Autonomous vehicles in France: where do we stand today and first insights of socio-economic assessment in Saclay

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NEW METHODOLOGY FOR MULTI ADL4 FOT

1 multi FOT project:
- Multi vehicles
- Multi services
- Multi environment

Adaptation of FESTA methodology

New implementation plan

Common assessment methodologies

Common descriptions: Use cases, Service description, Data framework

Results
- 12 Assessment domains
- 60 level 1 research questions
- 77 KPIs identified
- More than 200 data models
1. Socio-economic impacts
What are the societal costs and benefits of the deployed service?

2. Demand analysis
What attendance is expected for the target service?

3. Traffic modelling
What are the consequences of their target service deployment in terms of traffic?

4. User behaviour
What are the service users behaviours?
What are the other road users behaviours? What is their impact on road safety?

5. Environmental analysis of the service
What are the environmental consequences of the target service deployment?

6. Business models
What are the expected costs and revenues for an AV service?

7. Acceptance
How is the service received by its users and by other road users?

8. Traffic impact
How does an AV fit in with the traffic in real conditions?

9. Unit environmental analysis
What are the environmental characteristics of an AV?

10. Governance
How is the AV deployment organised locally and on the national level?

11. Safety
What are the relevant scenarios for safety validation?

12. ODD
What is an attainable ODD for a vehicle/infrastructure system?
Methodologies for demand analysis
# OVERVIEW

<table>
<thead>
<tr>
<th>Discrete choice model</th>
<th>Simulation model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stated preferences surveys</strong></td>
<td><strong>Agent-based model (VIPSIM) coupled to macroscopic model (VISUM)</strong></td>
</tr>
<tr>
<td>Experimental service</td>
<td>Target service</td>
</tr>
<tr>
<td>Target service under specific constraints</td>
<td>+ Assessment of socio, eco and env impacts</td>
</tr>
<tr>
<td>+ Based on real data</td>
<td>+ Spatial and temporal upscaling</td>
</tr>
<tr>
<td>+ Revealing users preferences</td>
<td>+ Representation of impacts</td>
</tr>
<tr>
<td>⇒ Administration and analysis costs</td>
<td>⇒ Model Development</td>
</tr>
<tr>
<td>⇒ Analysis limited to the surveyed area</td>
<td>⇒ Model Calibration</td>
</tr>
</tbody>
</table>

- Sensitivity to the quality of service and fare
- Value of time
- Willingness to pay

<table>
<thead>
<tr>
<th>General/ Aggregated</th>
<th>Person/ Desaggregated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socioeconomic Impacts</td>
<td>Socioeconomic Impacts</td>
</tr>
<tr>
<td>Mode share evolution</td>
<td>Mode share evolution</td>
</tr>
<tr>
<td>⇒ Specific period of the day and a specific travel purpose.</td>
<td>⇒ Activities of the day</td>
</tr>
</tbody>
</table>

- Agent-based model (MATSIM)

- Based on real data
- Revealing users preferences
- Administration and analysis costs
- Analysis limited to the surveyed area
- Assessment of socio, eco and env impacts
- Spatial and temporal upscaling
- Representation of impacts
- Model Development
- Model Calibration

- Person/ Desaggregated
MICROSCOPIC SIMULATOR OF AUTONOMOUS TAXIS : VIPSIM

VIPSIM (Vedecom Integrated Passenger transport SIMulator) is a microscopic agent-based simulator developed par VEDECOM to describe a shared autonomous taxi service, in particular:

- Movements and interactions of vehicles and passengers.
- Relocation strategies of empty vehicles.
- Ridesharing strategies.
ARCHITECTURE OF THE SIMULATOR VISUM – VIPSIM
MODEL ASSUMPTIONS

- **No regulation**

- **Production costs based on the literature**: per vehicle:
  - Fixed Costs+: 50€ per day per taxi
  - Variable costs: 0,4€ par km

+ Supposant le coût d’achat à 36000 € par véhicule et la durée d’amortissement 2 ans

- **Demand estimated from surveys**
  - Utility parameters
  - Mode preference
  - Origines and destinations
Application case : Saclay
PRESENTATION OF THE TERRITORY

- An heterogeneous urbanization, East-West and in progression.
MOBILITY CHARACTERISTICS

SUPPLY

- Road Infrastructure: **645 km**
  - Four major axes: Highway A10, National route 118 and 2 Departmental routes
- 12 bus lines, 1 BRT bus line
- 2 train lines

DEMAND

- Imbalance of population and jobs
  - 33000 inhabitants vs 22000 jobs (Insee, 2017)
- High exchanges with Paris and neighbor cities
- 78% of active inhabitants in Sacaly are working outside of Palaiseau (Insee, 2017)
AV SERVICE

- An Autonomous taxis service is proposed in order to enhance the current PT supply.

It uses the BRT infrastructure while offering in addition a feeding service.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network length</td>
<td>13 km</td>
</tr>
<tr>
<td>Stations</td>
<td>21 stations</td>
</tr>
<tr>
<td>Fleet size</td>
<td>60 vehicles</td>
</tr>
<tr>
<td>Average speed</td>
<td>30 to 70 km/h</td>
</tr>
</tbody>
</table>
## OPERATIONAL PERFORMANCES

<table>
<thead>
<tr>
<th>Indicateurs de performance techniques</th>
<th>Valeur</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean waiting time</td>
<td>3 minutes</td>
</tr>
<tr>
<td>Maximal waiting time</td>
<td>19 minutes</td>
</tr>
<tr>
<td>Mean travel time</td>
<td>3 minutes</td>
</tr>
<tr>
<td>Mean trip distance</td>
<td>4 km</td>
</tr>
<tr>
<td>Mean distance per vehicle (for one peak hour)</td>
<td>22.5 km</td>
</tr>
<tr>
<td>Mean loading rate of vehicle</td>
<td>1.4</td>
</tr>
<tr>
<td>Empty vehicle kilometers</td>
<td>70 %</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Modal share</th>
<th>Public transport</th>
<th>Motorized modes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>aTaxis</td>
<td>BUS</td>
</tr>
<tr>
<td>Before</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>After</td>
<td>21%</td>
<td>30%</td>
</tr>
</tbody>
</table>
IMPACT OF FLEET ON PROFIT FOR A FIXED FARE (2€)
IMPACT OF FLEET SIZE AND FARE

Profit

Social surplus
NEXT STEPS

- Different methodologies for the evaluation of a multi-service and multi-environment projects.
- Connections between methodologies established and a FESTA methodology consolidated.
- Three methodologies identified for demand analysis, allowing to address different scales of analysis.
- The simulation approach will allow to evaluate future upscaled scenarios, but calibrated on experimental observations, conducted surveys, etc. with different projection scenarios.
- Coupling an agent-based model and a macroscopic model achieved, allowing to optimize operating conditions.
Thank you for your attention

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