Aspects of implicit and explicit human interactions with ubiquitous geographic information

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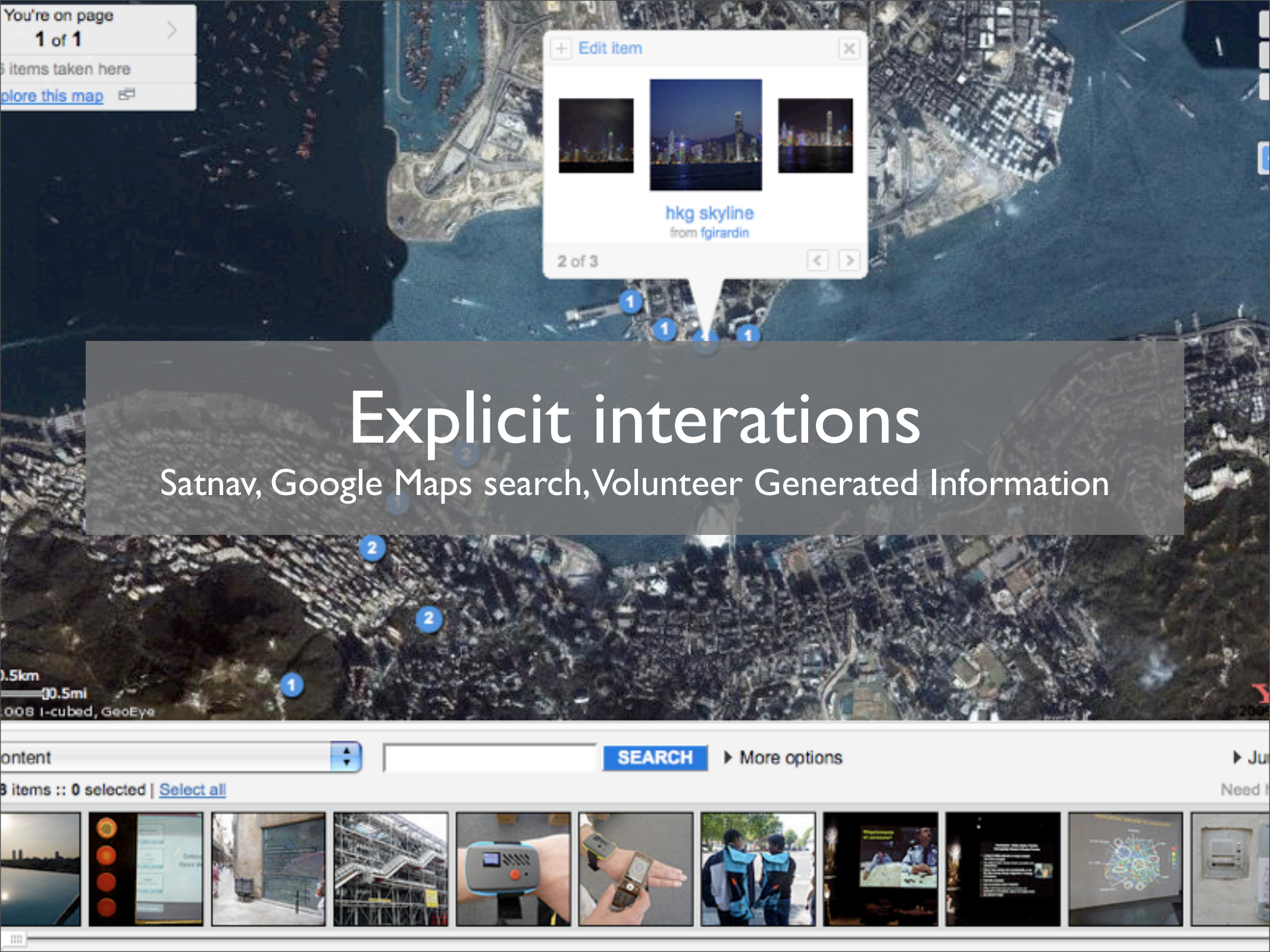
Universitat Pompeu Fabra
PhD thesis defense, Barcelona, July 14, 2009

Ubiquitous geographic information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"Current technology requires information to be served from somewhere and delivered to somewhere [...] ***at geographic scales a bit always has an associated location in real geographic space****."*

Goodchild, M. F. (1997). Towards a geography of geographic information in a digital world. Computers, environment and urban systems, 25(6):377–391.

Implicit interactions

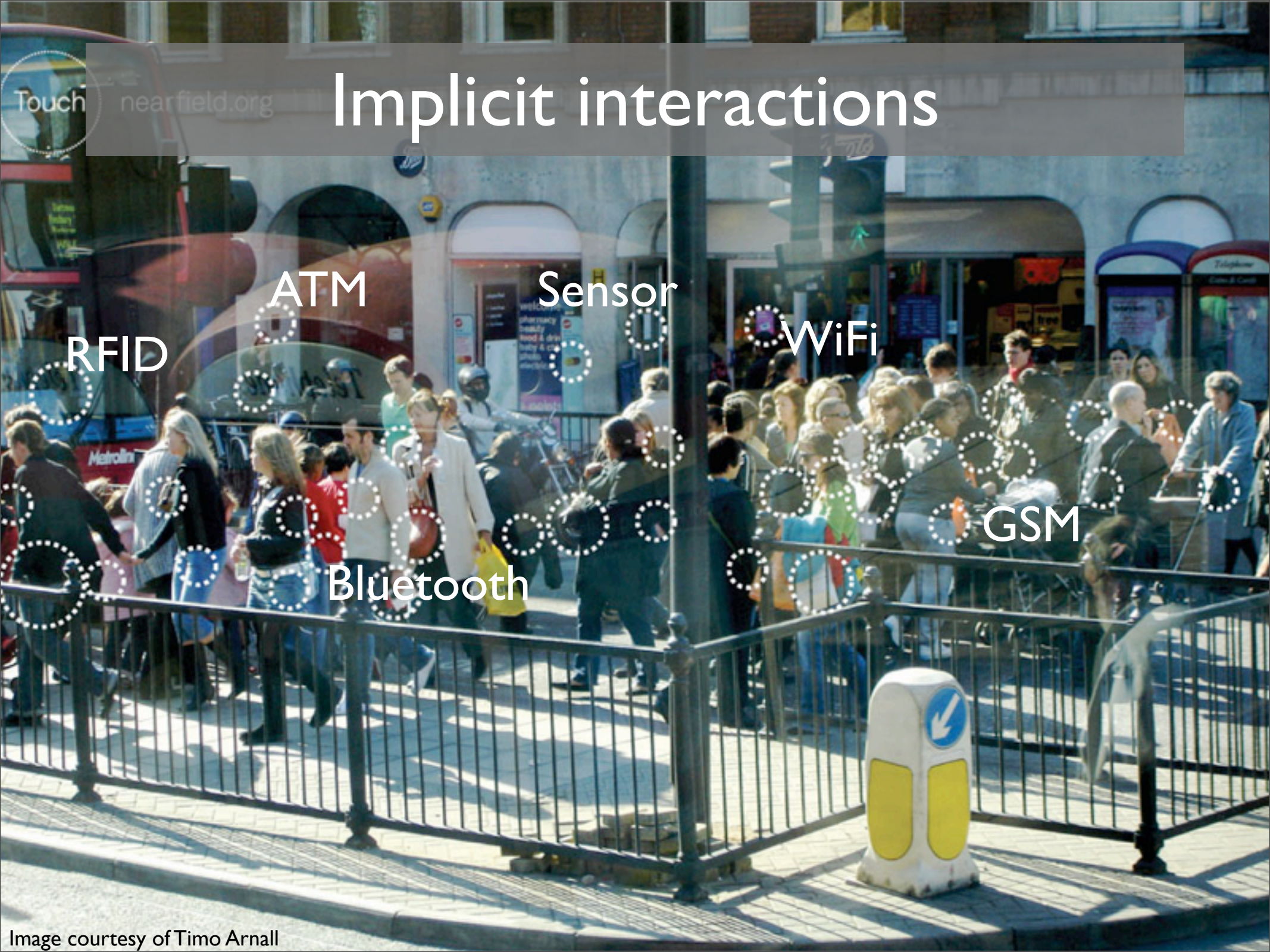
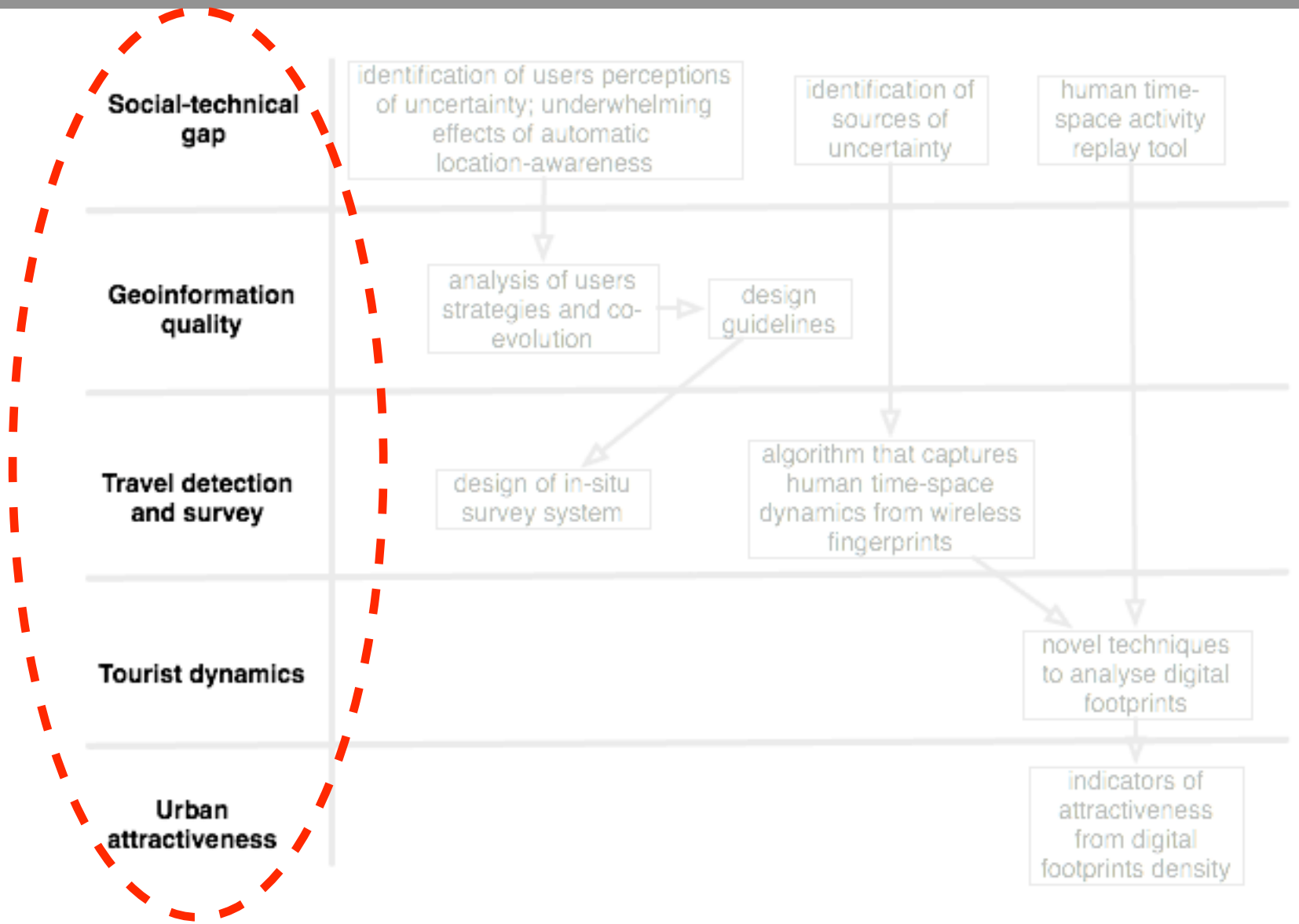


Image courtesy of Timo Arnall

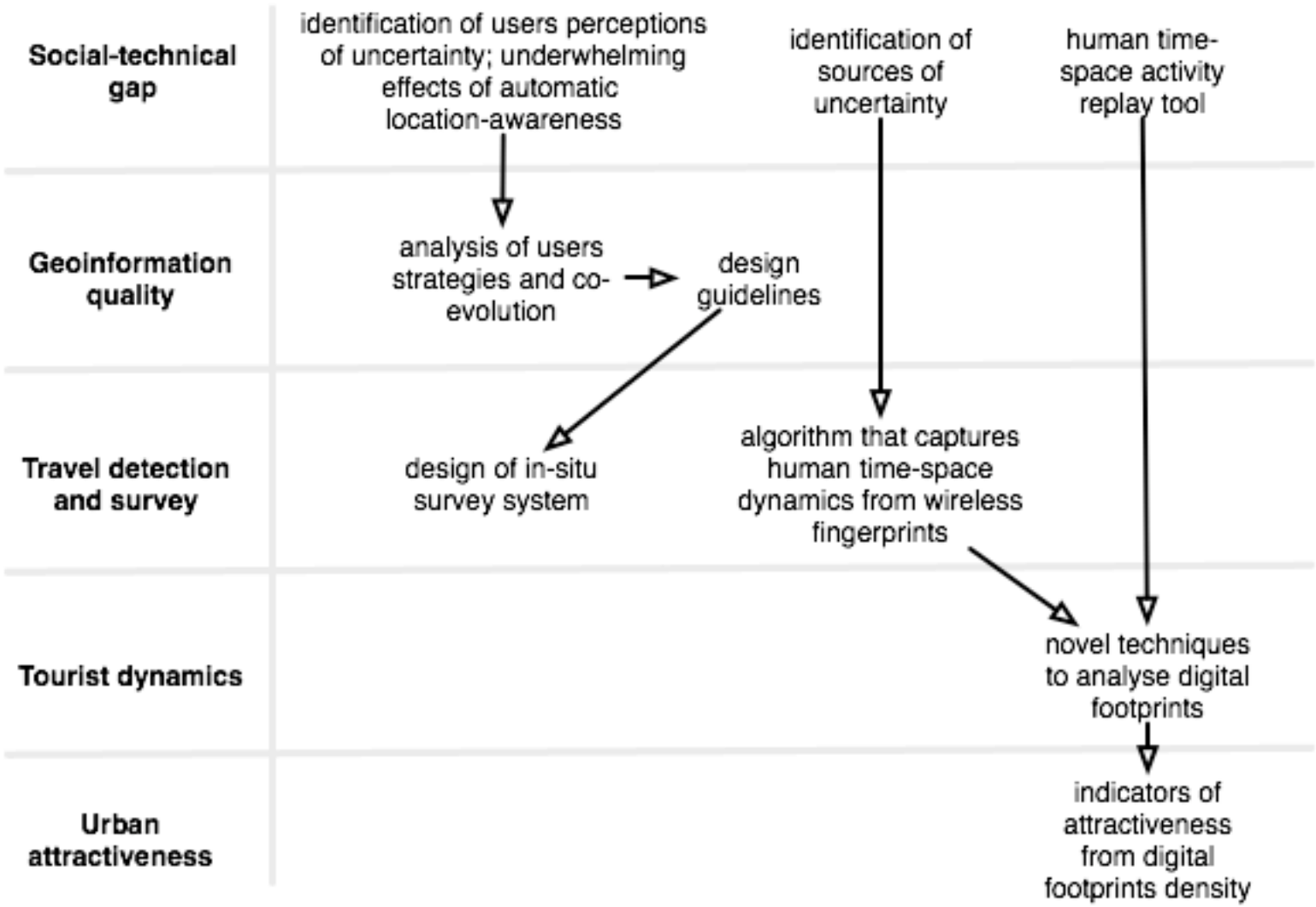
Main motivation

There is still very little understanding on the implications on people of this ubiquitous presence of geographic information

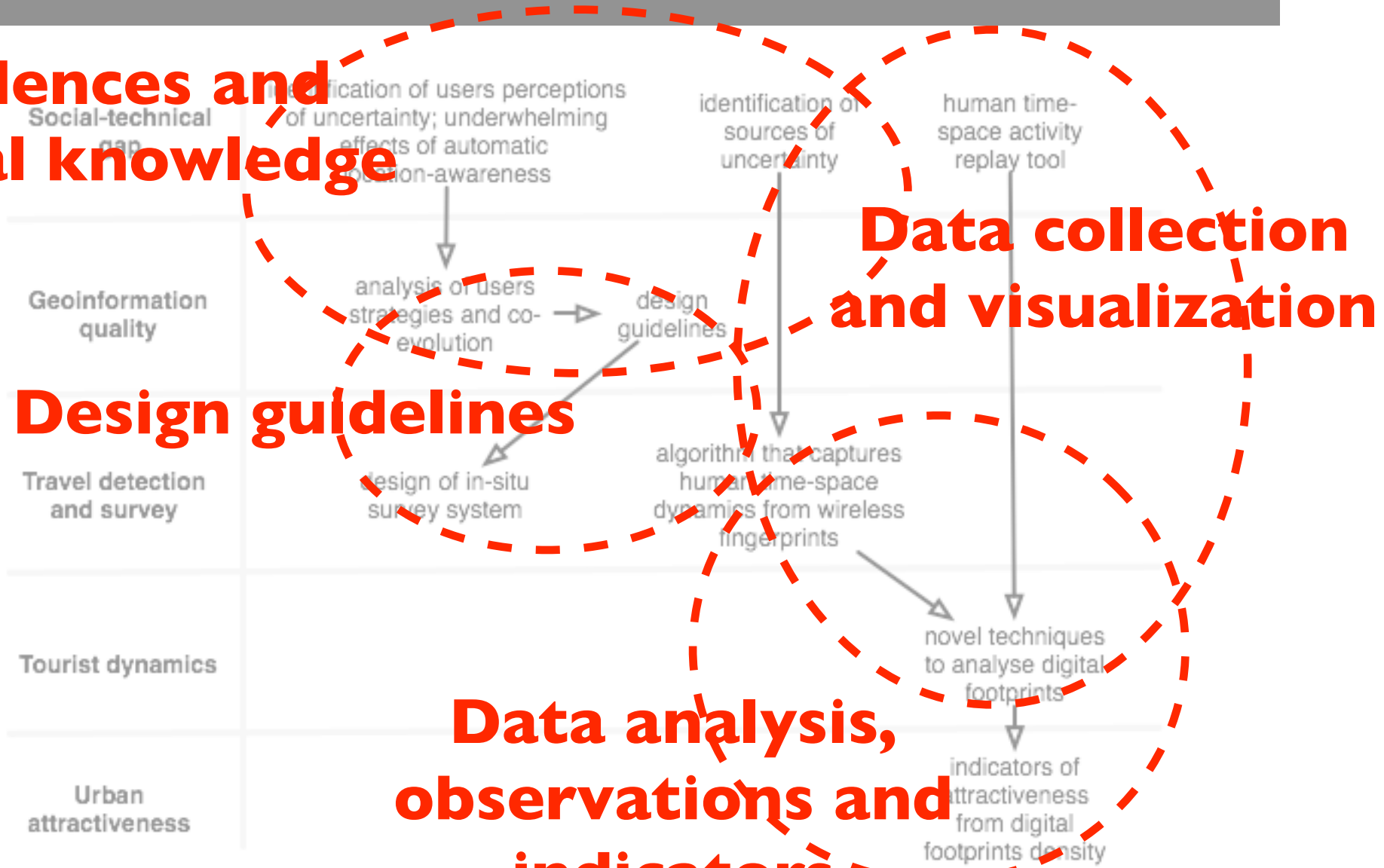
Studied aspects



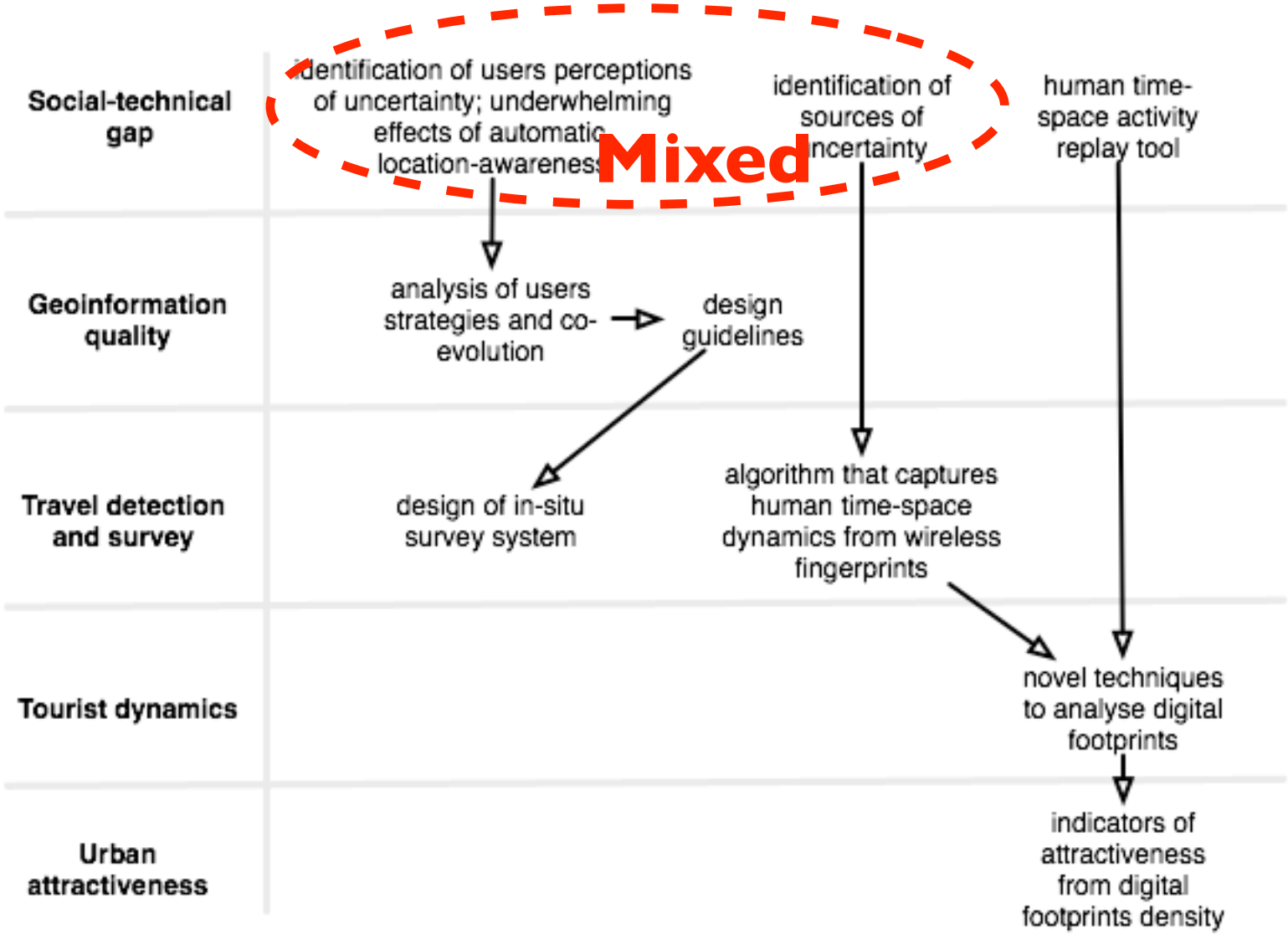
Thesis articulation



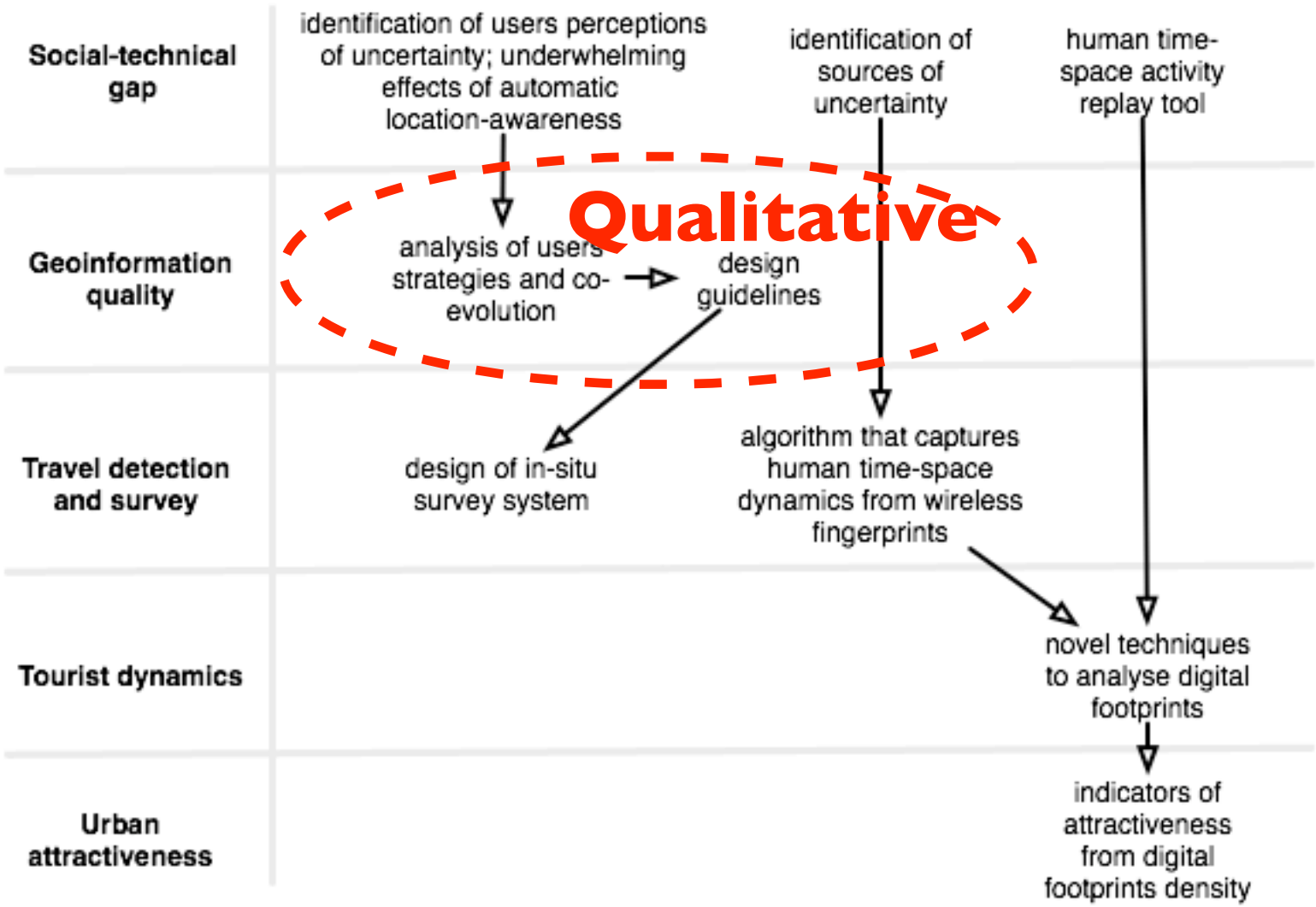
Thesis articulation



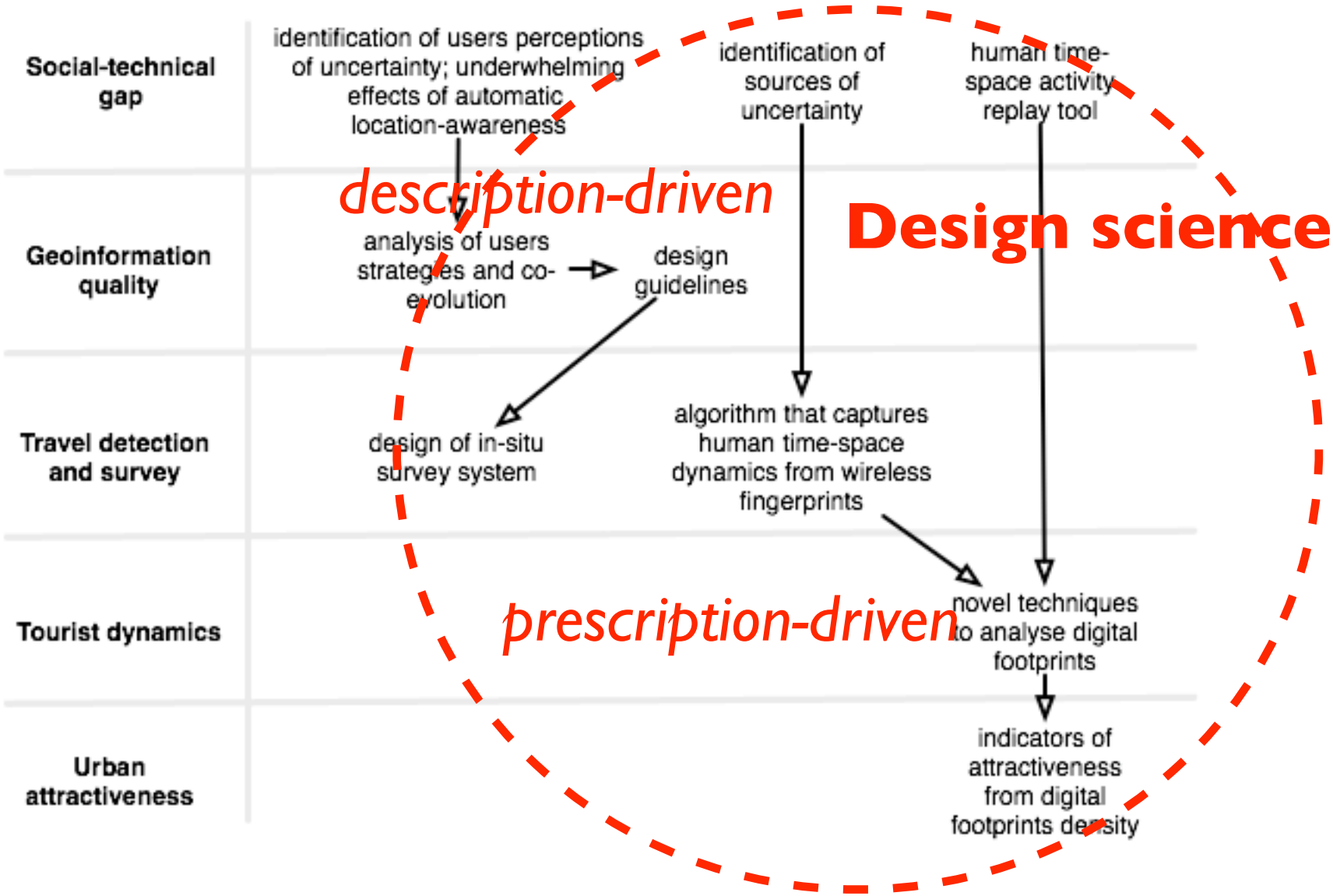
Research methods



Research methods



Research methods



Roles played by the technological infrastructure as source of uncertainty in ubiquitous geoinformation perceived by its users

Social-technical gap

Geoinformation quality

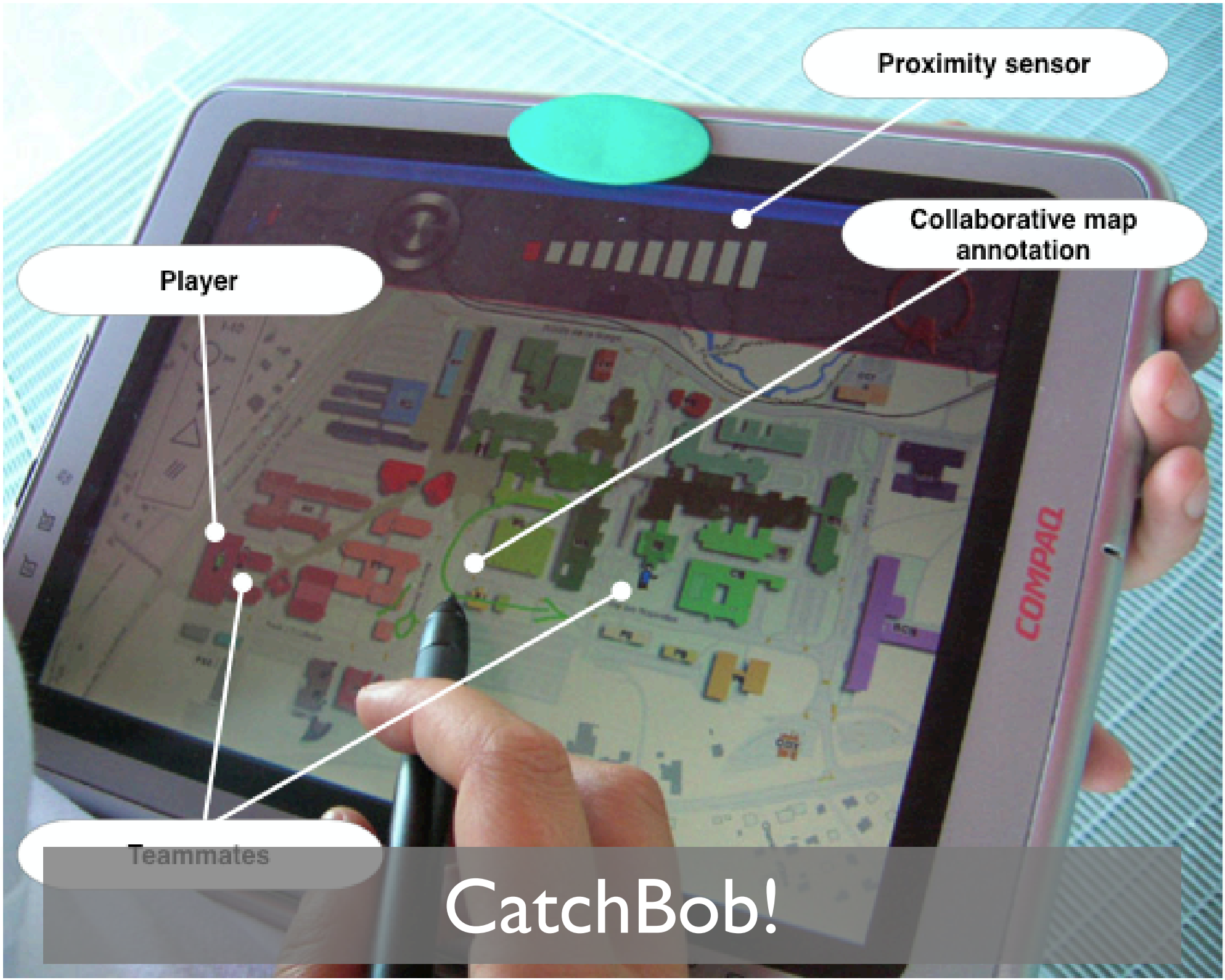
Travel detection

Tourist dynamics

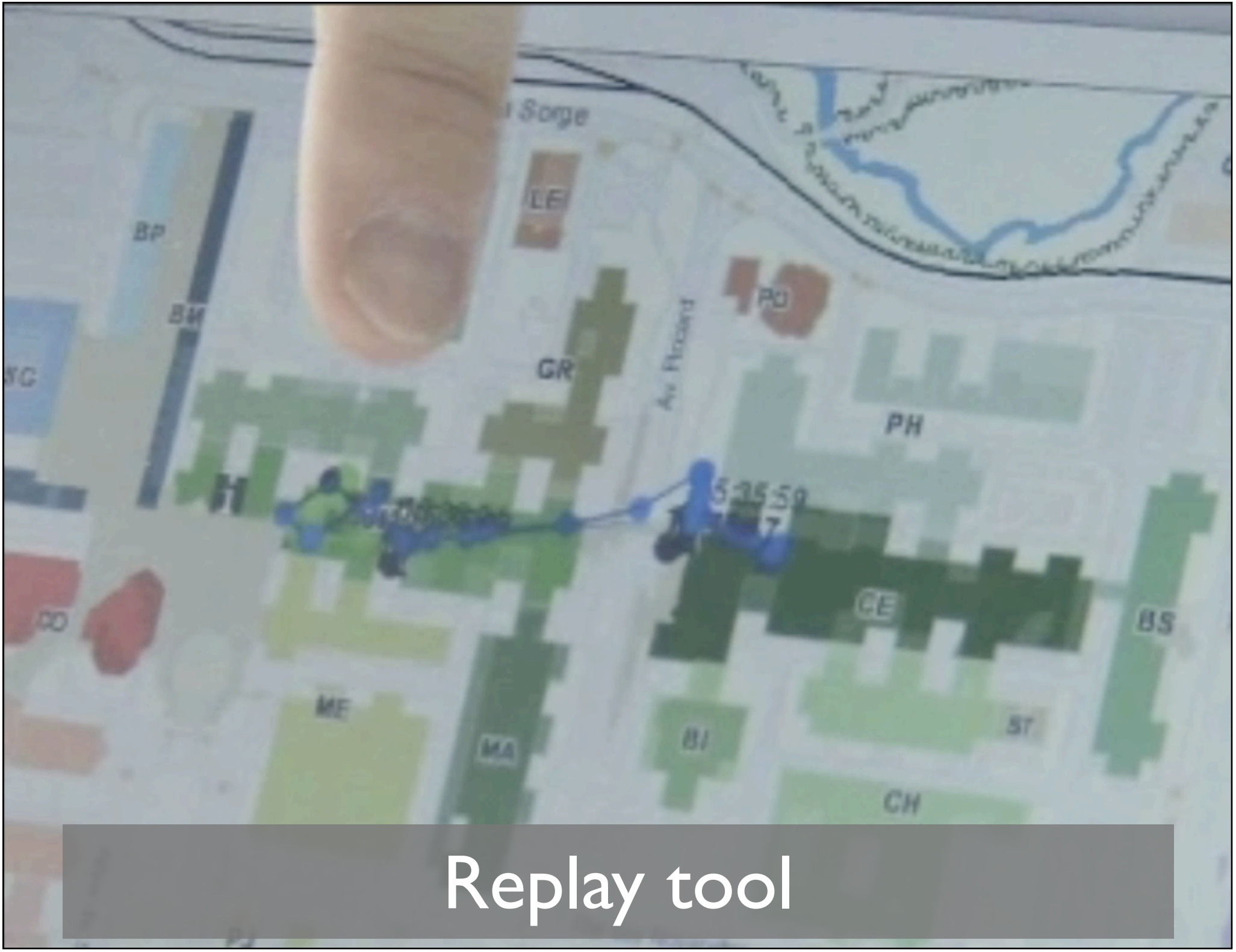
Urban attractiveness

Method

- Pervasive game as alibi
- Mixed quantitative (game logs) and qualitative data (post-game questionnaire and confrontation)
- Procedure: planning, game, questionnaire, replay (group confrontation)
- 60 participants (20 teams of 3 players)


Proximity sensor
Collaborative map annotation
Player
Teammates
COMPAQ

CatchBob!



Replay tool

CatchBob!

Nicolas Nova, Fabien Girardin, Pierre Dillenbourg
Center for Research and Support of training and its technologies (CRAFT)
Swiss Federal Institute of Technologies Lausanne (EPFL)

Images: Ecole des Arts Décoratifs de Genève
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Take-aways

- The quality of the ubiquitous geoinformation influences the user experience and the infrastructures must be consciously attended, as they are unevenly distributed, unevenly available
- Different types of reactions to uncertainty
- Underwhelming effect of automatic location-awareness

Need a wider context, with a wider range of applications, devices and artefacts, common for ubiquitous systems.

Social-technical gap

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Urban attractiveness

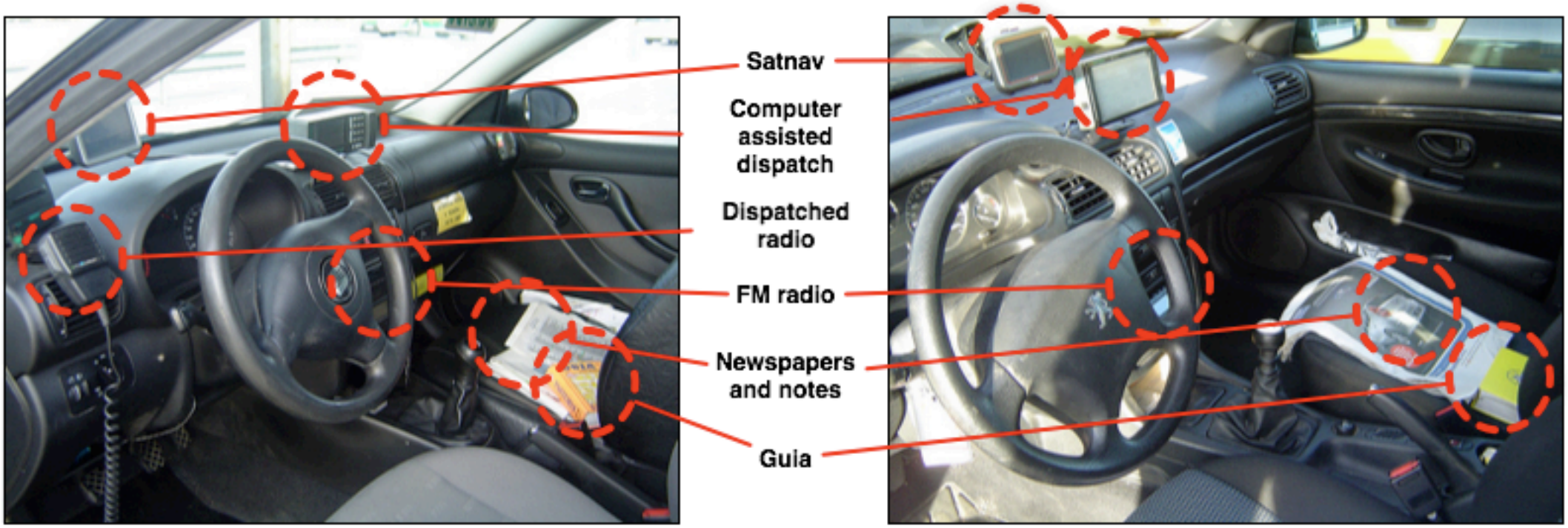
Analysis of users stategies and co-evolution in the real-world


Taxi drivers practices

Method

- Ethnographic study with 12 informants
- Procedure: artifact model, semi-structured interviews, coding
- Focus: acquisition, expectation gap, evolution

Ecosystem of artifacts



Some findings

- No new sphere of practice, but underwhelming effects of automating wayfinding.
- Assessing the quality of the geoinformation
- Social amputation: affects the learning of the city
- Design strategies such as seamful design

Human time-space activity sensing; design guidelines (seamful design)

Social-technical gap

Geoinformation quality

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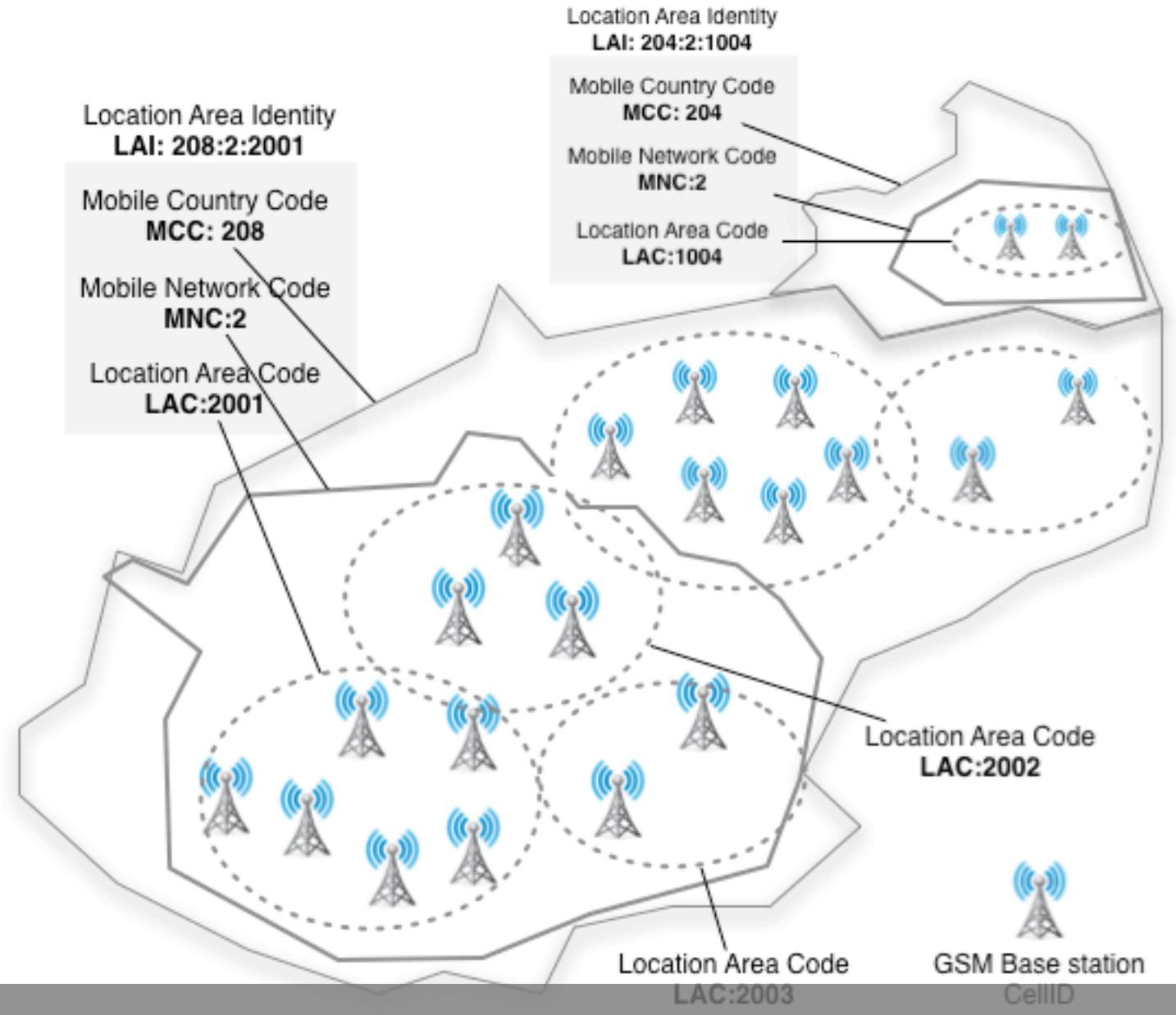
Urban attractiveness

The ubiquitous technologies that afford us new flexibility in conducting our daily activities are simultaneously providing the means to study our activities in time and space.

"I am sure that this accumulation of traces … is worth pointing out. ***The precise forces that mould our subjectivities and the precise characters that furnish our imaginations are all open to inquiries by the social sciences****. It is as if the inner workings of private worlds have been pried open because their inputs and outputs have become thoroughly traceable."*

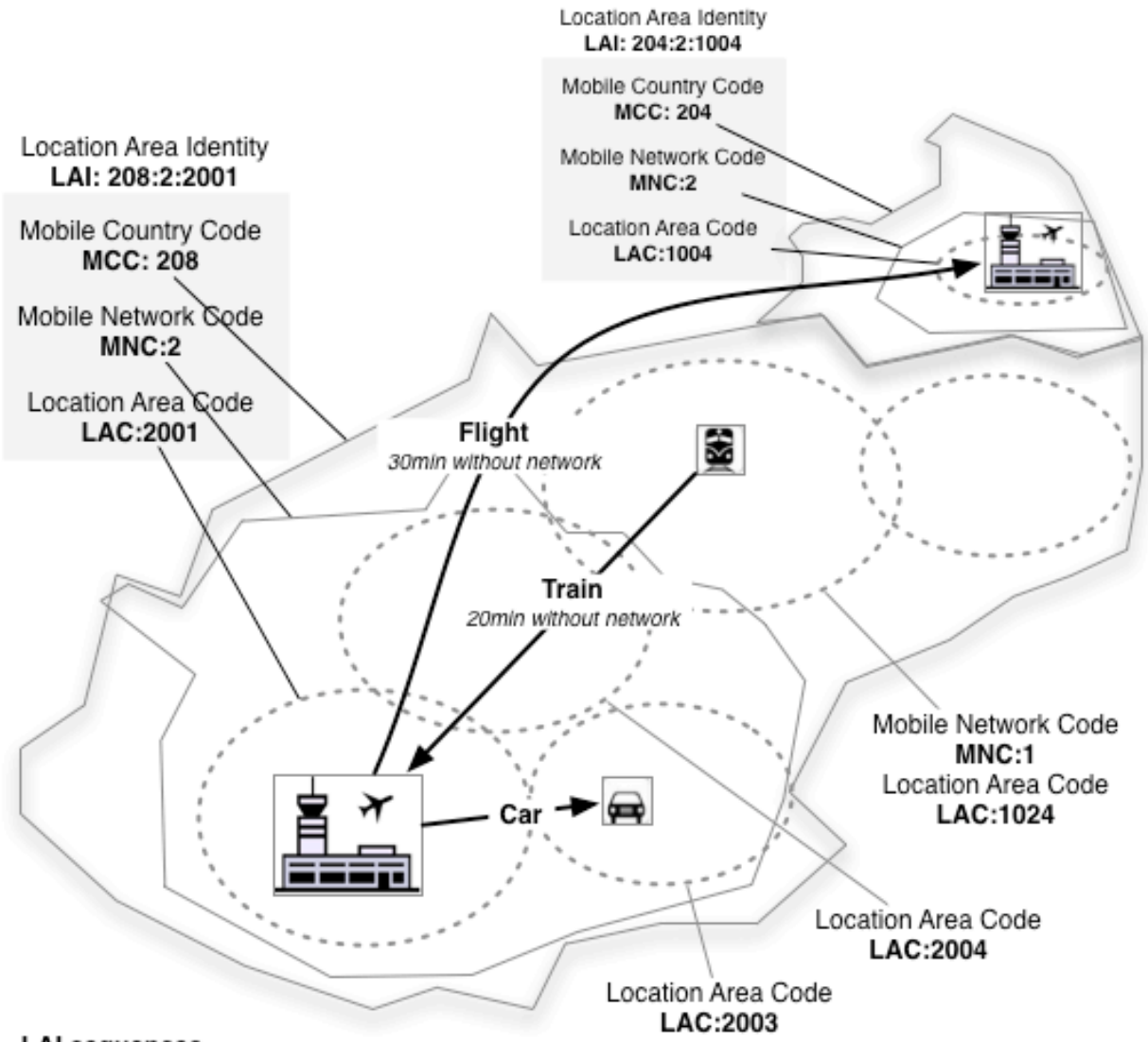
Latour, B. (2007). Beware, your imagination leaves digital traces. Times Higher Education Supplement

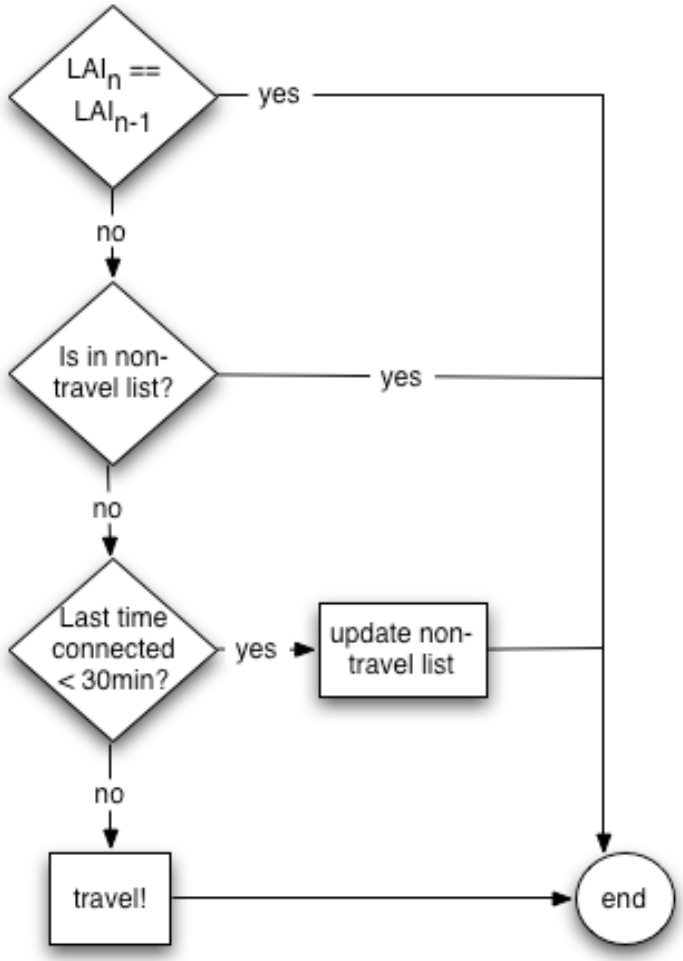

Any country
Any user
Anywhere
Accurately
Privacy
Cost
Longetivity
No fatigue effect
NOKIA
BOEING
It seems that you have traveled by plane recently. Is that right?
Yes
No
Air-travel survey



LAI fingerprinting

Algorithm

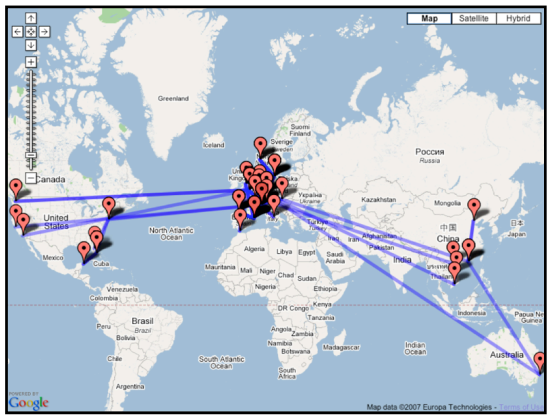


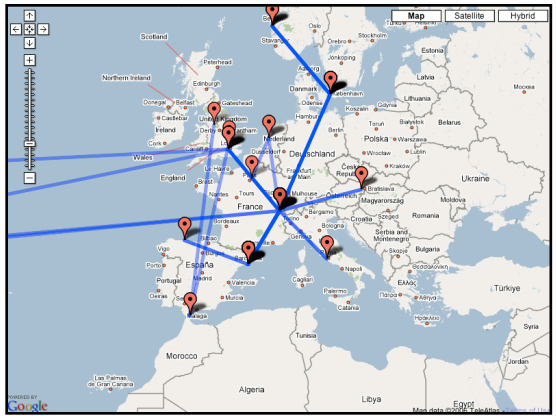


LAI sequences

```
Flight: 208:2:2001 -> 204:2:1004
Train:  208:1:1024 -> 208:2:2004 -> 208:2:200
Car:    208:2:2001 -> 208:2:2003
```

World-wide evaluation





- 12 months, 6 participants, multiple carriers
- 97% flight detection rate (74/76)
- Issues with: stop-overs and short flights
- No negative response to false positives (needs further studies)
- Revision of algorithm according to social rules

Human time-space replay tool

Social-technical gap

Geoinformation quality

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Tourist dynamics

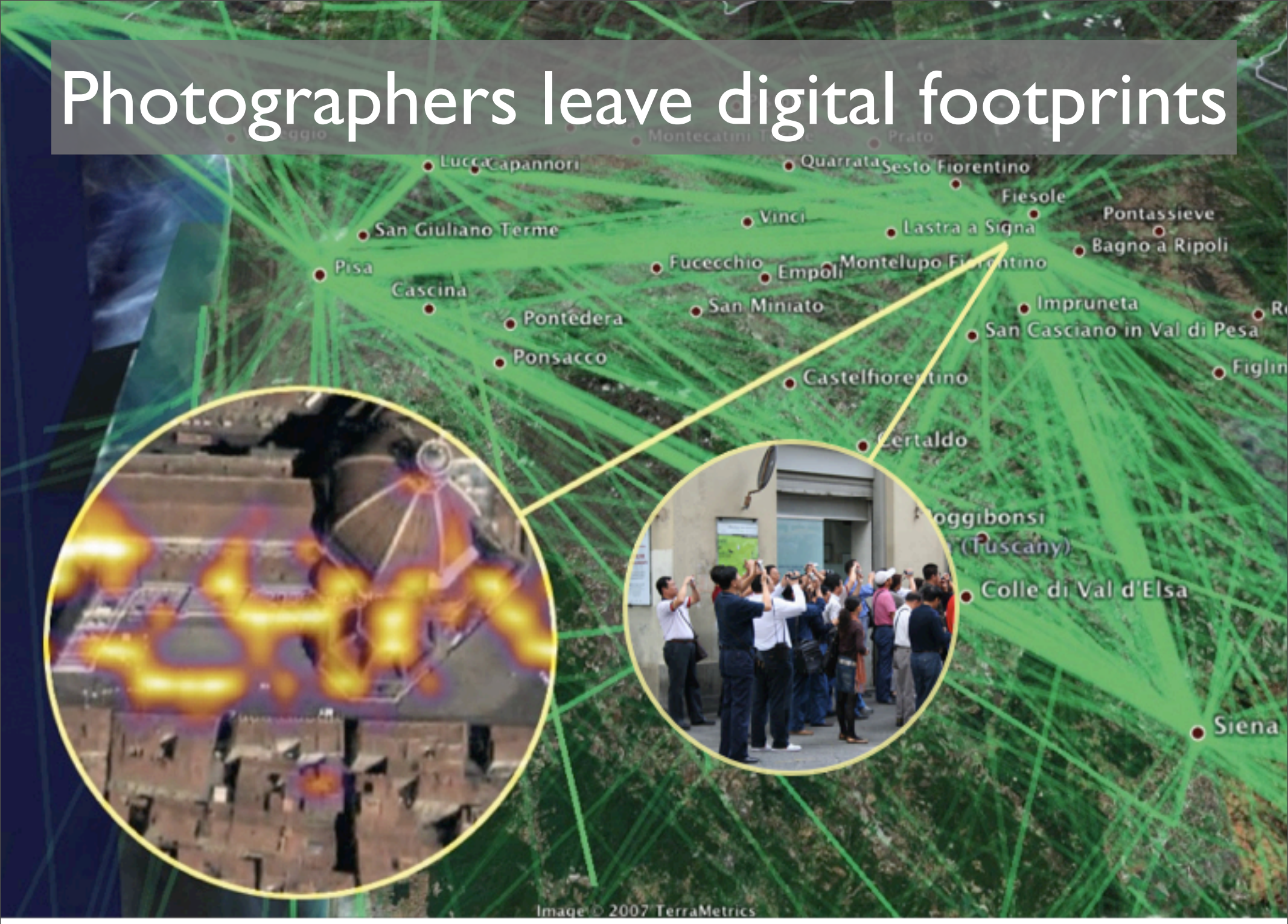
Urban attractiveness

Considers explicit user-generated ubiquitous geoinformation to provide more empirical evidences of travellers' density and flows

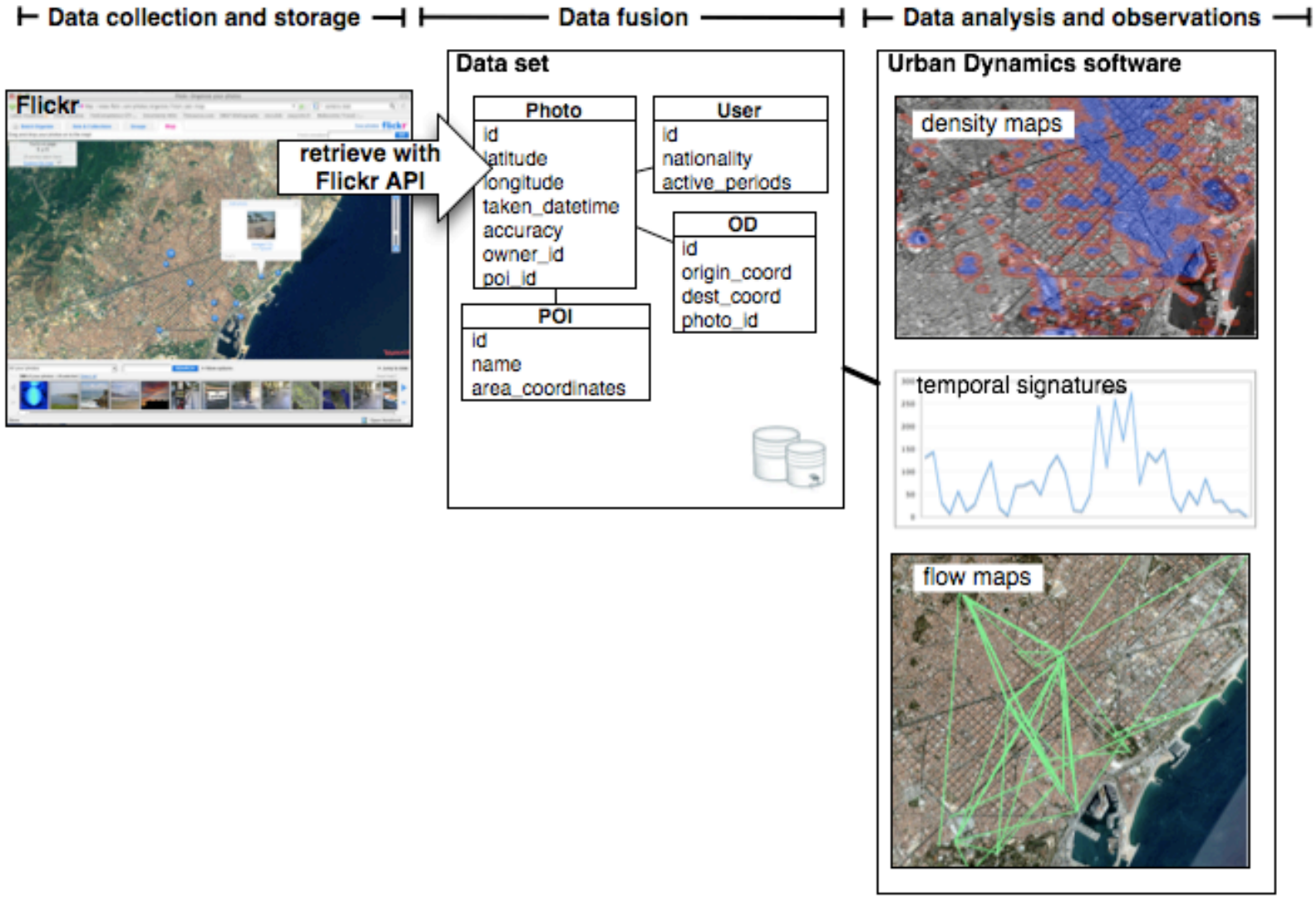
"When many individual diagrams are aggregated to the level of cities and regions, these visualizations may provide geographers, for the first time, with truly dynamic maps of dynamic human processes. ***One might imagine them as twenty-first century "weather maps" of social processes.***"

Zook, M., Dodge, M., Aoyama, Y., and Townsend, A. (2004). New digital geographies: Information, communication, and place. Geography and Technology, pages 155–176.

Photographers leave digital footprints



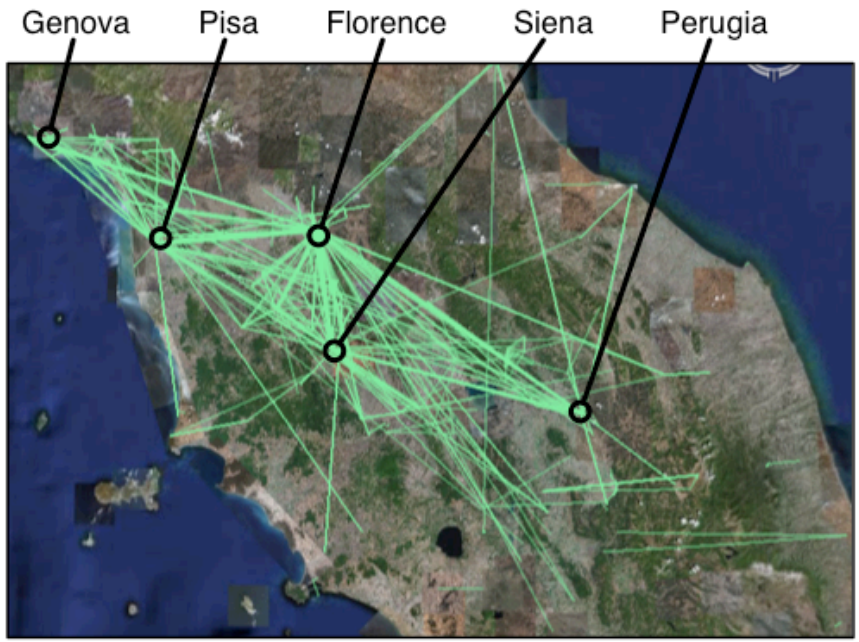
Digital footprinting

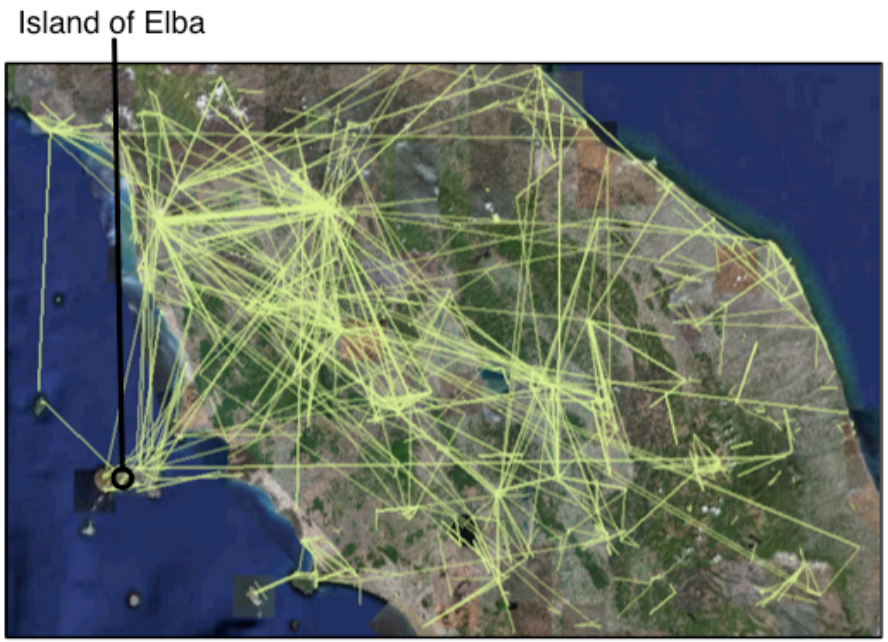


Density and scales

Province of Florence (2005-2007)
81,017 georeferenced photos, 4280 photographers

Origins and traces





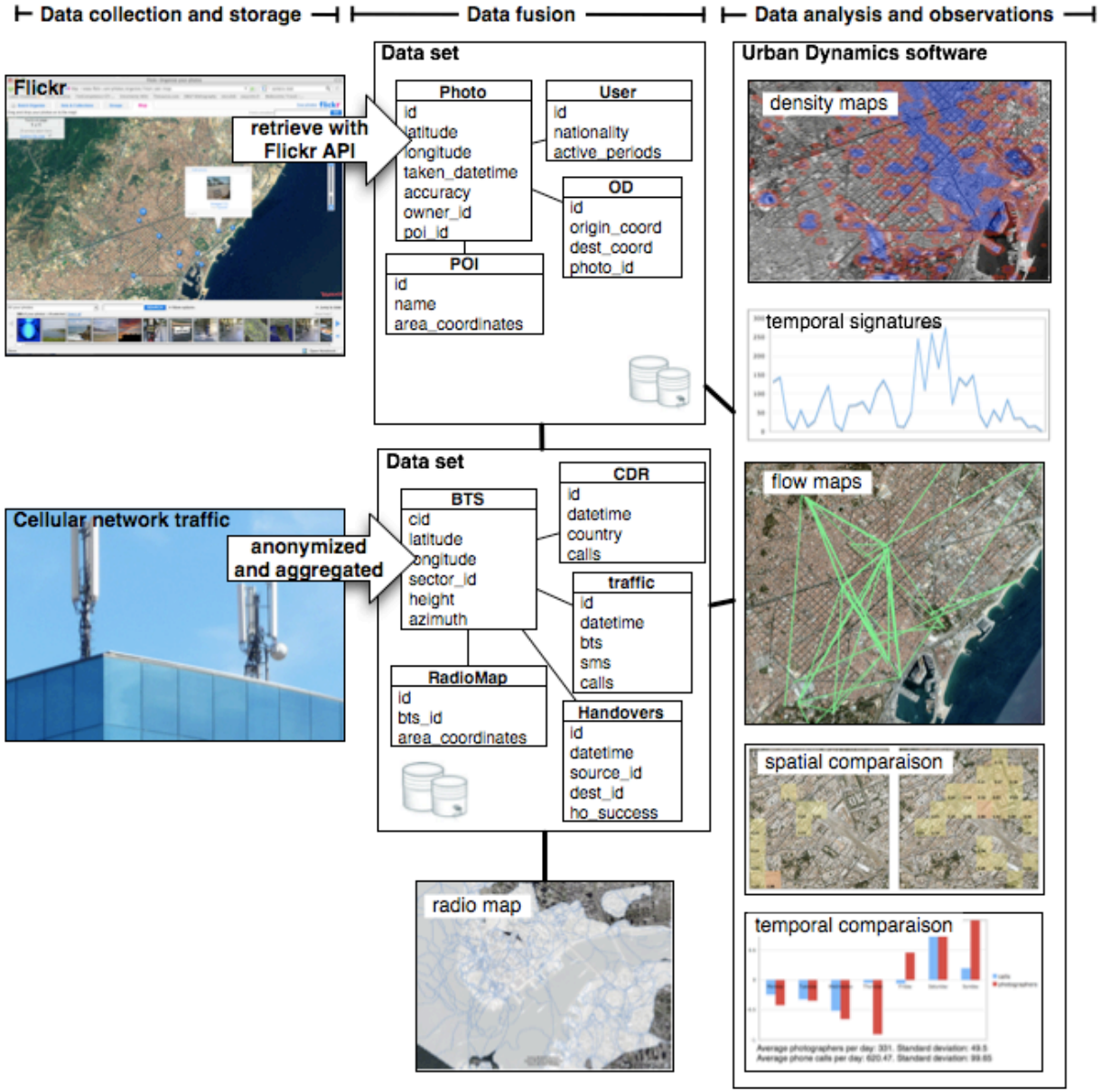
Tourists and locals can be recognized from their practice

60% of users disclose their home country

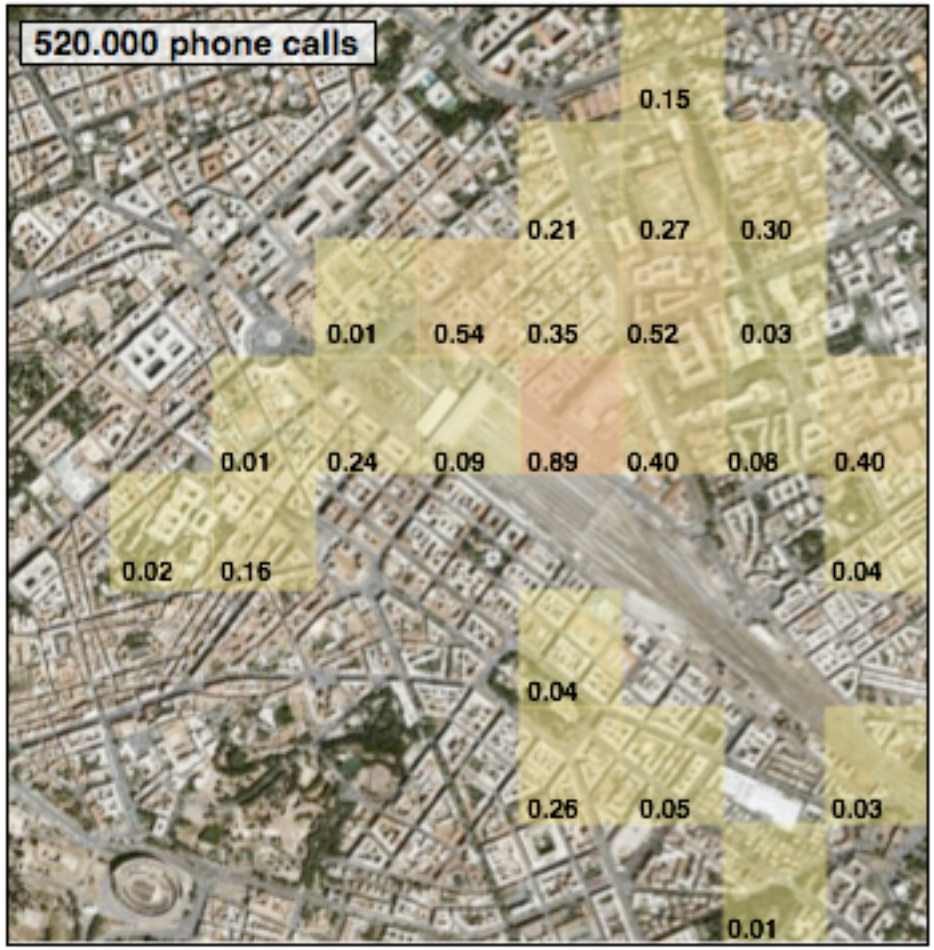
Value of the act of communication


Partners of photographers as well

Digital footprinting



Space and visitors activities

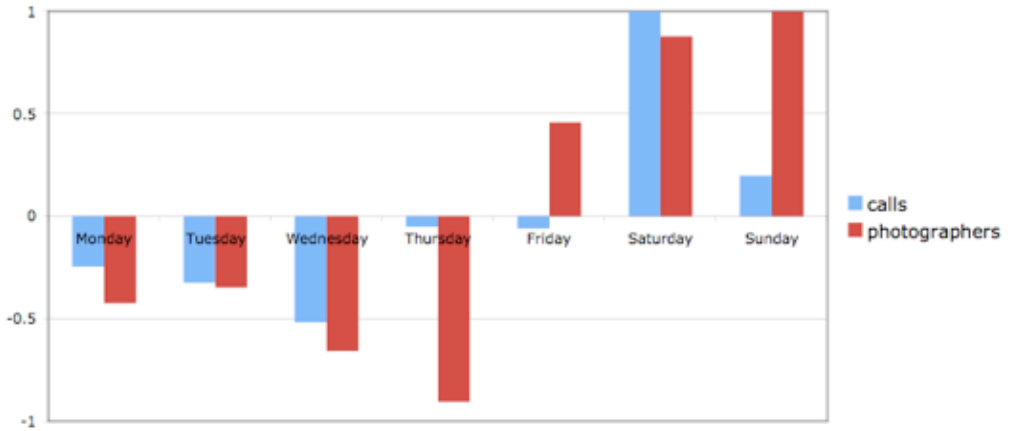


Rome city center (Sept-Nov. 2006)

Place and temporal presence

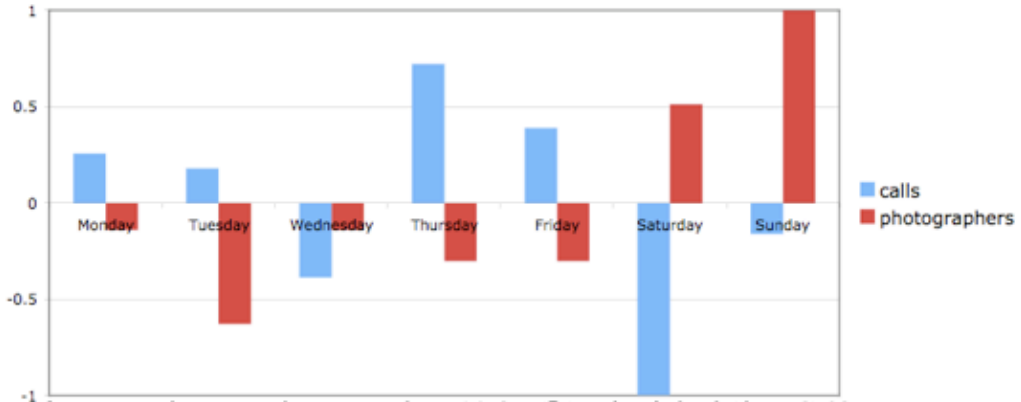
Temporal comparison of days of the week. September-November 2006

Colloseum



Average photographers per day: 331. Standard deviation: 49.5
Average phone calls per day: 620.47. Standard deviation: 99.65

Train station



Average photographers per day: 10.85. Standard deviation: 3.43
Average phone calls 1165.35 per day. Standard deviation: 198.43.

Social-technical gap

Geoinformation quality

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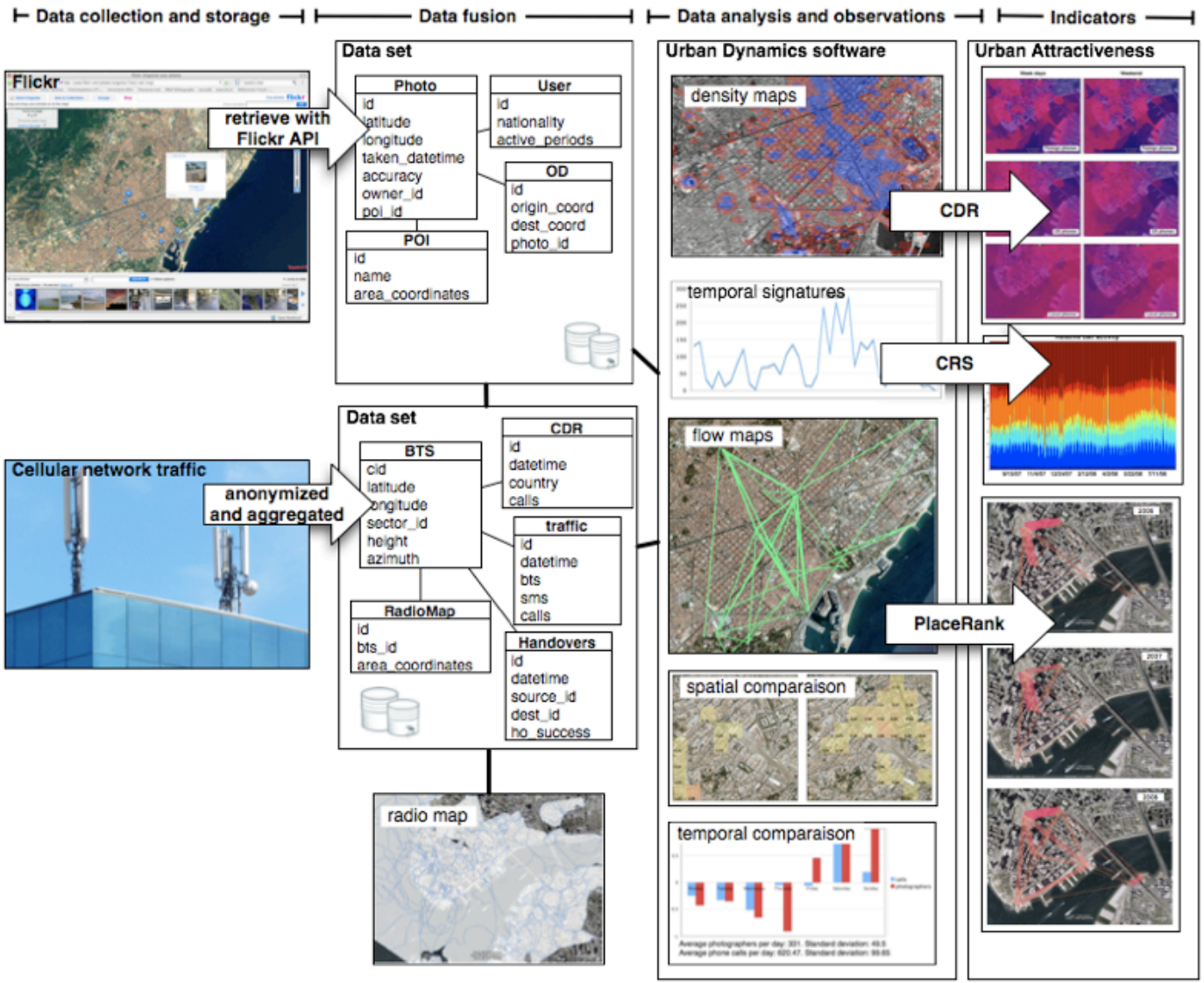
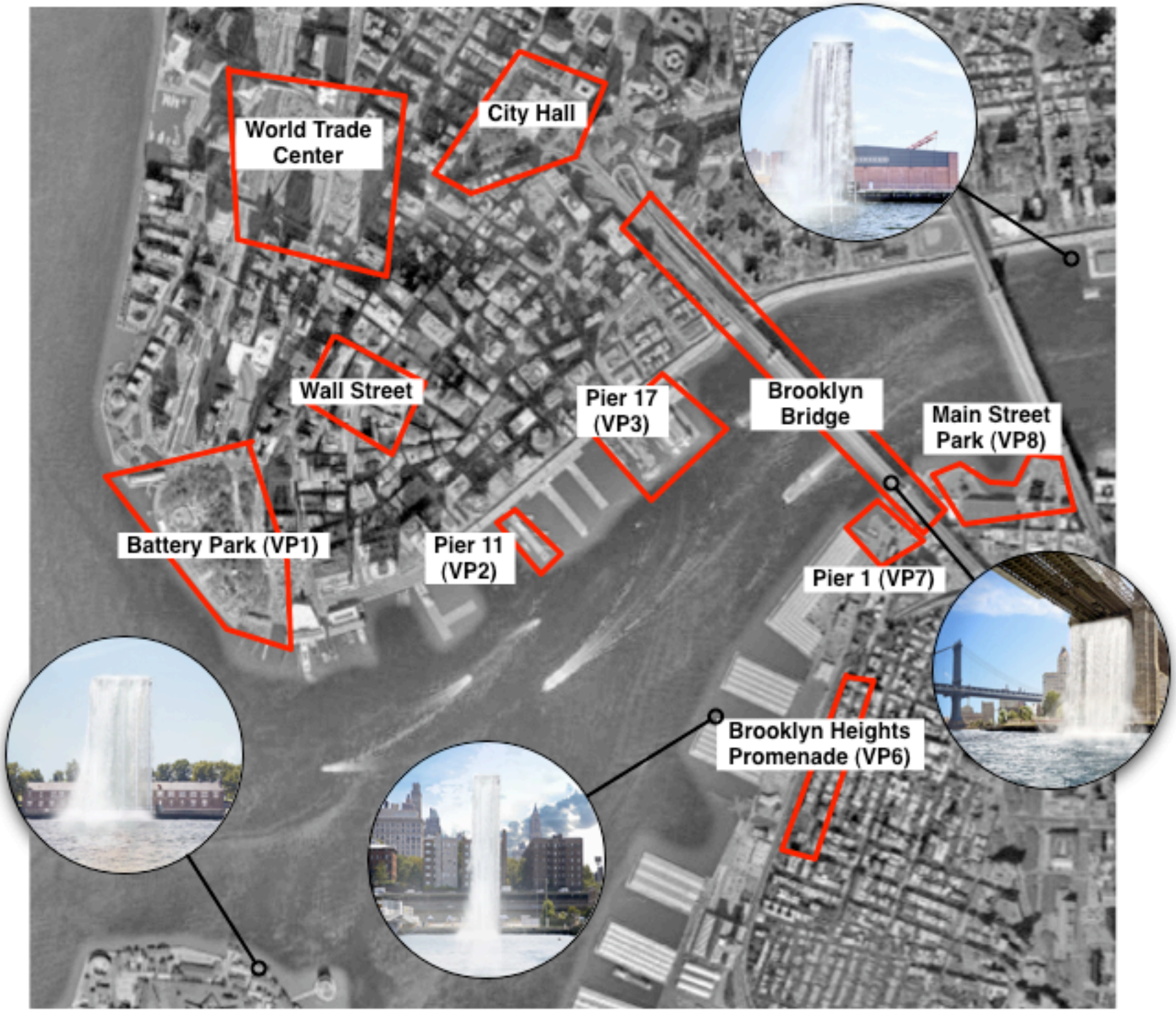
Urban attractiveness

Analyse the evolution of the presence of digital footprints to define indicators that quantify the urban attractiveness

Attractiveness of the NYC Waterfront

Digital footprinting




World Trade Center
City Hall
Wall Street
Pier 17 (VP3)
Brooklyn Bridge
Main Street Park (VP8)
Battery Park (VP1)
Pier 11 (VP2)
Pier 1 (VP7)
Brooklyn Heights Promenade (VP6)

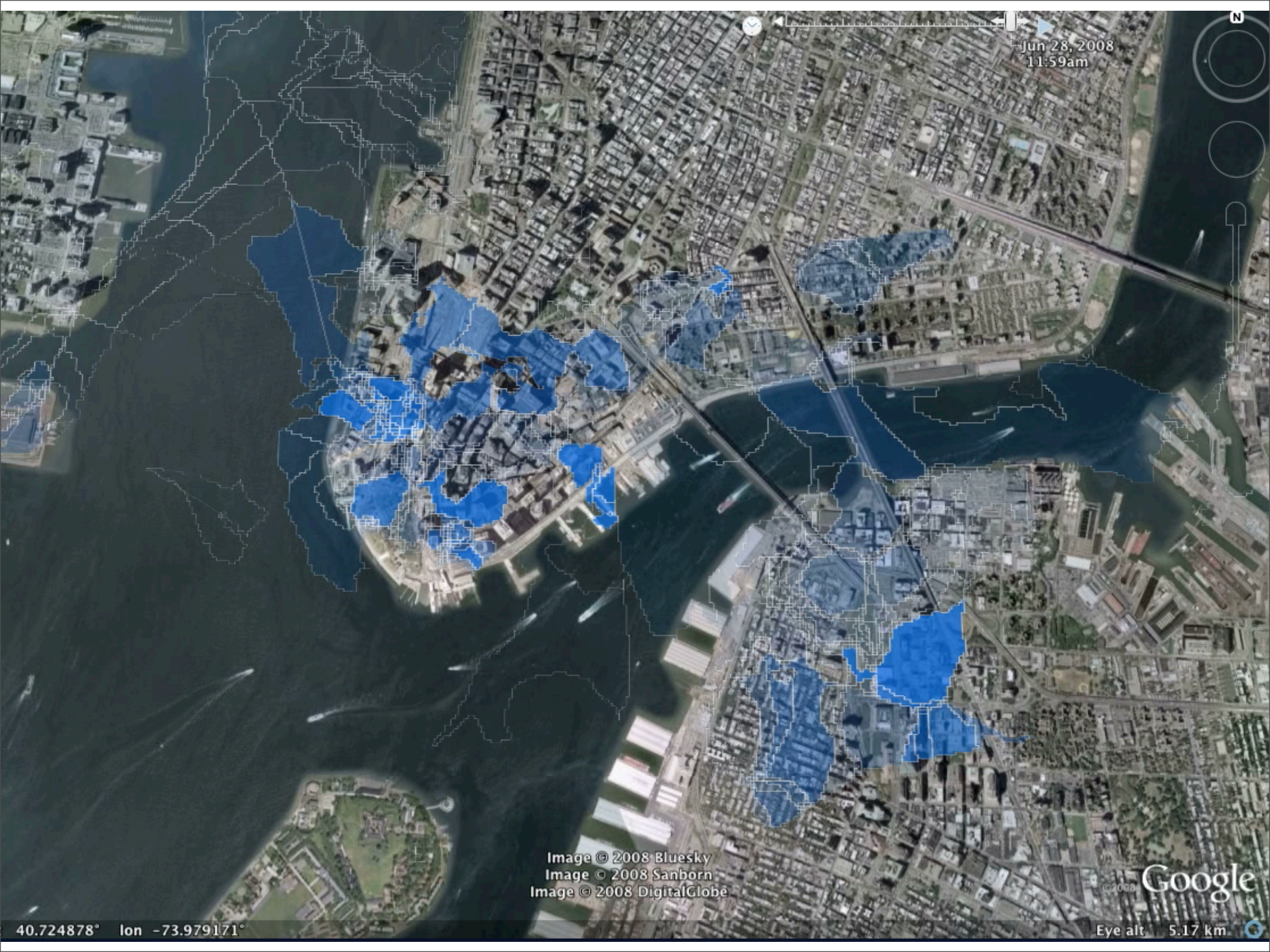

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Image © 2008 Bluesky
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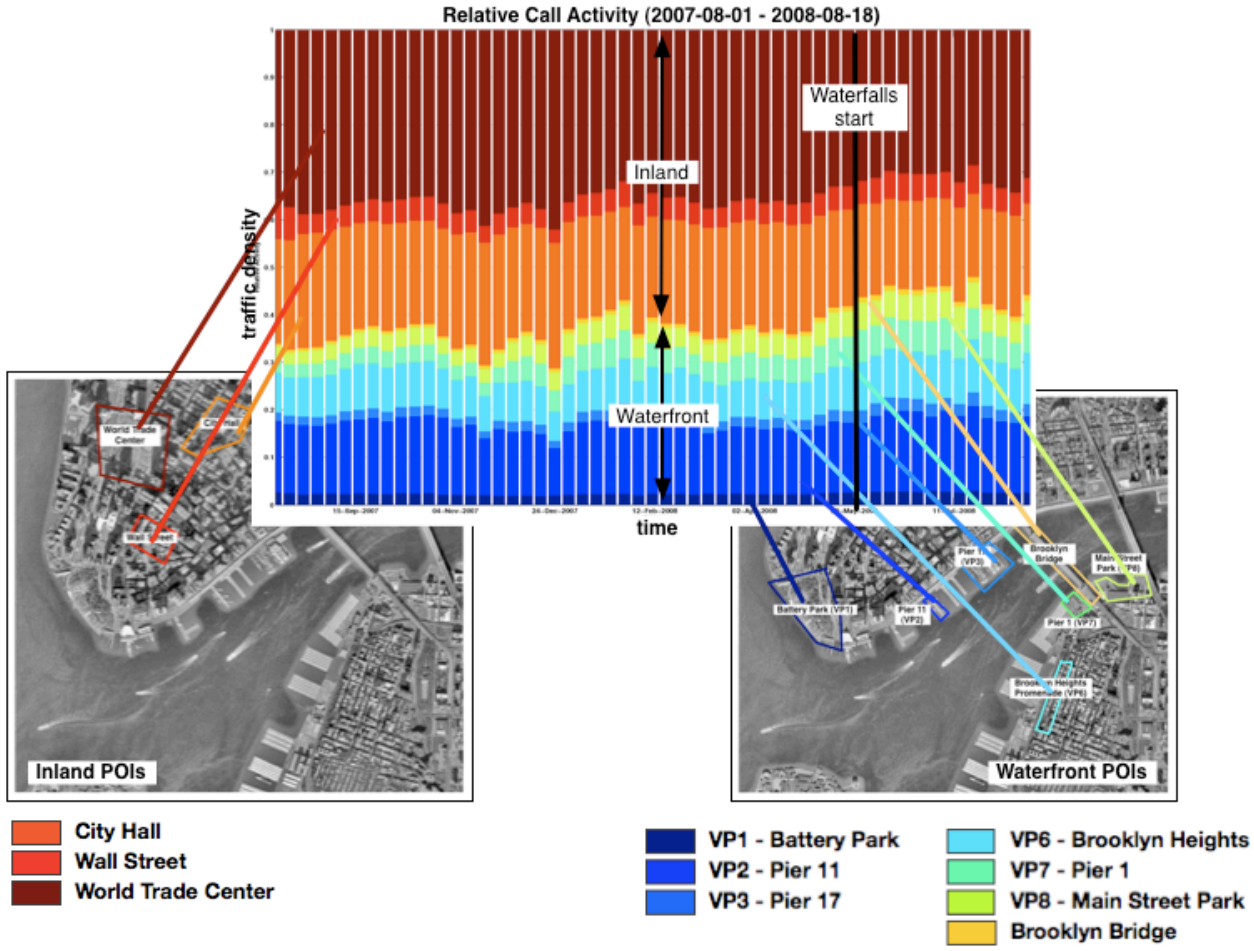
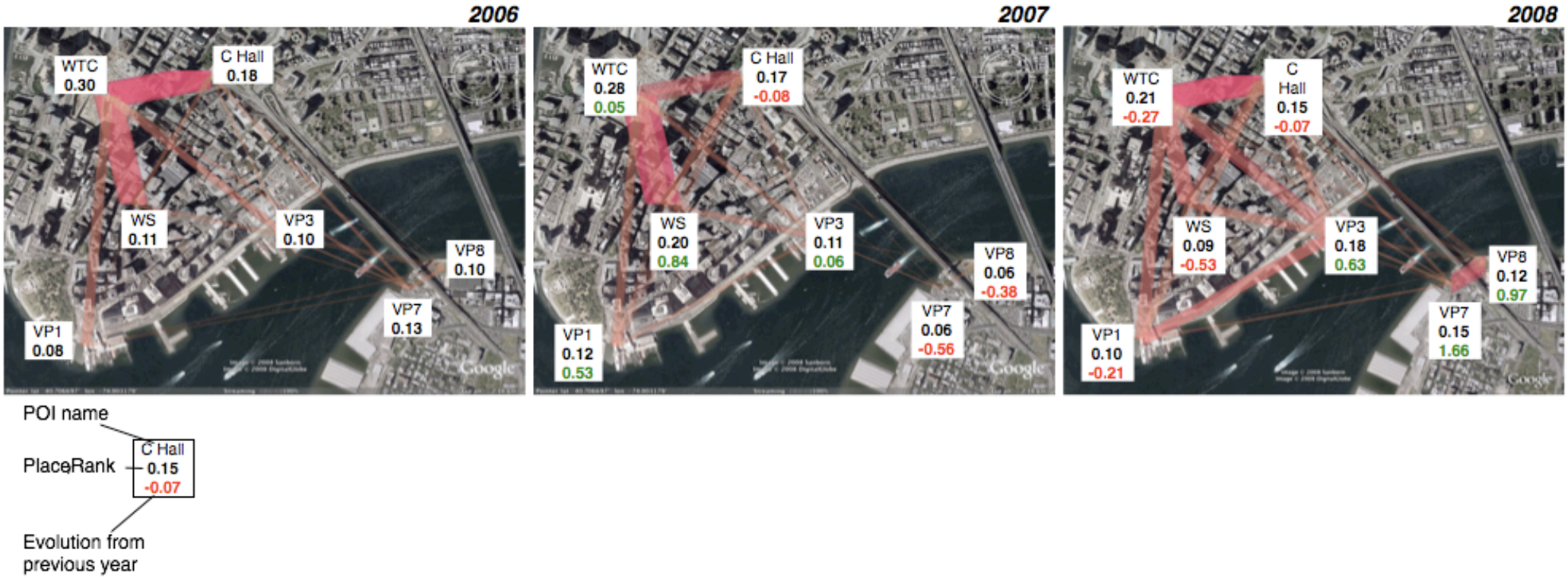
40.724878° lon -73.979171°
Eye alt 5.17 km

Comparative relative strength



The CRS indicator compares the (normalized) activity of one area of interest with respect to the overall activity of the city.

PlaceRank



PlaceRank determines the centrality of a location within a set of areas of interest based on the amount of digital footprints generated in each area and the traces that connect them

Digital footprinting limitations

- The **extent of their reliability** is still unclear: Lack of callibration with ground truth data (hard to collect and get access).
- **Sense what is cheap to sense**: In some cases our case study detects weak signals generated by a diffuse population over a long period of time in one of the noisiest cities in the world in terms of wireless network usage.

Conclusions

Conclusions

- The ubiquitous technologies that afford us new flexibility in conducting our daily activities are simultaneously providing the means to study our activities in time and space.
- Explored how the logs, fruits of these interactions, could reveal elements of human and social use of the ubiquitous technology itself

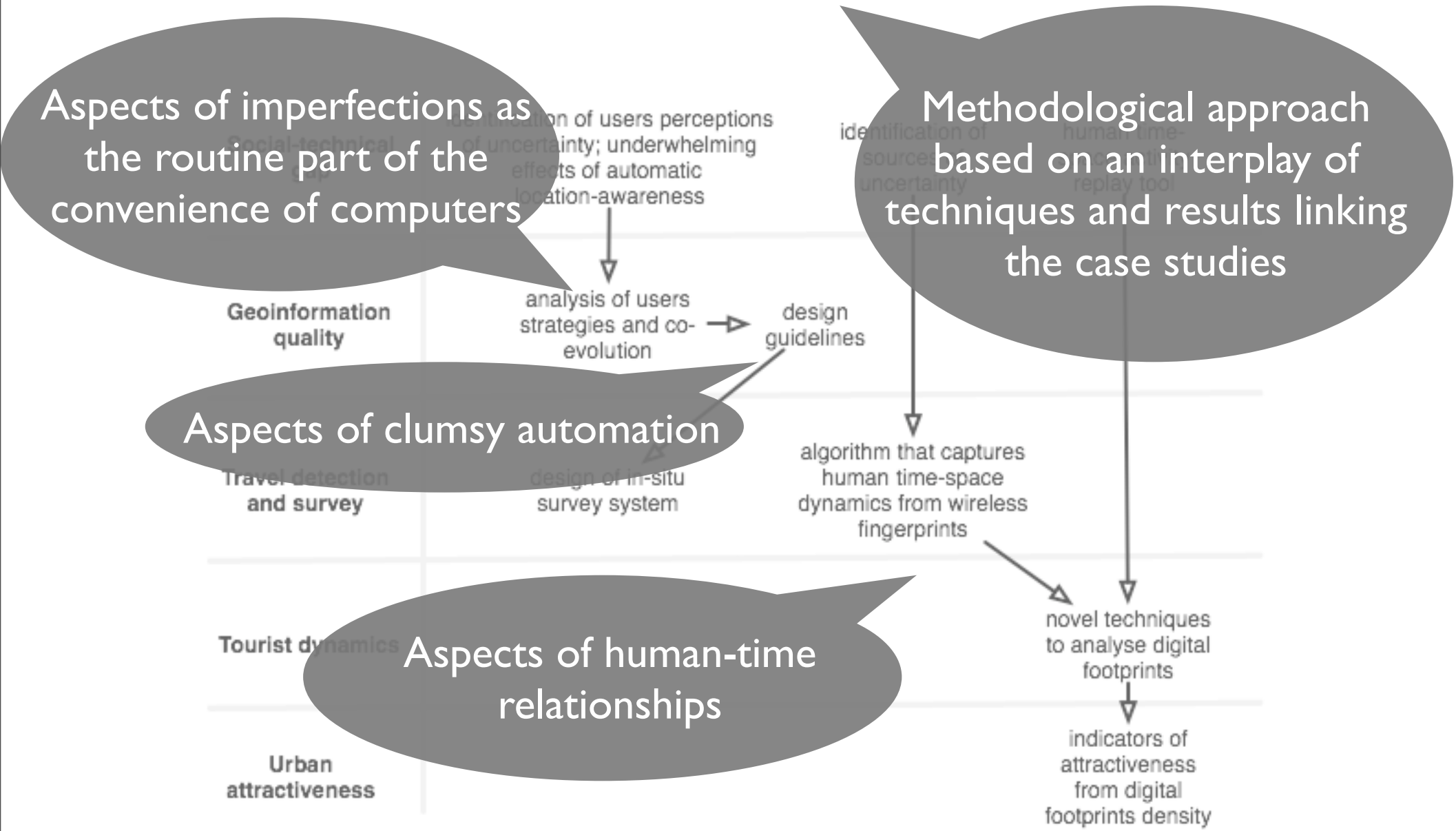
Conclusions

- We focused on the human side of these data. For instance inderwhelming effect of automating the interactions could harm the richness of this explicit interaction with geoinformation
- In our context, the understanding of the limitations and the imperfection of the geoinformation seems part of the knowledge and design solution
- People adapt to the technology, but also adapt the technology to them

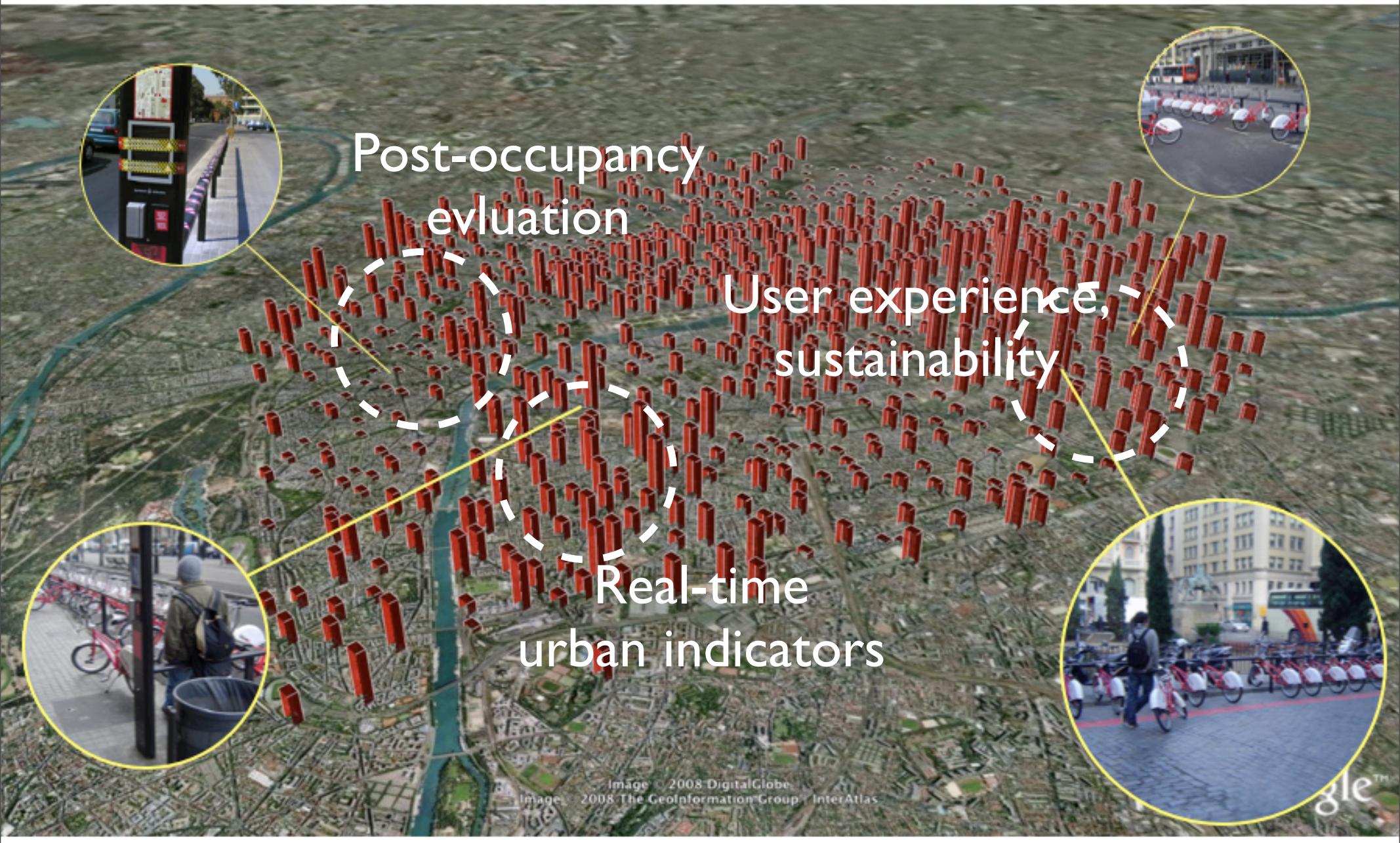
Contributions

- **In collaboration** with MIT (Prof. Carlo Ratti) and EPFL (Prof. Pierre Dillenbourg).
- **Published in**: IEEE Pervasive Computing, Journal of Location Based Services, International Journal of Spatial Data Infrastructures Research, ACM CHI.
- **In the media**: New York Times, Le Monde, El Periodico.

Discussion of contributions



Future works



Future works

Privacy and ethical issues

Gathering data from people without their knowledge? Who owns the data?

The risk to reveal individuals from anonymized and aggregated sensor data?

How much are people willing to give to get a service in return?

Thank you!

Financial support of Barcelona Media and TENCompetence