Final report

Automation for increased accessibility?

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1 Sammanfattning

Vi befinner oss i början på en transformation av transportsystemet som har möjlighet att leda till ett säkrare, mer hållbart och socialt inkluderande transportsystem. Automatisering, tjänstefiering och elektrifiering är komponenter som troligtvis kommer bidra till den visionen.

Stora grupper i samhället möter idag hinder i delar av transportsystemet, vilket antingen skapar begränsad rörelsefrihet för individen eller stora kostnader för samhället. I argumentet för autonoma fordon och det automatiska transportsystemet används ofta dessa grupper som exempel då man vill beskriva nyttan av denna teknikutveckling. Men hur väl möter dessa lösningar deras behov? Ser behoven olika ut för olika grupper, och kan de till och med vara i konflikt? För första gången har vi möjlighet att anpassa transportsystemet till dessa gruppers behov innan ramverk, tekniklösningar och infrastrukturmodeller fastslås. Istället för att tvinga fram dyrbara efteranpassningar, kan vi påverka utvecklingen genom att redan i utvecklingsfasen ta fram mallar och måttstockar för hur väl dessa behov tillgodoses.

Genom en serie workshops där specifika behov identifierades hos personer med funktionsnedsättning – specifikt personer som är blinda eller har en synnedsättning, respektive rullstolsburna – har projektet kartlagt nyttor som automatiserade fordon kan skapa för dessa användare. Projektet har också tagit fram en metod för att utvärdera och jämföra lösningar inom området automatiserade transportsystem utifrån identifierade nyttoperspektiv. Denna metod har sedan validerats genom jämförelse av två olika transportlösningar som bygger på fordon från EasyMile.

2 Executive summary

We are at the beginning of a transformation of the transport system that has the potential to lead to a safer, more sustainable and socially inclusive transport system. Automation, servicification and electrification are components that probably will contribute to that vision.

Today, large groups in society face obstacles in parts of the transport system, which leads to either restricted mobility for the individual or high costs for society. When arguing for development of autonomous vehicles and automatic transport system, these groups are often used as examples of who will benefit from this technology. But how well do these solutions meet their needs? Do the needs differ between groups, and may there even be conflicting needs? For the first time we are able to adapt the transport system to the needs of these groups before frameworks, technology solutions and infrastructure models have been determined. Instead of retrofitting a system already in use, we can influence the development by already in the development phase creating templates and standards for measuring how well these needs are met.

Through a series of workshops where specific needs of people with disability – specifically people that are blind, visually impaired or wheel chair users – the project has identified different types of benefits that automated vehicles can offer these user groups. The project has also developed a method for evaluation and benchmarking of solutions in the area of automatic transport systems based on the identified types of benefits. The method has then been validated through comparison of two different transport solutions based on the EasyMile vehicles.

3 Introduction

3.1 Background

Ensuring accessibility to public transport has historically meant retrofitting accessibility solutions onto the current transport system – adapting stops to allow boarding for people with physical impairments and step by step, as contracts run out, replacing older types of vehicles with newer that are equipped with ramps, wheelchair spaces, etc.

Through the development of a new, automated, transport system, we have an unique opportunity to influence the design of vehicles, infrastructure and legal frameworks from the start, so that all the positive effects for persons with disability that the technology promises can be realized. Thoughtfully designed with regard to these groups, the automated transport system has a great potential for increased accessibility.

This project has developed methods and tools that can be used to measure how well these goals are met by different proposed solutions.

3.2 Purpose and Research Questions

This project is motivated by the societal challenge to create a sustainable transportation system with high accessibility for all people. This work goes beyond traditional roadmaps that suggest increased research in situation awareness and intelligent sensor technologies to support AD development. Traditional incremental technological development typically has problems fully utilizing the benefits of the new technology since consideration must be taken to the existing system. Hence the importance of carefully designing a user-oriented system from the beginning to avoid costly and cumbersome add-ons.

The overall research question for the work presented in this project is: “How can the benefits of autonomous transports be measured?”

3.3 Aim

This project aimed to identify tools, methods and models to evaluate how automated vehicles can contribute to improved accessibility for persons with impairments.

4 Method

4.1 Research approach

The method proposed in this work is based on collaborative design thinking. Design thinking is a creative process used “to match people's needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity” (T. Brown, 2008).

4.2 Demography

The main participants in the workshops are the visually impaired. Between 5 and 10 persons from this user-group were present at the workshops, they were accompanied by researchers and transportation experts from e.g. vehicle OEMs, municipality and the local public transportation company. In total there were approximately 20 persons present at all workshops. The age of the participants was between 30-65 and it was a fairly even distribution of men and women at the workshops.

4.3 Segmentation

In Sweden alone there are approximately 120 000 persons that are visually impaired and out of these, 10 000 are severely visually impaired or completely blind. The total population in Sweden is 10 million (SCB, 2017). However, due to integrity reasons, it is not allowed to register impairment and thus, it is hard to give exact numbers. The flexibility of the eye’s lens is gradually reduced from the age of 40 (if not earlier), inevitably leading to the need of using glasses in order to see properly and consequently, be able to drive a car. Thus, 50% of all persons above 50 need reading glasses and all persons above 80 need them.

Although the visually impaired are among those that would benefit the most from an automated transport system, there are other groups whose mobility will be improved when such a system is in place: the elderly, children, people with more severe forms of physical disabilities, people with some types of cognitive disabilities – e.g. difficulty reading or interpreting information, concentration difficulties or intellectual impairment.

The sizes of the above mentioned groups can be roughly quantified based on information from Sweden. In Sweden there are about 150 000 persons (1,5%) with dementia, about 2 Million (20%) are under 18 years old (the necessary age for acquiring a driver’s license), 130 000 (1,3%) are wheelchair users, 4-5% have dyslexia, 3% of adults have ADHD and about 40 000 persons (0,4%) have an intellectual impairment.

For further statistics concerning the number of people with various kinds of disability, visit http://www.funka.com/design-for-alla/tillganglighet/statistik/

4.4 Identifying and assessing benefits of automated mobility solutions

Preparation workshop

The first step was to identify the possible focus areas relevant for the user group. This was accomplished in the Preparation workshop, where domain experts within transportation research, public transport, mobility services and city planning, gathered and a gross list of more than 50 focus areas were identified through a series of discussion tasks. The condensed list can be found below:

- The person travelling
- Ethics
- Public and private
- Technical developments
- The physical environment
- The vehicle
- Jurisdiction

Workshop 1

The first workshop with the user-group was named *Current state of transportation for visually impaired people*. At the workshop were 10 visually impaired persons and 20 persons with full vision. 5 groups were formed and discussions around the different phases of a trip were evaluated by means of how interaction-points were experienced by the visually impaired passenger. The purpose of the second workshop was to give all participants a common base of knowledge and insight about traveling as a visually impaired person. To give further information about how persons with visibility impairment are traveling, five of the visually impaired participants were accompanied by another person with full vision during the trip to the first workshop. The visually impaired person was instructed to make the journey as if she was traveling on a regular day. During the trip both video and voice recordings were made that were later used to give inspiration in the discussions. Especially the contact points between different modes in the transport were documented. Walking to the transport, getting on and off the vehicle, and finally, finding the way to the venue of the workshop which was previously unknown for all the participants. Examples of trips included public transport by bus, tram and ferry, and mobility service. This workshop clearly concluded, traveling as a visually impaired person is a troublesome activity. Forward planning while using mobility services is one example. Forward planning to have enough time to transfer between one mode of transportation to another is also a task that is troublesome. Being able to bring luggage, unless it is mentioned while making the booking, in the mobility service is another. Other facts discovered include that are often no announcements at a stop, notifying passengers what bus or tram is arriving at the stop, or while in the transport, what stop is next. This makes it difficult to catch the correct transport and leave the vehicle at the correct stop. Other issues are related to navigation and finding the address of the passenger (for the mobility service). Problems with comfort, including difficulties countering abrupt movements in a bus or tram while standing (or even sitting) were reported, sometimes leading to falls.

Workshop 2

The second workshop was called *Future expectations of the automated transportation system* and aimed to inform participants of future possibilities for transportation. This workshop included seminars around automated driving, mobility as a service, city design and public transport. Experts within those domains gave inspirational talks and the following discussions aimed at identifying the future vision of the participants who discussed questions like; *“How would you like to travel to work given that there are automated vehicles available?”*; *“How would you like to interact with the mobility service of the future?”*.

The result of these discussions gave input towards the goal of this work - identifying the benefits of automation for visually impaired people - where they identified the waiting time for a journey as distinct to the total journey time. This led to a separation between these two benefits. Another variable is comfort, where for example it is foreseen that it will be more comfortable to bring luggage, and to avoid switching between different modes of transportation.

In the following workshops, 3-4, the participants are guided through the design thinking process of ideation to generate scenarios which use their own travel patterns and what aspects they value and how these are accounted for in the future automated transport system. To be able to focus on the different interaction points, workshop 3 concerns Before, Way to and Way from the transport, whereas workshop 4 concerns During and After the transport.

Workshop 3

The third workshop was called *Interaction point investigations before the transport* and concerned the focus areas in Table 1 Before, Way to and Way from the transport. The participants were guided to identify interactions within each journey step where challenges exist today for visually impaired users. User-reported interactions and challenges identified during workshop 1 and potential solutions identified during workshop 2 were used as material to inspire the users. From this starting point, the participants used creative thinking to imagine potential solutions to these challenges. For the purpose of this work, the solutions needed not to be fully realizable, but to present a theoretical solution to the existing challenge. The groups then worked to identify and discuss in which ways they would experience benefits (in comparison with existing transport alternatives) if such a solution were to be implemented.

Workshop 4

The fourth workshop is called *Interaction point investigations During and After the transport* and concerned the focus areas in Table 1 During and After the transport. The focus and methodology for this workshop was otherwise identical to the preceding workshop.

Workshop 5

Before the fifth and final workshop the results from the previous workshops were gathered and the expected benefits were identified and described. The fifth workshop concerned two important activities. 1) Confirmation of the identified benefits and the description thereof, see Table 2. 2) The main activity was to assign values representing how important each benefit is to the user in their daily transport. The users were instructed to value each benefit in relation to their current travel situations in order to create a value that may be used for benchmarking future mobility solutions. The work was performed individually for each of the users in the group. The grading was between 1-10, there were 5 participants in total, 3 female and 2 male, age range for the group was between 30-65 approximately.

Interaction point	**Description**
Before	This interaction point includes the activities before the trip, e.g. planning and booking.
Way to	In this step the user translocates from, e.g. their home to the vehicle. This step also includes getting onto the vehicle.
During	This interaction point concerns travel within the vehicle, when the user is in the vehicle and any eventual inter- changes until she is getting off.
Way from	This step includes exiting the vehicle and the way to their final destination.
After	This step includes the interaction with the service after the journey, e.g. payment, feedback, customer service.
Interaction	This step describes all interactions with the transport system and autonomous vehicles outside of the journey itself, for instance as a pedestrian.

Table 1. Interaction points

Self-documenting methods

During the workshops all the outcomes were documented by the participants in a shared online document. Each group had one shared online document and all the group members were able to contribute in writing the findings of the group. This facilitated the data collection and reduces risk of mistakes during transcription etc. Audio recordings of the discussions were also collected and used to complement where details were missing in the written material.

5 Results

Based on the workshops a number of focus areas have been identified. Within each focus area are sub topics that further explains the details of the area. The purpose of this mapping is to assure that all relevant focus areas, where any benefit may occur, are covered. And ultimately, where in the travel process the potential benefit may be found.

5.1 Identified benefits of automation for visually impaired

Traffic safety

Safe transportation solutions are an enabler for automated driving. Without a high level of traffic safety it will be challenging to attain any of the following benefits.

Personal safety

Visually impaired persons are vulnerable in several ways. To be able to trust the system to take you to your desired destination in a safe manner and prevent putting the passenger in any peculiar or dangerous situation is also an enabler for automated driving for the user group. Generally, in the case of ridesharing it is important to not let in any unauthorized person into the vehicle.

Travel time

Road vehicle automation can reduce travel time mainly due to increased road efficiency (vehicles can drive with shorter time-gaps) and due to automated routing, plan- ning and optimization.

Waiting time

Automated and connected vehicles can give more precise estimated-time-of-arrival (ETA) to the passengers, thus, reducing contingency of ETA.

Accessibility

Reconstruction of the transportation system allows design of vehicles and infrastructure that allow both common use and handle individuals with special needs. Accessibility concerns e.g. how to on-and-offload auxiliary means, luggage, grocery etc. In addition, without stigmatization, being able to have flexible functions that support accessibility of automated transport, e.g. support in getting access to the vehicle, finding it and getting in and out.

Comfort

An automated vehicle has the potential to give the passengers a more comfortable ride. Seating and interior design are both enablers of comfort. The definition also includes comfort while waiting for the transport to arrive.

Flexibility

An automated vehicle should be able to adapt to the needs of the passengers. Flexibility concerns how well the transportation system is designed to handle the transportation needs. For example, how flexible is the system to make an extra stop along the trip?

Predictability

Eliminating the human driver from the transportation service allows automated and transparent information flow between the vehicle/service and the customer/passenger. This in turn makes the service more predictable making the service more attractive for the user-group.

Safeness

Being in control of the situation and to be able to travel completely on your own in a safe manner is an enabler for a successful introduction of automated vehicles. It should be safe in terms of feeling safe that the car is not lost or will not stop in an unsafe area. To feel safe in the vehicle while on your own, can be enabled by voice controlled communication to a service operator.

Independence

Being able to be completely in control of your travel is a sign of independence.

Socially acceptable

Society in general needs to accept that self-driving cars will be used by all members of the transport system. Visually impaired as well as children. Social acceptance is an enabler for the introduction of AD. With the assumption that future automated vehicles will be self- driving (SAE level 5), and shared e.g. not owned by the driver/passengers, we may see increased ridesharing and in particular it would be possible to provide services that enables ridesharing with like-minded persons.

Social integration

Social integration refers to social equality and that all needs are acceptable.

Integrity

Personal data about passengers or their location should not be shared with the surroundings. The vehicles should be designed so that they do not call attention to or unduly expose the passengers.

5.2 Identified benefits of automation for wheelchair users

The participants in the workshop series included both persons with visual impairments and wheelchair users. The list of identified benefits was found to be the same for both target groups.

The group of wheelchair users was deemed too small a sample group to produce figures for a measurement tool. This is a potential area for further research.

A substantial amount of qualitative data was collected regarding both travel experiences using today’s travel system as well as ideas and possibilities for future solutions to existing challenges. These have been documented in the Customer Journey Map.

6 Measurement tool for accessibility

The elicited benefits concern many aspects of both physical travel and social life, namely traffic safety, personal safety, travel time, waiting time, accessibility, comfort, flexibility, safeness, independence, predictability, social acceptance, social integration and integrity. From an industrial and societal perspective it is desirable to harmonize the development of the components within the transportation system to allow efficient usage and accessibility. The benefits may be used for evaluation and benchmarking in several activities e.g. in the development of business models and design, prototyping and evaluation of products or services.

Here we present the proposed method. In the most general description it is a tool that can be used to investigate the expected benefit of a proposed mobility solution. In this work we have particularly focused on mobility solutions for visually impaired persons, some were visually impaired from birth whereas some were visually impaired because of illness.

The first part of the final workshop started with a discussion about the expected benefits, found in Section 5, to make sure all participants had the same interpretation of the benefits. During the second part, the participants graded the importance of the particular benefit for five parts of their travel process namely, before, to/from, during the transport, after and how they interact with the service/vehicle outside their transportation. The task was to take into account their everyday travel. The median score and the sample width of the score of each benefit can be found in Table 2 and the median, min and max values are visualized in Figure 2-6.

The mean score forms a reference score and indicates how important the corresponding benefit is for the user today, and how well they meet the user expectations, in their utilization of mobility solutions. Two different approaches can be applied to use the scores for future evaluation.

6.1 Benchmarking through comparison

With the results obtained from the user group we now know how they value the benefits in their everyday travel. By letting the user-group value a new mobility solution that is introduced, a benchmark can be made to compare how well the new mobility solution meets the expectations of the users. The scores of each benefit can be compared to the reference scores one by one.

6.2 Benchmarking through rating score aggregation

To allow comparison of the general opinion of two mobility solutions an aggregated score may be used. The median estimator is used to aggregate the scores from the different users for each benefit. To provide a detailed scale, we use the mean estimator to aggregate all benefits from the user group of the mobility solution *m*. The mean value η is calculated by

$$\eta_m = \frac{1}{MN} \sum_{j=1}^{M} \sum_{i=1}^{N} C_{j,i}$$

where *C* is the median value of the current benefit *i*, within the current interaction point *j*. *M* is the total number of interaction points and *N* is the total number of benefits.

The benchmark is performed by comparing the aggregated value of the two mobility solutions η_1 and η_2.

To illustrate the usage of the model, we introduce a realistic example from a bus shuttle service enabled by the automated vehicle provided by Easymile. The ratings in the example below are however fictional.

The shuttle is electric, drives in low speed and has room for in total 12 passengers and is used in a few cities today[1]. It can be operated in both metro mode and in on-demand mode. In metro mode it stops at all stations on a pre-defined route on a fixed time table. In on-demand mode the vehicle is called as a taxi.

To evaluate and compare the user group's expected benefit of the two Easymile service modes, we ask the question: "How well do the metro/on-demand services respectively cover your mobility needs and your expectations?"

The user group then rate each benefit in Section 5 for each of the five different interaction points for metro mode (MM) and on-demand service mode (OD) respectively. With 13 benefits, five interaction points, and two service modes the users have to make 130 ratings for a complete evaluation. If necessary, focus can be put for example on one interaction point (e.g during the travel) to reduce the number of ratings at a specific time.

Figure 7 visualizes a comparative evaluation of the two Easymile service modes in relation to each benchmark benefit dimension. In the example, the benchmark benefit rating originates from the workshops described in Section 4, while the ratings of the Easymile service are fictive for the example. The figure shows that most ratings are within one standard deviation of each benefit, some are higher, and one is lower than the mean minus one SD. If we take a closer look at the *Predictability* benefit, we can see that the on-demand service mode does not reach up to the desired predictability of transports in daily life. On the other hand, the metro service mode exceeds the desired predictability.

For the rating of *Flexibility*, the on-demand mode is significantly higher than the desired flexibility whereas for the metro mode, the rating is at the lower end of the desired level.

This method can be used in several ways. Firstly, the visualization in Fig. 2 clearly shows where the service modes are better or worse than the benchmark. This can be used to direct improvement efforts to specific aspects of the travel. The graph shows the strengths and weaknesses of each service mode. For example, the on-demand service needs to improve its predictability. Secondly, by applying the weighting formula in Equation 1 the aggregated values can be used as decision support when comparing the overall benefit of a technology or service for a specific user group.

The aggregated results in Table 4 indicate that the on-demand service has a higher aggregated rating score. By splitting the aggregated values into the five interaction points we can see at what interaction point the differences are. For example, depending on the particular needs of the user of the tool, different focus areas may be of interest. For the infrastructure provider the two first interaction points may be of greater interest and for the vehicle manufacturer the third interaction point may be more interesting.

However, the method is developed to highlight the individual benefits for the particular user-group and while aggregating the results in a mean value, valuable information is lost.

[1] easymile.com

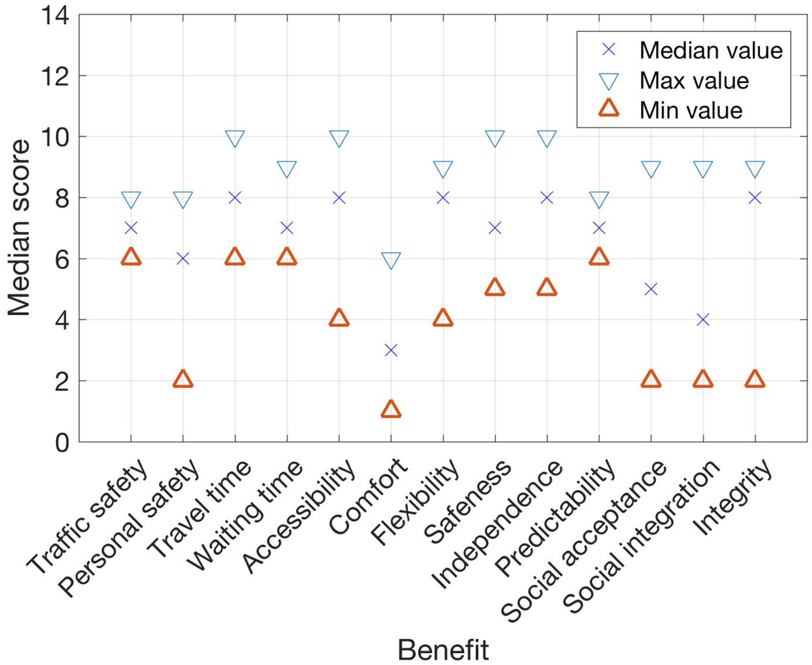

Figure 2. Median and sample width of the identified weights of the benefits of automation for the visually impaired user group for the first interaction point (before transport).

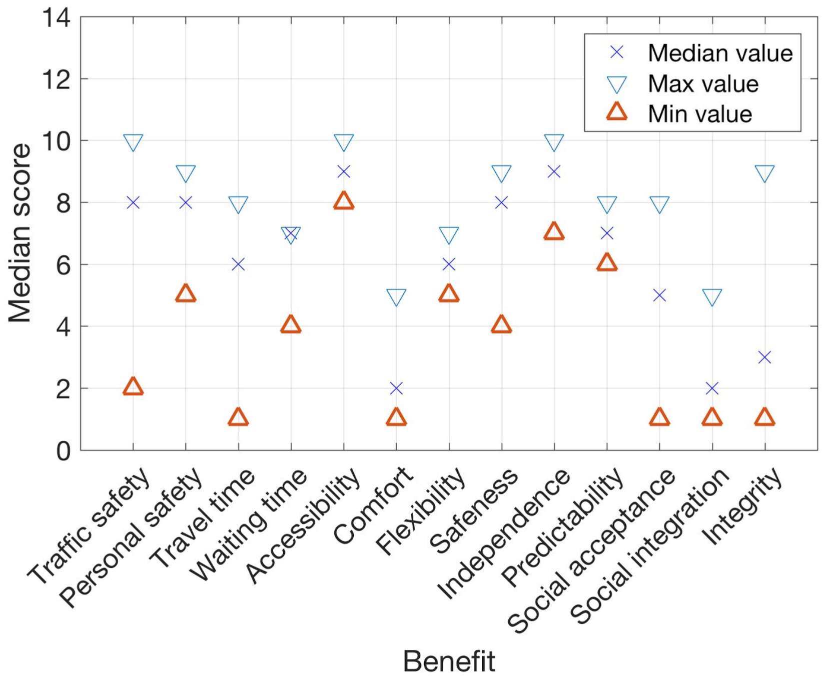

Figure 3. Median and sample width of the identified weights of the benefits of automation for the visually impaired user group for the second interaction point (way to/from transport).

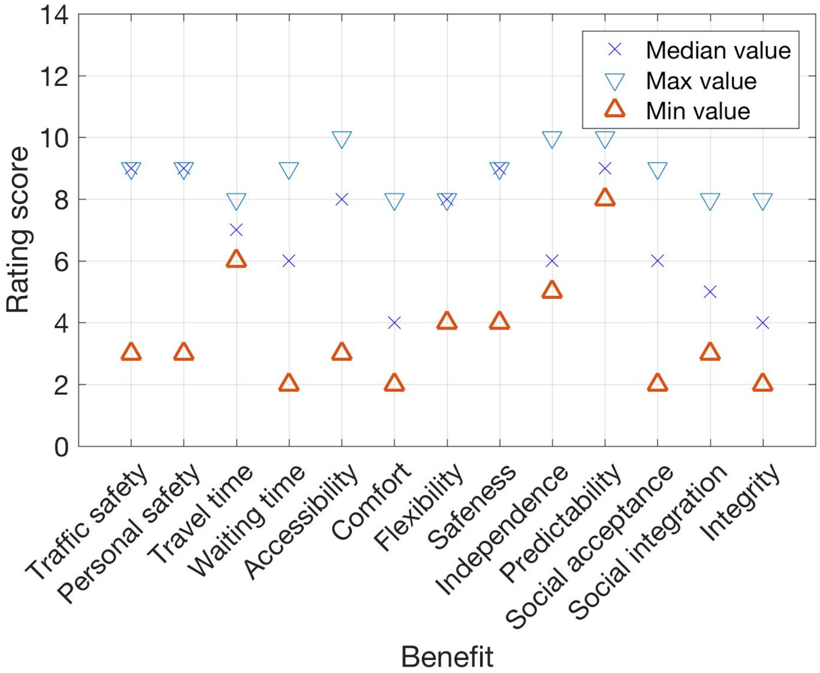

Figure 4. Median and sample width of the identified weights of the benefits of automation for the visually impaired user group for the third interaction point (during transport).

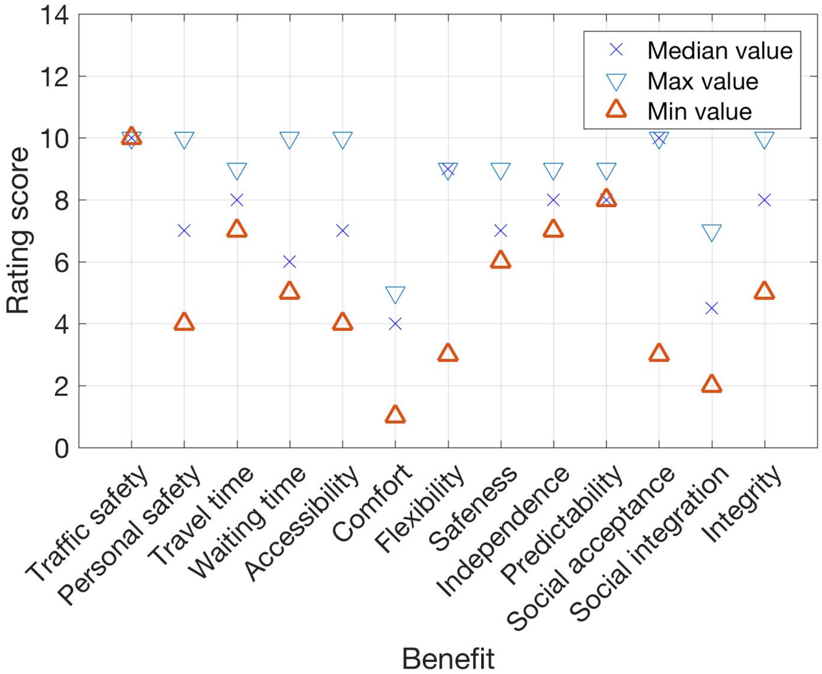

Figure 5. Median and sample width of the identified weights of the benefits of automation for the visually impaired

user group for the fourth interaction point (after transport).

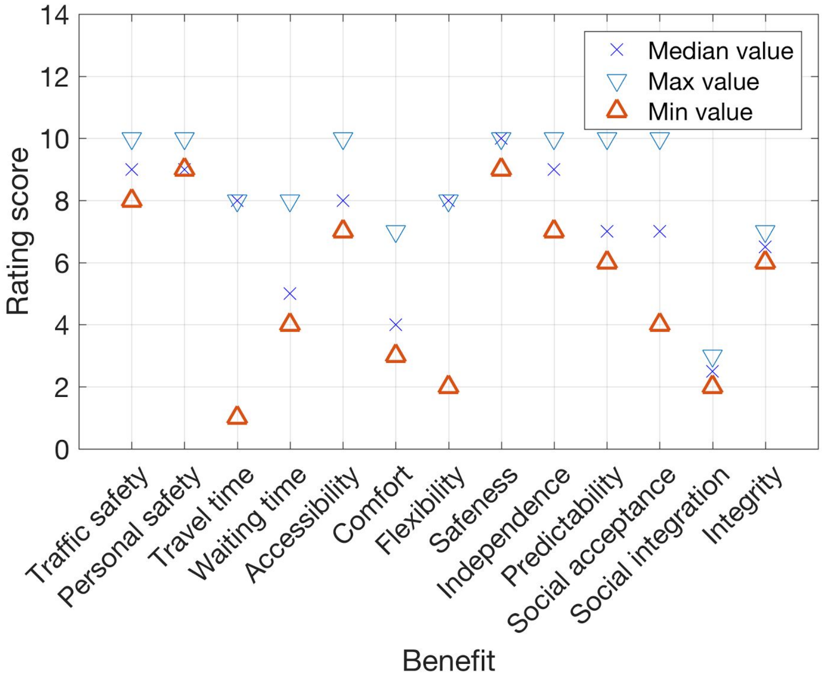

Figure 6. Median and sample width of the identified weights of the benefits of automation for the visually impaired user group for the fifth interaction point (interaction with transport).

Benefit	Weights (γ)				
	Bef.	To/Fr.	Dur.	Aft.	Int.
Traffic safety	7(2)	8(8)	9(6)	10(0)	9(2)
Personal safety	6(6)	8(4)	9(6)	7(6)	9(1)
Travel time	8(4)	6(7)	7(2)	8(2)	8(7)
Waiting time	7(3)	7(3)	6(7)	6(5)	5(4)
Accessibility	8(6)	9(2)	8(7)	7(6)	8(3)
Comfort	3(5)	2(4)	4(6)	4(4)	4(4)
Flexibility	8(5)	6(2)	8(4)	9(6)	8(6)
Safeness	7(5)	8(5)	9(5)	7(3)	10(1)
Independence	8(5)	9(3)	6(5)	8(2)	9(3)
Predictability	7(2)	7(2)	9(2)	8(1)	7(4)
Social acceptance	5(7)	5(7)	6(7)	10(7)	7(6)
Social integration	4(7)	2(4)	5(5)	4(5)	2(1)
Integrity	8(7)	3(8)	4(6)	8(5)	6(1)

Table 2. Median and sample width of the identified weights of the benefit of automation for the visually impaired user group for all five interaction points.

Benefit	Scores on-demand mode					Scores metro mode				
	Bef.	To/Fr.	Dur.	Aft.	Int.	Bef.	To/Fr.	Dur.	Aft.	Int.
Traffic safety	10	10	10	10	10	9	9	10	10	10
Personal safety	9	8	9	9	9	8	6	8	9	10
Travel time	10	9	8	6	8	6	5	6	8	10
Waiting time	7	9	6	5	8	9	8	8	8	9
Accessibility	9	9	9	7	6	9	9	9	9	9
Comfort	8	8	8	8	8	8	8	8	9	8
Flexibility	9	9	10	10	8	9	6	5	10	6
Safeness	10	10	10	10	10	10	7	8	10	9
Independence	9	9	10	10	10	9	8	6	10	10
Predictability	7	8	7	6	6	9	9	10	7	10
Social acceptance	9	8	6	8	6	9	9	10	6	8
Social integration	10	9	7	9	7	10	10	9	7	8
Integrity	8	7	9	9	9	8	6	7	9	9

Table 3. Identified benefits of automation for the visually impaired user groups. Comparison between how the user-group value the benefit in today’s transportation system, Weight benchmark, and a future Automated (AD) taxi service.

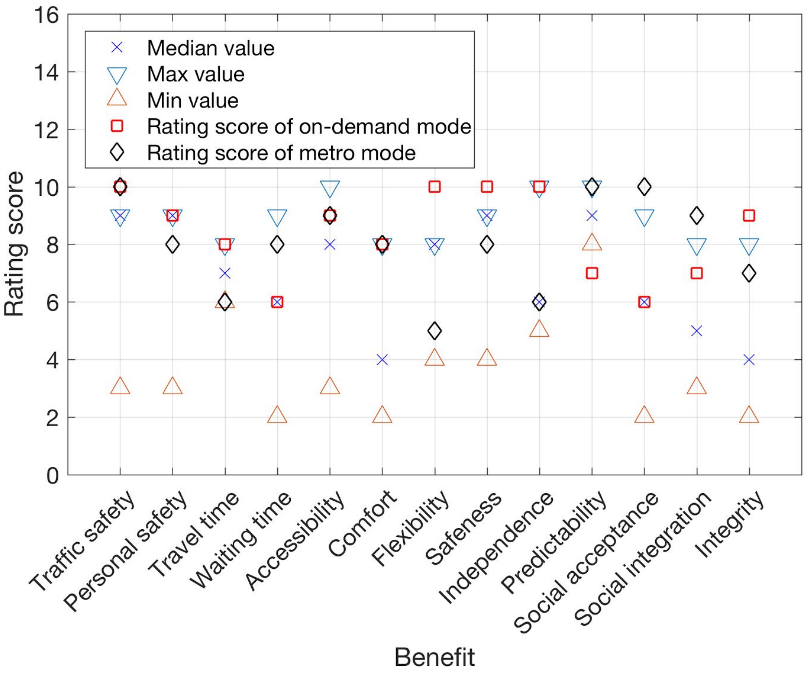

Figure 7. Median and sample width of the ratings of the different benefits for the interaction point during transportation along with the rating scores of the EasyMile services, metro mode and on demand model.

Interaction point	Mean	
	OD	MM
Before	8.8	8.7
To/From	8.7	7.7
During	8.4	8.0
After	8.2	8.6
Interaction	8.1	8.9
Mean	8.4	8.4

Table 4. Results from comparing the integrated rating scores from the two modes of the EasyMile transportation service on-demand (OD) and metro mode (MM).

7 Further research

Hypothesis: Benchmarking through extrapolated values

During the analysis phase in the project a second benchmarking method has been identified for further research. The method would enable future projects in automation to gain more insight from early-stage user-testing of prototypes. The method requires more research and verification and has therefore not been described in the research article and instead is presented here as a hypothesis for further study.

The method would work as follows:
User-testing of one or more prototypes of new autonomous transport solutions is performed using a homogenous control group representing a broad section of users.
The control group rate the benefits of the new solutions in the same way as in Table 3.
The values from the visually impaired user group (Table 2) are used to create a weighting algorithm that when applied to the results in Table 3 can affect the given values in either a positive or negative direction according to the relative value that the visually impaired user group have assigned to the chosen benefits.
The weighted results give a model of how the visually impaired user group may have chosen to rate the new solution.

The innovation in this approach is that by mapping the value of identified benefits for several further user groups, it would be possible to extrapolate the potential benefits for multiple segments of society with specific needs. The results of this modelling can then be used to identify areas where the benefits of a chosen solution differ greatly (in either a positive or negative direction) for specific user groups and then perform more specific user testing to confirm and more closely analyse the differences.

8 Goal fulfilment

The goals of the project as defined in the application:

This project aimed to identify tools, methods and models to evaluate how automated vehicles can contribute to improved accessibility for persons with impairments.

The results of the project show that the goals of the project have been fulfilled. In particular, the benefits of automation for visually impaired and persons with disabilities have been identified. A tool to benchmark how those benefits are experienced in today’s transport system compared to any future mobility solutions has been developed and exemplified in this project. This makes it possible to evaluate how a future mobility solution may contribute to better accessibility for the user-group. A workshop-based method is proposed to identify the benefits for any user-group, and in this project it has been applied to the visually impaired and disabled user-groups.

9 Dissemination

9.1 Dissemination of knowledge and results

The project and its intermediate results were presented at Viktoria Forum in December 2016. Viktoria Forum is a conference where Viktoria invites collaboration partners and financiers. Intermediate results were also presented on a Thursday seminar at SAFER, Vehicle and Traffic Safety Centre at Chalmers in April 2017.

A film was created with a visually impaired driver where we illustrated some of the benefits as well as challenges for a visually impaired person who is making an errand at the pharmacy. The film – "Leif – destined to drive" – can be found here: https://vimeo.com/193432367/4193b630dc

The project results are also published at the Drive Sweden site (in Swedish):
https://www.drivesweden.net/Drive-Sweden-projekt/automatisering-okad-tillganglighet-0

An article was written in the newspaper Metro, covering the project goals (in Swedish). The article can be found in Appendix C and online at https://www.vasttrafik.se/Documents/Dagens%20Pling/Pling_170524.pdf

Norconsult has a customer magazine – Norconsult I DAG – that also covered the project in an article "Trygg trafik för alla" in issue #1 2017. The article can be found in Appendix D.

The project results will also be presented at a future Drive Sweden Forum, to ensure that the methods that have been developed are known by the Drive Sweden community and used where applicable.

9.2 Publications

The project has produced two academic contributions. The first was a conference presentation during IMC16 In Dublin 26-27 June 2017. The conference presentation is named: Freedom on four wheels - Assessing the benefits of autonomous driving for the visually impaired. The abstract for the presentation is included in this report, see Appendix B.

The second contribution is a draft journal paper that is to be submitted to Transportation Research Part F named: Measuring the benefit of automation: A case study for visually impaired drivers. This paper also concludes the findings from the project. A draft of the article is included in this report, see Appendix A.

10 Project partners

Table: Overview of project partners and their corresponding contact person.

Part	Kontaktperson	E-post
Norconsult Astando	Martin Holmgren	martin.holmgren@norconsult.com
Norconsult AB	Carolin Folkeson	carolin.folkeson@norconsult.com
RISE Viktoria	Cristofer Englund	cristofer.englund@ri.se
Västra Götalandsregionen	Susanne Bengtsson	susanne.bengtsson@vgregion.se
Västtrafik	Jonas Johansson	jonas.johansson@vasttrafik.se
Volvo Cars	Annie Rydström	annie.rydstrom@volvocars.com

Appendix A: Measuring the benefit of automated driving

Appendix B: Abstract IMC 16

Appendix C – Metro Pling article

Appendix D – Norconsult I DAG article