



Traffic & environmental impact assessment under distinct operational speeds for automated shuttle bus services



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Together with:

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The SHOW project

Oikonomou M., Sekadakis M., Katrakazas C., Hillebrand, J., Vlahogianni, E., Yannis, G.

- **SHOW Partners:**

70 partners from 13 EU-countries

- **Duration of the project:**

48 months (January 2020 - January 2024)

- **Framework Program:**

Horizon 2020 - The EU Union Framework Programme for Research and Innovation - Mobility for Growth

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Introduction

Oikonomou M., Sekadakis M., Katrakazas C., Hillebrand, J., Vlahogianni, E., Yannis, G.

- Connected and Autonomous Vehicles (CAVs) are expected to **change transportation systems fundamentally** by increasing aspects such as road capacity and fuel efficiency, and decreasing environmental emissions.
- Connected Automated Transport Systems (CATS) are expected to be the first to align with their **large-scale business cases** by enhancing urban transportation activities and making transit systems more attractive to passengers.
- The current study aims to assess the traffic and environmental impacts of **automated shuttle bus services under different operational speeds** for various market penetration rates of CAVs.



Simulation Scenarios

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- **Three sets of simulation scenarios** were investigated:
 - i. Different CAV market penetration rates (MPRs) 0%-100% in 10% increments
 - ii. With or without (baseline scenario) the automated shuttle bus service operation
 - iii. Distinct operational speeds (15, 30 and 45 km/h) for the automated shuttle bus service



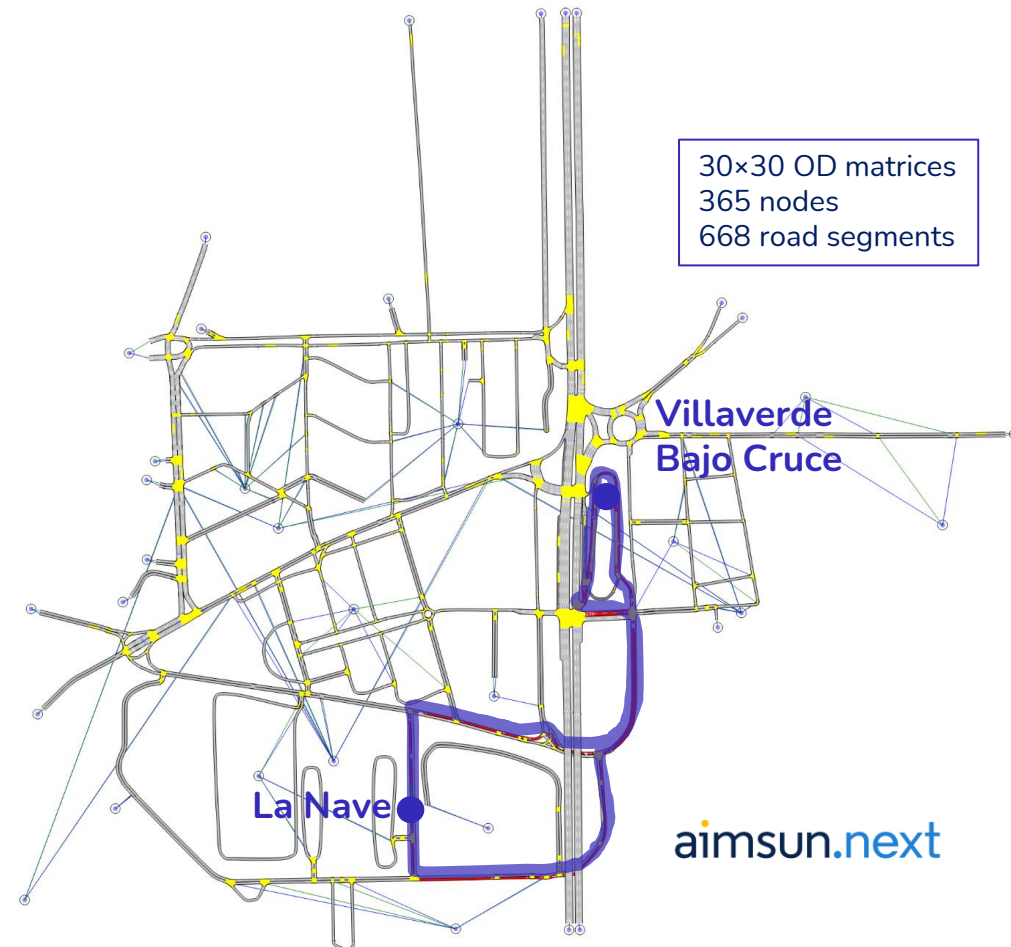
Methodology

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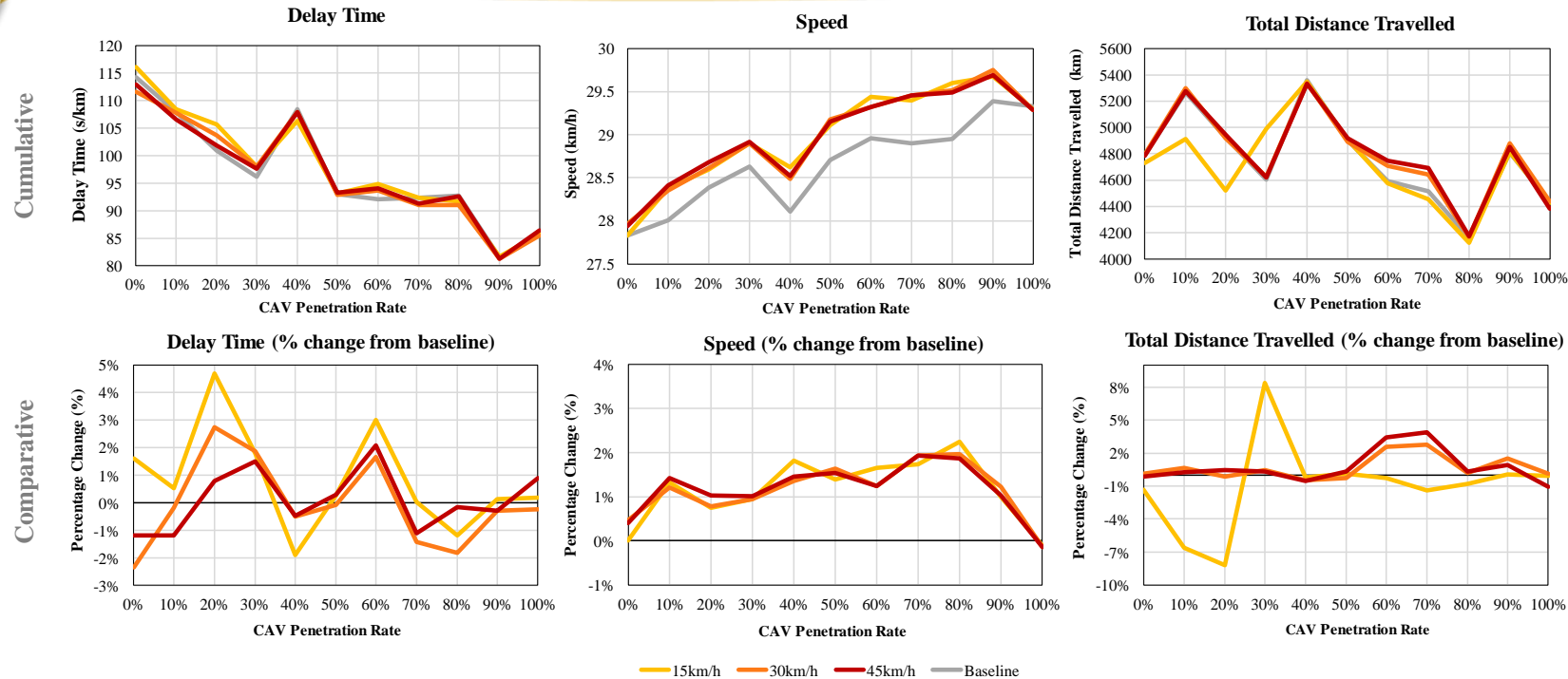
- In order to investigate an automated shuttle bus service and further examine its operational speed, the **microscopic simulation method** was selected using the Aimsun Next software.
- The **automated shuttle bus service** was introduced in the Villaverde district network in Madrid, Spain, operating in parallel with the existing public transport.
- The service included one 12 m **autonomous electric shuttle bus** with 15 min frequency. The service circular route had a total length of 1.6 km and two bus stops.

 **Villaverde district
(Madrid, Spain)**



Network Level Traffic Impacts

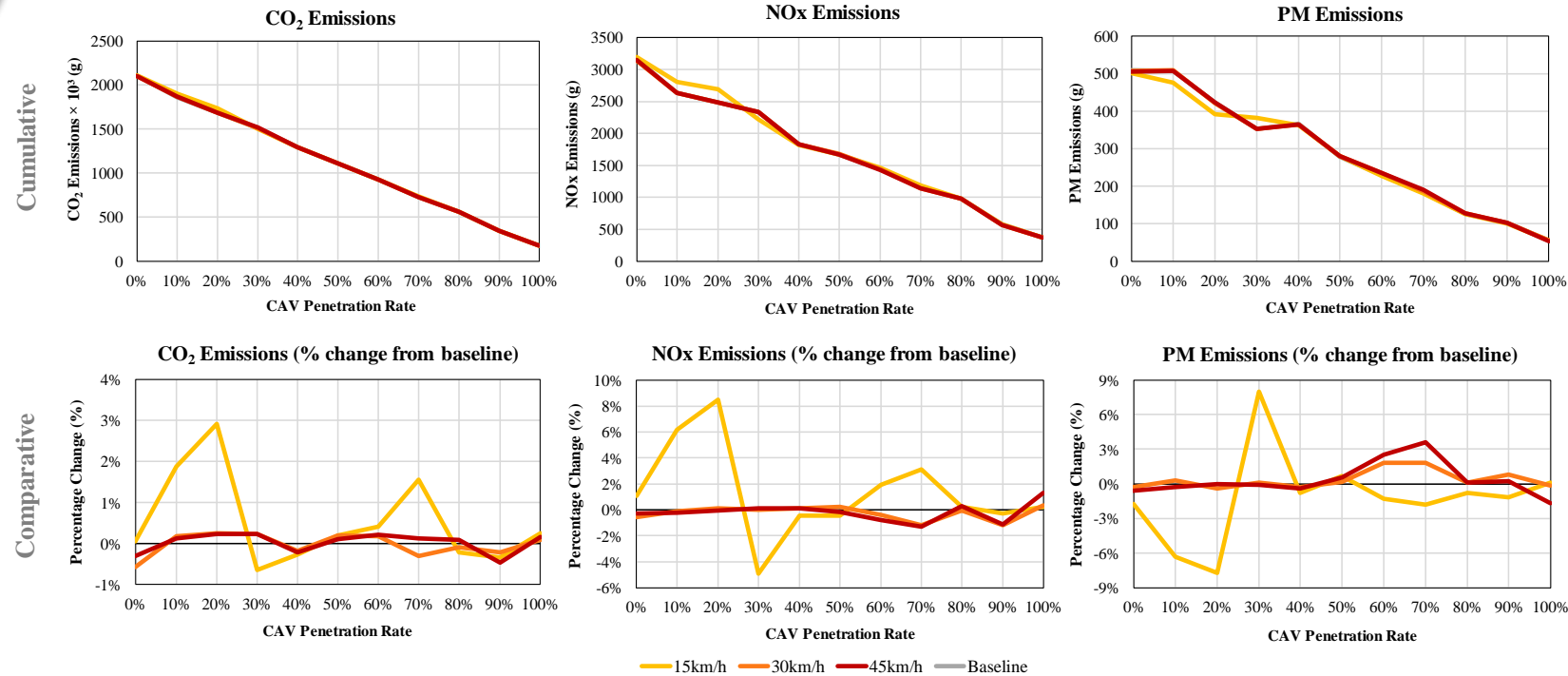
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- By increasing CAV MPR, the **traffic conditions are improved** and specifically, speed is increased, while delay time and distance travelled are decreased.
- Higher operational speed services (30 and 45 km/h) lead to **lower delay time, higher driven kilometers** for CAV MPRs above 30%, while no differences are noticed in speed values.

Network Level Environmental Impacts

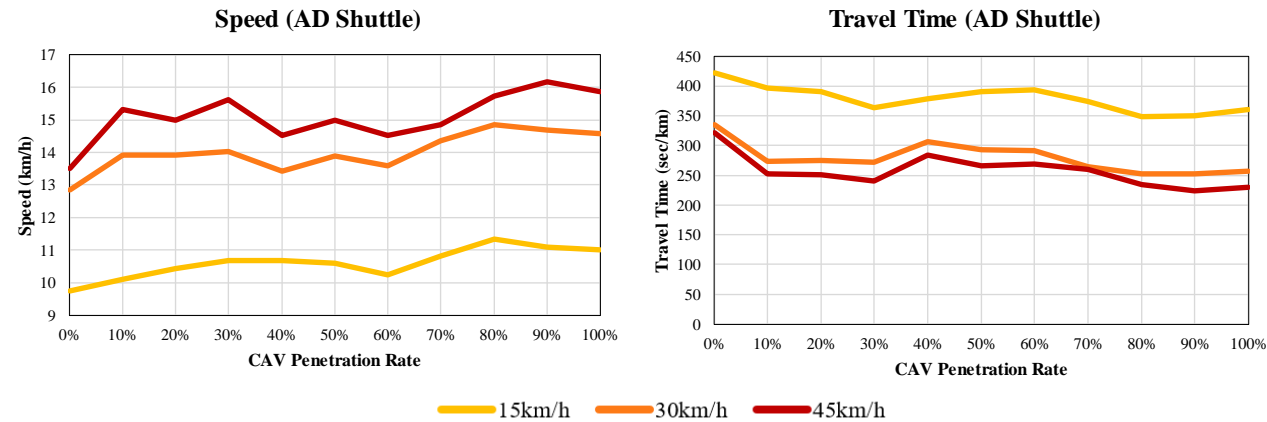
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- **Traffic emissions are decreased** linearly and drastically when increasing CAV MPR.
- 30 and 45 km/h operational speed services lead to **emissions similar to the baseline ones** across all MPRs, while the 15 km/h speed service fluctuated drastically below 70% MPR.

Shuttle Service Level Impacts

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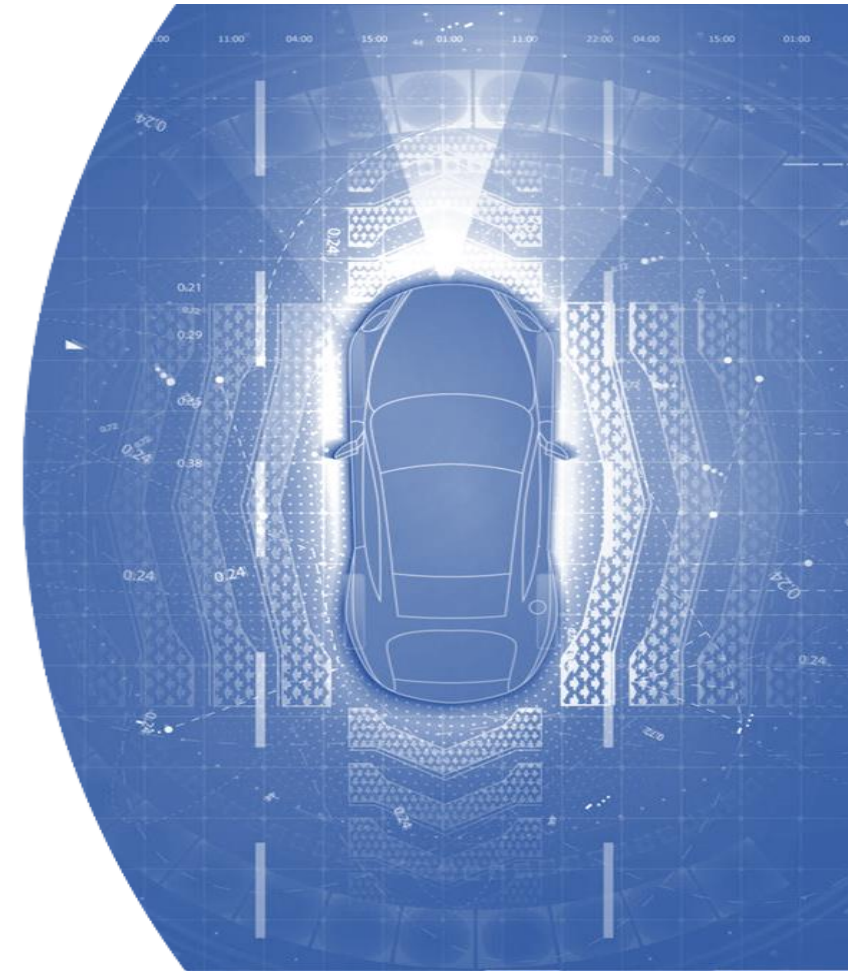
- By increasing CAV MPR, shuttle service **mean speed is slightly increased**, while travel time was decreased.
- 30 and 45 km/h speed services **fluctuated similarly** through the increasing CAV MPR.
- 45 km/h speed service records the **highest speed and lowest travel time**, while the 15 km/h operation records the lowest and highest respectively.

Conclusions

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- **Both traffic and environmental conditions** are improved when more CAVs exist within the network. Specifically, average speed is increased, while delay time, distance travelled and traffic emissions are decreased.
- No major differences between the **different operational speed services** were noticed on network level.
- A **higher operational speed** of an automated shuttle service operates **more efficiently** for lower CAV MPRs, while it seems that does not impact traffic and environmental conditions in higher MPRs.





Thank you!

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