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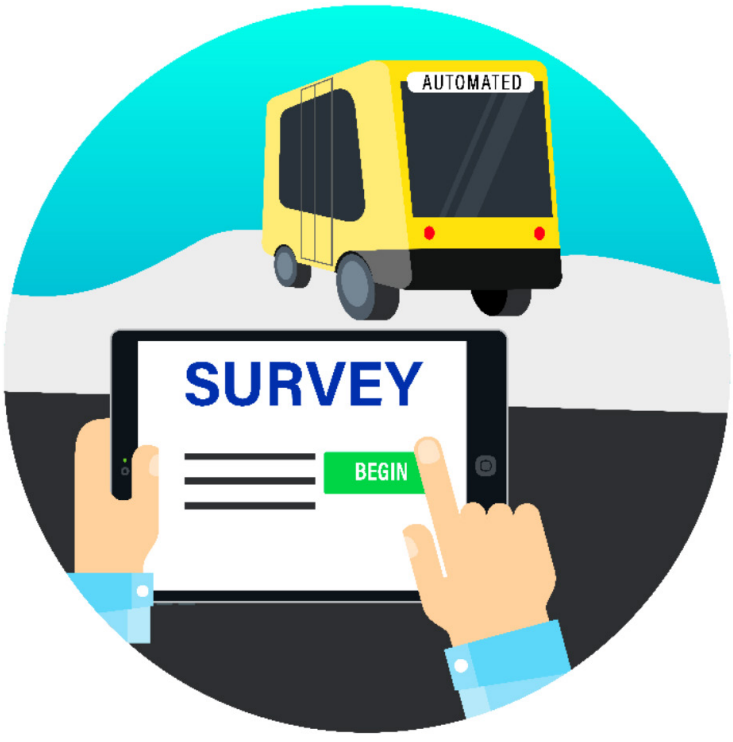
Survey Research for Automated Shuttle Pilots: Issues and Challenges

MAY 2021

FTA Report No. 0193
Federal Transit Administration



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Federal Transit Administration

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Metric Conversion Table

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liter	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
NOTE: volumes greater than 1000 L shall be shown in m^3				
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
TEMPERATURE (exact degrees)				
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C

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14. ABSTRACT

As public and private entities increasingly test the use of automated shuttles for passenger transportation, project sponsors need evaluation methods that measure the willingness of potential passengers to use these vehicles and to identify factors that may increase or decrease acceptability. Toward this end, many automated shuttle pilot sponsors have used surveys as part of their overall evaluation program. This report reviews approaches used by recent projects and provides discussion for the development of future surveys across three key areas—survey population, survey approach, and questionnaire design.

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ABSTRACT

As public and private entities increasingly test the use of automated shuttles for passenger transportation, project sponsors need evaluation methods that measure the willingness of potential passengers to use these vehicles and to identify factors that may increase or decrease acceptability. Toward this end, many automated shuttle pilot sponsors have used surveys as part of their overall evaluation program. This report reviews approaches used by recent projects and provides discussion for the development of future surveys across three key areas—survey population, survey approach, and questionnaire design.

SECTION

1

Introduction

As public and private entities increasingly test the use of automated shuttles for passenger transportation, project sponsors need evaluation methods that measure the willingness of potential passengers to use these vehicles and to identify factors that may increase or decrease acceptability. Toward this end, many automated shuttle pilot sponsors have used surveys as part of their overall evaluation program. This report reviews approaches used by recent projects and provides discussion for the development of future surveys. The focus is primarily on survey issues that are specific to automated shuttles; however, much of the discussion is applicable to any demonstration of a new passenger transportation technology. More general information on transit survey methods and best practices is available through the Transit Cooperative Research Program.[1] This study was sponsored by the Federal Transit Administration (FTA) Office of Research, Demonstration and Innovation as part of its Strategic Transit Automation Research (STAR) Plan.[2]

Automated Shuttle Survey Challenges

The literature is clear that surveys have limitations with regard to new technologies.[3] In general, it is very difficult for respondents to predict their future attitudes towards, and use of, a "really new product," particularly when it is highly inconsistent with their prior experience, such as a vehicle with no human operator. This means that user surveys should be carefully designed and carefully interpreted. Researchers and practitioners can still explore ways to engage users and evaluate respondent reactions and attitudes when they are exposed to new or emerging technologies. Survey results can help inform the design of a future service.

In addition to these general issues with new technologies, some particular aspects of typical automated shuttle demonstrations and pilots can make survey design and interpretation challenging:

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[1]TCRP Synthesis 63: "On-Board and Intercept Transit Survey Techniques,: 2016, http://www.trb.org/Publications/Blurbs/156542.aspx.

[2]For more information on this work and the Strategic Transit Automation Research Plan document, visit https://www.transit.dot.gov/research-innovation/strategic-transitautomation-research-plan.

[3]Hassol, Joshua, David Perlman, Lora Chajka-Cadin, and Jingsi Shaw, "Understanding Surveys of Public Sentiment Regarding Automated Vehicles: Summary of Results to Date and Implications of Past Research on the Dynamics of Consumer Adoption," USDOT Intelligent Transportation Systems Joint Program Office, November 2019, FHWA-JPO-19-764. https://rosap.ntl.bts.gov/view/dot/43628.

- **Representativeness of the Operational Design Domain (ODD) and vehicle**. Many demonstrations are designed and implemented in a carefully-selected ODD (e.g., short routes, minimal obstructions, and low speed limits) that may not be representative of the ultimate intended use. Likewise, the vehicle used in testing may differ from the future design.
- **Onboard attendant**. When an onboard attendant is present (as is nearly always the case in current test activities, particularly those open to the public), the presence and behavior of an attendant can heavily influence the passenger experience of the test ride. This represents a potential source of bias and limits the applicability of the findings to future services where an attendant may not be present.
- **Cost**. Demonstrations and pilots are often fare-free or use a simplified fare structure. Thus, survey questions about willingness to pay will reflect hypothetical situations rather than direct experiments, which makes them less predictive of future behavior.
- Novelty. The inherent novelty of using a new technology is likely to bias user interest in trying and assessments of the service. Automated shuttles also often have an unconventional design that may attract initial interest.
- **Unclear Baseline**. Most automated shuttles are demonstrated on entirely new routes, for which there are no baseline demand data available. In other cases, the shuttle may supplement or replace existing services, in which case respondent views may be influenced by comparisons to the prior service. If the project is introducing a transportation service where one did not exist before, it will be important to assess the relative value of the automation vis-à-vis the value of simply providing a new service.

SECTION

2

Example Projects and Surveys

Several recent projects have publicly released their survey instruments. This section contains information on four selected automated shuttle projects and their accompanying surveys, along with links to more information. These projects were selected as illustrative of the current range of automated shuttle survey efforts.

Automated Vehicle Pilot at Joint Base Myer-Henderson Hall

- **Lead**: United States Army Corps of Engineers (USACE) Engineer Research and Development Center
- **Project Summary:** 90-day pilot of a Local Motors Olli shuttle at a military installation in the Washington, DC region.
- **Survey:** 154 paper and web-based surveys of riders and non-riders, with a focus on trust in automation and perceived safety; project included analysis of operational data.
- **More Information:** Allen, James, et al., "Autonomous Vehicle Pilot at Joint Base Myer-Henderson Hall: Project Report Summary and Recommendations," ERDC/CERL TR-20-9, U.S. Engineer Research and Development Center, September 2020, https://erdc-library.erdc.dren.mil/jspui/handle/11681/38088.

Automated Vehicle Pilot at EUREF Office Campus in Berlin-Schöneberg

- **Lead:** Delft University of Technology and University of Leeds
- **Project Summary:** Automated shuttle demonstration on an office campus.
- **Survey:** Passengers were surveyed on questions regarding demographics and shuttle and service characteristics, attitudinal questions, and indicators of acceptance. Also investigated were respondent perceptions with regard to perceived safety, perceived enjoyment, desired level of control, and environmental attitudes. Other indicators of acceptance include respondent intended frequency to use, willingness to pay, and behavioral intention to use shuttles as feeder in public transport.

- **More Information:** Nordhoff, Sina, Joost de Winter, Ruth Madigan, Natasha Merat, B. Arem, and Riender Happee, 2018, "User Acceptance of Automated Shuttles in Berlin-Schöneberg: A Questionnaire Study," *Transportation Research Part F, Traffic Psychology and Behaviour*, 58, 843-854, 10.1016/j.trf.2018.06.024.

Automated Vehicle Pilot at University of South Florida (USF) / Center for Urban Transportation Research (CUTR) Campus

- **Lead:** University of South Florida
- **Project Summary:** One-week demonstration of a Coast shuttle on a college campus. In addition to the survey, the project included field observations of vehicle and road user interactions and subject matter expert assessments.
- **Survey:** Paper-based on-board survey of all passengers (522). Passengers were asked about their experience on the vehicle, their level of trust and comfort with automation, and the impacts that a future service might have on their overall travel choices.
- **More Information:** "Campus Automated Shuttle Service Deployment Initiative," National Center for Transit Research (NCTR) Report No. CUTR-NCTR-RR-2018-06, Center for Urban Transportation Research, University of South Florida, 2018, https://scholarcommons.usf.edu/cutr_nctr/46.

Automated Vehicle (AV) Pilot at Tallinn University of Technology

- **Lead**: Tallinn Transport Department and Tallinn University of Technology
- **Project Summary:** Four-month pilot of a free circulator service at a public park, operated by students from Tallinn University of Technology and open to the general public. This study used several tools for data collection (passenger and non-passenger surveys, panel interviews with the operators, and analysis of the operators' Skype chat, which was the primary medium for discussion of operations.
- **Survey:** Online survey. Passengers were directed to the survey via QR codes and links on business cards. Non-passengers were recruited from a University course. Questions covered attitudes toward safety and security, ability, and propensity to use the service, and overall experience.
- **More Information:** https://search.proquest.com/openview/dabc5c7bf9c25a41e92f1a072d3fbeb7/1?pq-origsite=gscholar&cbl=2032327.

SECTION

3

Analysis

This section provides suggestions for consideration in developing surveys, across three key areas—survey population, survey approach, and questionnaire design—and provides examples from prior projects.

Survey Population

Both passengers and non-passengers should be surveyed if possible. Although shuttle passengers are uniquely able to provide information on their experiences, non-passengers can offer insights on why they did not ride or on their experience sharing road space with demonstration vehicles. These perspectives are particularly important for automated shuttles, which may travel at very slow speeds and stop unpredictably.

Non-passengers may choose not to ride for reasons similar to non-passengers of conventional transit services (e.g., "did not know where the vehicle was going" or "had my own car"), but there may also be reasons specific to the shuttle implementation. For example, they may have been unable to ride due to a physical limitation or some other limitation related to ability or status (e.g., for a shuttle without a ramp or a shuttle limiting rides to certain employees or students), or they may have been uncomfortable with riding in an automated vehicle. Capturing these and other reasons will improve the survey analysis. For surveys with multiple waves over time, non-passengers can also serve as a form of control group, allowing changes in passenger responses to be compared against those who did not use the service.

Employees and other stakeholders may also be part of the survey effort, where relevant. For example, for automated shuttles with onboard attendants, it can be valuable to survey the attendants about the issues they experienced onboard.

Survey Approach

There are many variations on transit survey recruitment and administration. Automated shuttle projects that plan to use surveys should select an approach that is cost-effective and aligns with their information needs.

A traditional approach in public transit is an intercept survey, which can be used to recruit survey respondents while they are onboard the vehicle or waiting at a stop. In-person survey staff can distribute and collect survey forms during the trip, conduct surveys directly using tablet computers, hand out survey postcards to be mailed back later, provide a website link for the

survey to be completed online, or some combination of these approaches. Alternatively, survey recruiting can be done offsite using telephone, mail, or e-mail solicitation, with the survey typically completed online. Non-riders can be recruited through similar methods or through intercepts at locations used by other modes (e.g., parking lots). Each approach has advantages and disadvantages that would need to be weighed against evaluation objectives. For example, onboard intercept surveys can be particularly valuable for capturing rider experiences while they are fresh in their minds, rather than having respondents complete the survey later. However, this type of survey can be logistically more complex because of the need to intercept riders and collect their completed survey during the timespan of the vehicle trip. Likewise, the use of in-person survey staff can improve response rates, potentially yielding a larger and more representative sample, but this approach can be costly and introduce some other forms of bias in the responses (e.g., if responses are influenced by the interaction with the interviewer).

A single survey wave may be sufficient to provide information on rider experiences. In other cases, however, multiple survey waves may be used to assess changes over time; for example, a "before–after" survey could be used to measure whether attitudes toward the automated shuttle changed after direct experience with the vehicle or whether rider assessments of the service change after a new policy or technology upgrade is implemented. Multiple survey waves can be implemented as panels (same respondents, with each effectively serving as his/her own control) or as a repeated cross-section.

Overall, the survey approach should be tailored to the analytical needs. In some cases, **a very simple survey may be all that is needed**, depending on the project objectives. A minimal survey, potentially implemented through a rider-intercept approach, might ask passengers to rate the ride and their attitude towards automation or new technologies on a 5- or 7-point Likert-type rating scale (such as from "strongly disagree" to "strongly agree") and ask how likely they would be to use such a service in the future. Such a survey would give a quick snapshot of passenger sentiment, potentially using standardized questions that can be benchmarked against other studies and services. However, other data sources would be needed to support more in-depth analysis of ridership and attitudes toward the service. For a more mature service that is expected to result in changes to mode choice or other aspects of traveler behavior, a diary-based survey or observational study may be needed to capture these changes.

If possible, the **use of mixed methods** can enrich analysis. Benchmarking survey responses against actual performance can help researchers identify the factors that may influence responses. For example, responses may vary due to external factors, such as the presence of an obstacle requiring manual intervention or weather conditions that decrease performance. Data on

the broader regional context, such as changes in congestion levels and fuel prices, can also help with the interpretation of survey data. Supplementary data, such as communication logs, maintenance records, or interviews with shuttle operators can provide a more comprehensive picture of how the automated shuttles operate, which factors influence passenger attitudes, and how to mitigate those issues that negatively influence passenger satisfaction. For example, the Tallinn University of Technology project's focus on operator communications and structured interviews with the operators provided a rich dataset to give context to passenger responses. Consider the use of **focus groups** as an option to allow for more follow-up and nuanced discussion.

The demonstration may provide an opportunity to survey participants on broader topics to support other organizational goals, but be aware of the limitations of asking for **opinions that are too far from the respondent's experience on the automated shuttle** (e.g., "now that you have been in an automated shuttle, how do you feel about using flying taxis or hyperloops in your daily commute?").

Questionnaire Design

The questionnaire design should be careful to **avoid confounding factors**. Projects may be providing a new transportation service in a prototype vehicle that may be more or less comfortable than a comparison vehicle (e.g., a conventional bus or the user's own passenger vehicle), and with an onboard safety attendant or customer ambassador. It may be difficult to disentangle the effects of these factors on a respondent's perception of the service so they are not conflated with the acceptability of the automation technology itself.

Writing questions to ask clearly about one item at a time can help with this. For example, the USACE pilot (AV Pilot at Joint Base Myer-Henderson Hall) asked questions about vehicle characteristics and perceived safety in multiple ways. Respondents were asked to agree/disagree that the vehicle is "intelligent," "safe," and "trustworthy" in separate questions. Respondents were also asked about specific vehicle behaviors, which may help to provide insight into their answers regarding characteristics and perceived safety. Similarly, the USF project asked questions about user acceptance in several ways, separating out factors related to the presence of an attendant, the vehicle's operating speed, and the campus environment.

Willingness to ride an automated shuttle may be influenced by several different elements, which should be clearly distinguished in survey design. Questions on this topic may include the items below, potentially with different versions for riders and non-riders:

- General concerns about safety of the automation vis-à-vis human driver
- Perceived overall safety of the vehicle (which can be influenced by vehicle speed, hard braking, or observing the onboard operator take manual control)
- Perceived personal security on the transit vehicle and in sharing the ride with others[4] (which can be influenced by the presence of a safety operator onboard, other passengers, and people outside the vehicle)

Non-users of current services (e.g., transit, ridesharing) may also have a more general discomfort with shared-ride modes if they are accustomed to the flexibility of their personal vehicle.

Similarly, many automated shuttle pilots currently operate at very low operating speeds (e.g., with top speeds of 12 mph or lower), which may be close to, or even below, average walking speeds. Prior studies indicate that the **low speeds have a complicated relation to user acceptance—**there seems to be a positive relationship between low speeds and user perceptions of safety and trust and a negative relationship with regard to the usefulness of service. For example, a recent report on a demonstration at MCity in Michigan noted that "riders and non-riders cited the shuttle's slow speed, 10 mph on average, as a negative factor. Interestingly, the low speed appealed to riders because they perceived the risk was lower, yet it worked against the shuttle as a practical solution to daily transportation challenges. Increasing the speed of travel was the highest rated improvement solution for both riders and non-riders, followed by improving the route, convenience, and quantity of the stops."[5] **Asking questions about speed in several different ways may help improve the usefulness of results.** If the low speeds are reflective of the early stage of technological development rather than an intentional design choice for the route, it may be advisable to perform a second study once vehicles operate at target speeds.

If asking about willingness to ride a hypothetical future service, describe the proposed service clearly; otherwise, respondents may make very different assumptions (e.g., cost, convenience, design) in their answers. For example, one survey of passengers on a demonstration offered to the general public asked, "If autonomous transportation is widely implemented, for what purpose are you more likely to use it?" The type of transportation was not specified. The respondent may envision a circulator shuttle such as used in the demonstration, could be assuming a personal vehicle, or could assume some other form of automated vehicle service.

[4]A separate issue relates to riders' health concerns about sharing onboard space with others. Although this issue has become prominent during the COVID-19 pandemic, it could continue for some time afterward.
[5]Kolodge, Kristin, Sarah Cicotte, and Huei Peng, "Mcity Driverless Shuttle: What We Learned About Consumer Acceptance of Automated Vehicles," University of Michigan MCity, October 2020, https://mcity.umich.edu/wp-content/uploads/2020/10/mcity-driverless-shuttle-whitepaper.pdf .

Include questions that allow for an assessment of the representativeness of the sample. Automated shuttle tests and surveys are voluntary. Riders are often those who are interested in the exploring this novel technology (so-called "early adopters"). These volunteer riders are not a representative sample of the general public. In contrast, many of those who may benefit from the services provided by automated shuttles (e.g., low-income individuals or people with disabilities), may not be well-represented in the early-adopter group. The USF survey included attitudes towards technology adoption to help gauge this early-adopter effect. The EUREF team similarly explored adoption by including items from the Unified Theory of Acceptance and Use of Technology (UTAUT)[6] constructs "performance expectancy," "effort expectancy," and "social influence."

Most surveys ask about demographic information, some in great detail, depending on the objectives of the project and survey. Basic demographic information will help the team assess the representativeness of the participant pool. Using response options and categories that align precisely with Census questions or other external sources of demographic data can enhance the usefulness and comparability of these questions.

At the same time, it is important to recognize that some respondents perceive demographic questions as sensitive and may decline to participate, reducing response rates. Demographic questions are often placed at the end of the survey for this reason, and response categories are often broad (e.g., asking for an age range rather than a precise value). Survey conductors may consider the limitation of recruiting a representative sample for a pilot project and consider other venues to involve other underrepresented but critical groups.

Finally, note that **although well-crafted survey questions can provide useful insight on rider experiences with automated vehicles, the actual propensity to ride will depend on many other factors**. These include service characteristics such as cost, frequency, destinations served, and connections to other modes. More generally, respondents' future mode choice may be strongly influenced by land use patterns and existing travel habits and vehicle ownership. This makes it difficult to forecast future usage from pilot survey responses, though these are still useful for assessing whether the project has cleared the bar in terms of user acceptance and trust.

The EUREF team identified social desirability as a potential factor that may bias results. For future studies, they suggested measuring participant actual usage of the shuttle (e.g., frequency of use), rather than self-reported attitudes towards using the shuttle.

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[6]Venkatesh, Viswanath, Michael G. Morris, Gordon B. Davis, and Fred D. Davis (2003-01-01), "User Acceptance of Information Technology: Toward a Unified View," MIS Quarterly, 27(3), 425-478.

SECTION

4

Conclusion

Well-designed user surveys can be part of a robust demonstration and evaluation program, providing insight into user and non-user experiences and eliciting qualitative details that complement other sources of data.[7] As with many emerging technologies, automated shuttles typically have characteristics that present evaluation challenges, particularly in testing phases where prototype vehicles may be imperfect proxies for future services. In some cases, these issues can be addressed through survey design choices, as discussed above and in the four example surveys cited. Projects exploring technologies with multiple novel aspects will benefit from carefully identifying survey objectives to elicit useful data as part of their overall evaluation approach.

[7]For more information on automated transit bus evaluation, refer to Luna, J., E. Machek, and S. Peirce (2019), *Considerations for Evaluating Automated Transit Bus Programs (Report 0149)*, Washington, DC: Federal Transit Administration, https://www.transit.dot.gov/research-innovation/considerations-evaluating-automated-transit-bus-programs-report-0149.

APPENDIX

A

Survey Instruments

Survey for Automated Vehicle Pilot at Joint Base Myer-Henderson Hall

Survey Questions

Questions in this survey are intended to be answered by ***both riders and non-riders*** *of Olli. Please answer all questions to the best of your ability stemming from your observation of the autonomous vehicle.* This is an anonymous survey, do not record your name or any other identifying information on this form.

Activity: Human Factors JBMHH Survey for Autonomous Vehicles (AV)
Project Identification Number: 2019-02-NR
Investigator: Lance L. Larkin, PhD, CEERD-CERL

1. What is your age? (Only adults of 18 years and older.) _____

2. Circle what describes you best:

Live or work on base	Work for the Dept. of Defense off-base	Do ***NOT*** work for the Dept. of Defense

3. Circle the most appropriate description of your interaction with the vehicle:

Safety Operator	Passenger	Observer (not riding on vehicle)	Other

4. How many times have you been a passenger on this vehicle?

Zero	1-2	3-4	5-9	10 or more

5. Is this your first time filling out this questionnaire (circle one)?

Yes	No

6. Have you been informed about the safe operation of this vehicle from any of the following sources? Circle all applicable answers. If you did not ride the vehicle, answer using any information you might have already seen about the vehicle.

Info via video display	Audio information	Steward/safety operator	Ads or publications	None

Directions: Please rate your agreement with each item based on your past or current experiences with the vehicle.

7. The vehicle is intelligent (circle one)

Strongly	Disagree	Somewhat	Neither	Somewhat	Agree	Strongly

8. The vehicle will be used regularly by people at Joint Base Myer-Henderson Hall (circle one)

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree

9. The vehicle is safe (circle one)

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree

10. The vehicle is trustworthy (circle one)

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree

11. If you were a rider: the vehicle and the ride were comfortable. (circle one)
If you were ***NOT*** a rider: the vehicle appeared to give a comfortable ride.

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree

Directions: Please rate the acceptability of each item based on your past or current experiences with the vehicle.

12. The vehicle avoids other vehicles, obstacles, and pedestrians without human intervention.

Totally Unacceptable	Unacceptable	Slightly Unacceptable	Neutral	Slightly Acceptable	Acceptable	Perfectly Acceptable

13. The vehicle responds to traffic rules (e.g., road signs, road rules) without human intervention.

Totally Unacceptable	Unacceptable	Slightly Unacceptable	Neutral	Slightly Acceptable	Acceptable	Perfectly Acceptable

14. Please leave any open-ended feedback prompted by the survey. Write the number of the question if you are referring to your answers above.

Survey for Automated Vehicle Pilot at EUREF Office Campus in Berlin-Schöneberg

Do you fill out the questionnaire for the first time?

yes no

Questions regarding your person

Please indicate your gender.

m f

Please indicate your age.

Do you work on EUREF Campus?

yes no

In which field do you work? (please tick only one response)

Operations/logistics
Commercial area/ administration
IT
Energy sector
Research & development
Eventmanagement
Start-up sector
Real estate
Transport and infrastructure
Other (please indicate):

Please indicate which which type of transport mode you currently use on the campus (multiple response options possible)?

Electro scooter
Electric vehicle
Bicyle
Conventional vehicle with combustion engine
Truck
On foot
Other (please indicate):

Have you used the shuttle service before? Please tick.

yes no

If so, please indicate how many times you have used the shuttle service before.

Please indicate to what extent you agree or disagree with the following statements, ranging from 1 = „very good" bis 6 = „very bad". The values in-between are used to rate your level of agreement or disagreement.
Please provide a response to every response category.

Please evaluate the service in total.

	very good					very bad
Attractiveness of the shuttle	○	○	○	○	○	○
Reliability of the shuttle	○	○	○	○	○	○
Usability/comfort of the shuttle	○	○	○	○	○	○

Please evaluate the vehicle in total.

	very good					very bad
Attractiveness of the automated vehicle	○	○	○	○	○	○
Size of the bus	○	○	○	○	○	○
Perceived quality of the exterior of the bus	○	○	○	○	○	○
Design of the bus from the exterior	○	○	○	○	○	○
Vehicle speed	○	○	○	○	○	○
Comfort of entry and exit	○	○	○	○	○	○
Spaciousness	○	○	○	○	○	○
Number of seats	○	○	○	○	○	○
If you took a seat: comfort of seating	○	○	○	○	○	○
Standing room	○	○	○	○	○	○
Grips in the bus	○	○	○	○	○	○
Place for luggage	○	○	○	○	○	○
Brightness	○	○	○	○	○	○
Quality/valence of the bus interior	○	○	○	○	○	○
Design of the bus from the interior	○	○	○	○	○	○
Atmosphere	○	○	○	○	○	○
Safety	○	○	○	○	○	○

Please indicate to what extent you agree or disagree with the following statements, ranging from 1 = „very good" bis 6 = „very bad". The values in-between are used to rate your level of agreement or disagreement.
Please provide a response to every response category.

	very good					very bad
How do you like the trip with the automated vehicle?	○	○	○	○	○	○
How do you like the idea of the use of automated vehicles in public transport?	○	○	○	○	○	○
To what extent can you envision the use of automated busses as mobility service in the city?	○	○	○	○	○	○
And to what extent can you envision the use of automated busses as mobility service in rural areas?	○	○	○	○	○	○

To what extent does this shuttle service (use of automated busses as shuttle) fit to Deutsche Bahn?

Please indicate to what extent you agree or disagree with the following statements, ranging from 1 = „very good" bis 6 = „very bad". The values in-between are used to rate your level of agreement or disagreement.
Please provide a response to every response category.

	agree strongly					disagree strongly	I don't know
Taking a ride in the driverless shuttle was fun and enjoyable.							
I like it to share the driverless shuttle together with other fellow passengers having the same destination.							
The driverless shuttle is useful.							
I find the trip in the driverless shuttle boring.							
I would use a driverless shuttle in my day-to-day commuting as it is better and more convenient than using my existing form of travel.							
I think the driverless shuttle will become an important part of the existing public transport system.							
Using the driverless shuttle is easier for me than using my existing form of travel.							
Using the							

driverless shuttle is similar to using existing public transport systems (e.g. Busses, Trains, and Trams).							
The driverless shuttle is easy to understand how to use.	○	○	○	○	○	○	○
I like it that the driverless shuttle drives at a low speed.	○	○	○	○	○	○	○
The driverless shuttle is more efficient/faster than my existing form of travel.	○	○	○	○	○	○	○
It would not take long to learn how to use a driverless shuttle.	○	○	○	○	○	○	○
I felt safe in the driverless shuttle throughout the whole trip.	○	○	○	○	○	○	○
I dislike it that I might have to share the driverless shuttle with unknown passengers.	○	○	○	○	○	○	○

Please indicate to what extent you agree or disagree with the following statements, ranging from 1 = „very good" bis 6 = „very bad". The values in-between are used to rate your level of agreement or disagreement.
Please provide a response to every response category.

	strongly agree					strongly disagree	I don't know
I would use an electric driverless vehicle from the train station or some other public transport stop to my final destination or vice versa.	○	○	○	○	○	○	○
I would share the driverless shuttle	○	○	○	○	○	○	○

together with other 6-8 passengers having the same destination like me.							
I plan to use driverless shuttles when they are available on the market.							
I intend to use a driverless shuttle for my daily trips.							
I would replace my current form of transport with a driverless vehicle.							
The protection of the environment is crucial for the choice of the driverless shuttle.							
I like it that I will use a 100% electric driverless shuttle from the train station to my final destination.							
Even if it were more expensive, I would like to choose the driverless shuttle as a more ecological form of travel.							

You almost made it! :-)

	Strongly agree					Strongly disagree	I don't know
I seriously consider using driverless shuttles after the trip with the shuttle when they are available							

on the market.

Please indicate to which extent you agree or disagree with the following statements on a scale from 1= "agree strongly" to 6 "disagree strongly".

	agree strongly					disagree strongly	I don't know
I feel comfortable in a vehicle without steering wheel, gas or brake pedal.	○	○	○	○	○	○	○
I don't like it that a steward is on-board the vehicle during the whole trip.	○	○	○	○	○	○	○
People who are important to me would like it when I would use a driverless shuttle.	○	○	○	○	○	○	○
I would prefer the driverless vehicle to drive without a steward on board.	○	○	○	○	○	○	○
I would like to manually steer the driverless shuttle when I want this.	○	○	○	○	○	○	○
I would like to have a button inside the driverless shuttle which I can press to stop it.	○	○	○	○	○	○	○
I would like to have my friends or family or	○	○	○	○	○	○	○

other important people to me adopt the driverless vehicle before I do.

The driverless shuttle is safe and reliable under severe weather conditions, such as snow, heavy rain or fog.

Please indicate to which extent you agree or disagree with the following statements on a scale from 1= "agree strongly" to 6 "disagree strongly".

	agree strongly					disagree strongly	I don't know
I would use driverless shuttles as mobility offer in rural areas.							
I would use driverless shuttles as mobility offer in the city.							

Please indicate how often you intend to use a driverless vehicle when it is available on the market.

- Daily or almost daily
- On one to three days per week
- On one to three days per month
- Less than monthly
- Never or almost never
- I don't know

Please now evaluate the driverless shuttle. Therefore, please read carefully every word pair and tick every row only once.

useful						useless
pleasant						unpleasant

bad	○	○	○	○	○	good
nice	○	○	○	○	○	annoying
effective	○	○	○	○	○	superfluous
irritating	○	○	○	○	○	likeable
assisting	○	○	○	○	○	worthless
undesirable	○	○	○	○	○	desirable
raising alertness	○	○	○	○	○	sleep-inducing

Driverless vehicles can operate without human supervision. Would you still prefer having some level of supervision?

- ○ No human supervision
- ○ Remote human supervision from a control room
- ○ Supervision by a steward on board

With the following and last question, we would like to know from you how much you would be willing to pay for the use of the driverless shuttle for a 10-minute use.

	0.00€-0.50€	0.51-1.00€	1.01-1.50€	1.51€-2.00€	2.01-2.50€	2.51€-3.00	Nothing	I don't know
How much would you be willing to pay for a 10-minute use of a driverless shuttle?	○	○	○	○	○	○	○	○

Do you have further ideas or remarks on the shuttle service that you would like to share with Deutsche Bahn?

Thank you!

Submit

Survey for Automated Vehicle Pilot at University of South Florida

Appendix A – Onboard Survey Questionnaire

1. **Was this your first-ever ride in an automated vehicle?**

   ☐ Yes ☐ No ☐ Don't know

2. **How familiar were you with automated vehicles before riding the automated shuttle?**

   ☐ Not at all familiar ☐ Slightly familiar ☐ Moderately familiar ☐ Extremely familiar

3. **How was your overall experience riding in the automated shuttle?**

   ☐ Very uncomfortable ☐ Neither uncomfortable nor comfortable ☐ Comfortable
   ☐ Uncomfortable ☐ Very comfortable

4. **Based on your ride, what aspects of the campus automated shuttle could be improved? Mark all that apply.**

   ☐ Increased feeling of safety
   ☐ Wi-Fi readability
   ☐ Increase my level of trust
   ☐ More conductor interaction
   ☐ Better interaction with pedestrians/bicyclists/other vehicles
   ☐ Increased speed of travel
   ☐ Other _____

5. **Please provide your opinion on the following statements if an automated shuttle service were to be available on campus.**

	Extremely unlikely	Unlikely	Unsure	Likely	Extremely likely
I would use the automated shuttle for some/all of my campus trips					
If necessary, I would be willing to pay a small monthly/annual fee to use the automated shuttle service					
I would be comfortable riding in an automated shuttle without an operator at all times					
I would trust the automated shuttle to operate smoothly around pedestrians, bicyclists, and other vehicles					
I would be comfortable with an automated shuttle operating through the campus on large sized sidewalks and walkways (at speeds of 8-10 mi/hr.)					

6. **Which of your following campus trip modes would you like an automated shuttle operating on-campus to replace? Choose one for each row**

On-campus trips using	Some	All	None	Don't know/Can't Say	N/A
Walk					
Bike/Campus Bikeshare					
Bull Runner					
Personal Vehicle					
Motorcycle/scooter					
Longboard/skateboard					

7. **Generally speaking, would you say that automated shuttles can be trusted to perform all safety-critical driving functions for an entire trip?**

☐ Strongly Disagree ☐ Unsure ☐ Strongly Agree
☐ Disagree ☐ Agree

8. **Has your trust level with automated technology changed after riding the automated shuttle?**

☐ Trust level increased ☐ Trust level decreased ☐ Trust level remains the same ☐ N/A

9. **What is your most concerning factor about using automated shuttles?**

☐ Safety-related concerns ☐ Higher travel time than my current travel time ☐ Unreliability of the service
☐ Privacy-related concerns ☐ Cost-related concerns

10. **What is your least concerning factor about using automated shuttles?**

☐ Safety-related concerns ☐ Higher travel time than my current travel time ☐ Unreliability of the service
☐ Privacy-related concerns ☐ Cost-related concern

11. **What is your gender?**

☐ Male ☐ Female

12. **Please select your age group**

☐ 17 or younger ☐ 25-34 ☐ 55-64
☐ 18-20 ☐ 35-44 ☐ 65 or older
☐ 21-24 ☐ 45-54

13. **What is your ethnicity?**

☐ Hispanic or Latino ☐ Not Hispanic or Latino

14. **What race do you identify yourself as?**

☐ White ☐ American Indian/Alaska Native ☐ Native Hawaiian/Pacific Islander
☐ Black or African American ☐ Asian ☐ Other _____

15. **What is your status at USF?**

☐ Student (undergraduate/graduate etc.) ☐ Faculty
☐ Postdoctoral Fellow/Research Scientist ☐ Visitor (visiting scholar, guest etc.)
☐ Staff ☐ Other _____

16. **Which category below indicates your annual household income? (if student away from home, only include personal income)**

☐ $0 – $24,999 ☐ $75,000 – $99,999 ☐ $150,000 – $174,999
☐ $25,000 – $49,999 ☐ $100,000 – $124,999 ☐ $175,000 – $199,999
☐ $50,000 – $74,999 ☐ $125,000 – $149,999 ☐ $200,000 and above

17. **How many people currently live in your household, including yourself?** (if student away from home, only include your present situation)

Number of children under the age of 5	
Number of children under the age of 16	
Number of children under the age of 18	
Number of members in your household who are 18 or older	

18. **Please provide information about your typical mode of travel, one-way distance, and one-way travel time to USF** (circle over the appropriate options in each row)

Mode of travel	Drive Alone	Share ride, as a driver/ passenger	Taxi/Cab/ Uber/Lyft	Campus shuttle	Public transit	Longboard/ Skateboard	Bicycle/ Campus bikeshare	Motorcycle/ scooter	Walk
Distance (one-way)	Less than 1 mile	1-3 miles	3-5 miles	5-10 miles	10-15 miles	15-20 miles	20-30 miles	30-miles or more	
Commute time (one-way)	Less than 5 mins	5-10 mins	10-20 mins	20-30 mins	30-45 mins	45-60 mins	60-90 mins	90 mins or more	

19. **Have you ever been involved in a traffic crash in the last 3 years?**

☐ Yes ☐ No

20. **How many vehicles (owned and/ or leased) are present in your household? Do not include bicycles.** (if student away from home, only include your present situation)

☐ 0
☐ 1
☐ 2
☐ 3
☐ 4
☐ More than 4

21. **When it comes to new technology, what best describes you?**

☐ I am skeptical of new technologies and use them only when I have to
☐ I am usually one of the last people I know to use new technologies
☐ I use new technologies when most of the people I know use them
☐ I like new technologies and use them before most people I know
☐ I love new technologies and am among the first to experiment and use them

Survey for Automated Vehicle Pilot at Tallinn University of Technology

https://docs.google.com/forms/d/1C5kTk2ALkbLSdTxjl8sBM1yTIGww5ncI8nkTEk5Llew/viewform?edit_requested=true

How do you feel about general traffic safety on-board? Please mark on a scale of 1 to 7.

Very unsafe
1
2
3
4
5
6
7
Very safe

How do you feel about your personal security on-board? Please mark on a scale of 1 to 7.

Very unsafe
1
2
3
4
5
6
7
Very safe

Would you also use the service with no operator on-board?

Yes, definitely
Yes, but not now
Maybe
No, never

When would you use this service? (More than one answer is allowed)

In bad weather
When carrying heavy items
Daily commute
As a link to transport hubs/ other public transport options
In closed large areas (e.g., campuses, industrial parks, airports, hospitals...)
Never
Other:

Would it be feasible for children to use this vehicle to travel to/from the school?

Yes
Yes, but only attended
No
Don't know

How would you describe your experience?

Very bad
1
2
3
4
5
Very good

If this service had been available as part of your daily commute, how often would you use it?

Daily
Weekly
Less often
Never

What wishes do you have about the future development on autonomous minibuses? Other feedback is also welcome!

Anonymous Passenger Survey

User Data

Can you please provide some information about yourself?
These would help us to better present our research findings.

Sex:

Female
Male

Age group:

< 18
18 – 30
31 – 45
46 – 60
> 61

Education:

Primary education
Secondary education (high school / vocational degree)
University Degree
Other:

Occupation:

Student
Employed
Unemployed / retired
Other:

How often do you use public transport?

Daily
Weekly
Less often
Never

How did you learn about the pilot? (more than one answer is allowed)

Saw the bus and approached it
From media (television, radio, newspaper, social media, project website...)
From family/ friends
Received personal invitation
Other:

Questionnaire for Control Group:

- How would you feel about general traffic safety onboard?
- How would you feel about your personal security onboard?
- Would you also use the service with no operator onboard?
- When would you use this service?
- Would it be feasible for children to use this vehicle to travel to/from school?
- How would you (theoretically) describe your experience?
- If this service had been available as part of your daily commute, how often would you use it?
- What wishes do you have about the future development on autonomous minibuses?
- Other feedback is also welcome!

Open Structured Question for Operators:

- Please describe your operational experience on the Navya shuttle bus and its technology (sensors, software etc.)
- How long did you operate issue-free?
- What were the most common issues during the operation?
- What caused these issues (environment, technology, traffic)?
- What were the main weather conditions that influenced the operation? (Specific questions on the impact of precipitation, wind, temperature, extreme weather condition etc.)
- How many issues directly or indirectly influenced the weather? (on the scale from 1–10)?
- Could you describe the split between routine and dynamic factors?

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