Poster Contribution

Citizen's Level of Acceptance of Four Different Mobility Concepts in Scope of the Project BüLaMo

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1 Summary

Climate protection measures, changes in social structures and people's mobility behavior call for sustainable adaptations in transport infrastructure. In this context, the project Citizen's Lab For a Mobile Münsterland (BüLaMo) aims at developing and evaluating sustainable mobility concepts for a German non-urban region. Sustainable concepts only take full effect if being accepted and used by citizens. Acceptance can be operationalized via intentional usage potential and is known to be dependent on user needs and wishes. One research question within *BüLaMo* is which improvement measures lead to a higher level of intentional usage potential of adapted mobility concepts. In this vein, ika of the RWTH Aachen University assessed citizen's intentional usage potential along with improvement measures regarding four different mobility concepts. Data was collected using an online survey with N = 219 participants. Results show general high levels of intentional usage potential of the mobility concepts surveyed. Based on the data, potential improvement measures could be suggested for implementation. Follow-up surveys are to examine a) if the actual usage rate as well as the current subjectively perceived usage potential fit the predicted usage potential and b) further improvements in order to increase the acceptance and usage rate. Final results are expected within the remaining project time ending February 2023.

2 Motivation and Objectives

Due to both, changes in social structures and efforts to meet the climate protection targets of the European Union, the mobility sector faces new challenges: While urban outmigration leads to longer commutes [1], climate protection efforts aim at reducing exhaust emissions [2,3]. At the same time, future mobility concepts should also meet the needs of an aging society as well as changing family- and household structures [4-6]. In this context, mobility concepts such as e-mobility and public transportation are commonly discussed as environmentally friendly alternatives to motorized private transport [1,7,8].

The aim of the project Citizen’s Lab For a Mobile Münsterland *(*BüLaMo) is to increase the usage of public transport in the rural region of Münsterland. Therefore, mobility concepts are being combined to optimally develop the infrastructure of the region and improve its attractiveness. At the same time, BüLaMo focuses on citizen‘s needs and demands for flexible mobility concepts, Together with two further institutes of RWTH Aachen University, the Institute for Automotive Engineering (ika) is engaged in the research activities of the project, by focussing the (future-) user perspective. In more detail, ika’s focus is on the assessment of the citizen‘s level of acceptance re the different mobility concepts. The activities address which improvement measures may lead to a higher level of acceptance, operationalized with the intentional usage potential of mobility concepts.

Novel technologies and concepts that offer certain advantages, such as environmental benefits, only take full effect if being used by citizens. Literature shows that user acceptance is one of the most crucial factors for the use of a concept [9], with the mere intention to use a concept being a robust predictor for a high level of acceptance [9,10,11]. Thus, acceptance is operationalized via the behavioral intention to use a mobility concept. Literature shows that the behavioral intention to use a technology depends on various factors, such as perceived safety, attitude towards using the technology, perceived ease of use, the behavioral intention to use the system and perceived usefulness [9]. Moreover, ika gathered citizen‘s needs and wishes regarding the mobility concepts. Based on these factors, potential improvement measures were deducted that could potentially further increase both, level of acceptance and likelihood of usage.

3 Mobility Concepts Researched

In this section the mobility concepts researched will be presented in brief.

On-demand shuttles shall be understood as a supplement to public transport, which is not restricted to existing bus stops, timetables and sharing stations. The shuttles, however, connect existing bus stops with freely chosen stops, e.g., the home address. As it can be ordered via phone call or app, a collection of requests enables passengers with similar routes to share the same shuttle at a time.

Novel fare structures include further opportunities as a mobility hub, like booking additional flatrate options for the on-demand shuttles, electric bikes or electric scooters. Additionally, transport means can be switched at these spots.

The *BüLaMo mobility app* offers the advantage of combining services of different transport means, such as public transport, car-, bike-, and scooter-sharing.

The *express bus "X90"* connects the cities Olfen, Lüdinghausen and Senden to the City of Münster with few bus stops and a direct route.

Mobility hubs are specifically equipped bus stations alongside the route of X90 offering a variety of additional services. Besides a weatherproof and – for safety reasons – camera equipped seating-area, passengers could rent bikes or order on-demand shuttles to reach their destination. Additional services such as kiosks, WiFi and lockers may be included as well.

4 Method

In the present project, ika follows a methodological approach that consists five stages. In the first stage, citizens are introduced to future mobility concepts. This stage is to assess the intentional usage potential in order to examine the potential level of acceptance by citizens. The realization of the different mobility concepts is part of the second stage. This third stage then focusses on the assessment of the factual level of acceptance based on real-life experiences of the target group. In case of a potential difference (Δ) between the results of both stages, citizens are asked to name wishes and needs for further improvement of the mobility concepts (see figure 1). Eventually, improvement measures will be implemented in stage 4. Stage 5 is the final evaluation of the concepts.

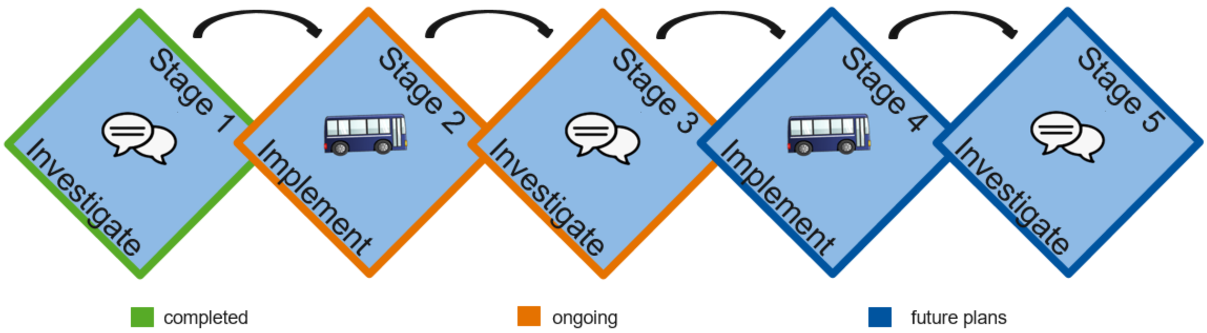

Figure 1. Time line of the different stages of the iterative approach in BüLaMo. The process is devided into five different, consecutively realized stages. The investigation of people's acceptance and the implementation of mobility concepts or improvement measures alternate. This iterative process enables an user-need based approach.

When compiling this short paper as well as the corresponding poster, the first stage is completed. Analogous to figure 1, citizen's intentional usage potential, along with improvement measures regarding the four different mobility concepts listed in the previous section, have been surveyed. The survey is based on the Car Technology Acceptance Model (CTAM) by Osswald [9], and includes information on demographics, mobility behavior and the behavioral intention to use the different mobility concepts. Items on the constructs mobility behavior and usage intention are rated on a 7-point Likert-scale. The higher the value, the higher the level of acceptance. As CTAM was originally developed to measure the acceptance of vehicle related technologies, some items were adjusted by the authors to fit the object of investigation. Data was collected from June 23, 2021 to September 23, 2021 using an online survey and the participants were recruited via flyer, postings in public transportation, newsletters and postings on social media and the project website.

5 Results of investigation stage 1

A total of N = 219 people took part in the survey. N = 81 incomplete datasets were identified, resulting in N = 138 valid data sets. IBM SPSS Statistics 27 was used for inferential statistics.

The age of the participants ranged from 18 to 83 years (M = 46, SD = 17.86). Most participants (93%, n = 128) stated to live in the district Coesfeld. The remaining 7% (n = 10) stated to live in Münster (5.1%, n = 7) and Selm (1.4%, n = 2). One participant (0.7%) did not specify their answer. This shows that most participants live in a non-urban region with small towns with a population of 10,000-30,000.

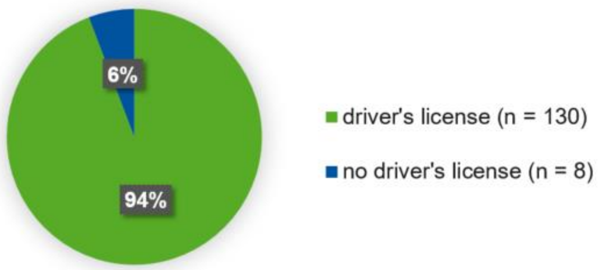

Figure 2. Amount of participants owning a driver's license. The green area indicates the percentage of participants who own a driver's license. The blue area indicates the percentage of participants who have no driver's license. Results show that the majority of participants own a driver's license. N = 138.

Most participants stated to have a driver's license (94%, *n* = 130). Only 6% stated to have no driver's license, see figure 2. Also, the majority (91.3%, *n* = 126) named that a car is available to their household, see figure 3.

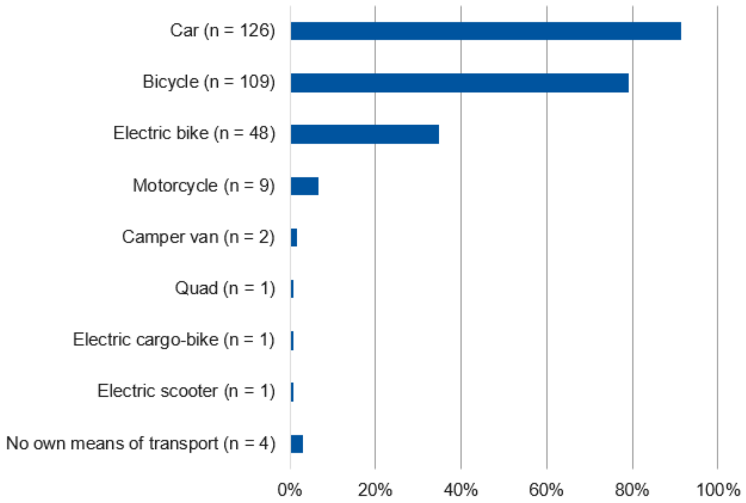

Figure 3. Means of transport that are available to the household. The figure shows the percentage of people that have access to the mentioned means of transport in their household. Multiple answers were possible. *N* = 138.

Concerning car ownership, 49% (*n* = 62) stated to have two cars in their household and 40% (*n* = 50) stated that their household owns one car. A percentage of 8% (*n* = 10) stated that three cars are available to the household, 3% (*n* = 4) have access to more than three cars, see figure 4.

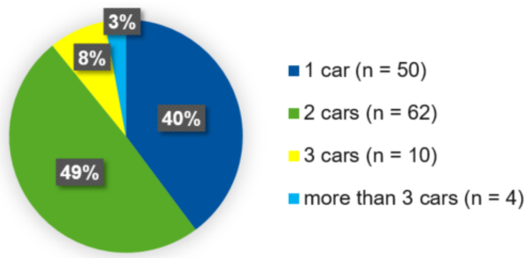

Figure 4. Amount of cars that are available to the household. The dark blue area shows the percentage of participants owning one car in their household, the green area shows the percentage of participants owning two cars in their household, the yellow area shows the percentage of participants owning three cars, and the light blue area shows the percentage of participants owning more than three cars in their household. Half of participants (49%) stated to own two cars, followed by 40% who have one car. A percentage of 8% stated to have three cars and 3 % stated to own more than three cars. *N* = 126.

The majority of N = 138 participants also stated that their household owns at least one bicycle (79.9%, n = 109) and 34.8% (n = 48) have an electric bike, see figure 3. Most participants owning an electric bike, additionally own a non-electric bicycle (n = 34/n = 48). All participants owning an electric bike own a car. An electric cargo-bike is available to the household of one participant (0.7%). A percentage of 6.5% (n = 9) stated that a motorcycle or moped is available to their household. Other participants stated that other means of transport are available to the household, being a camper van (1.4%, n = 2), a quad (0.7%, n = 1) or an electric scooter (0.7%, n = 1).

An amount of n = 5 out of n = 6 participants who mentioned that only a bicycle is available to their household go to school (n = 2), study at university (n = 2) or are in training (n = 1). Only one person whose household only owns a bicycle has a full time job. Also, participants who stated to own an electric means of transport other than a car own a car as well.

Participants were asked to name the frequency of use of different means of transport prior to the Covid-19 pandemic. Results show that the majority of participants used a car as a driver or passenger (almost) daily (47%, n = 63) or several times a week (31%, n = 42). The minority used the car several times a month (18%, n = 24), at maximum once a month (2%, n = 3) or seldom if ever (2%, n = 3). In contrast, the majority of participants stated that they used public transport hardly ever (51%, n = 67) or at maximum once a month (14%, n = 19). Almost all participants (94%, n = 120) stated that they hardly ever used sharing services, see figure 5. The age of the n = 7 participants using sharing services ranges from 20 to 52. However, n = 6/n = 7 participants are between 20 and 27. Only one participant using sharing services is over 50 years old.

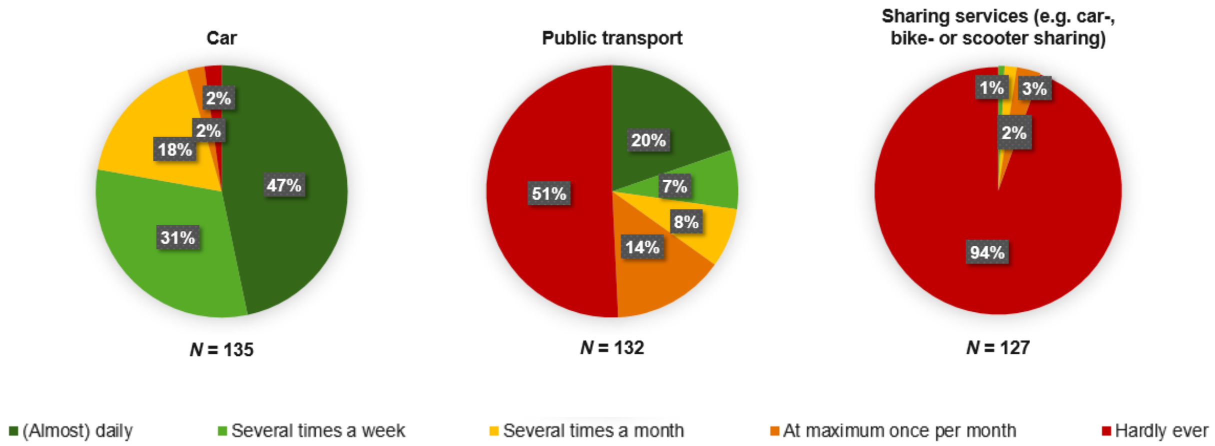

Figure 5. Frequency of use of different means of transport prior to Covid-19 pandemic. The three pie charts depict the frequency of use for different means of transport. The left pie chart shows the

frequency of use for cars, the middle chart shows the frequency of use for public transport. The pie chart on the right shows the frequency of use for sharing services. The colour indicates the frequency of use: dark green indicates daily use, light green a frequency of several times a week. Yellow indicates a frequency of several times a month, orange a frequency of once per month. Red indicates that participants used the means of transport hardly ever. *N* = 135.

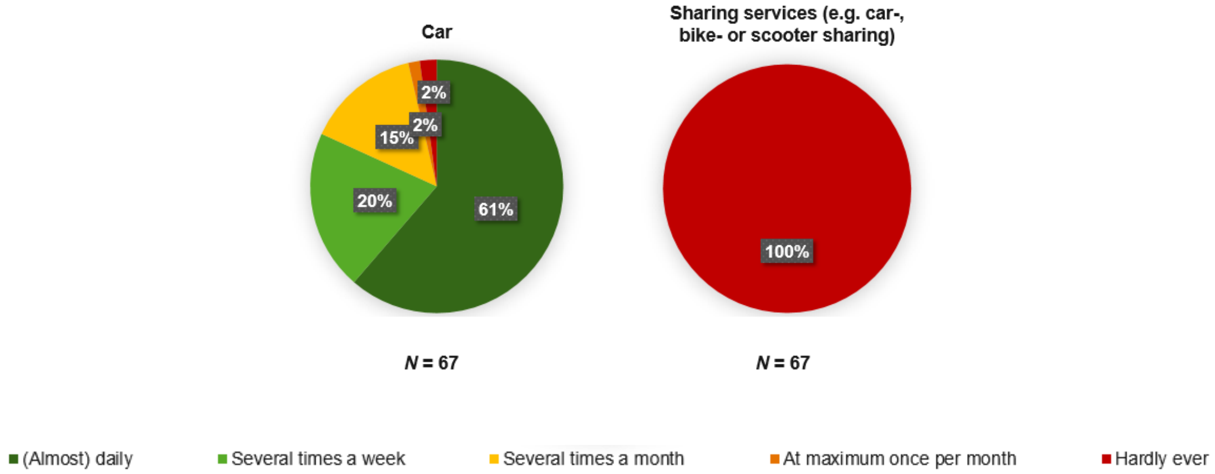

Figure 6. Frequency of use of different means of transport prior to Covid-19 pandemic for participants that stated to not use public transport. The left pie chart shows the frequency of use for cars. The pie chart on the right shows the frequency of use for sharing services. The colour indicates the frequency of use: dark green indicates daily use, light green a frequency of several times a week. Yellow indicates a frequency of several times a month, orange a frequency of once per month. Red indicates that the participants used the means of transport hardly ever. *N* = 67.

More than half of the participants who do not use public transport (*n* = 67) stated that they would principally consider using public transport (58%, *n* = 39/ n = 67). A percentage of 42% (*n* = 28/ n = 67) would not use public transport. Most frequently mentioned reasons being departure times (*n* = 18), location of the stops (*n* = 15), duration of travel (*n* = 11) and costs (*n* = 9). It is mentionable that most participants who do not use public transport own at least one car (*n* = 65/*n* = 67; 97%). Also, participants who do not use public transport also do not use sharing services (*n* = 67/ *n* = 67; 100%), see figure 6. Among participants who do not use public transport, the percentage of people using a car daily (61%, see figure 6) is greater than for the overall sample (47%, see figure 5).

For inferential analysis, participants' level of acceptance was compared to the mean value of the scale by using *one sample Wilcoxon tests*. This enables to assess the level of acceptance. Results show that participants' level of acceptance for the on-demand shuttle is significantly higher than the mean value of the scale, indicating a high level of acceptance, $z = 5.07$, $p < .001$, $r = .465$, see figure 7. A residuum of $n = 6$ participants mentioned that there is no necessity for an on-demand shuttle because people prefer using a bike or car to reach their destination. Other people prefer to use regular busses.

Regarding novel fare structures with a flatrate option for electric scooters and electric bikes, results indicate that participants' level of acceptance is significantly higher than the mean value of the scale, indicating a high level of acceptance, $z = 5.38$, $p < .001$, $r = .493$, see figure 7. A residuum ($n = 5$) wished for moderate pricing ($n = 5$), other participants ($n = 4$) see no necessity, as they would prefer using a bike, or mention that have a long commute that requires a car or other public transport.

Moreover, results show that participants' level of acceptance for the mobility app is significantly higher than the mean value of the scale, indicating a high level of acceptance, $z = 7.96$, $p < .001$, $r = .730$, see figure 7. A residuum of $n = 3$ participants mentioned the wish for easy handling of the app. Also, $n = 2$ participants liked that no paper tickets are necessary when using a mobility app.

Results show that participants' level of acceptance for the mobility hubs is significantly higher than the mean value of the scale, indicating a high level of acceptance, $z = 5.44$, $p < .001$, $r = .499$, see figure 7. When participants were asked to name the three most important service options, most participants mentioned public toilets ($n = 77$), WiFi ($n = 71$), digital info boards ($n = 63$), vending machine ($n = 40$), parcel service ($n = 35$), bank machine ($n = 34$) and lockers ($n = 22$). Less frequently named wishes were charging possibilities ($n = 3$), the possibility to purchase tickets ($n = 3$), rain protection ($n = 3$), shopping facilities ($n = 3$), parking lots ($n = 1$), accessibility for handicapped persons ($n = 1$).

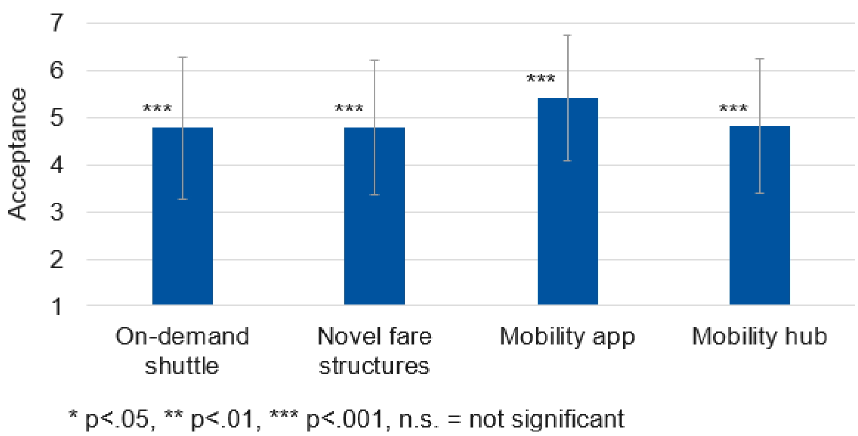

Figure 7. Level of acceptance depending on mobility concepts. The four graphs show the level of acceptance of the four different mobility concepts in BüLaMo: on-demand shuttle, novel fare structures, mobility app, and mobility hub. The stars indicate the significance level of the one sample

Wilcoxon tests. Error bars indicate standard deviations. The figure shows that all Wilcoxon tests are highly significant, indicating that the level of acceptance is significantly higher than the means of the scale. This indicates high levels of acceptance for all mobility concepts. N = 119, due to data loss.

6 Discussion and Outlook

Results on mobility behavior show that the majority of participants use the car far more often than public transport or sharing services. This is in line with the common assumption that the usage rate of public transport in rural regions is lower than in cities, which may be due to lacking services in rural areas [12] which support car usage [13]. However, results show that half of participants who do not use public transport (n = 39/ n = 67), would consider the use of public transport, indicating a general willingness. Participants who do not use public transport mentioned reasons such as unsuitable departure times or locations of the stops. Results also showed that participants rate the duration of travel to be a disadvantage in public transport. Also, almost all participants who are not using public transport, own one or more cars. Moreover, those participants use the car more often when being compared to the overall sample. Taking together the named disadvantages of public transport and the high usage rate among participants who do not use public transport, results may indicate that car usage targets the disadvantages of public transport. However, those drawbacks of public transport could be tackled with mobility concepts such as the on-demand shuttle that offers more flexible transport, independent from bus stop locations and schedules. The express bus route X90 offers public transport with lower travel times compared to regular busses, which would also tackle a named disadvantage of public transport. Overall, results show that the mobility concepts in BüLaMo would possibly fit the needs of citizens living in the Münsterland region, who are critical of public transport.

It is noticeable that only very few participants use sharing services at all. Also, results show that the few participants using sharing services are younger than the mean age of the overall sample. Most participants using sharing system are under the age of 30 years. However, this finding needs to be interpreted with caution, as the group of participants using sharing services in this sample is very small. Nevertheless, future research is encouraged to examine this slight trend with a larger sample. If this trend is true, future research could examine why younger people use sharing services and why other age groups seem to use it less. Also, future research could examine how other age groups can be targeted.

Results show general high levels of intentional usage potential of the mobility concepts surveyed as well as desires for the different mobility concepts. Based on the results, potential improvement measures could be suggested for implementation.

Since the ownerships of different means of transport in this sample overlap largely, an investigation of ownership-related effects was not possible. Future research could investigate whether the ownership of certain means of transport has an influence on the level of acceptance of the different mobility concepts and the use of different means of transport. This may require a larger sample size to ensure valid results. Such information yield valuable insights on the preferences of different groups. Results can be used to target certain groups, e.g. car drivers, more effectively and adapt mobility concepts according to their needs.

Throughout the project, the longitudinal survey approach will reveal more insights on citizen's actual acceptance. Also, future results in BüLaMo will show further post-implementation improvement measures. This iterative approach enables a gradual improvement of the mobility concepts over the course of the project.

BüLaMo offers promising potential in enriching the existing mobility offer in a non-urban region by designing, implementing and evaluating alternative, eco-friendly mobility concepts that are likely to meet the multi-layered demands of future individual mobility and public transport.

7 Acknowledgement

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