

Urban Mobility: Present and Future



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LOOKING FOR URBAN MOBILITY SOLUTIONS: *Is it a namely technological question?*



<http://www.internet-public-library.org/carbon-reduction/painless-carbon-reduction.htm>

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HOW WILL OUR FUTURE CITIES LOOK LIKE?

*Will we use flying cars to avoid the rush-hour
in the cities of the future?*



*Or will electrical, automated,
connected vehicles be the panacea?*

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BUT....

Before **proposing solutions to a relevant socio-economical phenomenon**, that so strongly conditions our quality of life, may be we should try to **understand the causes of the phenomenon.**

Ask ourselves whether the solution could namely be technological
or... **we do need something else?**

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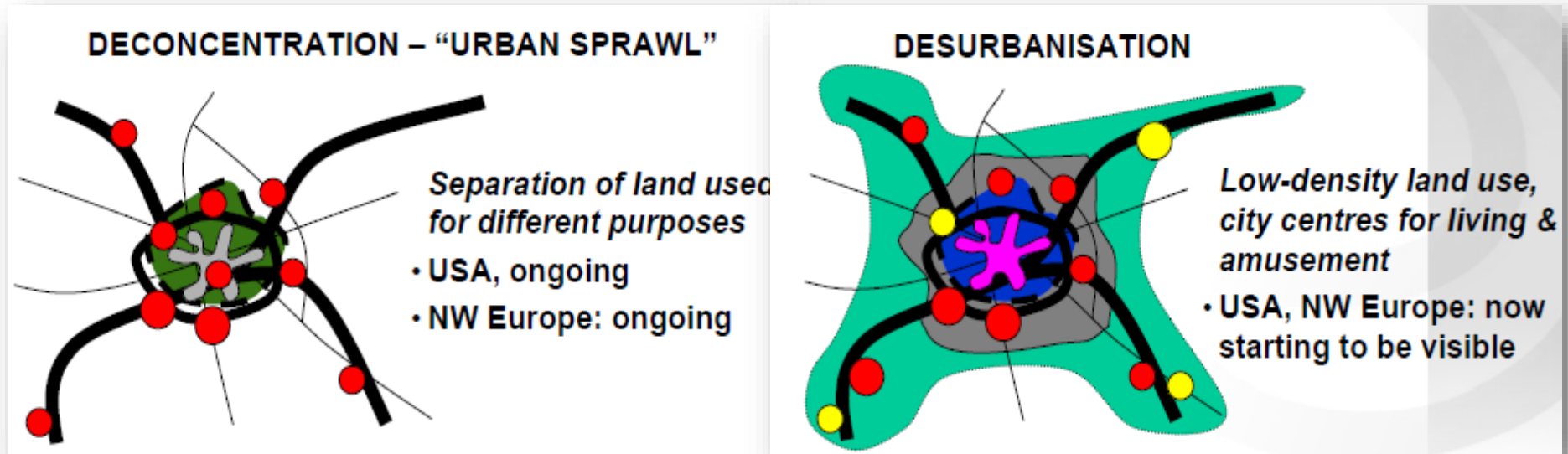
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TRENDS IN URBAN DEVELOPMENT



•Urban Growth

- In 2008 more than 50% of world population was living in cities
- Today 75% of anthropogenic GHG from cities
- In 2050 70% of world population will live in cities
- **Urban Sprawl: combined effect of growing affluence, changing life-styles and vast advance in personal mobility**

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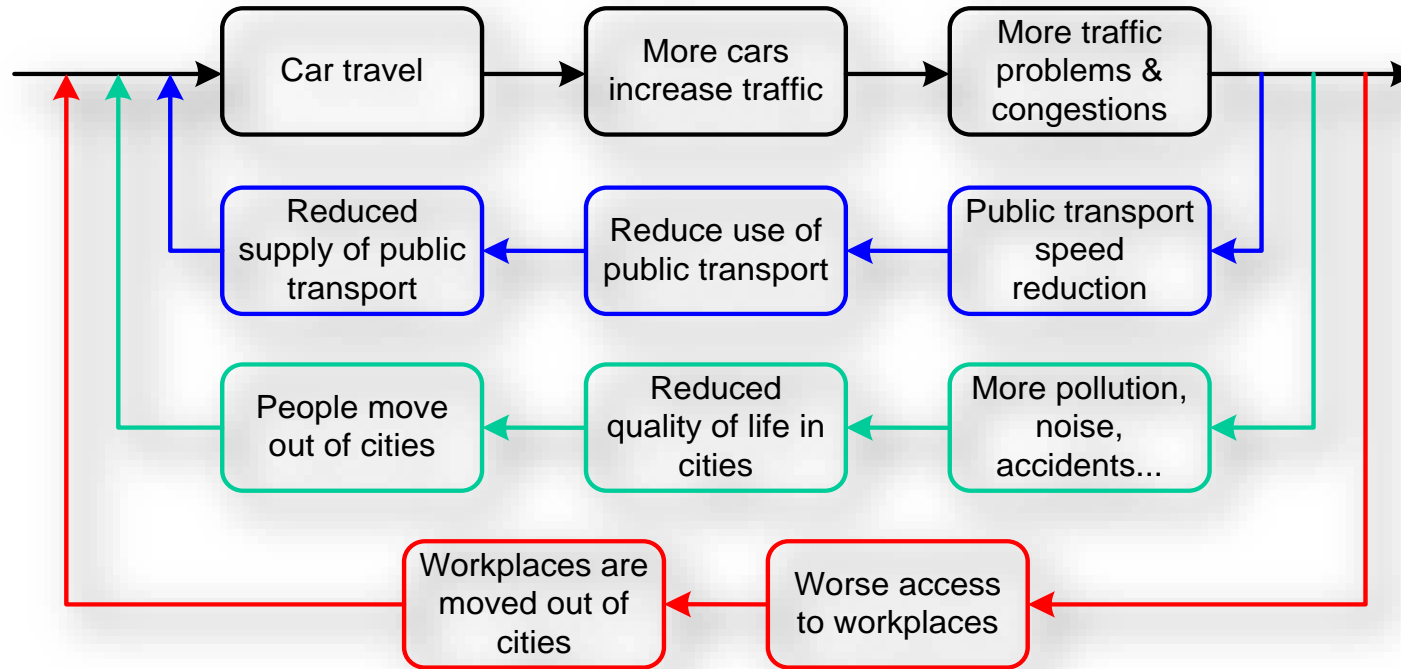


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ALTRAN



INTERDEPENDENCIES BETWEEN TRANSPORT MODES AND URBAN TRENDS



Separation of living and working areas

- ⇔ Enabled by (individual) transport systems
- ⇔ Congestion ⇔ Impact on energy consumption ⇔ emissions
- ⇔ quality of life & sustainability

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THE CITY AS A COMPLEX SYSTEM OF SYSTEMS

From “**Smart Cities**” (A market driven concept) to “**Wise Cities**” (A Citizen driven concept)

- W** Wellness and Walkable
- I** Intelligence & ICT
- S** Sustainable & Safety
- E** Ecology, Energy & Economy



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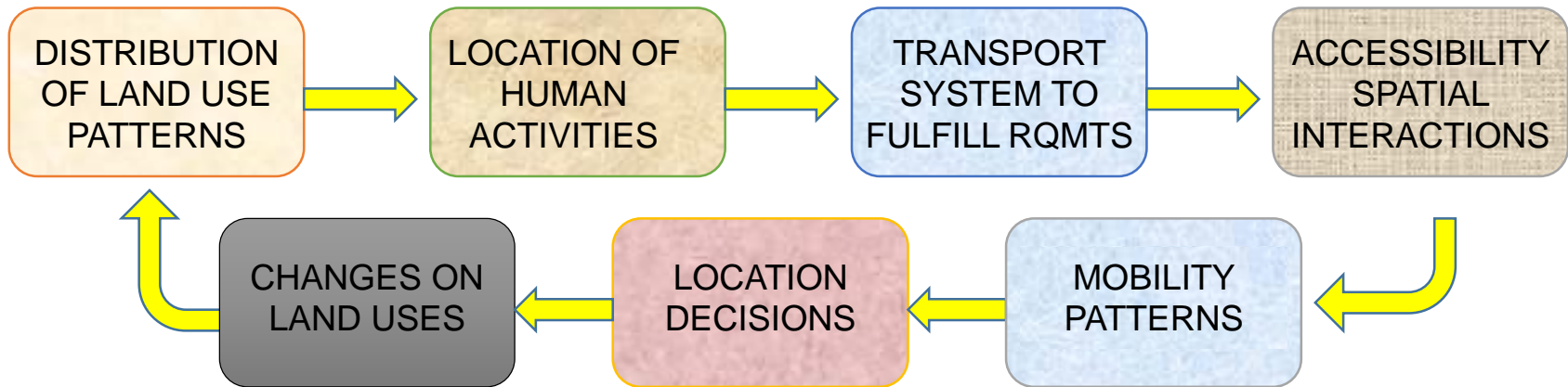
INVESTIGATING THE COMPLEXITY OF CITIES

Urban transportation systems are **complex dynamic subsystems of the city**, a larger more complex system ⇒ ***The Smart City as a System of Systems***

To understand the complexity of these systems a suitable **methodological modeling** approach is **System Dynamics**, which has the ability to account for the multiple variables, feedback loops between components and the role of the influencing factors

SPATIAL INTERACTION PARADIGM:

Interaction between individual mobility and location behavior



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UNDERSTANDING AND INTERPRETING MOBILITY IN TERMS OF THE SPATIAL INTERACTION PARADIGM



IDENTIFYING MOBILITY PATTERNS IN TERMS OF ORIGIN- DESTINATION (OD) TRIP MATRICES

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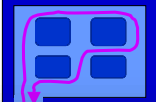
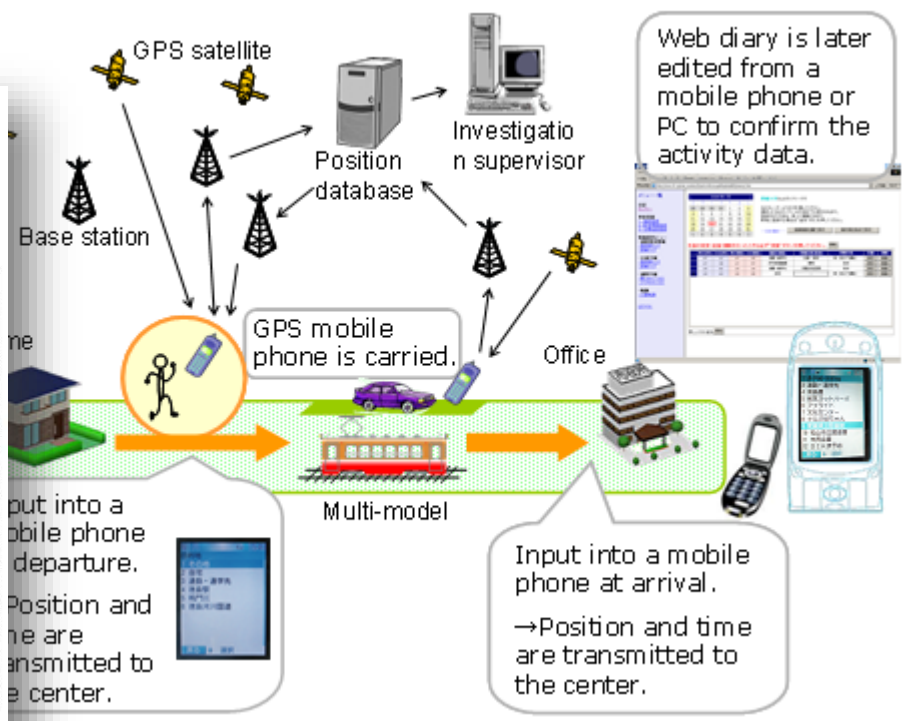
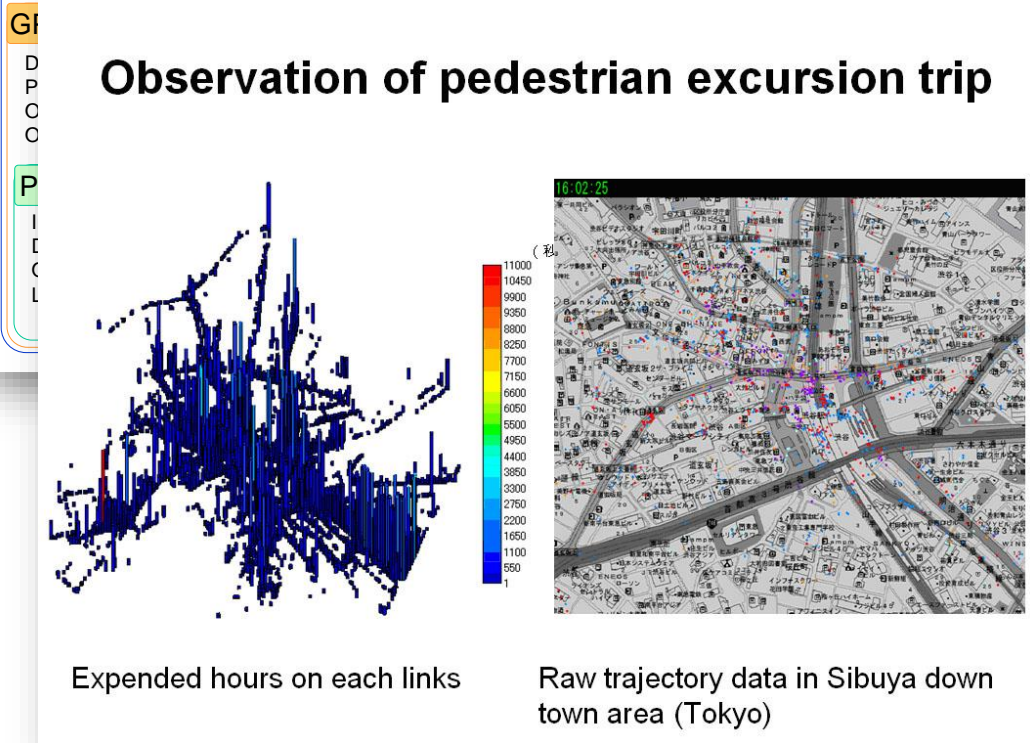


UNDERSTANDING MOBILITY: ELECTRONIC DATA COLLECTION FOR ACTIVITY BASED DEMAND MODELING

BCALs

- Sensor data
- No operation needed → Long-term monitoring
- In-store data
- Detailed actions observed

Micro

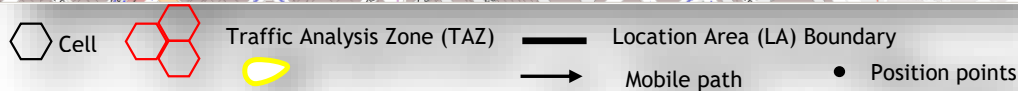
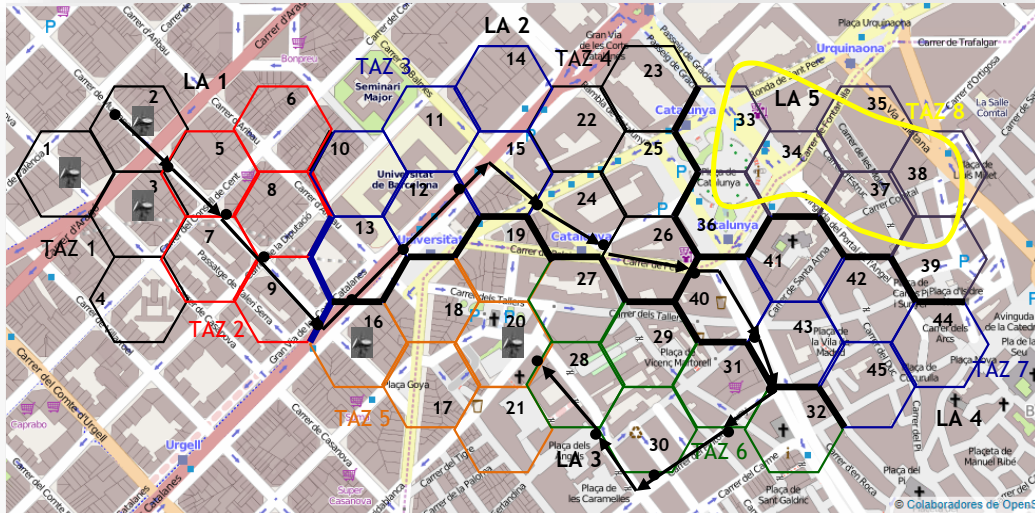



Source: Electronic Instrument Design and User Interfaces for Activity Based Modeling (Hato & Timmermann (2008))

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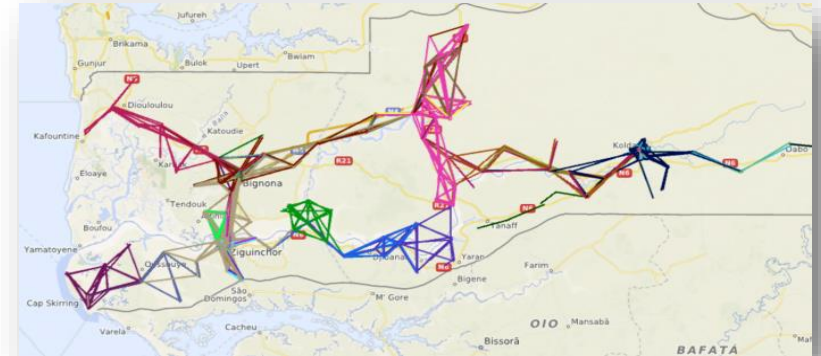
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EXPLOITING MOBILE PHONE DATA (tracking cell phones)

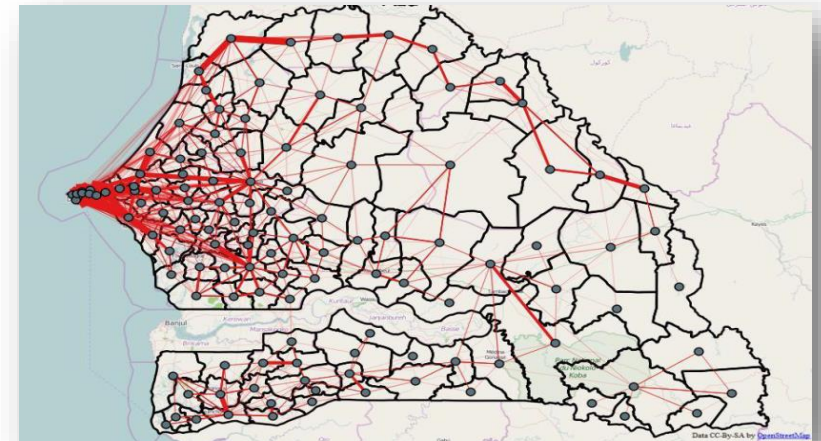


Sources:
J. Barceló, Analytics and the Art of Modeling, Intl. Trans. in Op. Res. (ITOR), 22 (2015) 429–471)

Gundlegård, D., Rydergren, C., Barcelo, J., Dokoohaki, N., Görnerup, O. and Hess, A. "Travel Demand Analysis with Differentially Private Releases". D4D Challenge Senegal 2014 (Netmob 2015, MIT, Boston)



Example of sequence aggregates



OD demand on the census tract level

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DYNAMIC INSIGHTS

<https://dynamicinsights.Telefonica.com/blog/488/smart-steps-2>

Smart Steps

is an Insights solution that uses anonymous and aggregated mobile data to help organizations make better business decisions based on actual behavior.



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EXTRACTION

Mobile event data extracted and stored from our network.



ANONYMIZATION

Personal data eliminated and hashed with an ID.



EXTRAPOLATION

Algorithms applied to represent entire population of Spain.



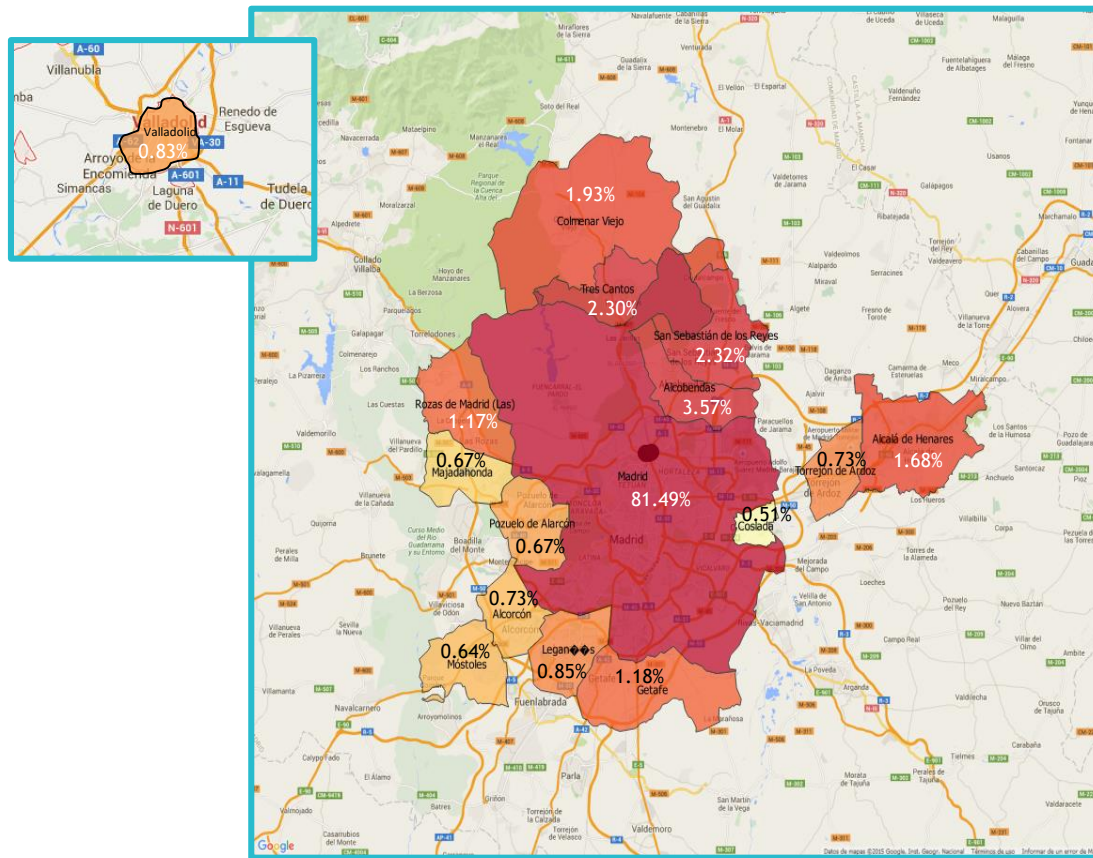
AGGREGATION

IDs grouped to crowd data, no individual is identifiable.

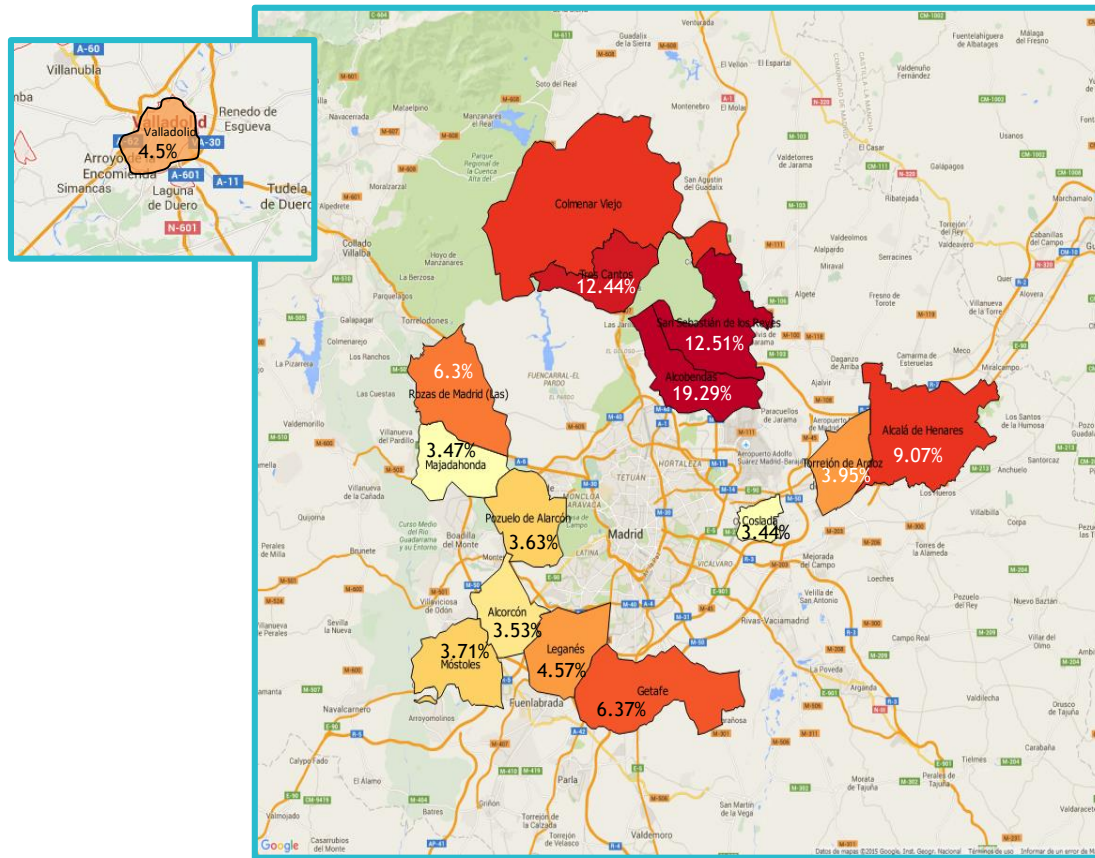


Smart Steps

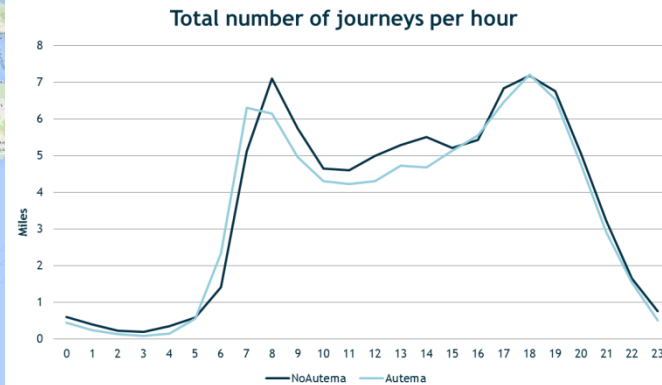
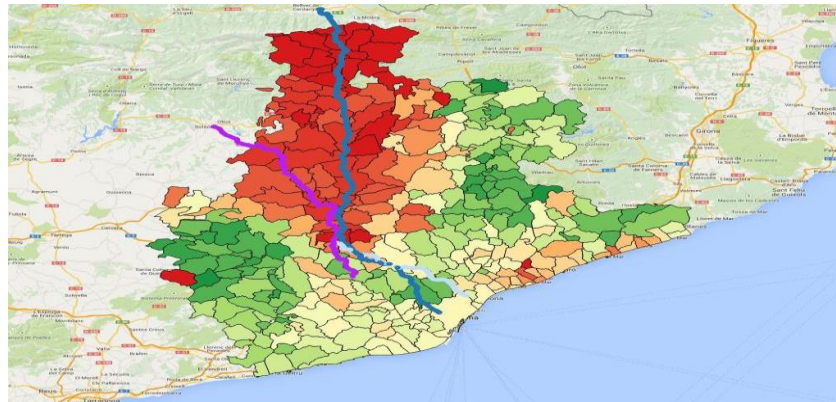
WHICH MUNICIPALITIES GENERATE MOST TRAFFIC IN THE NUDO DE MANOTERAS?



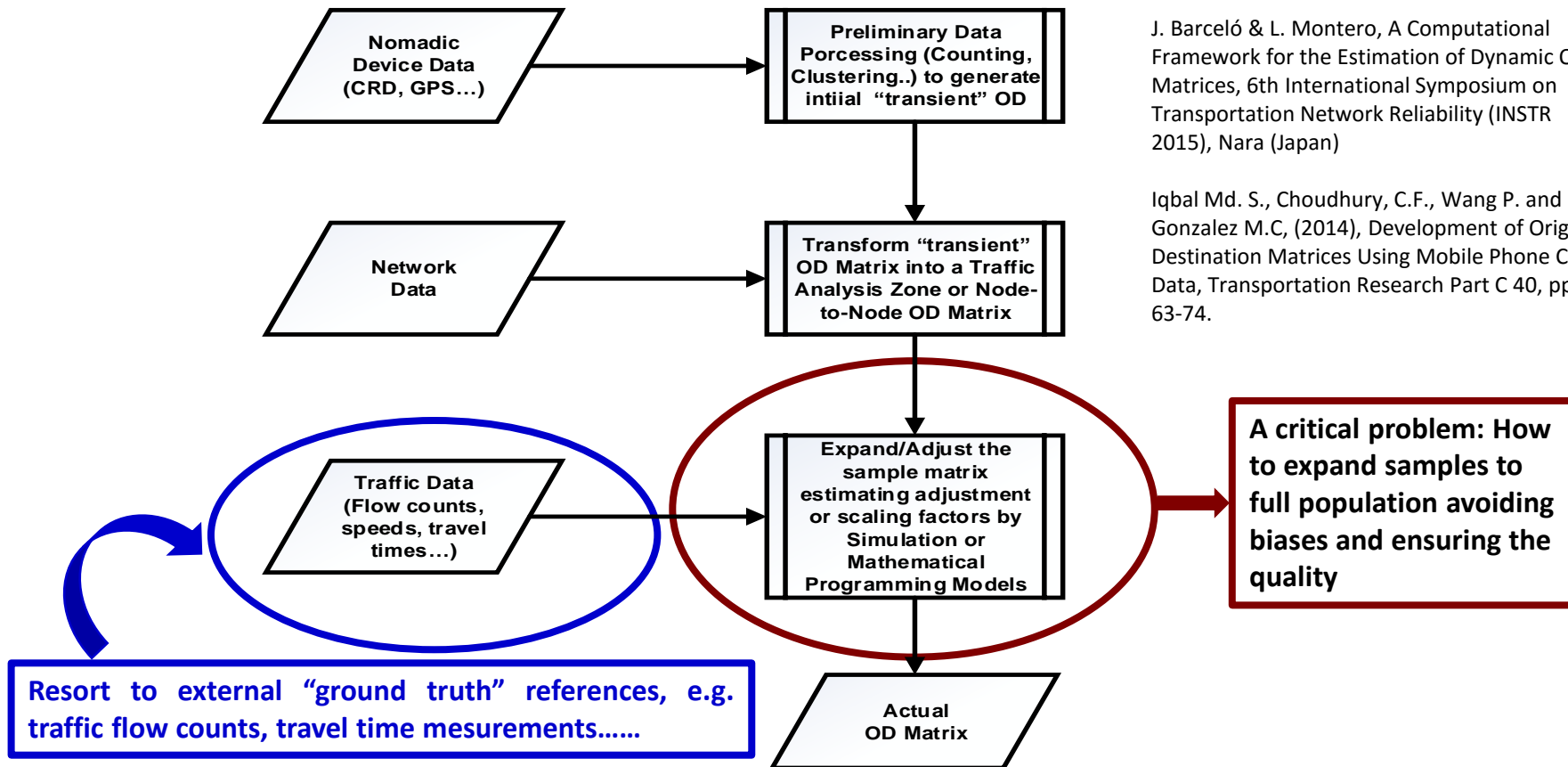
WHERE (EXCLUDING THE CENTRE OF MADRID) DOES THE TRAFFIC COME FROM?



Analysis of the traffic on the Manresa - San Cugat del Valles road. OD Matrix for all surrounding areas of the road.



CONCEPTUAL FRAMEWORK FOR THE ESTIMATION OF OD MATRICES COMBINING NOMADIC DEVICES DATA AND TRAFFIC DATA



J. Barceló & L. Montero, A Computational Framework for the Estimation of Dynamic OD Matrices, 6th International Symposium on Transportation Network Reliability (INSTR 2015), Nara (Japan)

Iqbal Md. S., Choudhury, C.F., Wang P. and Gonzalez M.C, (2014), Development of Origin-Destination Matrices Using Mobile Phone Call Data, Transportation Research Part C 40, pp. 63-74.

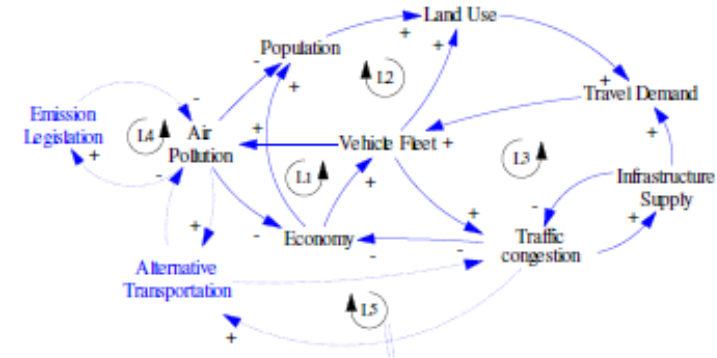
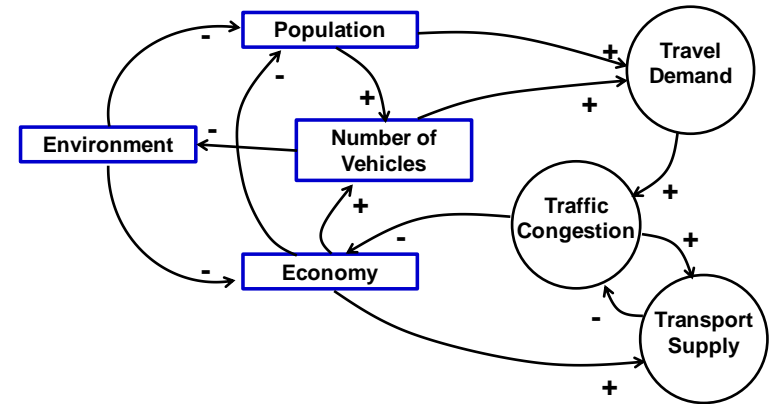
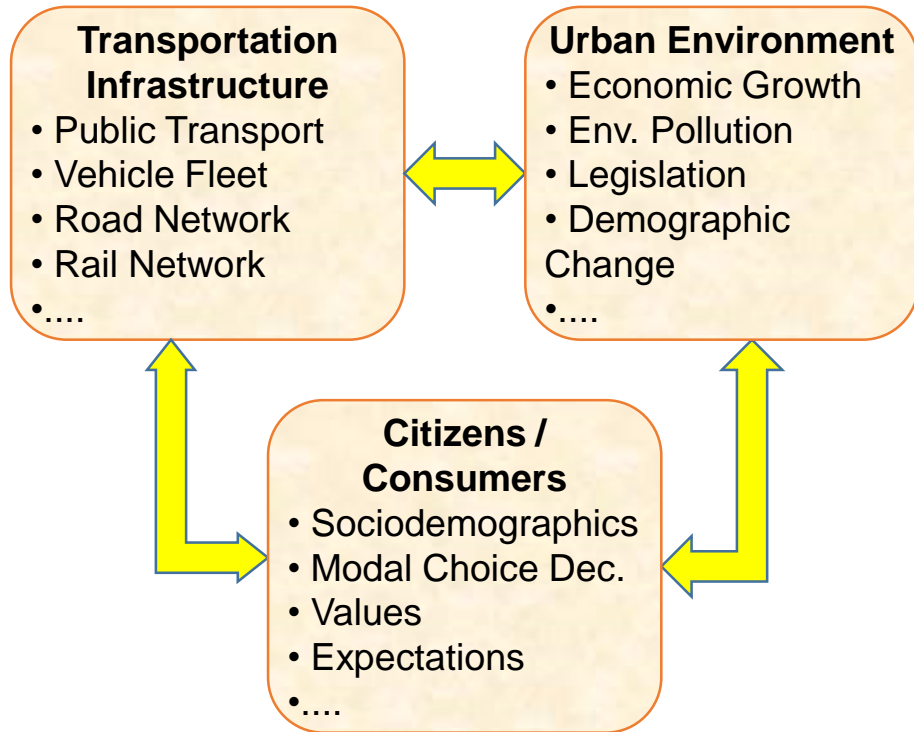
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MODELING URBAN DYNAMICS WITH SYSTEM DYNAMICS



Causal relationships of the urban transportation system with its environment

A System Dynamics Approach to Land Use Transport Interaction Modeling: The strategic model MARS and its application, Pfaffenbichler et al. Systems Dynamics Review, Vol. 26, No. 3, (2010)

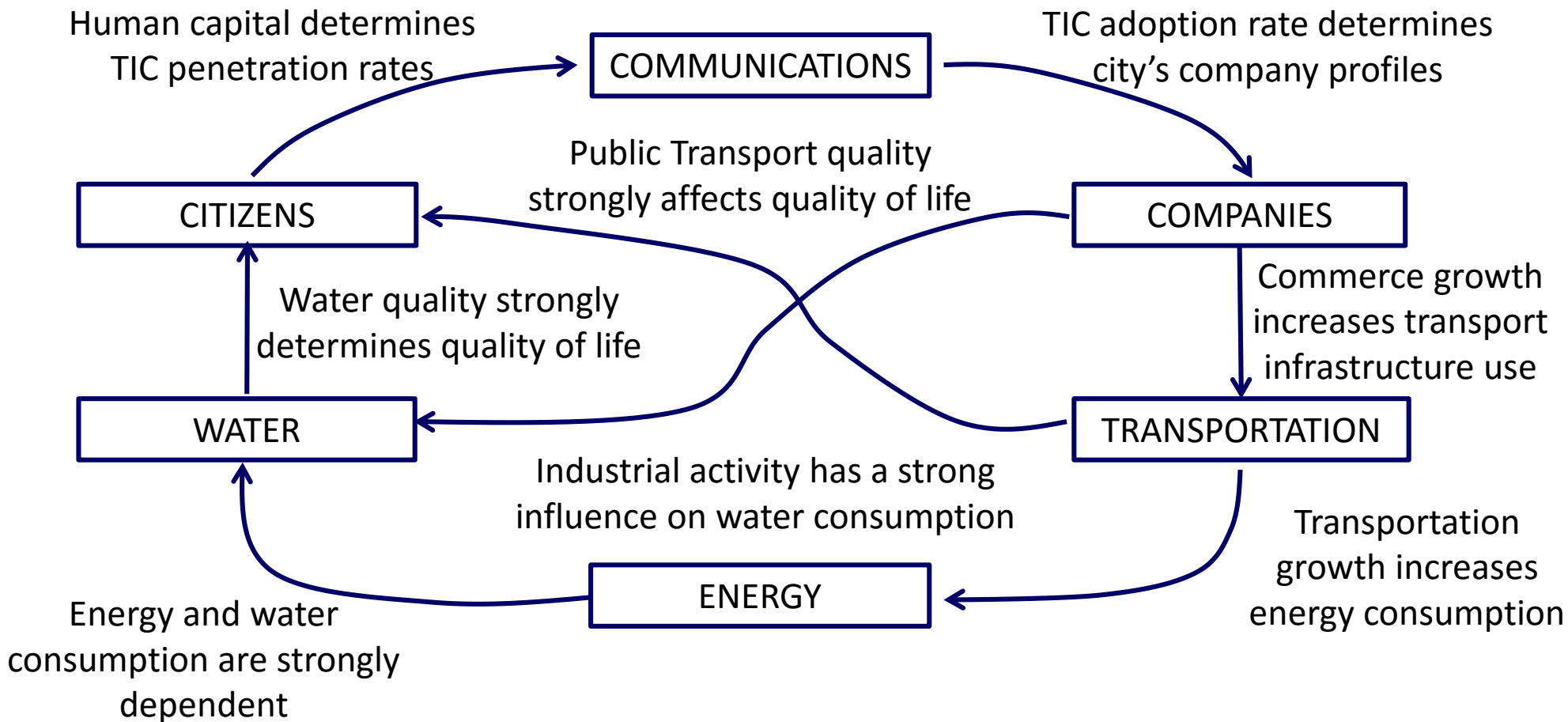
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EXAMPLE OF INTERRELATIONSHIPS AMONG ESSENTIAL SYSTEMS IN AN URBAN AREA (IBM Institute for Business Value)



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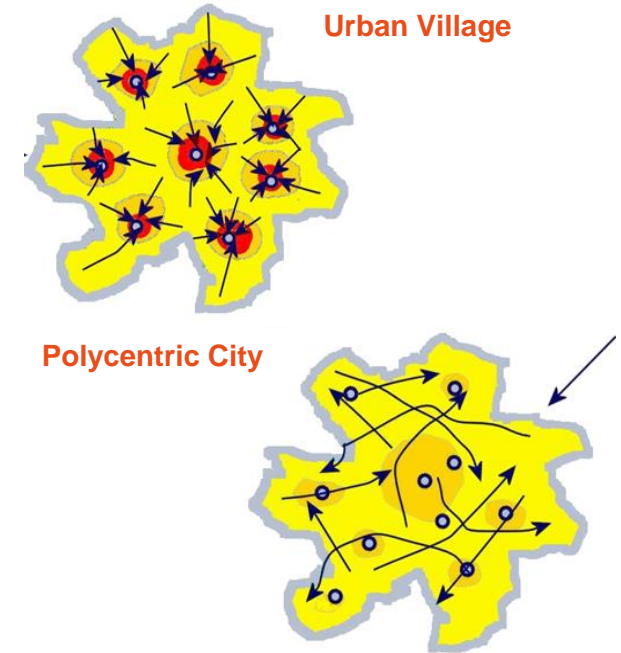


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THE SUSTAINABLE MOBILITY PARADIGM

- Alternative paradigm arising from the investigation of **complexity of cities**
 - Better understanding of the links between land -use and transport
- **Implies mixed use developments**
 - Preference to public transport
 - Accessible corridors near public transport interchanges
 - Satisfy the requirements of service and information based economies



- Sustainable transport asks for
 - **Urban forms keeping average trip lengths below the thresholds required for maximum use of the walk and cycle modes**
 - Not to prohibit the car but to design cities of such quality and at a suitable scale that people would not need to have a car**
- THE KEY POLICY BECOMES THAT OF **REASONABLE TRAVEL TIME** RATHER THAN TRAVEL TIME MINIMISATION

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EMERGING MOBILITY CONCEPTS

Future of Mobility & New Mobility Business Models (Frost & Sullivan, 2015)

- **Transformational Shifts:**
- **New Business Models - Growth of Car Sharing**
- **Growth of Ride Sharing Business Models** (“On Demand” Carpooling” UBER, SideCar, Lift....)
- **Within 3 years e-hailing taxis control close to 20% of the global taxi market** (process of ordering a car, taxi, limousine, or any other form of transportation pick up via virtual devices: computer or mobile device.)
- [E-HAIL](#), [Arro](#), [Easy Taxi](#), [Uber](#), [Lyft](#), [Carmel](#), [GetTaxi](#), [GrabTaxi](#), [TaxiMagic](#), [minicabit](#), [G-Ojek](#),
- **Integrated Mobility** Technology enabled, any device delivery of real-time, door-to-door, multi-modal travel encompassing pre-trip, in-trip and post-trip services bringing Convenience, Time & Cost Savings to the Mobility User
- **Group Rapid Transit to Replace Public Transport Buses** To reduce congestion and reduce queuing in the event of demand Spike
- **Changing relationships with vehicle owners - car ownership to mobility services**
- **Mobility delivered by non vehicle manufacturers – mobility assistants**

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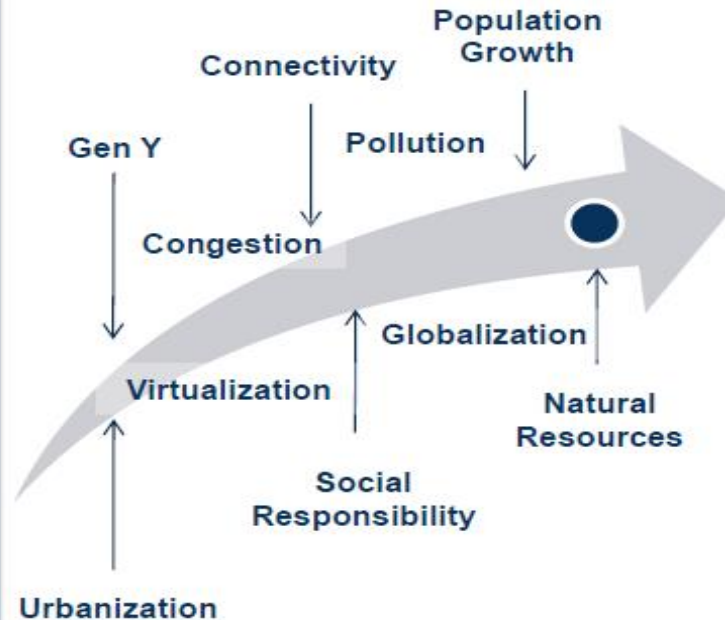
Paradigm Shift from Vehicle Ownership to Vehicle Usage



Transport = Private Vehicle

- Freedom
- Convenience
- Status
- Progress
- No Real Alternative

Mobility Integration: Paradigm Shift from Vehicle Ownership to Vehicle Usage



Transport = Door-to-door Mobility

- **New Vehicles:** BRT, EV, High Speed Rail
- **New Business Models:** Vehicle Sharing, Car Pooling
- **Inter-Connectivity:** Inter-modality
- **Urban Planning:** Reallocation of street space
- **Integrated Mobility:** New technology enabled multi modal integration

Source: Frost & Sullivan

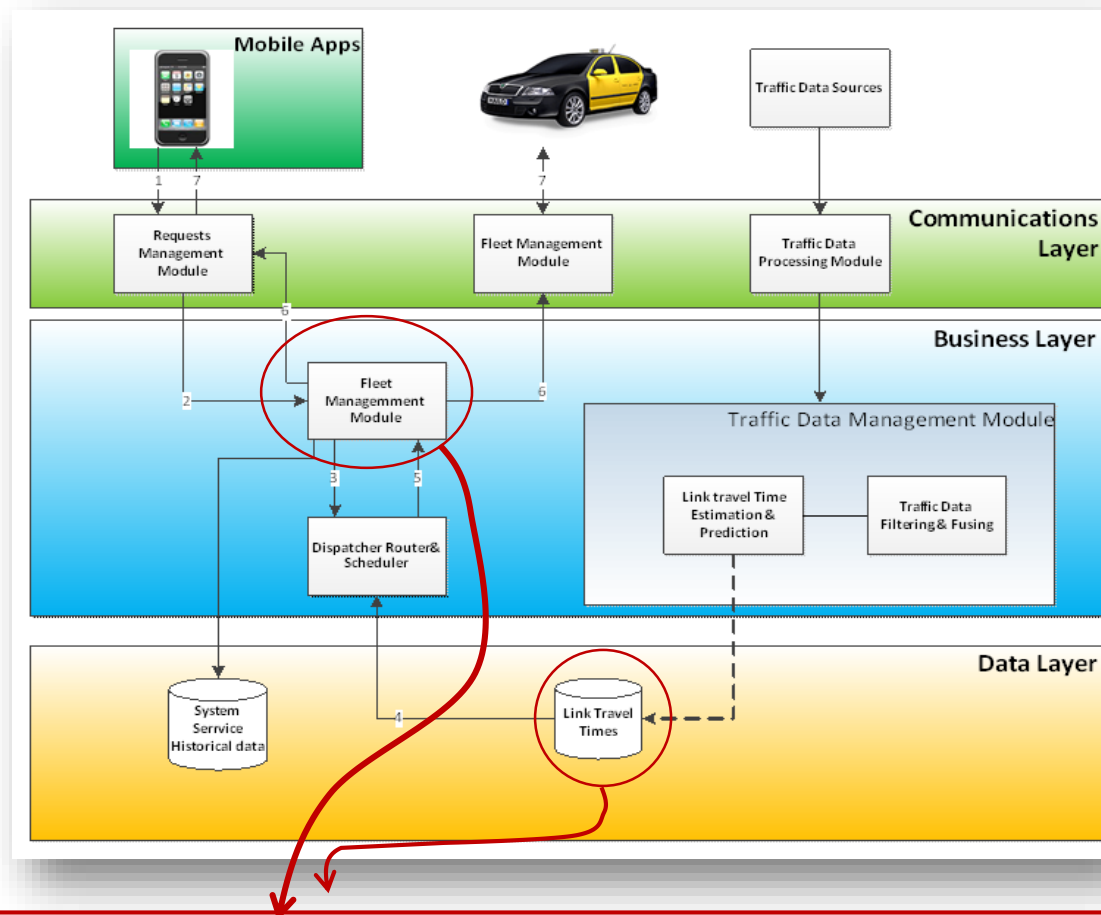
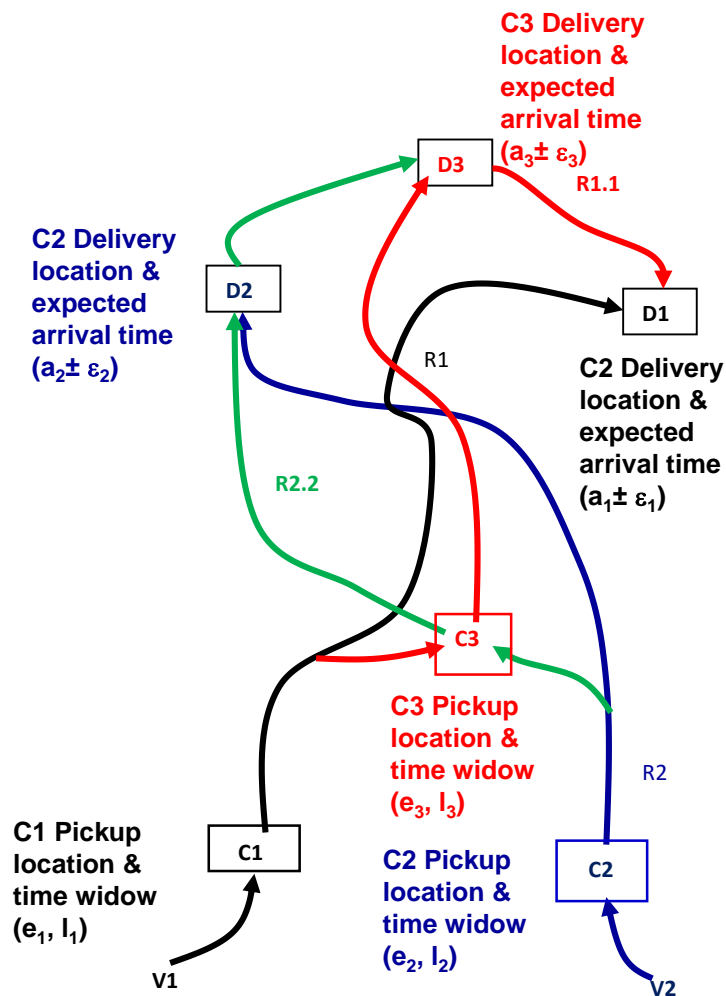
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DOOR TO DOOR SEAMLESS MOBILITY SERVICES



Pickup & Delivery routing problems with time windows and time dependent link travel times

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FORTUNE (October 26, 2015)

- **Toyota takes a small detour into car sharing**
- Toyota will launch a pilot car-sharing project using COMs, an ultra-compact electric vehicle.
- Toyota's car sharing project illustrates the growing interest and investment by automakers into how people get from point A to point B.
- It's no longer only about designing and selling as many cars and trucks as possible.
- Daimler, BMW, GM, and Ford are all operating, or testing, some variation of car sharing.
- The global car sharing industry is expected to exceed \$6 billion by 2020, according to the [Carsharing Association](#).

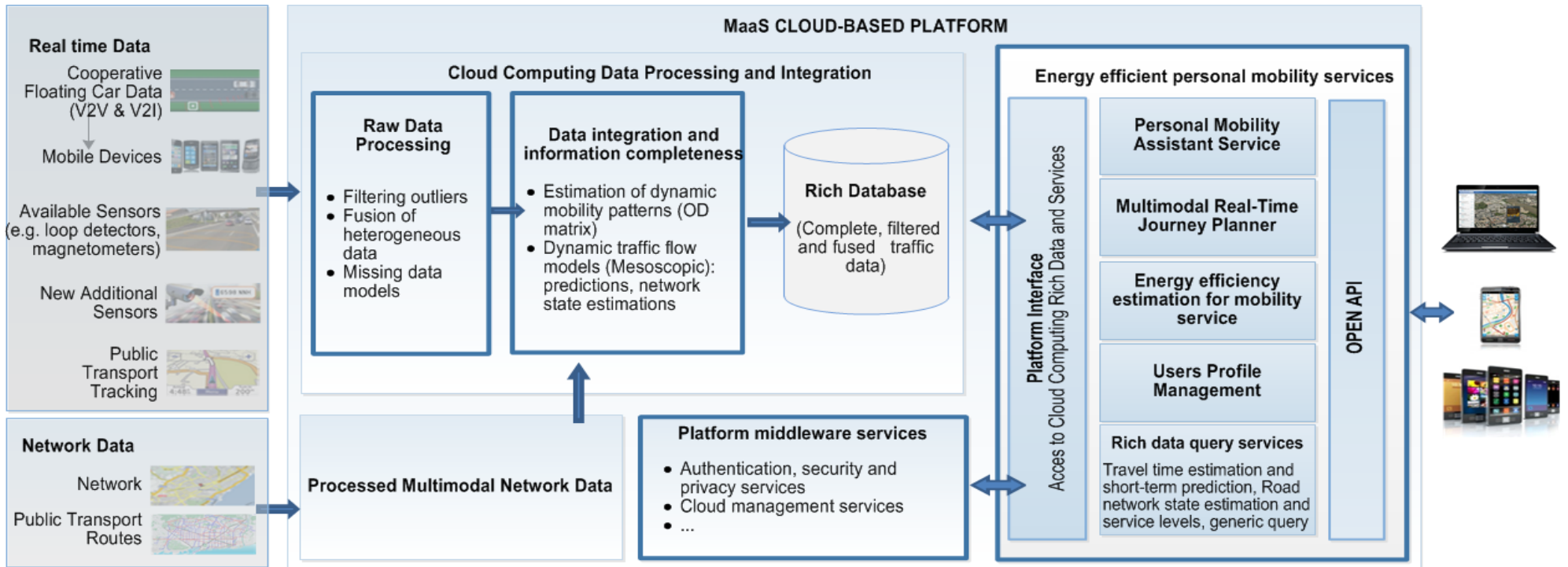
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MOBILITY AS A SERVICE (MaaS)



Seamless Smooth Door-to-door mobility services offered to users by ‘mobility operators’, supported by digital solutions operating in the cloud.

With open access to the **timetables, real-time location information, and payment systems** of existing transport service providers (e.g., railway operators, taxis, local transport operators, car sharing).

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Cooperative Automotive Research Network



Thank you for your attention!

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