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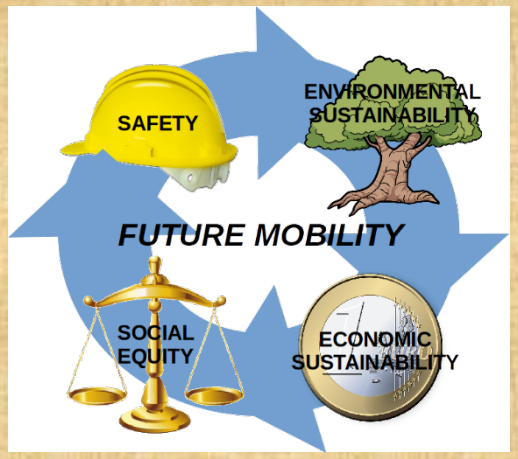
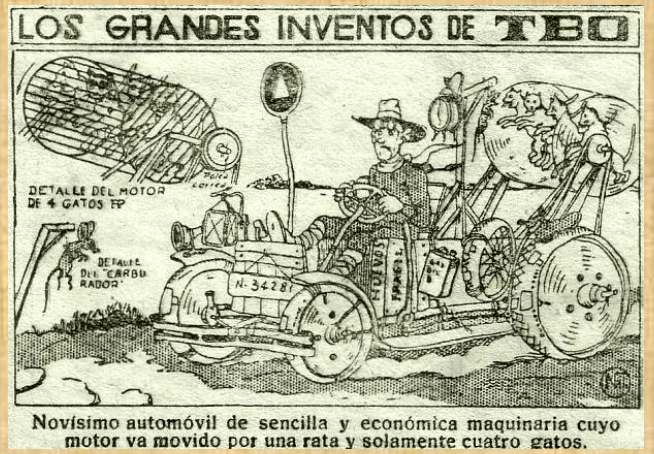
BARCELONATECH

PARADIGM CHANGES: FROM SMART CITIES TO WISE CITIES AND THE ROLE OF TRANSPORT MODELS





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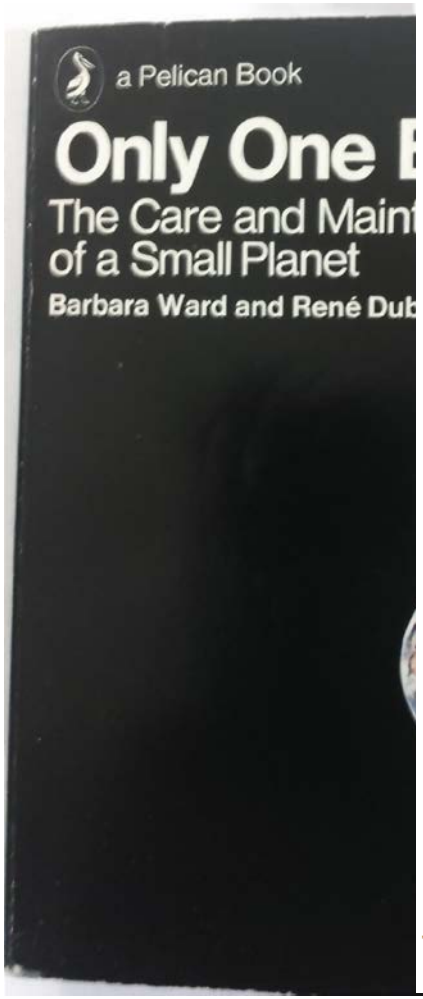
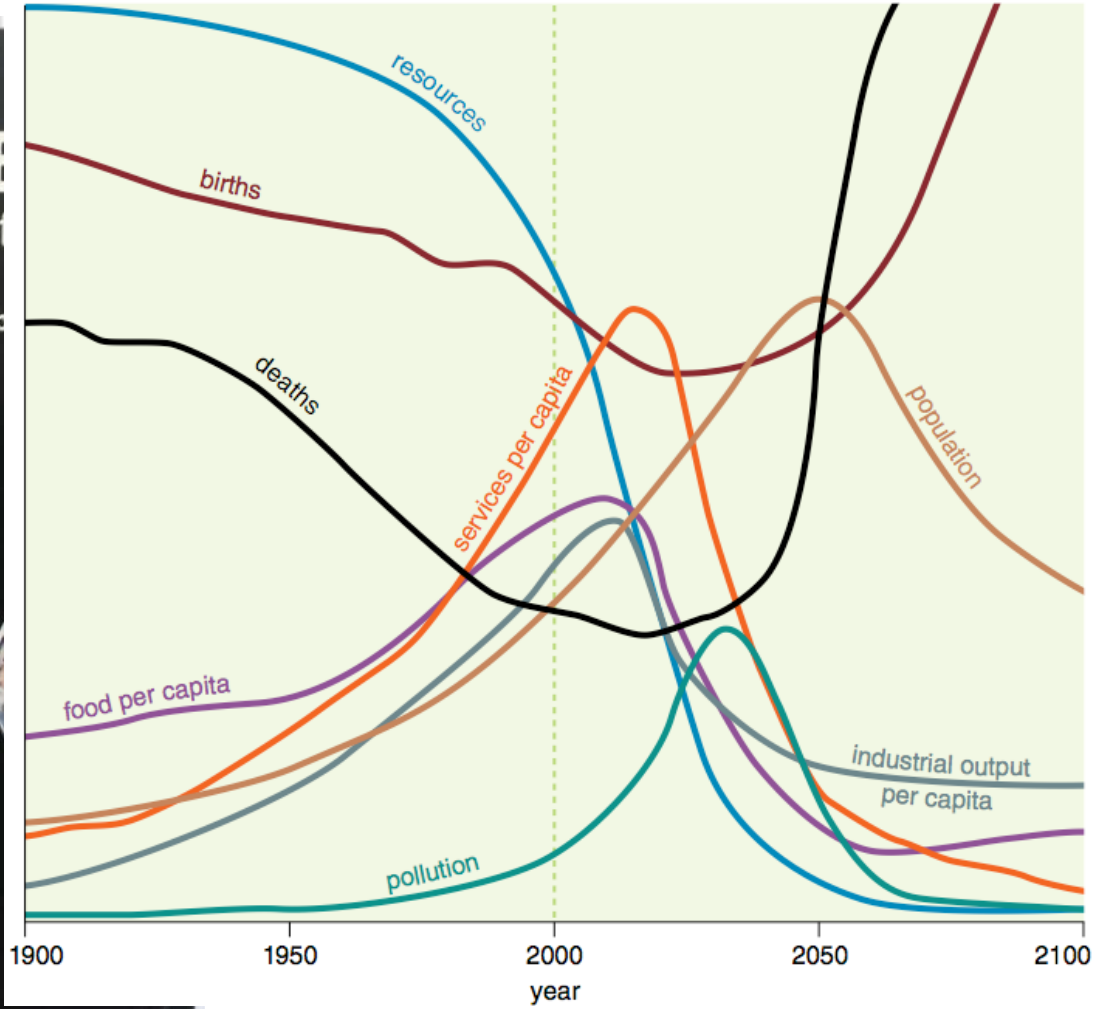
UN CONFERENCE ON "HUMAN ENVIRONMENT" (June 1972)





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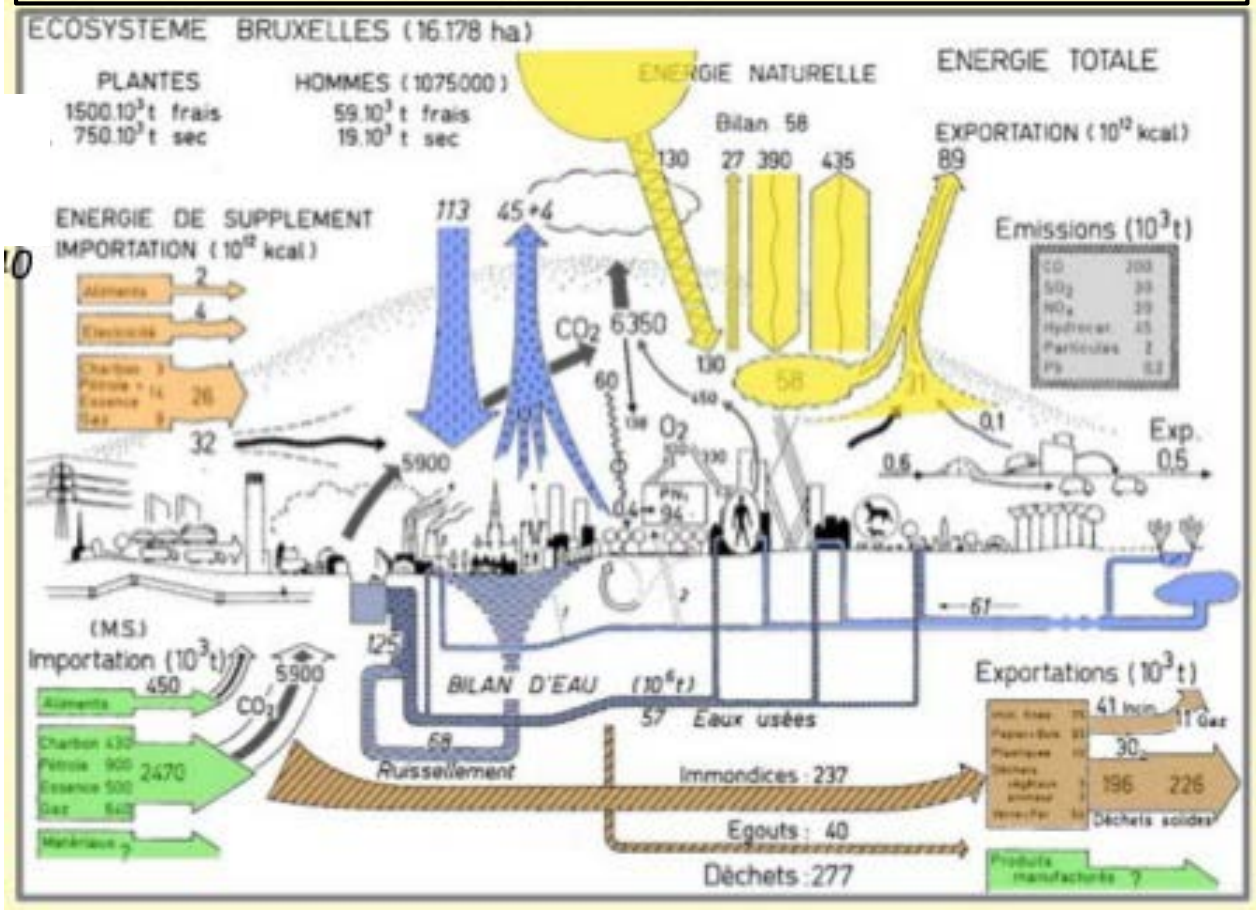
SUSTAINABILITY AND SUSTAINABLE DEVELOPMENT

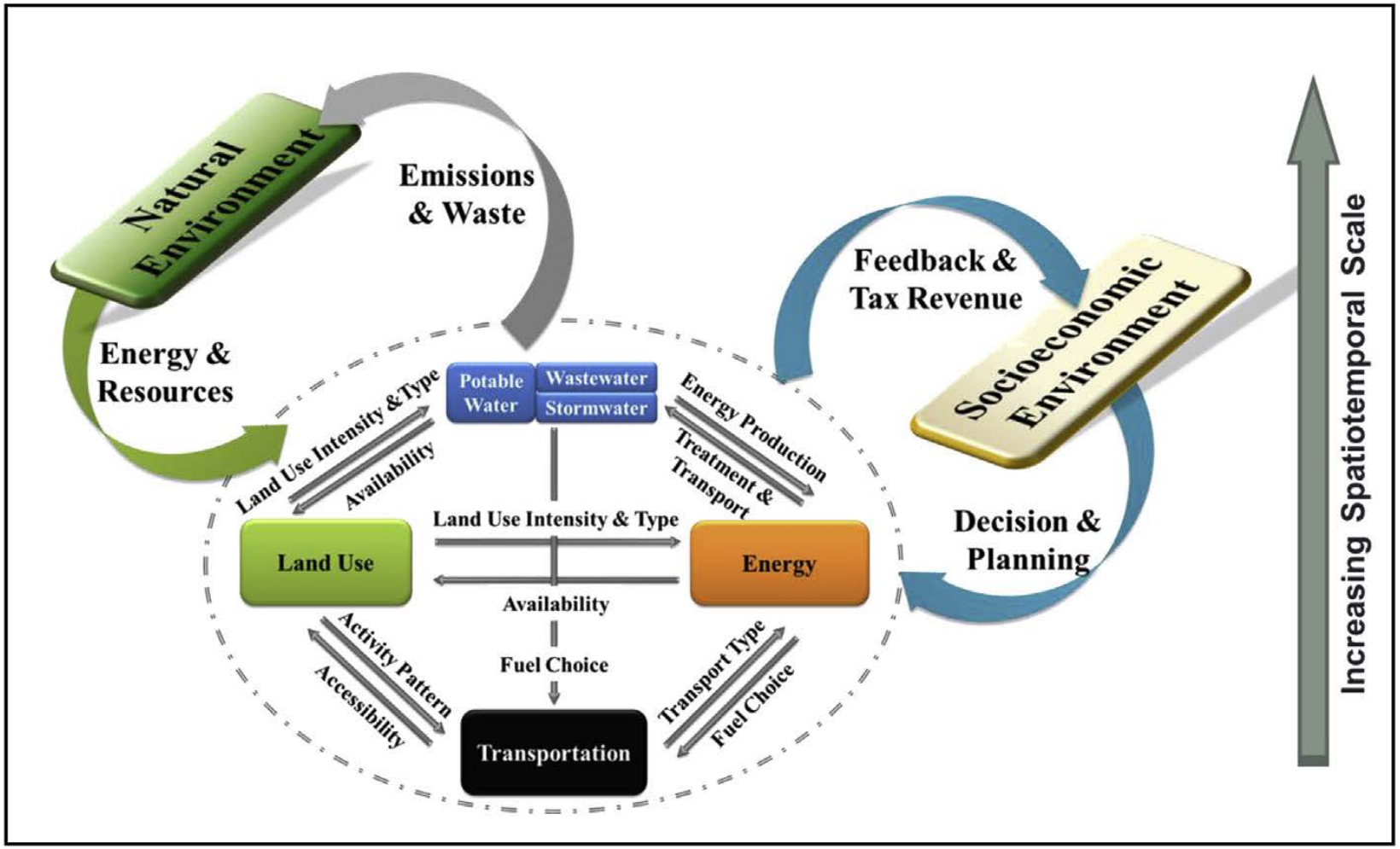
"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs".
World Commission on Environment and Development Brundtland Report (October 1987)



URBAN METABOLISM

- The notion of modelling urban areas using the analogy of biological metabolism is conceived as a cycle in which materials enter the city to sustain the population, build up infrastructure, and exit as waste and residues
- **"The metabolic requirements of a city can be defined as all the materials and commodities needed to sustain the city's inhabitants at home, work and play...The metabolic cycle is not completed until the wastes and residues of daily life have been removed and disposed with a minimum nuisance and hazard.**
- **As man has come to appreciate that the earth is a closed ecological system...he has the daily evidence of his eyes and nose to tell him that this planet cannot assimilate without limit the untreated wastes of his civilization"**

URBAN METABOLISM: TRANSPORT AND MOBILITY

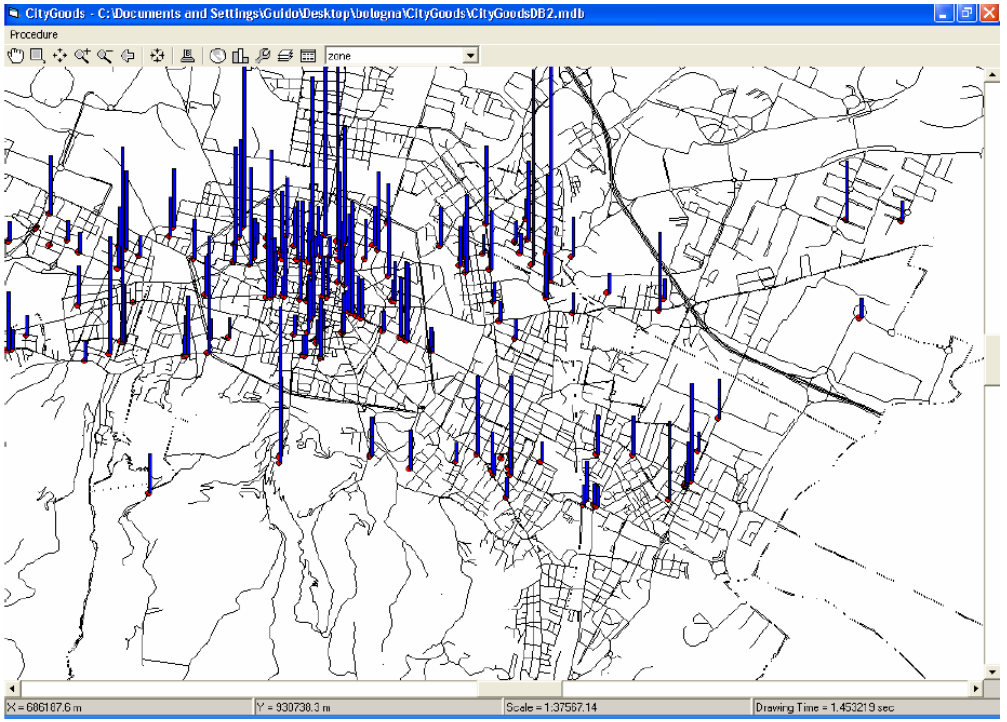


URBAN FREIGHT DISTRIBUTION (CITY LOGISTICS)

CITY → AN ECONOMIC, SOCIAL, POLITICAL AND CULTURAL UNITY SUPPORTED BY THE PHYSICAL AND MANAGERIAL ACTIVITIES NECESARY TO SUPPORT ALL THE ABOVE.

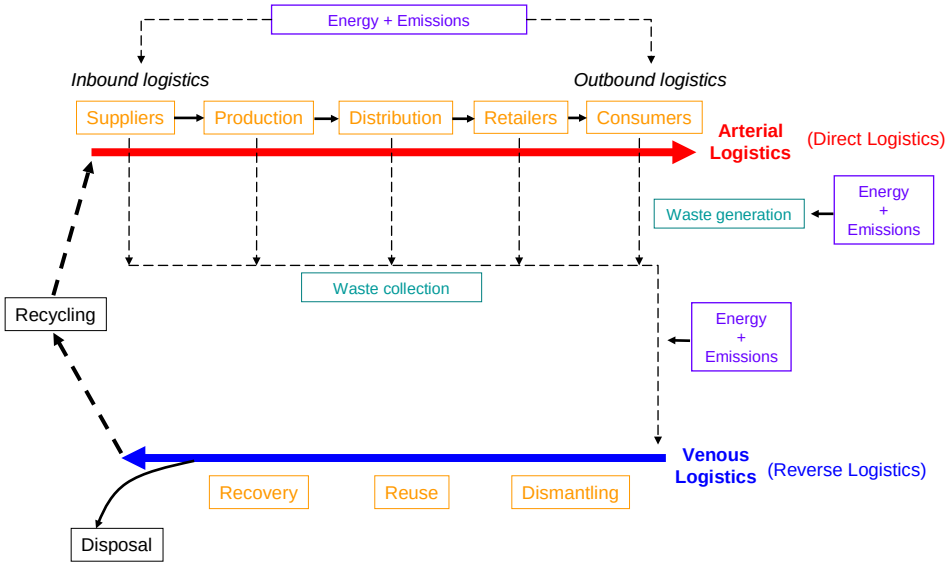
- Urban freight distribution has to a large extent been <u>neglected by urban transport policy makers</u>
  - Key for the social and urban areas
  - Faced with a number of
    - Congestion
    - Parking for deliveries
    - Reverse logistics (e.g. recycling and garbage collection
- Urban Goods Movement
  - INTERACTS WITH
  - IS SHAPED BY

⇒ THE URBAN CONTEXT



CITY LOGISTICS: regulations and urban form

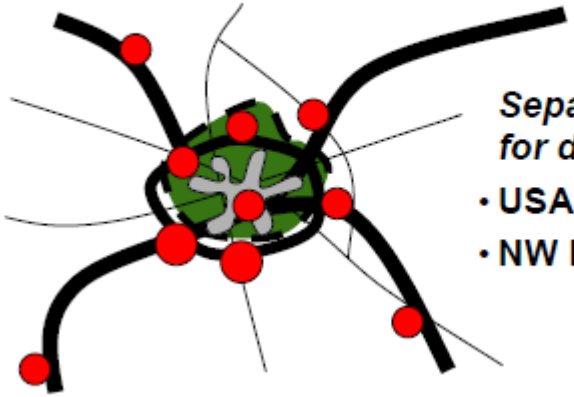
- Streets already closed before implementation
- New closed streets (permanent bollards)
- Secondary entry gates (EH) (Timetable programmed bollards)
- Exit gates (automatic bollards) (SA)
- Main gate control zone (EI)
- Access to main entry



MOBILITY AND URBAN DEVELOPMENT

TRENDS IN URBAN DEVELOPMENT

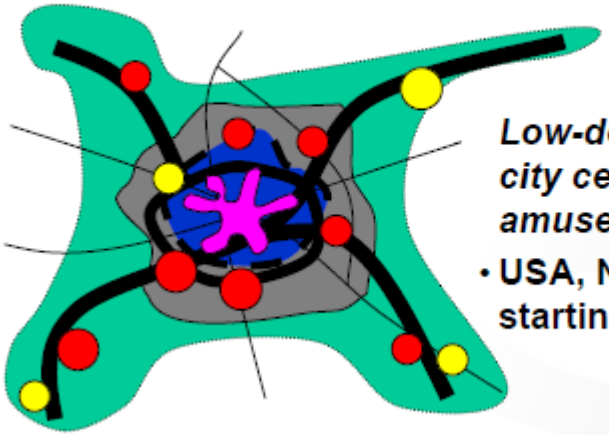
DECONCENTRATION – "URBAN SPRAWL"



Separation of land use for different purposes

- **USA, ongoing**
- **NW Europe: ongoing**

DESURBANISATION



Low-density land use, city centres for living & amusement

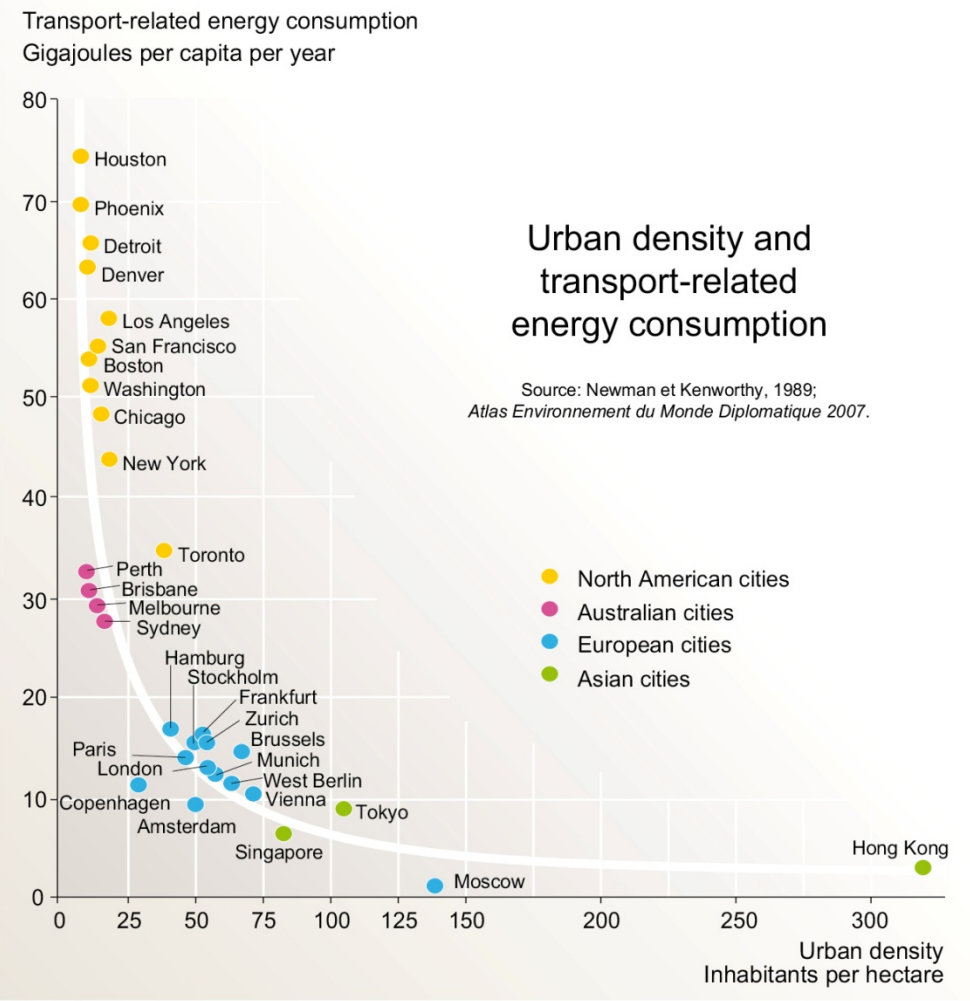
- **USA, NW Europe: now starting to be visible**

- **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**

Separation of living and working areas ⇔ Enabled by transport systems ⇔ Congestion ⇔Impact on energy consumption ⇔ emissions ⇔ quality of life

TRANSPORT, MOBILITY, QUALITY OF LIFE AND SUSTAINABILITY

- 30% of total energy and 71% of all oil in EU is consumed by transportation (European Commission, 2007)
- The urban-density and transport-related energy consumption raises serious concerns on our "urban planning rationality"



SMART CITY

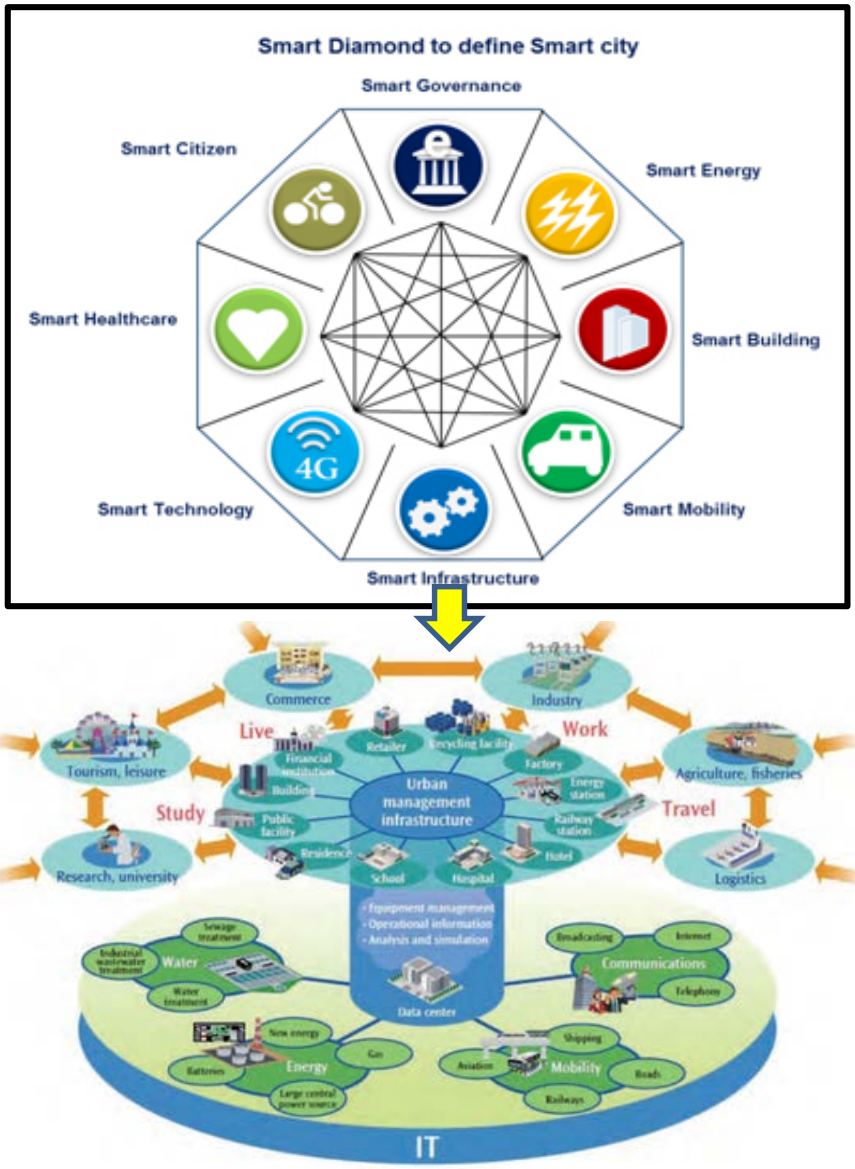
- What does “Smart City” actually mean?
- An approach to a “definition” could be:
- A concept emerging from a reflection on how “the development and pervasive application of the Information and Communication Technologies (ICT) can influence the urban development, the socioeconomic conditions and the quality of life”
- A Smart City would be in this way a technology centered and driven city
- Technology would lay at the heart of the concept as if technology by itself will “solve” all problems

SMART CITY: A market driven concept

- The proposed solutions for Smart Cities, based on the instrumentation and interconnection of mobile devices, sensors and actuators are **predominantly dominated more** by technology vendors than by initiatives of municipal authorities

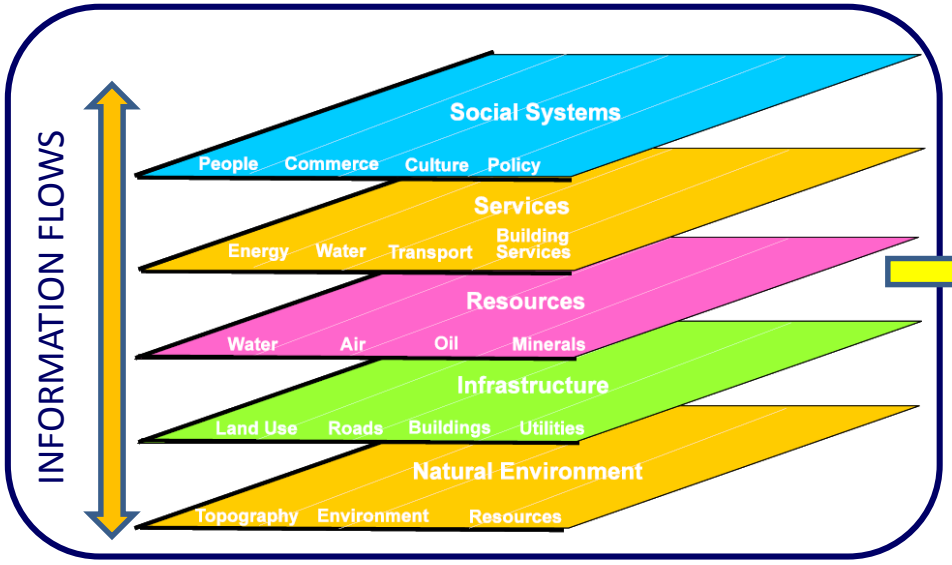
- The presumed diamond interactions between Smart City components is not usually translated into a holistic systemic vision

- Critical voices claim that "smart city solutions must start with the city not the smart". This implies a paradigmatic shift:
  - Understanding the city as a complex system
  - How work the interactions between the "diamond" components of the "Smart City"



KEY PROPOSALS FOR ONE OF THE MAIN PILLARS: URBAN MOBILITY

A) URBAN INFORMATION MODEL (ICT APPS)



REAL-TIME ADVANCED JOURNEY PLANNER

Interactive, integrated, multimodal, real-time decision support system (pre-trip, in-trip)

B) AUTOMOTIVE & PROPULSION TECHNOLOGIES

Vehicles (Electrical/Connected /Autonomous)
Energy Sources & Propulsion Technologies

SUSTAINABLE MOBILITY CHALLENGES

SUSTAINABILITY concerns three main concepts:


Social


Environmental


Climatic change

Currently addressed by the dominating Technological **Trends**

- Vehicles (Electrical/Connected/Autonomous)
- Energy Sources & Propulsion Technologies
- ICT → Ubiquitous availability of mobile devices (data sources & information receivers

But there are **risks** that technology dominated solutions led to

- **Do the same things differently**
- (e.g. replace propulsion and automotive technologies as if personal motorized mobility will not change)
- Apply technology to specific tasks without changing their character

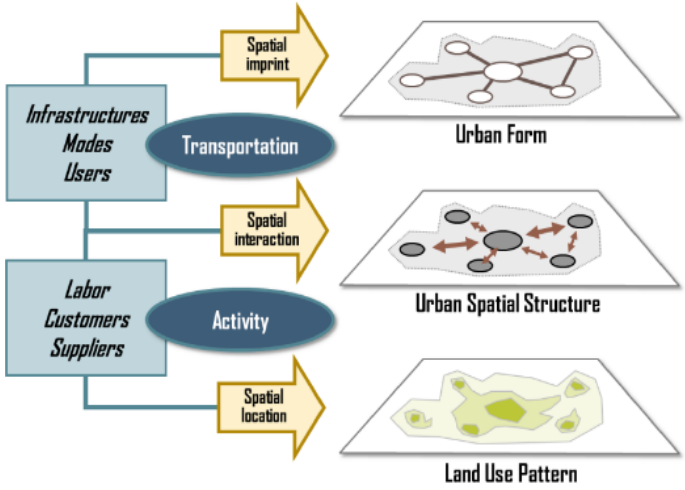
SUSTAINABLE MOBILITY CHALLENGES

Paradigm Changes

From “Car Ownership” to “Vehicle Usage”

Transformational Shifts

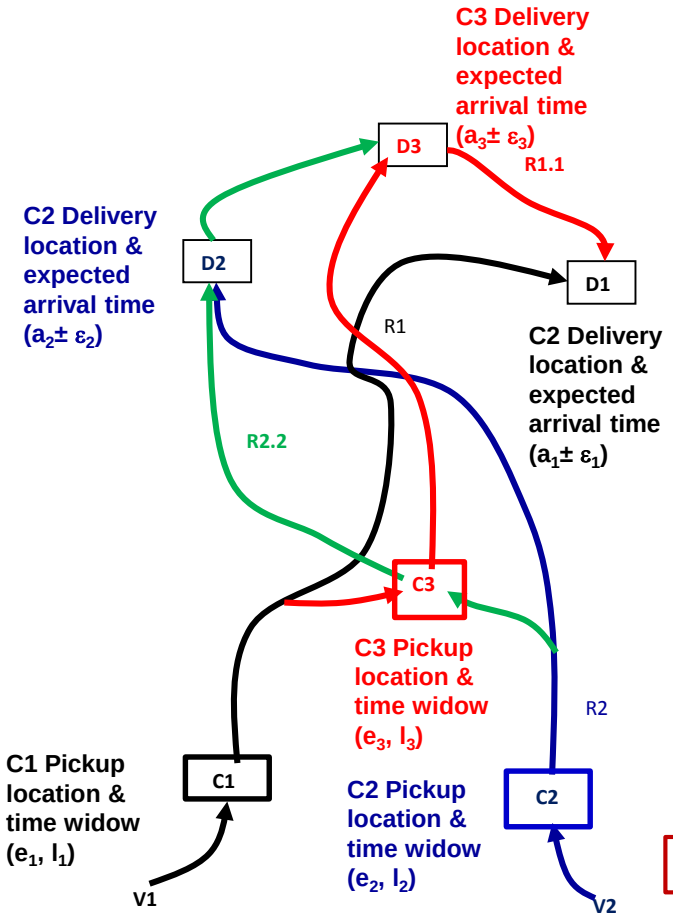
New Business Models - Growth of Car Sharing
Multiple Passengers Trip Sharing
Mobility as a Service (MaaS)
Personal Integrated Journey Planners
Demand Responsive Public Transport &
New forms of multimodality

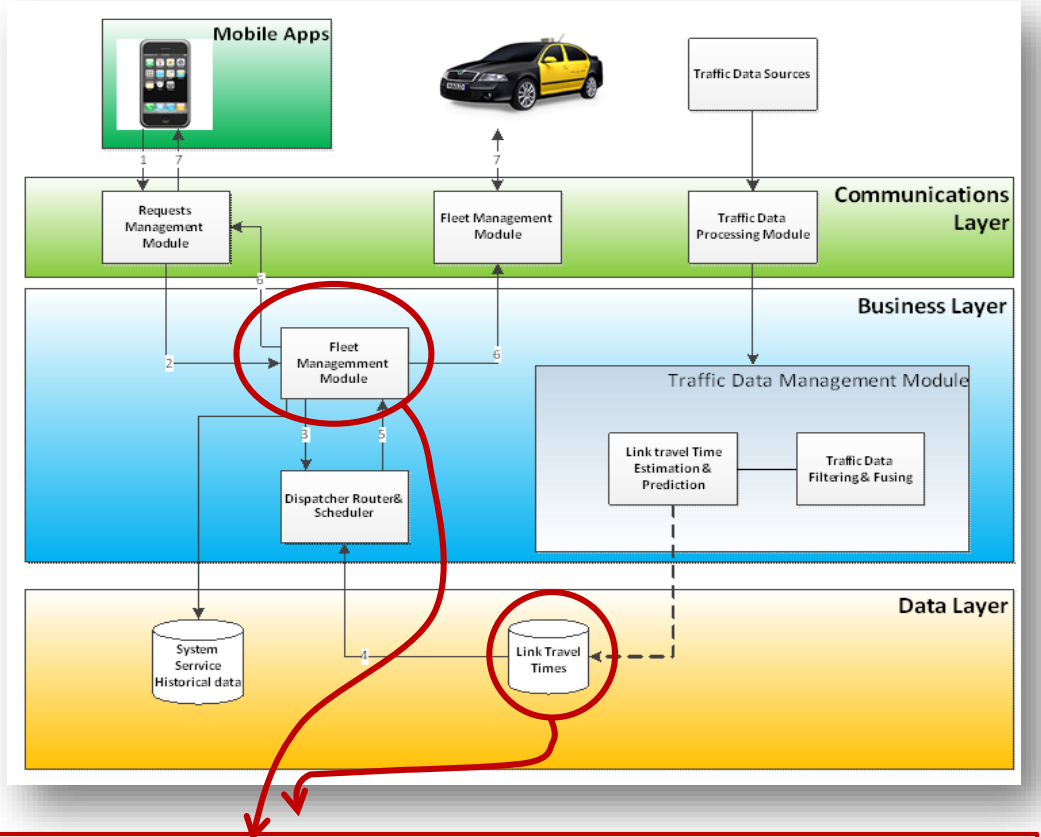


Urban Form & Urban Dynamics

- How do they determine mobility
- Technology enabling of “virtual accessibility” making physical mobility unnecessary

DOOR TO DOOR SEAMLESS MOBILITY SERVICES





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

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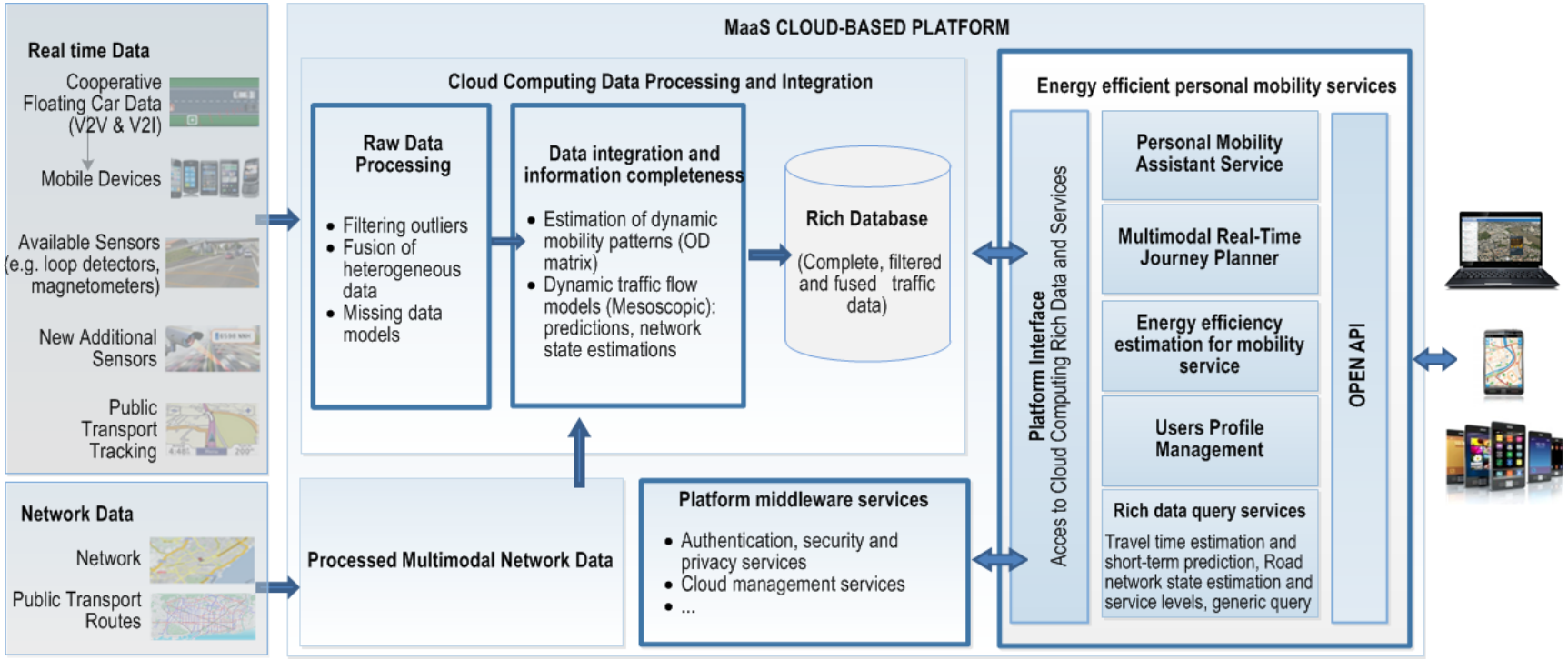
NEW ICT MOBILITY PARADIGM: MOBILITY AS A SERVICE (MaaS)



However, technology dominated solutions implicitly assume that

We will always do the same things but differently

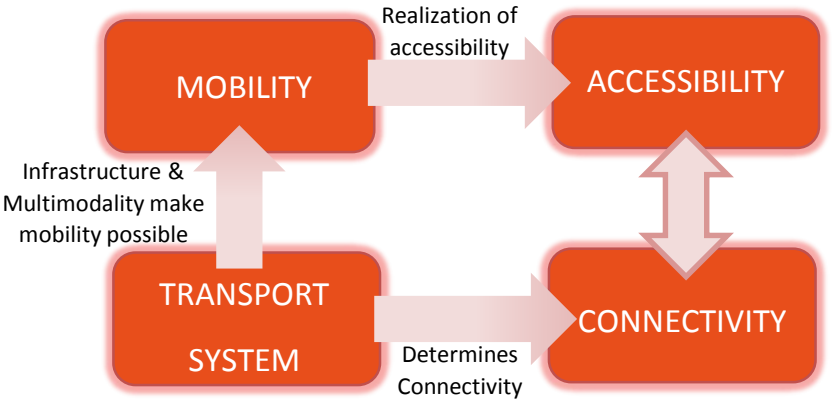
(e.g. replace propulsion and automotive technologies as if personal motorized mobility will not change)

Apply technology to specific tasks without changing their character

MOBILITY, ACCESSIBILITY & SUSTAINABLE MOBILITY

MOBILITY is the movement of **people and goods** efficiently and safely and may be regarded as the ability to travel

When and where the traveler needs, in the most efficient way



URBAN MOBILITY is a mean to the end of accessibility and must:

- Ensure the realization of accessibility: citizens must reach destinations to satisfy needs and have access to places where activities happen
- Be Sustainable: accounting for technicalities and other means to achieve the realization of accessibility

TECHNOLOGY seen as a necessary but not sufficient condition

CHANGING THE PARADIGM: THE CITY AS A COMPLEX **DYNAMIC SYSTEM** OF SYSTEMS

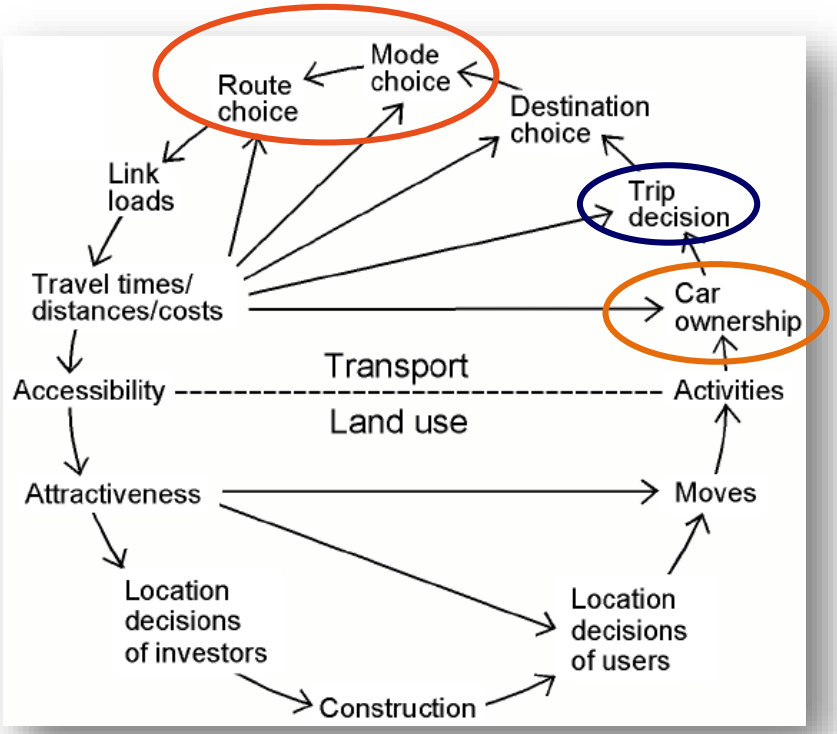
Understanding how a **city's mobility system** will evolve as a consequence of the underlying forces and their interactions

Change the paradigm

Smart Cities

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

A **market** driven concept A **Citizen** Driven Concept

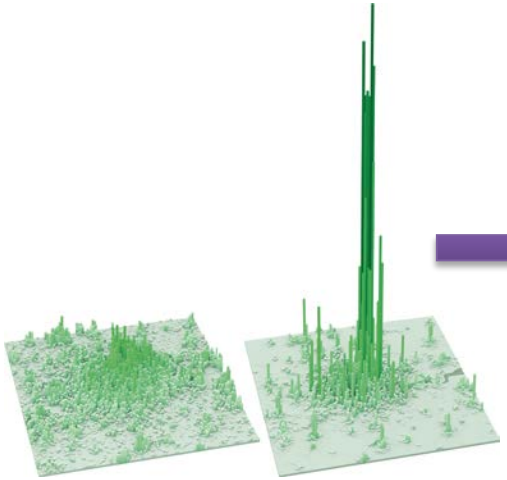


Methodological approach: combining ***System Dynamics*** and ***Transportation Modeling*** to account for the multiple variables, **feedback loops between components**, and the role of the influencing factors, e.g. ***social and technological paradigm shifts***

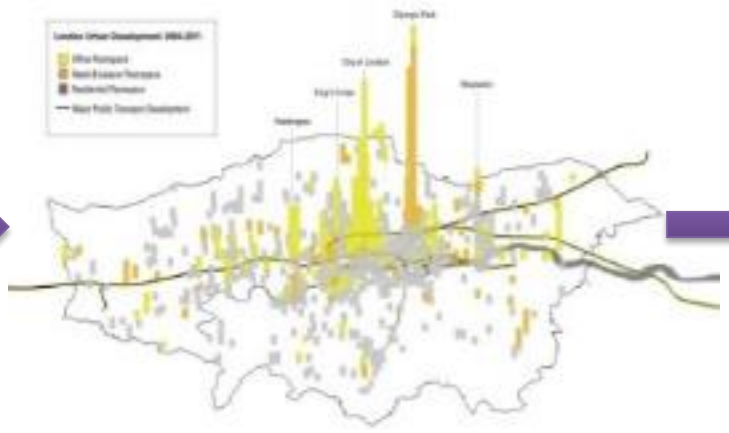
- **Automotive technologies driven decisions**
- **Available multimodality driven decisions**
- **ICT driven decisions**

TECHNOLOGY AS A NECESSARY BUT NOT SUFFICIENT CONDITION

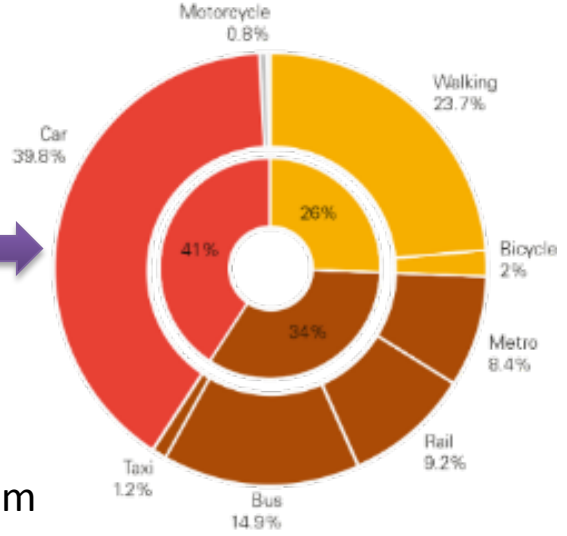
SUFFICIENCY ⇒ UNDERSTANDING HOW URBAN FORM & URBAN DYNAMICS DETERMINE MOBILITY



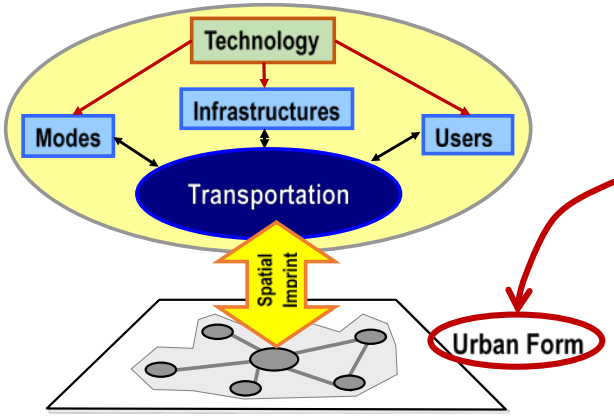
Dwellings Work places

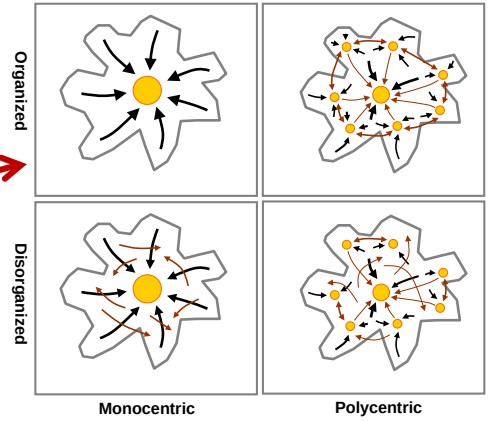


Dwellings & Work places ⇔ Transport System
(Time evolution)



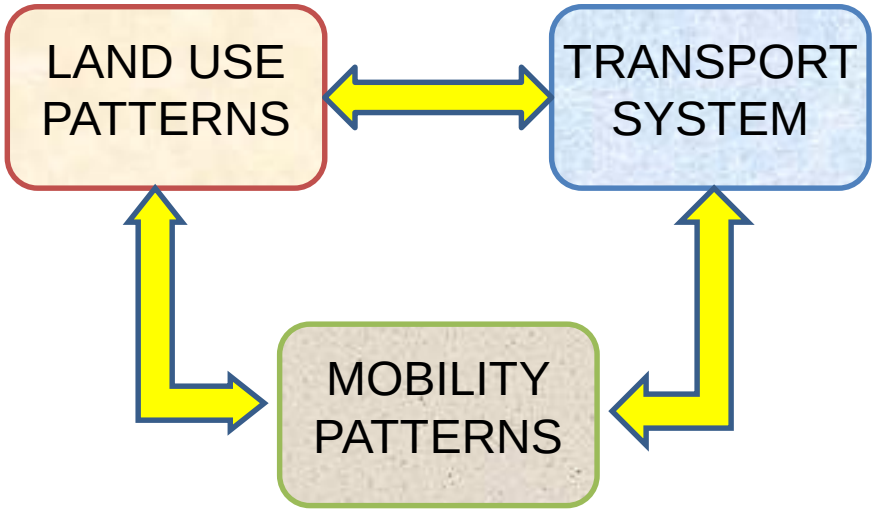
How the transport system is used



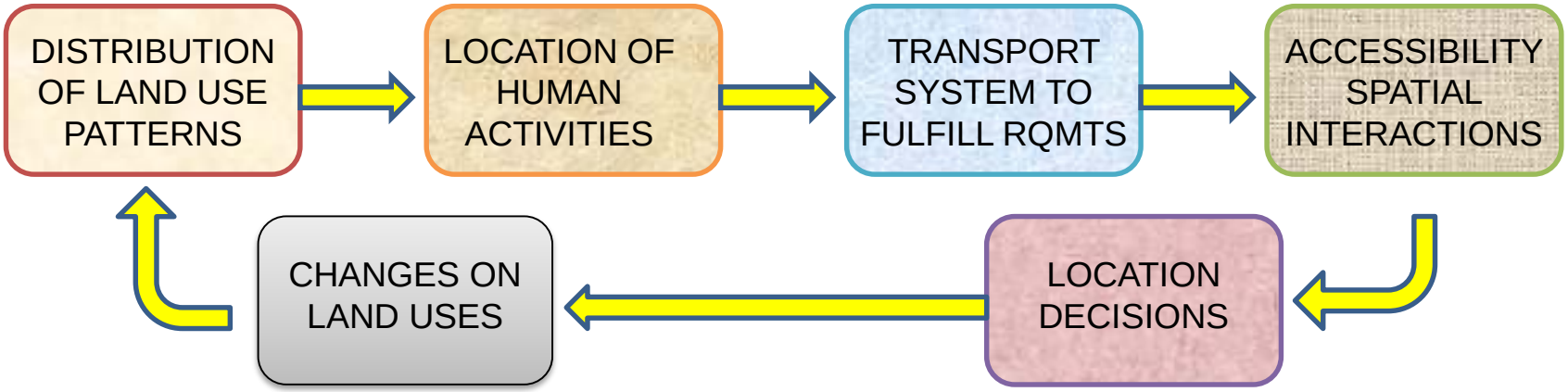


W Wellness and Walkable
I Intelligence & ICT
S Sustainable
E Ecology, Energy & Economy

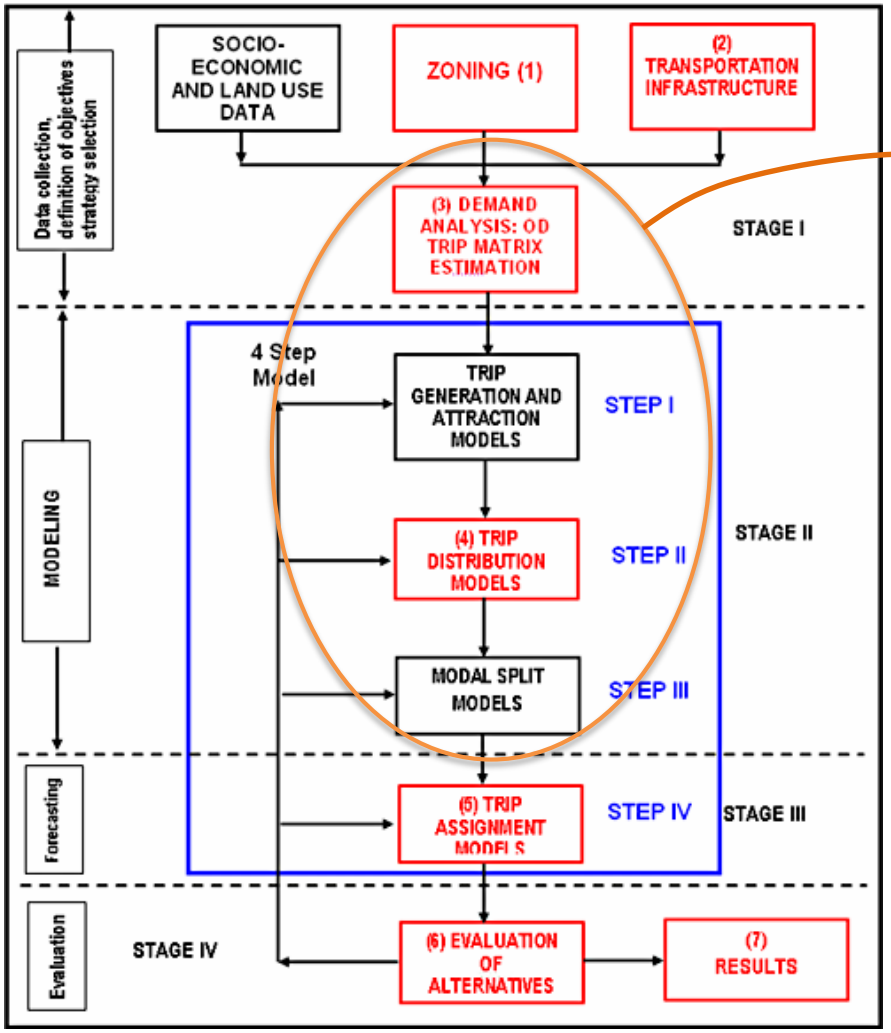
TWO-WAY INTERACTION BETWEEN TRANSPORT AND URBAN FORM

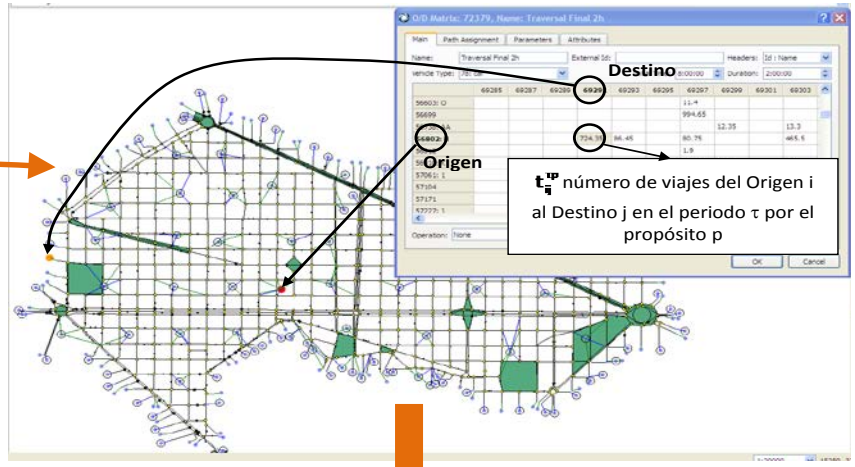


SPATIAL INTERACTION PARADIGM: Interaction between individual mobility and location behavior



LIMITATIONS OF THE CONVENTIONAL 4 STEPS TRANSPORT MODELING APPROACH





Flows on a network are in equilibrium that satisfies Wardrop' s user principle when for path flows h_k^* and path costs u_i^* :

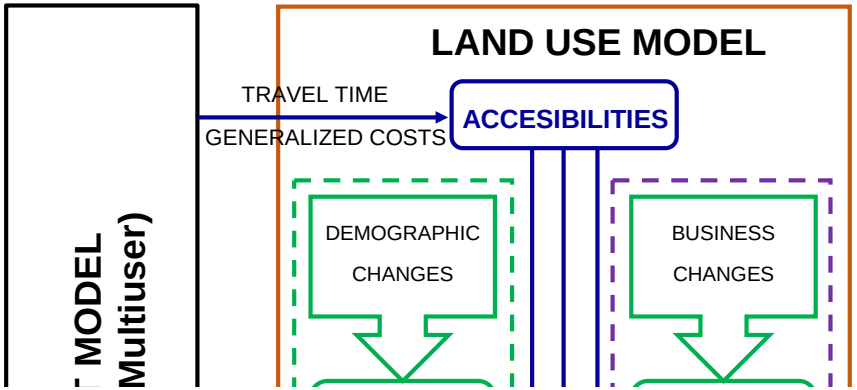
$$\left.\begin{aligned} &\left(s_k - u_i^*\right)h_k^* = 0, \forall k \in K_i, i \in I \\ &s_k - u_i^* \geq 0 \qquad \forall k \in K_i, i \in I \\ &\sum_{k \in K_i} h_k^* - g_i = 0 \quad \forall i \in I \\ &h^* \geq 0,\ u^* \geq 0 \end{aligned}\right\}$$

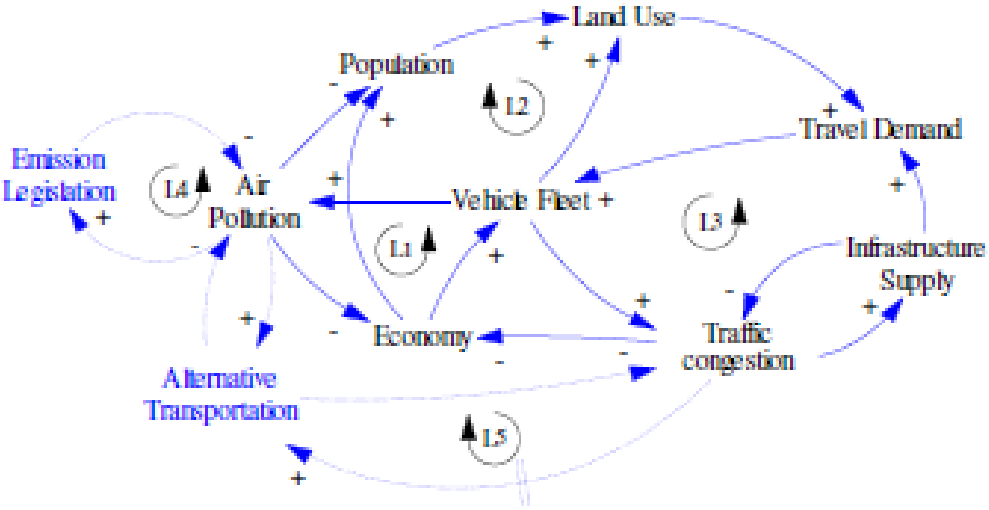
CHANGE OF MODELING PARADIGMS: Integrated Urban Dynamics & Land Use

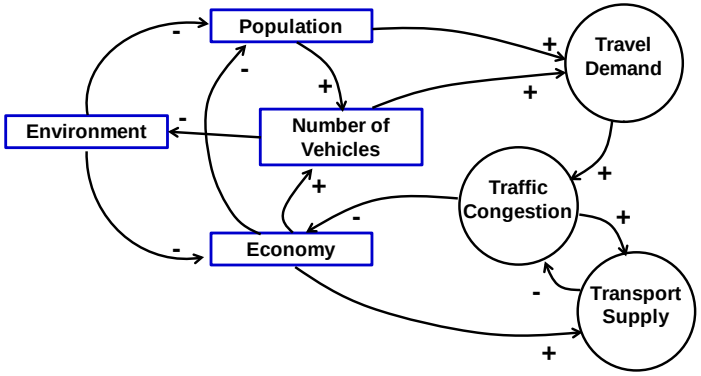
Transportation Infrastructure
- Public Transport
- Vehicle Fleet
- Road Network
- Rail Network
- ....

Urban Environment
- Economic Growth
- Env. Pollution
- Legislation
- Demographic Change
- ....

Citizens / Consumers
- Sociodemographics
- Modal Choice Dec.
- Values
- Expectations
- ....



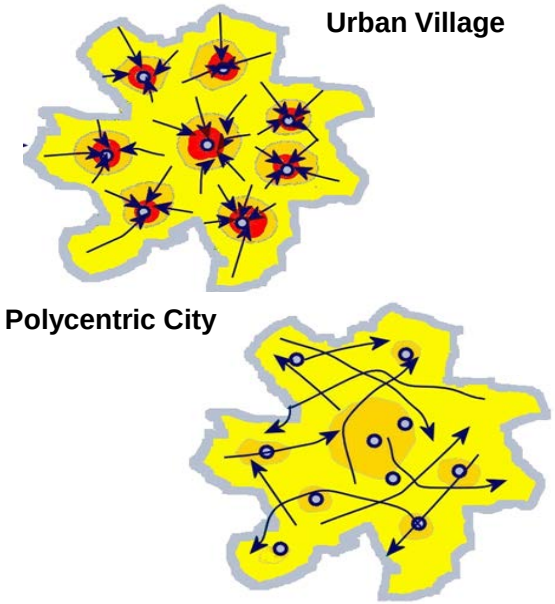




Causal relationships of the urban transportation system with its environment. A System Dynamics Approach to Land Use Transport Interaction Modeling: The strategic model MARS and its application, Pfaffenbichler et al. Systems Dynamics Review,Vol. 26, No. 3, (2010)

THE SUSTAINABLE MOBILITY PARADIGM

- Alternative paradigm requiring
  - To investigate the complexity of cities
  - To strengthen the links between land -use and transport
- Implying 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 a t 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

TO CONCLUDE I WOULD SAY THAT:

- THINKING OF THE URBAN MOBILITY OF THE FUTURE
- Implies **thinking of doing different things, and**
- **looking for new approaches** to solving problems

THANK YOU VERY MUCH FOR YOUR ATTENTION