SARA1 Project Report

Shared Automated Vehicles - Research & Assessment in a 1st pilot

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1 Background

Automated vehicles (AVs) are developing fast on a technological level. The potential of AVs come with business and system level benefits as well as a potential value delivered through services to users of transport systems. Autopiloten is one of the pilots and initiatives of shared automated vehicles that are occurring in Sweden. SARA1 is a research project that complements Autopiloten aiming to understand the effects and potential of AV:s for shared services. It is important to not only evaluate these pilots from a technical perspective but also to start assessing societal, users and system perspectives.

SARA1 Project members were researchers from two different schools of KTH, coordinated by the Integrated Transport Research Lab (ITRL), and working closely with Nobina Technology AB, the autonomous bus operators. The research included three wave survey and a simulation study. New findings risen from the project for assessing user willingness to use and pay of shared automated vehicles as well as system level effect of pilot AV on existing public transport systems. The data has been collected & analyzed during spring and summer of 2018. The interest for the project has been big, both national and international. It has been presented at more than 4 academic and industry conferences, more than 2 academic publications.

The project has been successful in several ways. Targets has been reached, and knowledge about user perspective has been created and spread both within and outside the project community. It has led to insights and knowledge that may be used in development of future pilots, systems and services.

2 The purpose, research question & Method

The aim of the project has been to increase knowledge and understanding about how automated vehicles (AV) can contribute to and complement public transport, by collecting and analyzing data from a pilot in first pilot performed in Stockholm Kista during spring 2017.

During the study period, KTH ITRL team focuses on the impacts of the autonomous bus (AB) to the users both on individual level and system level. At individual level, we focused on the users willingness to use (WTU) and also willingness to pay (WTP) of the services. To achieve this objective, we deployed 3 waves of longitudinal survey among 500 respondents who live, work or study in or around Kista Science City and Helenelund train station. And the research questions were:

- How likely are people to use AV services?
- What are the factors affecting their acceptance and intention to use AV services?
- How do people perceive services operated by AV?
- In which ways would people changes their existing travel behaviour due to access to AV services?

At the system level analysis, the effect new autonomous busses have on existing public transport network in terms of vehicle frequencies, travel times, satisfied demand, and investment operating costs. The impact is determined based on an optimization-based simulation approach. For this aspect the research inquiry was on the tradeoff between investment costs and service provided.
3 Objectives

The project objectives have been:

- Understanding the usage of the service and the reasons that influence the decision.
- Analysis on how AVs can be used for different types services, and who would be willing to use the service.
- Analysis on where and how to employ what kind of autonomous busses for public transport.

4 Results and objectives fulfillment

The results of the WTU and WTP studies show that users’ willingness to use and adopt a self-driving bus as a part of their last-mile transport for a longer term and trust level of ability of the autonomous bus (AB) to operate safely even without a steward on-board play influential roles in affecting their willingness to pay for AB services. Different groups of users prefer different types of AB services. Car owner, business owners, students prefer and have a higher WTP for premium AB services such as non-shared/limitedly shared AB service with little waiting time. Pensioners, on the other hand, would appreciated social interactions by taking shared AB services, instead of a premium service with little waiting time. WTU of people are also highly influenced by the expectation of what AB service would looks like in reality. For example, we found that the existing public transport users would not use the existing AB services as they perceived it would be much slower and less frequent than the existing public transport services.

Through the system level analysis, we found that AB has a potential to significantly improve the average frequency of the service. However, the demand and turn over impacts would highly depends on the route of the services.

Further details on the data collections, methods, and results can be seen at the technical report of the project.

5 Dissemination and publications

As a part of research dissemination, the research outputs have been disseminated in various events, including at/via:

1. the 7th Symposium of the European Association for Research in Transportation, Athens, Greece, 4-7 September 2018 (2 article presentations).
2. the 2018 Nationella Konferens i Transportsforskning, Göteborg, 15-16 October 2018 (2 article presentations).
5. Poster Presentation at Persontrafik Stockholm Fair 2018 (1 poster).
6. Presentation of results in Drive Sweden Forum at KTH, October 17th 2018 (2 presentations and panel discussion).
6 Conclusions & future research

When it comes to willingness to use a last mile shared AB service, travel fare is the basic factor that affects willingness to use the service. When travel fare is priced higher than travel fare of commuter train service, people willingness to use decreases. However, when the fare is priced cheaper than travel fare of commuter train service, people may not increase their willingness to use the service. Frequency is the key performance factor. Increase or decrease in frequency will affect people willingness to use the service. Ride comfort due to driving speed and pattern of AB acts as an exciting factor. Failure to fulfill this does not contribute much to willingness to use the service. However, when the ride comfort increases, people are more willing to use the service.

Unlike the normal belief that public transport users will be the potential users of last mile shared autonomous bus service, this study found that the existing public bus users are not ready to change their travel option to shared AB service. They perceive frequency of the last mile shared AB service to be bad. Similarly, those who walk for daily commute have low willingness to use last mile AB service. They perceive travel fare of using the service to be more expensive in comparison to travelling by train. Interestingly, those who use personal mobility device such as e-kick scooter and cycling for daily commute have higher willingness to use last mile AB service.

When it comes to willingness to pay for AB services, user willingness to use the service and their level of trust of the ability of the AV used in the service to interact safely with other road users on the road form the basic factors in influencing their willingness to pay for the AB services. For the services such as non-shared on-demand AB service and demand responsive shared AV service with short waiting time, users require certain standard of ride comfort from using the AB service. On another hand, for shared AV service with long waiting time, users do not concern about the ride comfort, but they concern about travel time of using the service in comparison to travel by car.

Those who are tech-savvy are readier to accept AV services and pay for the services. They have positive impression of AV services and express higher willingness to pay for the services. Those who know well about the technology behind automated driving technology have lower trust of AV being able to drive safely on road. Despite having positive willingness to use AV services, their willingness to pay for the services is low. Lastly, those who have experience of taking EZ10 ride trial operated in Krista express lower willingness to use AV services. Since the existing autonomous bus used in the trial operation cannot drive with the speed equivalent to normal bus and its need of human intervention to take over when it stops down, the autonomous bus cannot deliver the service qualities delivered by the existing public bus service especially on maintaining good frequency. Hence, those who have taken the ride and understand more about how an autonomous bus works have lower tendency to use and pay for the service.

The simulation part of the project conclusions be summarized in two take away points. First, the clear evidence for a reduction in total cost by deploying autonomous vehicles. In the case study “Kista Area” the most savings are generated if autonomous buses are deployed on AB lines 1, 2 or 4. A strong indicator for the magnitude of total cost savings can be seen in the passenger load on each line. The higher the passenger load, the higher the total cost savings are possible. Second, is the fact that the effect of the decision variables frequency and capacity have on the total cost outweighs in this analyzed case the effect of the vehicle type. This means that the deployment of autonomous buses on, especially, new bus lines must be according to frequencies and capacities which match the demand on these lines. A deployment of autonomous buses outside an optimal frequency and capacity has the negative effect of bad travel experience for the passengers. This will show in higher travel total times due to more frequent denied boarding’s and longer waiting times.

The gained knowledge can also be used for future projects as a general guideline on where and how to operate autonomous bus pilots. Especially the deployment of many buses and multiple different case studies can be analyzed fast and insight in the system performance can be gained.

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The results created, and the experience gained in this project will be used in more detailed analyzes and studies of large-scale deployment strategies of autonomous vehicles. The results will be published in an international high-quality journal by the end of the year, the journal will be either be Transportation Research Part E: The Logistics and Transportation Review or Transportmetrica A. Further presentation of the results will be done in Transportforum 2019 and the National conference in Transport Research. Also, moving on, research will focus on investigating overtime change in perceptions and intention to use last mile shared autonomous bus service based on the data collected from the second wave and the third wave of surveys conducted before.

7 Deltagande parter och kontaktpersoner

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