

Title Page

Title: **Evaluation of Sustainable Shared Mobility Initiatives in Rudersdal Municipality**

Sílvia Casamitjana Formiga^{a,b}, Carlos M. Lima Azevedo^b and Romèò Arianna^c

^aIndustrial Engineering and Management Engineering, Universitat Politècnica de Catalunya; ^b Department of Technology, Management and Economics Intelligent Transportation Systems, Technical University of Denmark; ^c Centre for Regional Development, the Capital Region of Denmark

Corresponding authors

Sílvia Casamitjana Formiga
silviacasamitjana@gmail.com

Carlos M. Lima Azevedo
climaz@dtu.dk

Romèò Arianna
romeo.arianna@regionh.dk

Statement:

This project is co-financed by the GEMINI project under Grant Agreement No. 101103801.

Disclaimer:

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the Climate Infrastructure and Energy Executive Agency (CINEA). Neither the European Union nor CINEA can be held responsible for them.

Evaluation of Sustainable Shared Mobility Initiatives in Rudersdal Municipality

Sílvia Casamitjana Formiga^{ab}, Carlos M. Lima Azevedo^b, Romèò Arianna^c

^aIndustrial Engineering and Management Engineering, Universitat Politècnica de Catalunya; ^b Department of Technology, Management and Economics Intelligent Transportation Systems, Technical University of Denmark; ^c Centre for Regional Development, the Capital Region of Denmark

Background and purpose

In recent years, shared mobility has primarily spread in large cities and it is still a relatively new concept in the Danish context, especially outside of big cities. What has not been addressed much is whether shared mobility can complement public transportation (PT) by design in Denmark, as it is the case in other countries (e.g.: the Dutch bike-sharing service OV-fiets, owned by the Dutch Railway). In this context, this paper analyses the performance of a PT-sensitive shared mobility initiative in the suburban municipality of Rudersdal, Denmark.

This work was carried out as a collaboration at the Technical University of Denmark (DTU) in collaboration with Region Hovedstaden, in connection with the European-funded Horizon Project GEMINI (No. 101103801). This initiative aims to develop and test sustainable business models for New Mobility Services to accelerate the transition to climate neutrality by promoting a modal shift toward shared mobility, active travel, and micromobility, as well as improving their seamless integration with public transport (Gemini Project, n.d.; Horizon Europe Programme, 2022; Pék et al., 2024).

The focus of the GEMINI Project in Denmark is the implementation of a multimodal mobility hub in Rudersdal that connects public transport with shared mobility options. These hubs' premise is to serve as visible, accessible interchange points designed to enhance connectivity, support multimodality, and reduce dependence on private cars. By offering designated pick-up and drop-off areas, they also increase the visibility and reliability of shared vehicles and help to improve acceptance among non-users (Czarnetzki & Siek, 2023; Nikitas et al., 2025; Region Hovedstaden, 2025).

In this work we evaluate shared mobility usage patterns and their relationship with public transport in the Rudersdal pilot, using operational trip data and user survey data provided by the mobility operators. Rudersdal is a suburban unit located in the northern sector of the Capital Region of Denmark, characterized by a mixed landscape of low-density residential zones and peri-urban natural environments. Functionally, the municipality is integrated into the Greater Copenhagen metropolitan system through a regional rail (S-train), arterial road corridors, and high-frequency bus services. This spatial and infrastructural connectivity facilitates daily commuter flows to central Copenhagen while maintaining a semi-urban environmental context suitable for field-based experimental research (Knowles, 2012). However, first–last mile constraints persist due to dispersed urban form and dependence on feeder modes for access to main transit nodes.

Our analysis focuses on the analysis of shared mobility patterns over a one-year study period (Aug 2024 - Jul 2025) and to extract insights that can support future shared mobility deployments by operators, the municipality, and other stakeholders in managing mobility in suburban areas.

This work is guided by the following research questions:

1. How do shared mobility demand and trip characteristics vary across temporal and spatial dimensions?
2. What differences in trip characteristics can be observed across user segments?
3. To what extent and under which conditions does shared mobility complement or act as a connector to public transport?

Methods, analyses and procedures used

Using one year of operational trip data (August 2024 - July 2025) from three shared mobility operators, combined with user survey data, the thesis examines how shared mobility usage patterns vary across temporal and spatial dimensions, how these patterns differ across user segments, and how shared mobility connects with public transport. The three operators, Dott, GreenMobility, and KINTO1 represent app-based shared mobility operators in the Copenhagen region that provide station-based bike sharing, two-way and one-way car-sharing services respectively designed to complement public transport by improving first–last mile accessibility and reducing dependence on private car ownership.

Temporal patterns were analyzed at hourly, daily and seasonal scales to capture fluctuations in usage over the course of the day, week and year. The spatial analysis explored how trips were distributed across

¹ <https://ridedott.com/>, <https://www.greenmobility.com/dk/en/>, <https://kinto.services/dk/en/>

zones and hubs, identifying areas of high activity and highlighting differences between user groups and between weekdays and weekends.

To assess integration with public transport, the analysis examined the proximity of shared mobility trip origins and destinations to public transport stops, compared shared mobility travel times with alternative modes through Google Maps API queries, including public transport, walking and driving, and used classification trees and logistic regression models on user survey data to understand factors influencing intermodal trips.

Results

The results show that shared mobility demand differs significantly between weekdays and weekends, as well as across seasons and times of day. E-bike-sharing usage is highly seasonal and weather-dependent, whereas car-sharing services are more stable year-round. Weekday demand is strongly linked to commuting peaks, whereas weekend usage is more evenly distributed throughout the afternoon and evening. Trip durations varied by operator: most e bike trips lasted under 10 minutes, GreenMobility car trips under 1 hour, and Kinto's round trip model encouraged multi hour or multi day bookings. Spatially, trips are concentrated around mobility hubs, public transport stations, residential areas, academic centres, and business parks. User segmentation reveals that frequent users typically make shorter, routine journeys, while occasional users display more diverse and less predictable travel behaviour.

The analysis further proves a connection between shared mobility and public transport. Most trips start or end close to public transport stops (ca. 100m distance), indicating a potential first- and last-mile function. Travel time comparisons across transport modes show that shared mobility is most competitive for short trips, while public transport remains faster for longer journeys. Survey results indicate that a notable share of respondents reported combining shared mobility with public transport (39% of Dott users and 28% of GreenMobility users), and that younger users and those used to active modes are more likely to do so.

Overall, the findings demonstrate that shared mobility can function effectively outside major urban centres like Copenhagen when supported by appropriate infrastructure, such as mobility hubs located near public transport and points of interest. While the analysis is limited by data availability and its focus on a single municipality, the results suggest that shared mobility has significant potential to improve accessibility and promote more equitable and sustainable mobility systems in suburban contexts. Future work should explore integrated Mobility as a Service platforms and the expansion of shared mobility solutions across other suburban Danish contexts.

References

- Czarnetzki, F., & Siek, F. (2023). Decentralized mobility hubs in urban residential neighborhoods improve the contribution of carsharing to sustainable mobility: findings from a quasi-experimental study. *Transportation*, 50(6). <https://doi.org/10.1007/s11116-022-10305-9>
- Gemini Project. (2023). GEMINI homepage, from <https://www.geminiproject.eu/>
- Horizon Europe Programme. (2022). GEMINI Greening European Mobility through cascading innovation INItiatives.
- Knowles, R. D. (2012). Transit oriented development in Copenhagen, Denmark: from the finger plan to Ørestad. *Journal of transport geography*, 22, 251-261.
- Nikitas, A., Alyavina, E., Sadik, C., & Michalakopoulou, K. (2025). Decoding mobility hubs: Opportunities and risks underpinning their introduction for the contexts of transport and the wider society. *Journal of Transport Geography*, 127, 104296. <https://doi.org/10.1016/j.jtrangeo.2025.104296>
- Pék, J., Kruszel, M., Arianna, R., Desiderio, A., Papanikolaou, A., Suchaneck, A., Ciccarelli, G., Sarang, A., Soufflet, S., Lipaj, A., Sencar Srdic, M., Furian, K., Ferreira, C., Balu, H., Silva, J., Tengvall, R., & Heikkilä, K. (2024). Greening European Mobility by Accelerating the Adoption of New and Shared Mobility. D3.1. Interim Progress Report of Mobility Living Lab Implementation.
- Region Hovedstaden. (2025). GEMINI. D3.3 Copenhagen Demonstrator. Interim Report.