Automation and public transport

Sustainable Cities - Viewpoints of the Pioneer Alliance
IoT for Smart Cities School
Online Open Session
October 21, 2020
Levitate project

- **LEVITATE** focuses on the development of a new impact assessment framework

- **LEVITATE** enables policymakers to:
  1. manage the introduction of connected and automated transport systems (CATS)
  2. maximise the **benefits** and
  3. utilise the technologies to achieve **societal objectives**

- Development of an open access web-based **Policy Support Tool** targeting Decision makers at **all levels**: Municipalities, Regional Authorities & National Governments
Project Structure

- Multi-disciplinary methodology to assess short, medium and long term impacts

- Case studies: mobility, environment, safety, economic and societal indicators

- Range of forecasting and backcasting scenarios: automated urban transport, passenger cars, freight services

- New web-based Policy Support Tool – Decision Support System
CATS within public transport (1/2)

- Extensive **Literature Review** process within LEVITATE

- **5 grades** of automation for rail-bound services (UITP, 2012)

- **5 levels** of road automation (additional to baseline) have been introduced (SAE, 2016)

- Levels are **descriptive** rather than normative and **technical** rather than legal
  - No particular **order** of market production is implied
  - Minimum **capabilities** for each Level

Source: UITP, 2012
CATS within public transport (2/2)

- Public transport constitutes a significant element of urban mobility
- Two extreme scenarios describing the uptake of CATS
  - **Pessimistic scenario**: public transport will suffer due to the focus on autonomous private cars
  - **Optimistic scenario**: shared autonomous cars will be fully integrated into public transport and provide great coverage for all regions of the city, thus rendering private cars superfluous
Impact taxonomy

- **Direct impacts**: Noticed by each road user on each trip
  - Travel time, vehicle operating cost, freight operating cost, access to travel

- **Systemic impacts**: System-wide impacts occurring in the transport system
  - Amount of travel, congestion, modal split of travel, shared mobility rate, vehicle utilization rate, vehicle occupancy

- **Wider impacts**: Wider societal impacts occurring outside the transport system
  - Parking space, road safety, energy efficiency, vehicle emissions, public health, inequality in transport, commuting distances
Societal level impacts (1/3)

• **Fully automated public transport** is projected to lead to:
  • reduced crash rates,
  • increased punctuality,
  • shorter headways,
  • greater vehicle availability
  • greater modal splits for public transport

• **First and last mile AV services** can boost the use of other transport systems, affecting modal split and increasing congestion.
Combination of AVs with the urban bus system is expected to:

- Increase travel comfort, by reducing crowdedness and enhancing privacy
- Reduce travel costs
- Increase availability, timeliness and reliability of transportation service

Autonomous taxis or car sharing could be considered as part of the public transport as with suitable business models they can promote sustainability, reducing the number of private cars and congestion accordingly.
Societal level impacts (3/3)

- Automation can also **facilitate** a transition to Mobility as a Service (MaaS) that could **limit** the **negative effects** of road transport, as long as it promotes car sharing, ride sharing or sourcing and not private mobility solutions.

- Possibility of **increased urban sprawl** due to increased mobility opportunities (MaaS)

- **Fewer vehicles** that operate more efficiently would reduce car traffic and **advance public transport choice**
Market penetration

- **3 scenarios** regarding the global uptake of CATS: progressive, neutral and obstructed.
- Global sales penetration of automation **levels 3-5 by 2035** will be **85%, 25% and 10%** for the three scenarios respectively.
- **Bus, van and HGV markets** are assumed to occur at the same rate as for cars and all scenarios assume that the sales will increase over time.
- It is **difficult and speculative** to define CATS penetration rate regarding public transport.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>LDVs (cars &amp; vans)</th>
<th>HGVs</th>
<th>Buses</th>
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<tbody>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2025</td>
<td>110,000</td>
<td>4,000</td>
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<tr>
<td>2035</td>
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<td>4,600</td>
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<tr>
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<tr>
<td>Central</td>
<td>11,880</td>
<td>429</td>
<td>90</td>
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<tr>
<td>Obstructed</td>
<td>220</td>
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</tr>
</tbody>
</table>

*Source: Babbar & Lyons, 2017*
LEVITATE WP5 results (1/3): Methodology

• Identification of relevant specific sub-use cases (SUCs) based on:
  • Targeted review of recent literature
  • Knowledge gained through existing research at European level
  • A dedicated stakeholder consultation, through a workshop conducted using a “Future Enquiry”

• Identification of methods needed to quantify impacts relevant to sub-use cases

• Obtain first sub-use case simulation modelling results
LEVITATE WP5 results (2/3): Point-to-point automated urban shuttle service SUC

Description

- Urban automated shuttle bus service **connected two modes of transport** in Athens Network.
- The shuttle service **scenarios** include peak and off peak hour traffic conditions, the use of a dedicated lane and an incident condition.

Simulation modelling results

- **Delay time is reduced** with the increase in the penetration rate of AVs during peak hour, while it is rather stable during off peak hour.
- **Total distance travelled is increased** with the increase in the penetration rate of AVs during peak hour, while small oscillations are observed.
- Automation **decreases CO₂ emissions** during both peak and off peak hour.
LEVITATE WP5 results (3/3): Automated urban shuttle service in a large-scale network SUC

Description

• Urban automated shuttle bus service **complementing public transport** in the city of Athens.

• The shuttle service **scenarios** include peak and off peak hour traffic conditions and the use of a dedicated lane.

Simulation modelling results

• Automation **decreases delay time** during both peak hour and off peak hour.

• **Total distance travelled gets significantly higher values** when the number of autonomous vehicles is increased.

• **CO₂ emissions are decreased** during both peak and off peak hour, when more automated vehicles exist in the network.
Planning for the future

- According to ERTRAC Connected Automated Driving Roadmap (2019), two development paths related to high levels of automation in the urban environment:
  - **Personal Rapid Transit (PRT):** smaller vehicles mostly utilised for transportation of people (e.g. urban shuttles for first and last mile use or even longer distances). Operation in both in a collective or individual mode on restricted, specific or open roads
  - **City-buses and coaches:** incorporate numerous automated functionalities: traffic jam and driver assistance, bus-platooning, bus-stop automation and other tasks on restricted, dedicated or open roads
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