Decision support system for accessing costs and risks of connected and autonomous vehicles as mobility service in urban contexts

Mónica Rodrigues[a], Maria C. Costa[b], Jorge M. Bandeira[a]

[a] Department of Mechanical Engineering, Centre for Mechanical Technology and Automation (TEMA), University of Aveiro

[b] Department of Mathematics, Center for Research & Development in Mathematics and Applications (CIDMA), University of Aveiro

ABSTRACT

A predicted increase of connected autonomous vehicles (CAVs) in our roads paved the way for new opportunities and challenges towards the promotion of sustainable mobility. However, the impacts of CAVs on the road environment and its implications are widely dependent on technological choices and public policy [1,2].

Therefore, this research (PhD Workplan) intends to assess whether CAVs could be effective mobility solutions for improving social, economic and environmental efficiency [4]. This question will be addressed by developing a decision support tool driven by comprehensive data analysis and modelling processes. The outputs achieved will integrate a tool that will support transport system's planning and the implementation of urban strategies to introduce CAVs [3,5].

Thus, the research's main focus encompasses the development of a model-driven decision support system (DSS) that allows assessing the costs and risks of implementing CAVs in urban context [3,4]. Three specific research objectives are assumed: I) Predicting impacts of CAVs operation in urban contexts, by analyzing cost-efficiency, transportation demand and mobility patterns considering market penetration scenarios of CAVs in Portugal; II) Conceiving a hybrid transport planning tool to assess possible restrictions to CAVs on different types of links through field data testing and simulating scenarios using a microscopic traffic model. Data will support the development of a macroscopic model for a full network assessment performance; III) Developing a multidimensional decision tool directed to a wide range of stakeholders, both from public or private sectors, to compute the benefits, costs, constraints and risks of implementing CAVs on urban mobility systems.

Preliminary results from different urban arterials indicate that CAVs can have negative or negligible impacts in some urban contexts. However, if the impact on the traffic flow's energy performance is considered into the internal car following algorithm, global energy savings of up to 12% can be achieved.

KEYWORDS: Future Mobility, Mobility Planning; Predictive modelling; Risk Analysis for CAVs.

ACKNOWLEDGEMENTS

This work was supported in part by the FCT- Fundação para a Ciência e a Tecnologia under Project UIDB/00481/2020 and Project UIDP/00481/2020; in part by Centro2020 Regional Operational Programme, under the PORTUGAL2020 Partnership Agreement, through the European Regional Development Fund under Grant CENTRO-01-0145-FEDER-022083; in part by the Driving2Driverless under Grant POCI-01-0145-FEDER-031923; in part by DICA-VE under Grant POCI-01-0145-FEDER-029463; and in part by InFLOWence under Grant POCI-01-0145-FEDER-029679.

REFERENCES

[1] Conlon, J., Ballare, S., Lin, J., (2018). Analysis of environmental impacts of autonomous vehicles. In Transportation Research Board 97th Annual Meeting (No.18-05434).

[2] Litman, T. (2020). Autonomous vehicle implementation predictions: Implications for Transport Planning. Victoria, Canada: Victoria Transport Policy Institute.

[3] Mirchandani, D., & Pakath, R. (1999). Four models for a decision support system. Information & Management, 35(1), 31-42. DOI:10/1016/s0378-7206(98)00074-3.

[4] Schroten, A., Esse, H., Wijngaarden, L., Sutter, D., Parolin, R. Fiorello, D., Brambilla, M., Maffii, S., Beyrouty, K., Fermi, F. & Bieler, C. (2019). Handbook on the external costs of transport: version 2019. Luxembourg: Publications Office of the European Union.

[5] Yatskiv, I., & Yurshevich, E. (2015). Data Actualization Using Regression Models in Decision Support System for Urban Transport Planning. In Advances in Intelligent Systems and Computing (pp. 553-561). https://doi.org/10.1007/978-3-319-19216-1_53