New paradigms of urban mobility in the learning city. What place for autonomous mobility?

Pr. Dominique Barth, Université Paris-Saclay
New paradigms of urban mobility in the learning city.

What place for autonomous mobility?

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Mobility is an essential subject for smart and sustainable cities which gives rise to a wide range of scientific activities to meet technological and digital needs, social issues and legal and economic requirements. These activities imply multidisciplinary collaboration between these fields which is at the heart of the program proposed here according to three main themes: mobility as a service, mobility and the temporal organization of the territory, mobility and spatial planning.

Organisers:

- Dominique Barth, Pr. Laboratoire DAVID, computer sciences
- Eric Monacelli, Pr. Laboratoire LISV, robotics
- Jakob Puchinger, Pr. LGI/IRT SystemX, computer sciences

Pluridisciplinary scientific committee

- Patrice Atkin, DS IRT SystemX, industrial systems,
- Yoann Demoli, MdC PREPTEMPS (UVSQ), sociology of mobility,
- Stéphanie Coeugnet-Chevrier, Chercheure, Institut Védécom, psychology and ergonomy,
- Valérie Gyselink, DR LAPEA (Univ. Gustave Eiffel), psychology,
- Patrick Haggard, Pr. UCL London, chaire d'Alembert IEA/Univ. Paris-Saclay, cognitive sciences,
- Sandrine Lacour, DR CNRS, ISSP (ENS Cachan), politic and law sciences,
- Latifia Oukhellou, dir. GRETTIA (Univ. Gustave Eiffel), computer sciences.
- François Sarfati, Pr. Centre Pierre Naville (UEVE), sociology of work
congestion, delay and comfort

Environmental impact, Economic cost

Quality of life, health, inclusiveness

Mobility suffered, mobility chosen
New mobility usages:

- Disruption through (technological) innovation
- Disruption through planning (politics)
- Price disruption (economic)
New mobility usages:
- Disruption through (technological) innovation
New mobility usages:
- Disruption through (technological) innovation

Autonomous mobility, Automated vehicle?
Public transport or individual vehicles?
Offer a better mobility service for all, while reducing cost and environmental impact?

Orchestrate "tailor-made" different means of mobility for every need, with service quality guarantees.

Enable a transition to new uses for all without rupture or coercion.
TRANSPORTATION
Ensure connectivity,
Manage flows and congestion

VS

Respond to user requests
SERVICE

Transport operator
Service (public? minimum?)
Mobility Operator
Governance and actors of urban mobility

“Augmented” territorial governance and/or delegation of services to digital companies?

Who is the future "mobility operator"?
Mobility civil engineering company?
Transport equipment manufacturers?
Transport operators?
Energy supplier?
GAFAM?

Who moves in a MaaS logic
A transport means?
A human being?
A Smartphone?
Congestion and urban logistic

Urban logistics is the set of traffic flows related to the delivery of products from their collect points to their delivery points in the heart of an urban territory.

Impact on urban mobility in Europe:
A significant portion of city traffic. (10 to 15%)
A low fill rate for city delivery vehicles. (38% in London)
Responsible for 25% of CO₂ emissions related to urban transport.

Congestion and territorial governance
Specific logistics (waste, fluids, energies)
Use of urban resources
Congestion and urban logistic

Urban logistics is the set of traffic flows related to the delivery of products from their collect points to their delivery points in the heart of an urban territory.

- Uses shared resources of the territory (roads, parking spaces, energy)
  IoT and IA for a plastic territory

- Increasingly subject to quality of service and environmental constraints (LOW EMISSION ZONES)

- Increasingly dynamic collection and delivery services
  Autonomous vehicles for urban logistic

Congestion and territorial governance

Specific logistics (waste, fluids, energies)

Use of urban resources
MaaS and LaaS
MaaS and LaaS: promise or utopia?

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MaaS and LaaS: promise or utopia?
MaaS and LaaS: promise or utopia?

QUALITY OF SERVICES

- Comfort
- Trust/availability
- Return guarantee
- Security
- Access to service

Parking,
Information,
Pluri(bi) modality
Cost,

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MaaS and LaaS: promise or utopia?

Response to feelings of insecurity
Life quality
Reliable information to users
Comfort
Multi-modality
Last mile mobility and logistic
Bike sharing
Autonomous vehicles
Return guarantee

Car sharing
Parking assistance
Electrical mobility
MaaS and LaaS: promise or utopia?

.... yes, but need DATA
- Relevant
- Sufficient
- Qualified

Car sharing
Parking assistance
MaaS and LaaS: promise or utopia?

Digital Orchestration

Inclusive MaaS

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MaaS and LaaS: promise or utopia?

Territorial governance

Platform: mobility digital twin

- Inclusive MaaS
- Plastic et resilient territory
  - Spatial and temporal organization activities of the territory
  - Mobility of services

Mobility operator (?)

Trust and efficiency
Towards what territorial solutions?

Digital city and mobility:
Optimizing time: towards coordination of schedules and resources

- **Observatory of mobility**: knowing (quantity and quality) timetables, flows, activities, populations.

- **Know the constraints and resources**: mobility/activity resources, service and mobility constraints, distances and lifestyles?

- **Diagnose, simulate and predict** for a consultation for the organization of time.

- **Targeting, supporting and encouraging** mobility alternatives.

(Source Photos : Internet)
Towards what territorial solutions?

Digital city and mobility:
Optimizing space: towards relocation and demobilization?

- Reconciling land use planning and mobility,

- Bringing housing closer to workplaces (rethinking territories as "villages").

- Bringing work closer to housing: teleworking, third places, mobile offices (psycho-social risks, work in 2030?)?

- Reduce the mobility of energy by localizing its production?

- Bring services closer to citizens (mobile, virtualized)?

(Sources Photos : Internet)
Theme 1: Why autonomous mobility?

Theme 2: Autonomous vehicles, what impact on employment and economic dynamism in the territories?

Theme 3: Life on the move

Theme 4: The autonomous vehicle, an innovation that accentuates the fractures in the relationship to mobility?
Machine Learning for Urban Mobility

MANAGEMENT OF A FLEET OF AUTONOMOUS SHARABLE ELECTRIC TAXIS

« Service of autonomous shuffles needs learning territory »
Management of a fleet of autonomous, electric and shared taxis

T. Babicheva, D. Barth, W. Burghout, L. Kloul
First « yes »
Central Optimisation

« Similar » reinforcement learning?

Y  N
0,2  0,8

Y  N
0,2  0,8

T. Babicheva, D. Barth, W. Burghout, L. Kloul
Central Optimisation

« Similar » reinforcement learning?

Yes

T. Babicheva, D. Barth, W. Burghout, L. Kloul
Central Optimisation

« Similar » reinforcement learning?

« Best » one
Reinforcement learning for the management of a fleet of autonomous, electric and shared taxis

Central Optimisation

Period
Origin
Destination
Sharing
Charging level

Empty ride?

T. Babicheva, D. Barth, W. Burghout, L. Kloul
Could you?

Central Optimisation

Y       N
0.2    0.8

Destination Congestion (period)
If yes and Taxis available

Decision+

Sharing
Electric charge
Empty ride

Central Optimisation

Y     N
0,2   0,8

T. Babicheva, D. Barth, W. Burghout, L. Kloul
Y     N
0,2   0,8

Considering user utilities

Central /distributed Optimisation

Learn

Computing path

yes

Update infrastructure infos.

yes

T. Babicheva, D. Barth, W. Burghout, L. Kloul
« Service of autonomous shuffles needs learning territory »
Key open question for interdisciplinary about MaaS and autonomy:

- Legal responsibility in the event of an accident with an autonomous vehicle mobility services: mobility operator? Territorial governance? Individuals involved?

- Notion of contract and quality of service, particularly in the case of shared autonomous taxis: departure time and arrival time? Best effort?

- Safe operation of autonomous vehicles? Simulation/scenarios standards? Human expertise?

- Protection of personal data vs personalized service?

- Which public mobility service?

- Authorities and management of Low Emission Zones?

- Which public actors to manage and arbitrate access to roads (streets, parking spaces, charging stations, etc.)
Energy
Materials
Firsts
Uses
Data

Waste
Activity
Products
Data
Welfare

Networks of Urban Paths
Transport network
Social and Professional networks
Telecom network

Waste networks
Energy network

Urban Organism
Citizens

Networks
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