How Driving Automation Will Save Demand Responsive Transit

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Introduction

Research background

- The decline of public transport ridership and increased congestion has led to the proposal of several other solutions through the years, one of them being Demand Responsive Transit (DRT), or with its modern branding, micro-transit.
- Despite being viewed as a potential savior for public transportation, these services have not lived up to their promise. Ridership is low, and more than half of the systems have failed within a few years, diverting investment away from a much-needed public transit system. The reasons for failure are mainly due to high costs and low ridership with modern technology failing to improve the situation.

Research objective

- This research investigates the viability and potential advantages of deploying a DRT service in low-demand areas, with a particular emphasis on how driverless technology could influence this service.

Methodology

The analysis employs a three-step process.

1. **Estimation of demand:** The travel demand for transit is estimated based on service features such as fares and travel times.
2. **Operator model:** An integer linear programming (ILP) model is applied to optimize aspects such as fleet size, vehicle routing, and the number of drivers/supervisors to achieve profit maximization. A two-dimensional time-space network is used to build an integer programming (IP) model that optimizes the DRT system movements by using flow variables instead of individual routing variables.
3. **Estimation of key performance indicators (KPIs):** KPIs are used to evaluate the service from multiple stakeholder perspectives. The analysis covers operational costs, subsidies, consumer surplus, and social welfare under different fare rates.

Results

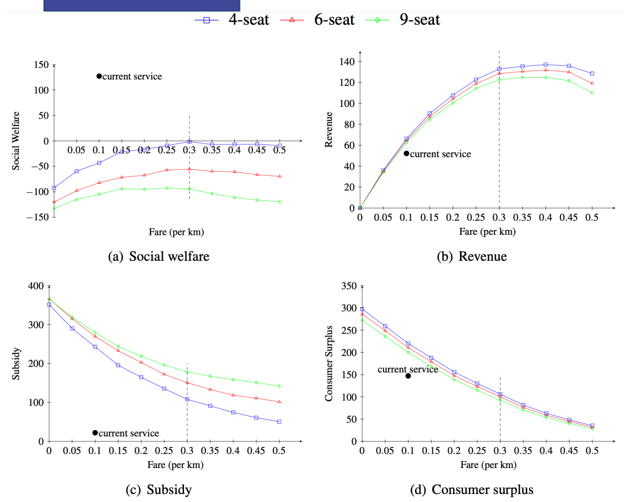

Figure 1. Overview of human-driven metrics (all are in thousand euros per day)

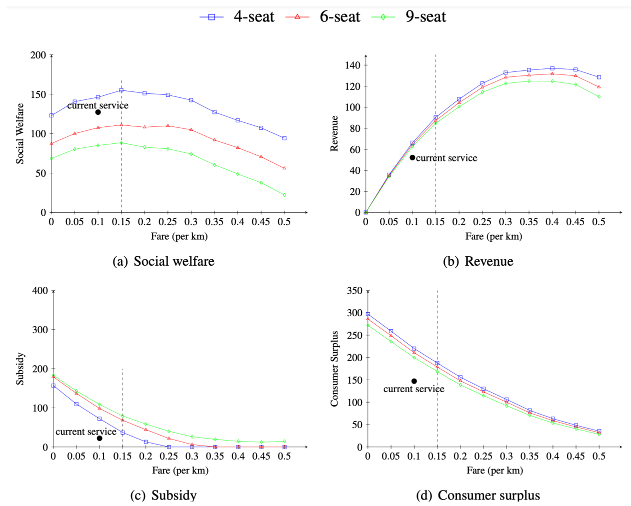

Figure 2. Overview of driverless service metrics (all are in thousand euros per day).

Conclusion

- Human-driven DRT service could, without adjusting the fare, serve approximately 20% more travelers than the existing fixed-route service, with a significant increase in consumer surplus. However, the operational costs and necessary subsidies for the human-driven DRT are considerably higher, resulting in a net reduction in social welfare compared to the current service.
- In contrast, implementing a driverless DRT service with optimized fares (which result in a 50% increase over the current fare) can improve social welfare by 10-30%, especially with smaller vehicles (4-seaters) better suited for low-density regions. Although higher subsidies are expected, the relatively low operational costs make them more manageable, providing a better balance between cost and service quality.

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