

# Public Transport Goes Autonomous – Identification of Tasks for the Human Vehicle Operator

## Master's Thesis of Melanie Barche

### Mentoring:

M.Sc. Johannes Lindner

M.Sc. Mario Ilic

M.Sc. Santiago Álvarez-Ossorio Martínez

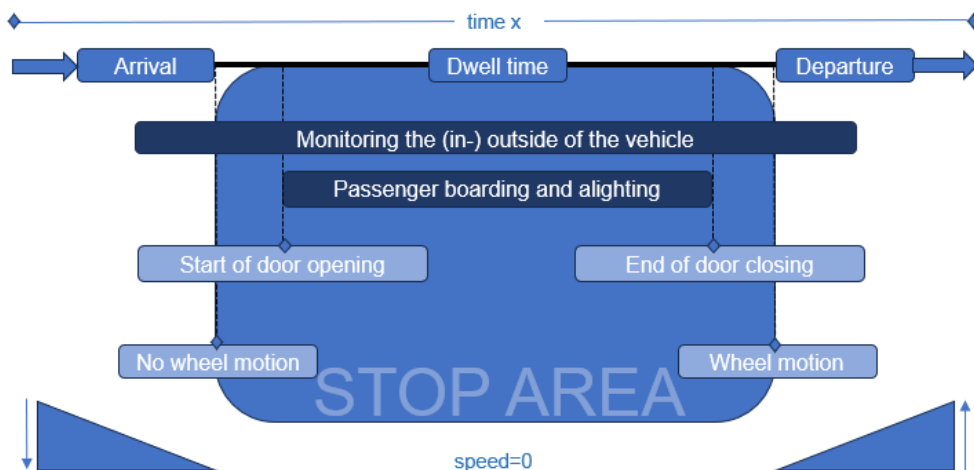


Fig. 1 The stop process

### Automated vehicles

- In addition to driving tasks, bus pilot projects already include communication and assistance functions, depending on the application and location
- The tram sector is initially focusing on depot automation
- Metro automation can be stated as an established operation with over 60 projects worldwide

### Human vehicle operator tasks

- Identified driver tasks largely align with the respective service instructions
- Drivers are required to perform sight-related, driving-related and service-related tasks (Fig. 2), which explicitly include monitoring all conditions in and around the vehicle, driving the vehicle correctly and with foresight, and dealing with customers
- Driver tasks differ between sectors, due to different systemic characteristics, external influences and available equipment

### Concept development

- Measures have been introduced to improve overall monitoring through sensor systems, the accessibility of vehicles through gap-bridging measures, the passenger information and overall, increase the level of safety
- Some examples are: Platform screen doors, cameras and radar sensors, ground traffic lights, acoustic and visual signals, interactive service terminal
- Futuristic equipment like Artificial Intelligence (AI) and Vehicle-to-everything (V2X) communication could take over drivers' tasks that relate to recognizing and predicting human behavior and reducing uncertainty in a complex driving environment

### Background and aim

Developments towards autonomous public transport require deeper knowledge of existing driver tasks to enable an operation without a loss of current service quality and safety. Next to the scarcity of scientific literature, available task descriptions lack a level of detail and represent an overall broad perspective.

This work aims to identify and summarize human driver tasks in the stop processes (arrival, dwell time and departure) (Fig. 1) of bus, tram and metro operation. To achieve this goal, qualitative expert interviews were conducted, and service instructions were consulted and analyzed.

Additionally, this work handles a concept development for the integration of technical solutions (vehicle-based and infrastructure-based) to enable automated operation in the stop process.

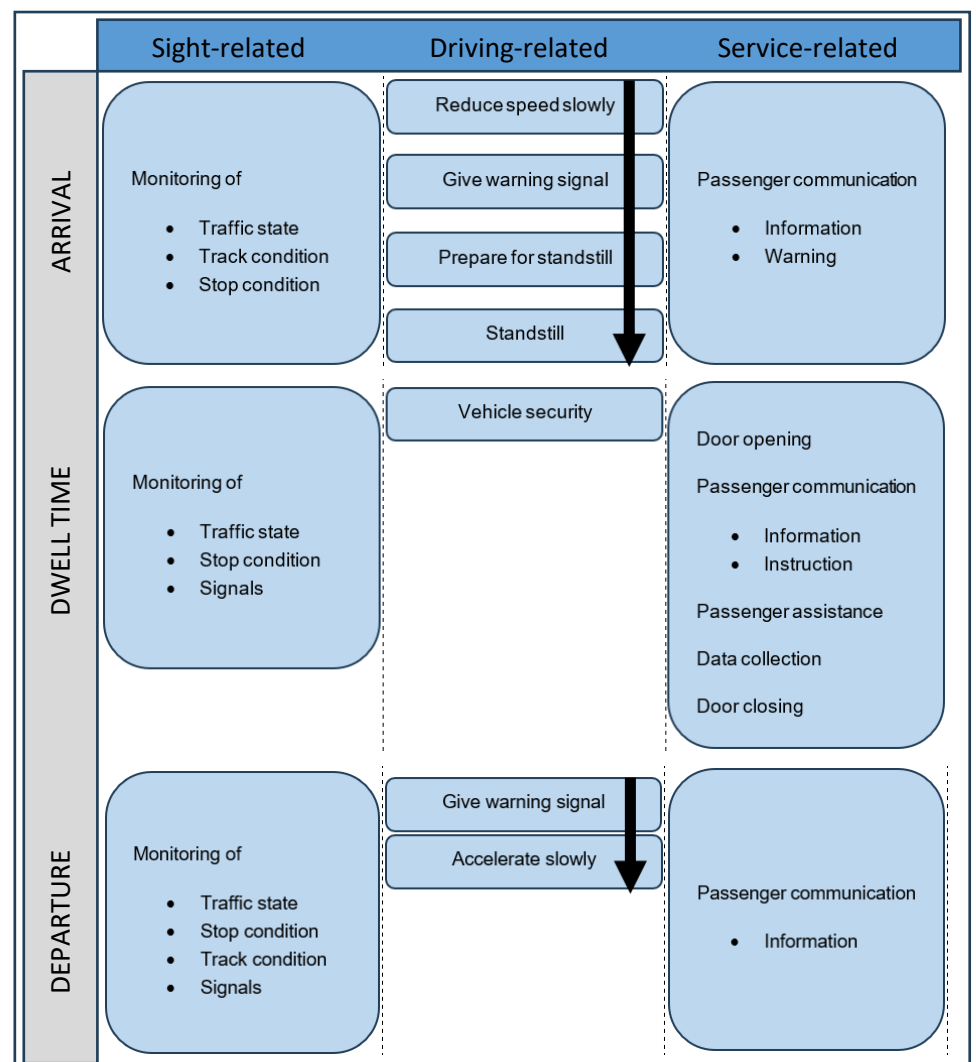


Fig. 2 Tram drivers' tasks in the stop process

### Discussion

- Sight- and driving-related tasks of the driver can be overtaken by sensor systems and accurate algorithms and actuators
- Accessibility measures are only a support, but do not provide a fallback-level
- Technical systems cannot cope with events that require authority and the quick presence of a human being