
 - How differs the behavior for individual user groups?



- Information used in **traffic demand modelling**
 - Mobility and activity patterns (e.g. Home-Work-Home)
 - Origin-Destination (OD) matrices and transportation modes used
 - Areas and durations of stays

19 How do you usually travel to work, school or college?

Mark one box only, for the longest part, by distance, of your usual journey to work, school or college.

- 1 Not at work, school or college
- 2 On foot
- 3 Bicycle
- 4 Bus, minibus or coach
- 5 Train, DART or LUAS
- 6 Motor cycle or scooter
- 7 Driving a car
- 8 Passenger in a car
- 9 Van
- 10 Other, including lorry
- 11 Work mainly at or from home

20 What time do you usually leave home to go to work, school or college?

- 1 Not at work, school or college
- 2 Before 06.30
- 3 06.30 - 07.00
- 4 07.01 - 07.30
- 5 07.31 - 08.00
- 6 08.01 - 08.30
- 7 08.31 - 09.00
- 8 09.01 - 09.30
- 9 After 09.30

21 How long does your journey to work, school or college usually take?

Write in minutes.

Means of travel to work, school or college 2002- 2006	2002	2006
	%	
On foot	11.4	10.9
Bicycle	2.1	1.9
Bus	6.7	6.1
Train	2.1	2.9
Motor cycle	1.1	0.7
Car driver	55.1	57.1
Car passenger	6.7	5.5
Other (incl. Lorry/van)	7.1	7.8
Work mainly at home	6.1	5.6
Not stated	1.7	1.6
Total	100.0	100.0

Census of Population of Ireland 2011

- **Human mobility analysis** to investigate commuting patterns
- Traditional mobility surveys are **labor-intensive** to gather such information with reasonable quality



Engage with the Data produced from your City

- Technology is now closely tied with the Internet
- With increased communication and data collection abilities such as GPS and cell phone triangulation/mobile devices, more data is available

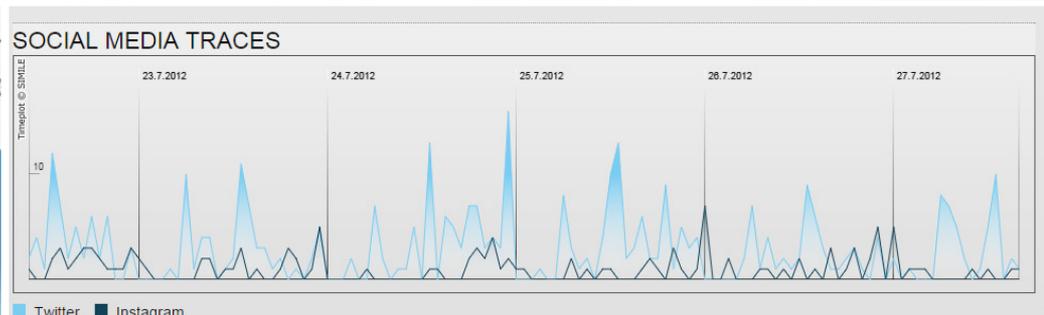
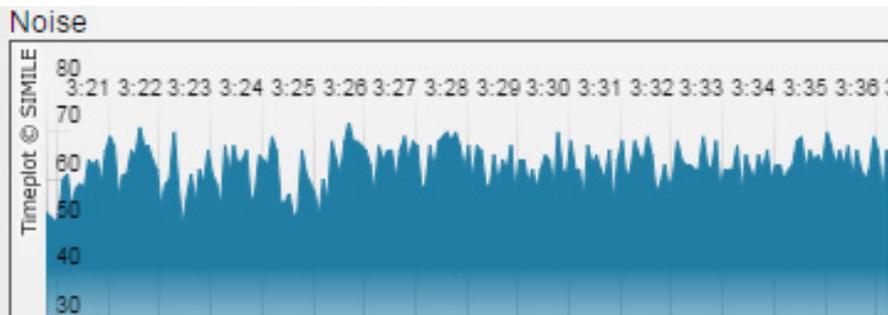
Manual Counting



- Identify **critical flow time periods** or document **traffic volume trends**
- **Limited** length of the **sampling period**
- Manual counting is **cumbersome** and **error-prone**

Video

Sense and the City



- Capturing **activities** in urban space with the help of **image processing (Video)**
- **Environmental sensors** for measuring noise and pollutant (e.g. NOX, CO)
- Linkage of collected data to **social media traces**

Bluetooth, WiFi



- Anonymized data collected through **noninvasive sensors** (e.g. Bluetooth, WiFi)
- Analyze peoples' and vehicles' **sequential movements**, the spatial layout, and their interplay

Counting Sensors



Transit Smart Card



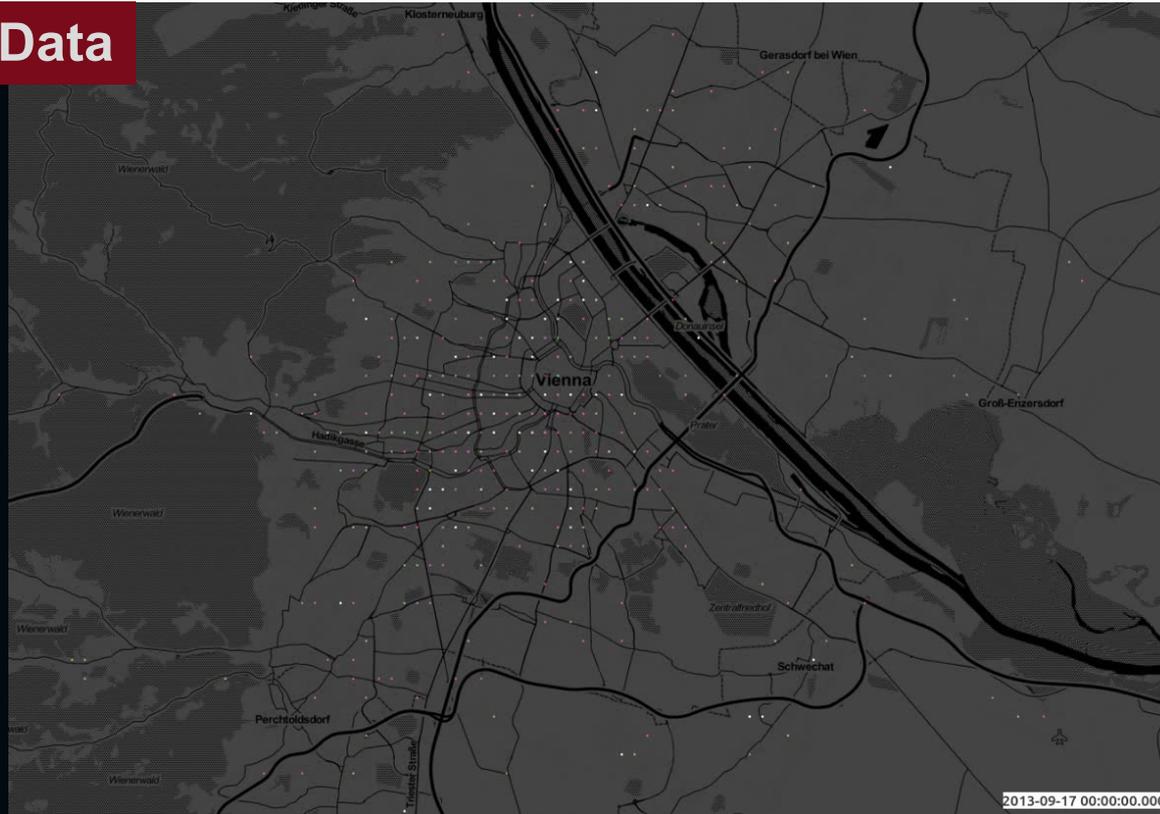
- **Counting sensors** in public transit vehicles (trains, busses, etc.)
- **Transit smart card** like Oyster Card (London) or T-money (Seoul)

Mobile Phone Data



- **Extracting key data for traffic demand modeling**
 - Commuter flows, origin-destination matrices, travel times, activity patterns,...
- **Processing large data samples** in reasonable time
- **Exporting results to traffic planning tools** such as PTV VISUM™
- Compatible to standard cellular network data such as **Call Detail Records (CDRs)** and **Signaling data** from mobile phone providers.

Mobile Phone Data

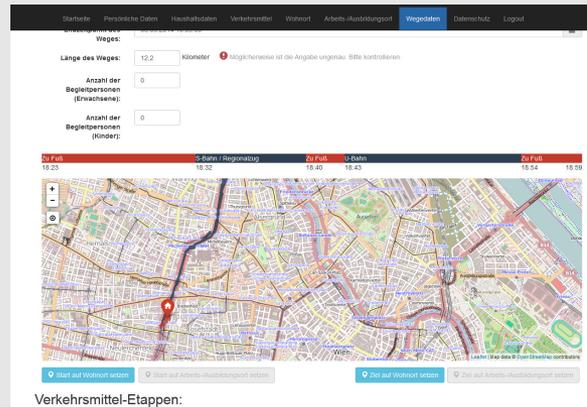


- Obtaining **OD-matrices** from **mobile phone data**
- Information was **verified** using data from mobility surveys
- Other examples from Dhaka (Bangladesh), Rio De Janeiro (Brazil), Beijing (China),...

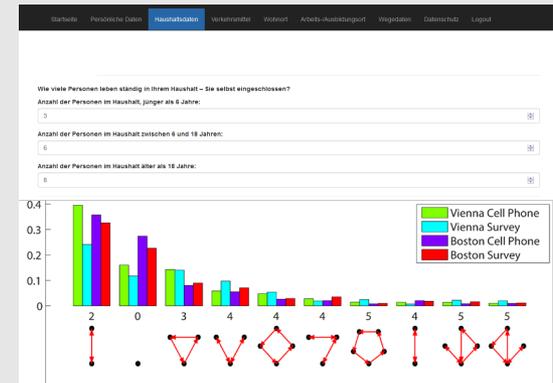
Smart Survey (GPS and other sensors in phones)



Smartphone App for collecting trips and trip purposes (participant)



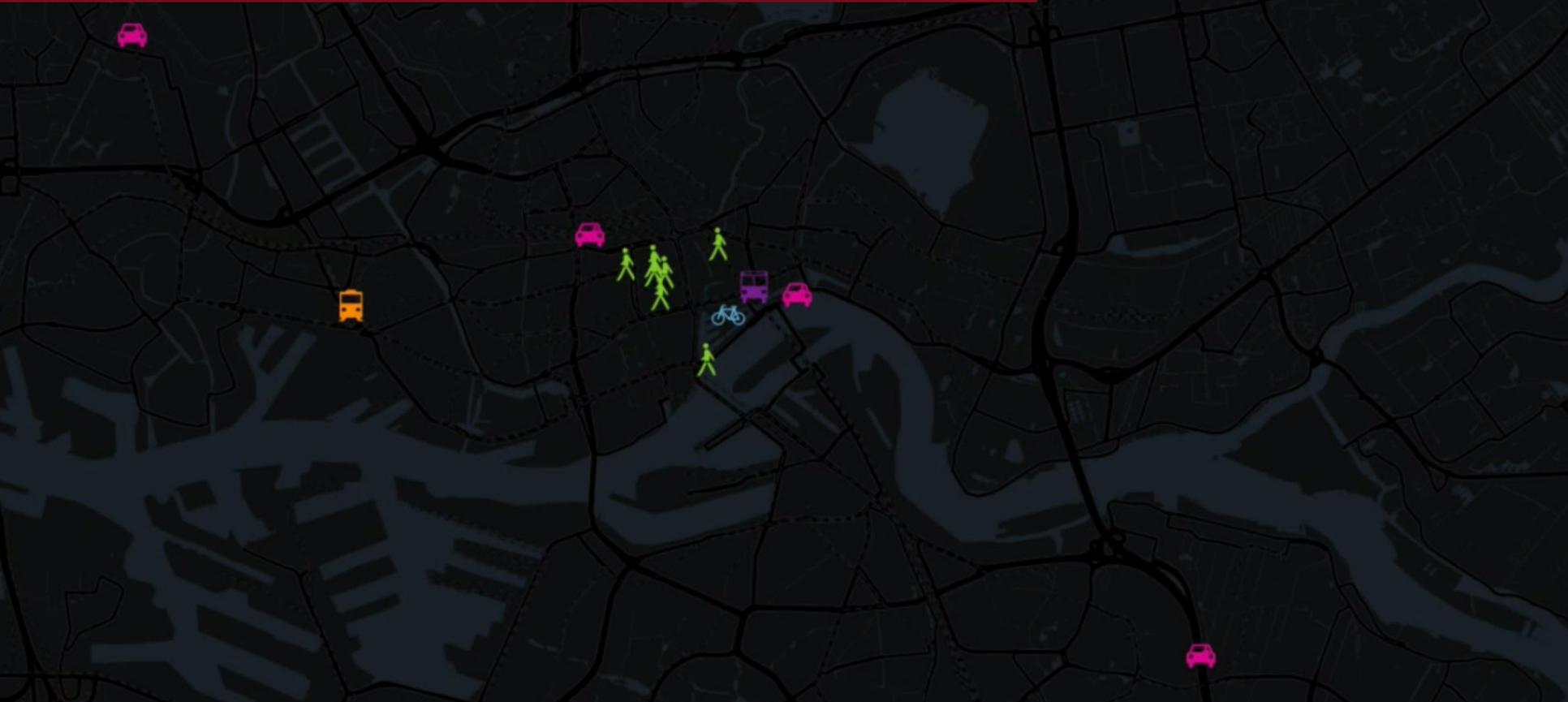
Web App for viewing, editing, deleting and confirming individual trip information and providing additional survey data (participant)



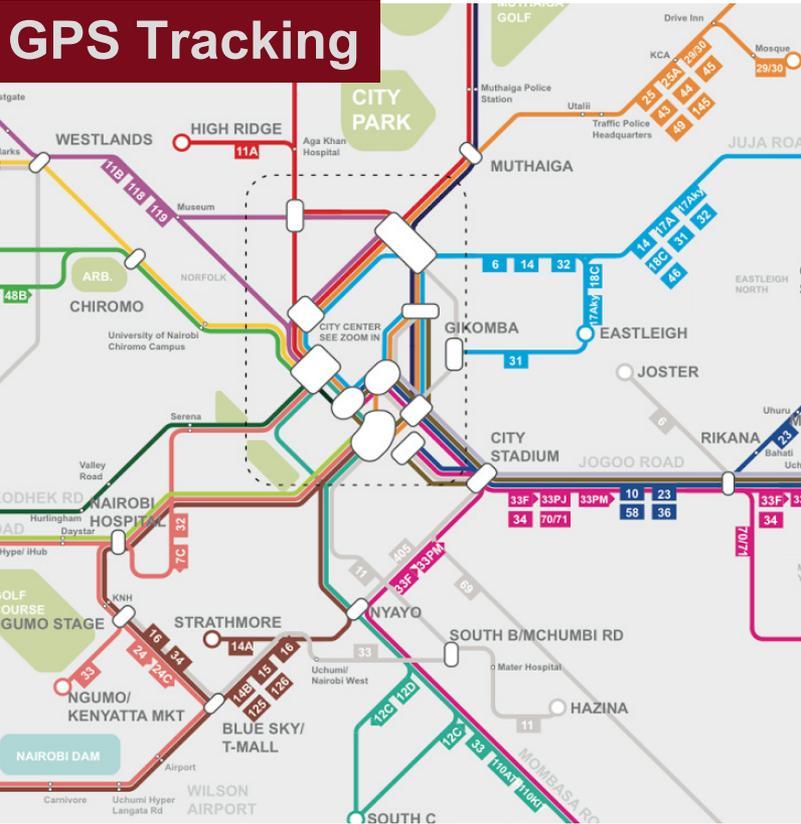
Web App for conducting the survey by providing statistics and exports to standard traffic planning tools (conducting party)

- Smartphone-App **automatically collects and extracts** trips and transport modes (deployed via official App-stores) based on **GPS, accelerometer, other phone sensors...**
- Enables to apply **customizable questions** about the person, household and trips online
- Collected data can be **analyzed and exported** any time on the Web (also during the survey)
- State-of-the-art **privacy and data security concepts**

Smart Survey (GPS and other sensors in phones)



- Approximation of the **human motion within particular geographic areas**
- **Eight different means of transport are automatically and reliably recognized**



- GPS tracking of informal traffic in Davao, Manila, Nairobi (Matatus)

Limitations

- Video
 - Needs to be secured against theft, weather issues (influencing tracking performance), robust power supply
 - Mostly temporarily installations, offline analysis
- Bluetooth+WiFi
 - Requires smartphones with communication technologies
 - Penetration rate of smartphones is increasing as they become more affordable (<\$100)
- Automatic Counting + Transit Smart Card
 - E.g. in use with BRT systems / metro lines
- Mobile Phone Data
 - Data availability (pre-paid contracts), legal issues and unclear revenue model
 - Funding from the Gates Foundations for servers (Brazil), legal framework in progress (Vietnam, Philippines), working group of the World Economic Forum (Sandy Pentland)
- Smart Survey (GPS and other sensors in phones)
 - Penetration of smartphones and cost of data is (slowly) improving
 - Consultancy model based on small samples (deployment through local survey staff)



- More accurate overall picture – More granular analysis at the level of individual journeys
- Understand load profiles – How crowded is a particular bus at a certain time?
- Plan interchanges in complex transportation systems
- Minimize walk times and reduce congestions
- Integrate other services such as retail

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