User Insights from Shared Mobility Practice in Rural Areas: Community-based Carsharing as a Grassroots-Movement

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Abstract. In recent years, carsharing has emerged as a socio-technical innovation that can help reduce the use of privately owned cars. To understand how carsharing can also be utilized in rural areas as a driver of a sustainable mobility system, studies on users' everyday mobility practices are a valuable source of knowledge. This study investigates emerging practices of rural carsharing in Germany based on 12 qualitative interviews and actual platform usage histories of rural carsharing users from seven carsharing schemes. The results indicate that grassroots movements are a key enabler of rural carsharing services. Rather than replacing private car ownership altogether, community-based carsharing primarily functions as a situated complement to existing mobility practices. Nonetheless, user-centered digital artifacts are required to facilitate everyday mobility practices by supporting booking, access, billing, vehicle information, and coordination. The study contributes to a better understanding of how current carsharing practices emerge in rural areas and what this implies for governing and designing digital tools for grassroots carsharing services.

Keywords. carsharing, shared mobility, rural HCI, grassroots innovation

1 Introduction

Motorized individual transport (MIT) dominates the modal split of current mobility patterns (Eisenmann et al., 2022) and is therefore not in line with the generally recognized goals of sustainability and CO_2 reduction (Schmidt and Hellali-Milani, 2016). Exclusively privately used vehicles contribute to the increase in traffic density, increased noise pollution in densely populated areas, and increased air pollution at the local and global level (Girod et al., 2013; Umweltbundesamt, 2022) and remain

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in public spaces for an average of 23 hours a day. Therefore, it is necessary to break up existing mobility practices and change them with sustainable alternatives, especially vehicle use (Hasselqvist et al., 2016).

In the context of a sustainable transformation of current economic forms, shared mobility services such as ridesharing and carsharing have gained increasing attention (Bossauer et al., 2020b; Hawlitschek et al., 2016; Neifer et al., 2024, 2023; Nobis, 2006; Teubner, 2014). Carsharing is particularly relevant in this context because it decouples vehicle ownership from vehicle use and can be organized through commercial, peer-to-peer, cooperative, non-profit, or community-based arrangements. Users usually receive a temporary right of use in return for a fee, which enables joint consumption to take place (Belk, 2007).

The problem of a lack of mobility alternatives in rural areas stems from people's dependence on private cars and can essentially be attributed to a lack of economic incentives for mobility providers (Bossauer et al., 2020a,c). The concepts of shared mobility, which are growing steadily in cities, cannot be transferred to rural areas similarly. Against this background, carsharing becomes relevant not as a direct replication of urban platform models, but as a potential complementary mobility option whose viability depends on local demand, organizational arrangements, and technical support. In addition, poor technical infrastructure in rural areas creates hurdles to overcome, especially for non-profit providers (Bossauer et al., 2020a; Neifer et al., 2023).

While previous research on carsharing has mainly focused on urban regions, there is a lack of studies in rural areas. Studies dealing with carsharing in rural areas are still primarily based on comparisons between urban and rural areas. However, it is challenging to transfer mobility services to rural areas. Insufficient demand for carsharing and intermodal transport services further underlines the lack of economic viability of the analogue transfer of an urban shared mobility concept to rural regions (Noij, 2019; Wappelhorst et al., 2014). This makes alternative organizational forms, including cooperative, non-profit, and grassroots initiatives, gain in importance. However, such forms should not be treated as self-evident solutions, as their viability depends on local resources, coordination work, volunteer capacity, and the digital infrastructures through which access and use are organized (Münzel et al., 2018).

This work, therefore, deals with how carsharing can also function in rural areas from the user's perspective and how ICT can be used to support this. Accordingly, the research questions are:

RQ1: What requirements do active users identify for community-based carsharing systems in rural areas?

RQ2: How can implications for successfully implementing community-based carsharing in rural areas be derived from these requirements?

To answer the research questions, an empirical qualitative study was conducted using 12 guided interviews with carsharing users who actively use carsharing on the "town carsharing" platform. Their accounts are grounded in actual platform usage histories and therefore reflect experienced rather than merely hypothetical use scenarios (Hall, 2013).

The main findings suggest that community-based carsharing in rural areas primarily functions as a situated complement to existing mobility practices rather than as a

simple substitute for private car ownership. Its viability depends on the interplay between everyday mobility needs, local organizational capacity, and digital support for booking, access, and coordination. This paper contributes to rural shared mobility research by showing how community-based carsharing is embedded in everyday mobility practices, how grassroots organizations shape service provision, and how ICT supports the coordination and governance of such services.

2 Related Work

2.1 Carsharing and Shared Mobility Models

Sharing resources is not a radically new idea. However, done right, it challenges the foundations of the current mobility system, which is largely dominated by private ownership (Lawo et al., 2021). Carsharing can be understood as an access-based form of shared mobility in which the right to use a vehicle is decoupled from individual ownership and organized through membership, booking, and time-limited access (Ferrero et al., 2018; Münzel et al., 2018; Nansubuga and Kowalkowski, 2021). In contrast to private car ownership, the vehicle is not held as a permanently available household asset, but made available as a commercially, collectively, or platform-mediated resource (Münzel et al., 2018). This distinction shifts the analytical focus from possession to arrangements of access, service provision, and coordination.

Carsharing is not a single organizational model. Prior work distinguishes between business-to-consumer (B2C), business-to-business (B2B), peer-to-peer (P2P), and cooperative or non-profit forms of carsharing (Millard-Ball and Schipper, 2011; Münzel et al., 2018; Nansubuga and Kowalkowski, 2021; Shibayama et al., 2013). In B2C models, vehicles are usually owned or operated by a professional provider and made available to individual users through station-based, roundtrip, one-way, or free-floating arrangements. B2B models address organizations that use carsharing to complement or replace company fleets. P2P models differ from these provider-owned fleet models because the platform primarily mediates access between private vehicle owners and users. Cooperative, non-profit, or community-based forms, in turn, are often organized around member interests and local service provision rather than commercial scaling (Illgen and Höck, 2020; Shibayama et al., 2013).

These distinctions matter because the organizational form affects how vehicles are financed, maintained, and allocated, how users gain access, how responsibility and risks are distributed, and whether service development is primarily driven by commercial growth, member needs, or broader social goals (Lagadic et al., 2019; Münzel et al., 2018). Research on carsharing business models further suggests that different forms may coexist because they address different spatial, organizational, and market conditions rather than simply competing within one uniform market (Münzel et al., 2018). For community-based rural carsharing, provider form is therefore more than contextual background as it shapes the socio-organizational conditions under which shared vehicles can be accessed, coordinated, and sustained (Shibayama et al., 2013).

2.2 Rural Carsharing and Grassroots Organization

While carsharing has been discussed primarily in urban contexts, rural and low-density regions pose different conditions for shared mobility services. Lower population density, dispersed settlement structures, longer travel distances, weaker public transport provision, and greater dependence on private vehicles make it difficult to transfer urban carsharing models directly to rural areas (Carroll et al., 2021; Hardy et al., 2018, 2019; Illgen and Höck, 2020; Leroy et al., 2023; Rotaris and Danielis, 2018; Shibayama et al., 2013). In such contexts, carsharing is often discussed less as a stand-alone substitute for private car ownership than as a complementary mobility option that may address gaps in local transport provision. However, the viability of such services depends on more than the technical deployment of vehicles. It also depends on local demand, coherent planning, governance arrangements, and the ability to reach or compensate for critical mass (Leroy et al., 2023; Rotaris and Danielis, 2018).

These rural conditions make community-based, cooperative, and grassroots forms of organization relevant. Grassroots initiatives are commonly understood as bottom-up responses to locally perceived social or environmental problems, often emerging from citizens, associations, or community groups rather than from commercial providers or state agencies alone (Ross et al., 2012; Schwabe, 2020). In the field of mobility, such initiatives may become relevant where conventional public transport or commercially scalable shared mobility services leave gaps. At the same time, grassroots organizations should not be treated as an inherently superior solution. Prior work emphasizes that community-based and volunteer-supported mobility services also face limitations, including resource scarcity, dependence on local networks, fragile funding, volunteer recruitment, and the need for supportive institutional conditions (Hult et al., 2021; Ross et al., 2012; Schiefelbusch, 2025).

For cooperative grassroots carsharing, Shibayama et al. (2013) distinguish such schemes from more open carsharing systems by emphasizing their more bounded member-owner-user constellations. They identify different roles that need to be covered for such schemes to operate: (1) a system provider offering booking, access, and logging technologies, (2) an organizer or association responsible for setting up and administering the scheme, and (3) ordinary members who use the vehicles and contribute through fees or other forms of participation. This distinction in roles links rural carsharing to the questions of local organization, coordination work, and digital support, without presuming how these arrangements are evaluated by users in practice.

These organizational characteristics also point to questions of local governance as community-based carsharing depends not only on providing vehicles, but on collectively organizing access, responsibility, trust, and support structures around shared resources.

2.3 Carsharing as a Mobility Practice

Carsharing can also be understood as part of an ongoing transformation of everyday mobility practices. While driving a car is an established and normalized practice, shared car use changes how access, planning, responsibility, and availability are organized in everyday life (Doody et al., 2022; Julsrud and Farstad, 2020; Svennevik et al., 2020). Therefore, it requires more than the acceptance of a new mobility

service as it involves new arrangements of materials, competences, and meanings, including vehicles, reservation systems, membership rules, digital access, and expectations of flexibility, reliability, and sustainability (Julsrud and George, 2020; Lawo et al., 2021; Shove et al., 2012).

A practice-theoretical lens shifts attention from isolated user choices to the routinized organization of everyday life. Practices have been described as routinized ways in which bodies, objects, knowledge, and meanings are arranged and enacted (Reckwitz, 2002). They are commonly analyzed through the interrelation of materials, competences, and meanings (Shove and Pantzar, 2005; Shove et al., 2012). In mobility research, this perspective helps to examine how transport modes become embedded in recurrent purposes, household arrangements, spatial conditions, and practical know-how rather than treating mobility as a purely individual decision (Maeder et al., 2023).

For carsharing, materials include not only shared vehicles, roads, stations, and charging infrastructure, but also digital artifacts such as apps, booking systems, and access technology. Competences include knowing when and how to book, combine, access, and return a vehicle. Meanings include expectations attached to autonomy, convenience, environmental responsibility, local belonging, or collective use. HCI and CSCW research has shown that such digital artifacts should not be reduced to usability features, but can be understood as part of the infrastructuring of everyday practices as they mediate coordination, visibility, availability, and appropriation (Hasselqvist and Hesselgren, 2019; Hasselqvist et al., 2016; Kjærup and Skov, 2021; Pipek and Wulf, 2009; Stein et al., 2017).

This perspective motivates our paper. Studying community-based carsharing in rural areas requires attention to how shared vehicles are situated within everyday mobility routines, how users learn and organize access, how digital and physical infrastructures support coordination, and how services may be further developed. The practice lens, therefore, provides sensitizing concepts for the analysis without predetermining whether carsharing becomes a substitute, supplement, or otherwise situated element of rural mobility.

3 Methodology

To answer the research questions, a qualitative interview study was conducted comprising 12 semi-structured, guideline-based interviews with active users of a “town carsharing” platform. The interviews were conducted online between September and November 2020, during the COVID-19 pandemic, and lasted approximately 60 minutes on average. They were recorded with the participants’ consent and transcribed anonymously before being analyzed using a thematic analysis approach informed by Braun and Clarke (2006). Initial sensitizing categories were derived from the interview guide, while subcodes and themes were refined through close engagement with the interview material. The codes were then merged and jointly discussed in the authors’ group to ensure a common understanding of the material.

The empirical cases were connected through one pseudonymized platform, referred to as “town carsharing”. The platform provided sharing software and hardware for local mobility providers and supported the basic technical

infrastructure through which the local schemes organized access to shared vehicles. The seven schemes should therefore not be understood as one single local association, but as locally organized carsharing initiatives using a shared platform-mediated infrastructure. They differed in their settlement contexts, number of vehicles, vehicle types, members, booking volumes, and average booking durations, as shown in Table 1.

From the participants' perspective, the platform became visible mainly through practical functions such as booking, availability display, access coordination, billing, and usage documentation. These functions were relevant because the local schemes relied on small user groups, association-based organization, and limited administrative capacity.

Participants were recruited through the local carsharing operators. After the research team had contacted the platform operator's customer organizations, the local associations forwarded the study invitation to their existing users and members. Interested individuals then contacted the research team and were subsequently invited for interviews. All participants provided informed consent before the interviews.

All seven schemes examined in this study were organized as non-profit associations and used the same commercial carsharing software provided by the platform operator. However, the hardware and vehicle handover mechanisms varied across the local schemes, reflecting differences in local preferences, vehicle fleets, and organizational routines. Some associations relied on key safes for vehicle handover, whereas others enabled keyless access via smartphone app. The local associations paid ongoing fees for the software license and technical support. Technical support was provided centrally by the platform operator, while some associations also relied on volunteer members who informally supported vehicle-related tasks, such as checking individual vehicles, handling minor problems, or assisting other members locally.

The timing of data collection needs to be considered when interpreting statements on commuting, public transport use, leisure mobility, and short-term travel behavior. However, the study focuses primarily on active users' experiences with existing community-based carsharing schemes and on structural conditions of rural mobility, local organization, and ICT-supported coordination. Moreover, several participants had used the service for multiple years before the interviews, so their accounts were not limited to pandemic-specific use.

The guideline consisted of mostly open but partly closed questions on everyday mobility, utilization, design, and further development of the carsharing service. These topic areas reflect the analytical interest in carsharing as an everyday mobility practice, as an organized service, and as a digitally mediated form of access and coordination. Socio-demographic data (gender, age, level of education, etc.) were collected at the end of the interviews. All participants consented to the anonymized processing of their data. The semi-structured form enabled statements on carsharing in rural regions to be recorded and compared with each other (Bortz and Döring, 2013).

The final sample included 12 active users from seven carsharing schemes in Germany, with one or two participants from each scheme. The seven carsharing projects (P1–P7), all connected to the pseudonymized "town carsharing" platform, are summarized in Table 1. Across the seven schemes, the number of vehicles, members, and bookings varied considerably, reflecting the heterogeneity of

community-based carsharing in smaller settlements and rural regions. Most schemes included electric cars and fixed locations with dedicated charging infrastructure. The average booking duration ranged from approximately two to nine hours per project.

Characteristics	P1	P2	P3	P4	P5	P6	P7
Geographical location	West	West	South	South	West	North	North
Offer since	08/2018	03/2014	12/2019	04/2016	09/2016	06/2019	04/2020
Number of vehicles	2	2	4	1	3	5	2
Vehicle type	E-Cars	E-Cars	2 E-Cars, 2 Cars	E-Cars	1 E-Car, 2 E-Bikes	2 E-Cars, 1 E-Rickshaw, 2 E-Bikes	1 Car, 1 Transporter
Members	30	120	30	50	40	100	160
Location inhabitants	1,500	1,600	16,000	650	380	6,400	4,900
Bookings	1,500	9,000	1,500	1,000	700	1,300	1,500
Mean booking duration (min.)	156	116	313	241	551	325	508

Table 1. Overview of the carsharing projects

The locations of the respective carsharing services are shown in Figure 1. The settlement structure types are differentiated into urban and rural regions. Urban regions include metropolitan and regiopolitan areas, while rural regions are classified as rural areas near urban regions and peripheral rural areas (BMVI, 2021). The 12 participants are summarized in Table 2. The average age of the respondents was 49.25 years, with five female and seven male participants.

ID	Gender	Age	Household Size	Cars per household	Carsharing usage since	Bookings
P1	female	57	2	1	09/2018	68
P2	male	64	3	1	12/2014	273
P3	male	42	4	0	08/2018	339
P4	female	58	2	2	02/2020	7
P5	male	31	2	2	04/2018	low usage
P6	male	54	3	1	09/2016	110
P7	female	46	3	1	10/2016	55
P8	male	72	2	2	05/2016	39
P9	female	44	130 (Community)	10	04/2014	210
P10	female	29	2	0	01/2020	56
P11	male	62	2	1	10/2019	low usage
P12	male	32	2	0	06/2020	35

Table 2. Overview of participants

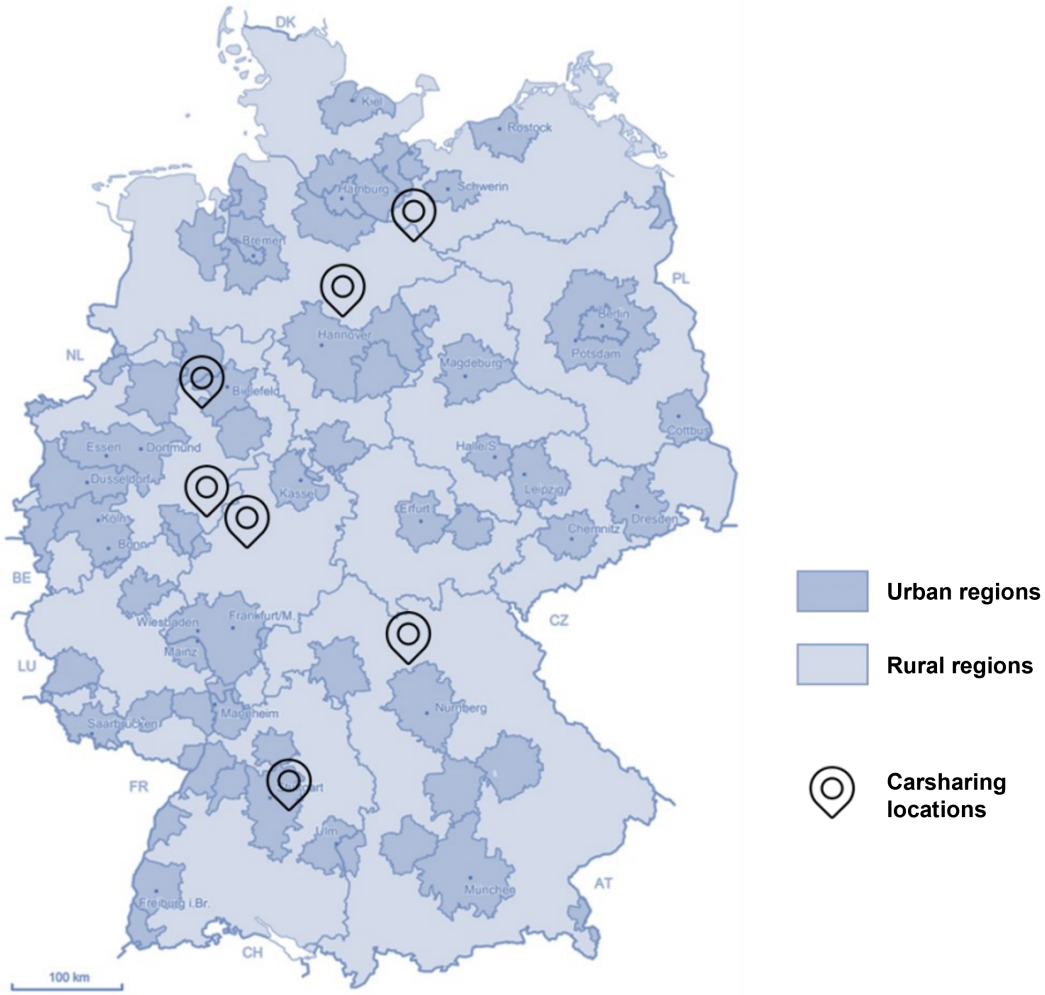

Figure 1. Locations of carsharing offerings. Source: Own representation according to BMVI (2021)

4 Results

The results are structured along the main themes of the interview guide and the analytical focus developed above. We first describe participants' everyday mobility routines and the role of available transport infrastructures. We then examine how carsharing is integrated into different trip purposes and household arrangements. Subsequently, we present findings on the role of the provider and the technical design of the service. This structure allows us to show how rural carsharing is embedded in everyday mobility practices, organizational arrangements, and digital forms of coordination.

As the interviews were conducted during the COVID-19 pandemic, statements on commuting, leisure mobility, public transport use, and vehicle availability are interpreted as situated accounts from this period. Where participants explicitly referred to pandemic-related changes, we indicate this in the results.

4.1 Everyday Mobility Routines

This section describes participants' everyday mobility routines and the role of available mobility infrastructures. It shows how carsharing is situated among private

cars, bicycles, and limited public transport options.

4.1.1 Mobility Infrastructure

The mobility infrastructure in rural regions is limited primarily to motorized private transport. Nearly all participants have very limited or no access to public transport. Accordingly, none of the interviewees had a public transport season ticket. The participants described mobility without their car or even a second car as difficult.

> *"And without a car, it's just difficult here in (...)."* – P2

Bus connections are offered almost exclusively via school buses or special services, such as community buses, which run at least once a day and, at most, every hour. In the evening, there are no more journeys. The buses only travel to the nearest towns and villages.

> *"We only have buses in the direction of (...), the next largest town. The big problem is the other municipality is over to (...), and there's nothing there. So, there's no way to get over there, especially for me and work; a connection in that direction would be vital (...). But since there is no possibility, I would have to cross (...), which would take one and a half to two hours. That's not possible."* – P5

Train stations, if available, can often only be reached by car or bicycle (not on foot) due to the distance. Using or traveling by public transport is considered costly because the general supply in rural areas is limited.

> *"Starting from here by public transport is bad. Another example, if I (...) want to go to the next largest city, which is about 18 to 20 kilometers away from here, then to use public transport reasonably sensibly, I would have to get on my bike, cycle 2.5 kilometers, from there I can then take the bus or train (...). But if I have a destination not in the middle of the city center, (...) I would then take the next bus back from the city center. That's the classic. Very complicated and involves a journey time of three-quarters of an hour. You can get there in half an hour by bike. And that's basically how it is here. It's very rural as far as that goes."* – P3

4.1.2 Regular Trips

Regular journeys include the respondents' daily commutes to work and other frequent, repetitive everyday journeys. These include weekly shopping (e.g., groceries), errands (e.g., doctor's visits), or regular sports and leisure activities. Respondents are comparatively willing to use the carsharing service for these journeys, especially for (larger) purchases.

> *"I use it (carsharing) maybe twice a week on average. And from that point of view, it's relevant, so if I didn't have it, then, yes, life would be a bit more complicated."* – P12

On the other hand, there is little potential for using carsharing for journeys to work. This is because the vehicle cannot be returned directly to the station and would, therefore, have to be rented for the entire working day.

"If I have to drive a whole day to (...), then the e-car will be too expensive at some point. You have to think about that too." – P2

In addition to using carsharing, the participants also frequently make regular journeys by bicycle.

"All routes we can reach by bike, we do by bike." – P6

Some accounts of regular commuting were shaped by the timing of the interviews. One participant, for example, explicitly distinguished between the daily commute before COVID-19 and the reduced office presence during the pandemic.

4.1.3 Short Trips

For this study, short trips were defined more broadly than in many urban mobility contexts, covering journeys of up to 39 kilometers. This reflects the dispersed settlement structures of the cases and the distances described by participants. Respondents were most likely to cycle for journeys of up to 20 kilometers.

"Firstly, the journey to work. I am about eight kilometers from my workplace in the neighboring town, and I mainly cycle there." – P10

"So when I go to the neighboring villages, I go by bike, even if it's 20 kilometers." – P12

Respondents traveled between 25 kilometers and 39 kilometers in their car or, if this was not available, by carsharing.

"Before Corona, the daily commute to work (by car) (...), that's about 25 kilometers." – P5

"To simply have a car at certain times when, yes, I'll say, I'm going shopping for drinks or something, and my husband isn't there or is away for a weekend, for example, or is away during the week with an overnight stay, so that I have an option." – P1

4.1.4 Long-Distance Mobility

All journeys over 39 kilometers are counted in the long-distance category. The study mentioned leisure activities and visits to family or friends in this context. Apart from this, irregular journeys to work, such as for further training or appointments with customers. The most frequently used means of transport for long trips in the study is the private car. Carsharing is only used if a private vehicle is unavailable or if the cost of a carsharing booking is considered proportionate for long journeys. The bicycle is no longer mentioned in this context.

"No, so if I know I'm planning a longer journey, I can switch to our own vehicles. And you always have to remember that carsharing vehicles are charged by the hour. And, of course, a longer journey would also cost more because it would simply take more time." – P9

"I've also traveled to training courses with it (carsharing), to Paderborn or something, when it didn't work out here at home with the car." – P1

4.1.5 Reasons for the General Choice of Mobility

BIKE USAGE Bicycles were the respondents' most frequently mentioned means of transport, particularly for short and regular journeys. The reasons given included the simplicity and flexibility that respondents associate with using a bicycle and the general enjoyment of cycling. Cycling was described as a more accessible mobility alternative than public transport, particularly in rural areas. Cycling was more likely to be rejected in bad weather and colder seasons, and for journeys of more than 25 kilometers.

> *"Well, I hardly ever travel by bus here (...). If I do, I cycle because it (the bus) is simply too impractical for me. Not necessary."* – P2

> *"And then I realized, especially in winter, that when it's dark and wet and raining, it's not so much fun on a bike."* – P10

> *"Well, in the past, when we still lived in the flat in the other town, I could cycle about 15 kilometers to work. But now that it's over 25 kilometers, the distance is too far for me."* – P5

PRIVATE CAR For most respondents, their car is the most frequently used means of transport, especially for longer journeys. Most households in the study have at least one private car, which can generally be used flexibly. The respondents also use their vehicles for shopping or longer journeys.

> *"As I said, you need a car to go shopping, which is rather difficult by bike, and I also go to work by car once a week. This is because we also have a dog, and (...) I have to go home at lunchtime and walk with the dog."* – P7

CARSHARING USAGE Carsharing is primarily used as a replacement for a second car. Carsharing is preferred over the purchase of an additional vehicle. According to the respondents, the costs of a second car would exceed the benefits. The possibility of switching to carsharing in the event of bottlenecks has also increased awareness of how often a second car would be left unused on the doorstep. In this context, a carsharing vehicle's significantly higher utilization rate than a private vehicle was also mentioned. A larger vehicle in the carsharing provider's portfolio can replace private cars procured explicitly for bulky and oversized (material) transport.

> *"We used to have a second car, but it stood around more than used. And that's why this situation is super good now."* – P1

> *"I have an all-round carefree package. I only need to organize the bookings for myself and get in, drive off and fill up, keep it clean, sign in, sign out, put it back, and be done. That's a huge advantage over having your car, especially if you rarely use it. Your car also ages when it's parked. I don't have to go to the MOT, I don't have to change tires, I don't have to worry about maintenance."* – P4

> *"Especially for families where there is only one car and the second car may not be necessary or not yet available. And that would then be an additional way of improving access to everyday problems, let's say, from shopping to doctors' appointments."* – P8

Some carsharing service users have even cited it as the reason for getting rid of their car or second car. Their own vehicle was not used enough, and the carsharing service could easily cover their needs.

> *"(...) I had a vehicle. I then sold it, and that's connected to the fact that there was this carsharing offer."* – P12

> *"We have realized that 95% of cars are parked in front of the house and are unused. And for the 5% that you need a car, you can either take the train or use the [carsharing car]."* – P6

4.2 Carsharing Offerings

4.2.1 Reasons for Usage

For all respondents, carsharing use begins with the start of the respective local carsharing project or at a very early stage of the project. Improving mobility for residents was cited as the reason for creating a carsharing scheme in the town. The use of the carsharing concept depends on the association's membership. The respondents stated that they initially signed up out of interest in the carsharing project and as support for the work of those involved in their neighborhood. As a rule, they joined after an introductory event organized by the respective carsharing provider or after a test drive or trial membership.

> *"With the carsharing organization, because I wear the hat and am also responsible for carsharing as Chairman of the Supervisory Board (...), it was important to us to improve mobility in our village."* – P8

> *"And then I searched for carsharing online on Google. And then I came across this association in (...), which was ideal for me, right on my doorstep. Small, organized, and fair in terms of the cost structure. And then I started this trial membership the following winter and tested it out (...)."* – P10

4.2.2 The Role of Carsharing in Everyday Mobility

Whether the participants in the study use the carsharing service depends on their reasons for using it. Respondents often book the vehicle for larger purchases (e.g., beverages) or visit neighboring cities a little further away. The service is also popular on weekends, e.g., for excursions, leisure and sports activities, or family visits.

> *"And otherwise, if you're traveling on the weekend, visiting your in-laws or something, we do that too. (...) We can also take the S-Bahn, but then you have to go via (...), change trains there, and then return to them. That's why we like to do it with carsharing."* – P10

Carsharing is also used on routes where the destination can only be reached by car.

> *"And doing that by public transport would take up half my day, so carsharing is efficient."* – P12

"The next important journey for me is to my hobby (...). Once a week, I go to (...), but then I use the car from carsharing because I can't get there by public transport, and it would also take too long by bike." – P10

Journeys to work are more frequently made by car or bicycle. The respective offers are round-trip variants, so carsharing is only used in exceptional cases. Otherwise, the carsharing vehicle would have to be booked for the entire working day and spend most of it unused at the workplace.

"But I say, if I have a training course like today and my husband also has to drive on business, then one car is not enough because we don't have the same route, and then we rent the [carsharing car] as well.". – P7

The carsharing service is particularly relevant when a significantly larger vehicle is required than users generally have available privately. Respondents find this very practical if the respective carsharing service includes a vehicle for large transport (estate car or van, for example).

"Because I also furnished a new apartment and then I used the van for all the furniture transportation and so on, totally practical." – P12

Some carsharing schemes allow older people to book a carsharing vehicle and be driven by volunteer drivers within the carsharing project. The interviewees did not specify how much this "cab" service is used. Nevertheless, this option offers older people a simple and safe addition to their mobility, as the participants often know each other personally within the village-based projects.

"And now the older people are being advertised so they do not have to call a cab. They know who will take them here in the village because they know each other. I think that also gives them a sense of security. Or simply." – P1

In addition to the dependence on the actual reason for using the carsharing service, use is also influenced by the mobility alternatives (own car, bicycle, public transport) generally available to users. If the household does not have a car, e.g., because this would mean more effort and/or higher costs, the carsharing service is an alternative that makes mobility possible for respondents in rural regions in the first place. The carsharing service becomes even more relevant for users if a bicycle or public transport is permanently unavailable.

"I use it maybe twice a week on average. Moreover, from that point of view, it is relevant, so if I did not have it, then, yes, life would be more complicated. So it would not be impossible. I like cycling, but it is good to have it (...). There were better public transport connections where I lived before, and I did not use a car daily. There I could do everything by bike and public transport. Furthermore, that is not possible here, and that is why, yes, (carsharing) has been a constant since I have been here." – P12

"If the weather conditions allow it, in 80 % of cases I ride my bike, of course, but there are also exceptional situations when it is extremely snowy or icy, in which case I use the carsharing car or just for shopping that I cannot get by bike." – P6

Some users consider carsharing to be more environmentally friendly. The reasons for this are the better utilization of the vehicles, a possible reduction in motorized private transport, and the design of the services with electric cars. They rate other motorized mobility alternatives as less sustainable and prefer carsharing.

> *"And for me, it's also kind of, yes, a political stance that I do not want to own my vehicle (...), and I also want to be a pioneer with electric cars. So you cannot somehow wish for the mobility turnaround and then not contribute anything."* – P12

> *"And I also think it is good that people get to know electric cars and learn about other types of mobility than gasoline vehicles."* – P2

According to the interviewees, mobility alternatives, especially public transport, require more planning and time for the planned route (with frequent changes or waiting times for connections). The generally difficult accessibility of mobility alternatives, e.g., because they are further away due to dispersed settlement structures in rural areas, also causes people to switch to carsharing.

> *"And then I started looking around for alternatives. They (...) are usually outside. That means the bus stops in the last town, but you still have to walk two kilometers further (...). So with the S-Bahn (...), the time factor, which, of course, shoots the whole thing up a bit in the planning. Because with the S-Bahn, you must always cover longer distances, change trains, and wait here and there."* – P10

> *"The carsharing is about 300 meters away from me, and I would have to drive somewhere to get a rental car first. Furthermore, if I need a vehicle in an emergency, I cannot drive any more kilometers to get a rental car."* – P5

The carsharing service allows the participants in the study a high degree of flexibility in organizing their everyday mobility. They state that they can access carsharing flexibly in terms of time and that the service represents a mobility alternative that they can use without much effort (e.g., compared to public transport). Carsharing was also described as a flexible alternative when public transport was perceived as undesirable, for example during the COVID-19 pandemic. At the same time, such statements need to be interpreted cautiously, as the pandemic temporarily affected commuting, leisure travel, public transport use, and overall trip frequency. The dependence on other means of transport, such as public transport, carpooling, and shared vehicles in the household, is eliminated. The carsharing vehicle can be booked at short notice due to the currently low utilization rate of all users and is usually available. This also makes booking for a whole day or even several days possible. As a household vehicle is often shared, private cars are generally less available for a long time.

> *"(...) In the past, when we did not have the e-car (carsharing), I used to take the train more often (...) or had to rely on colleagues who had the same route. So, you are more flexible now."* – P7

The carsharing option is also an attractive mobility alternative for respondents in everyday life, for cost reasons. They rate the service as more cost-efficient than the purchase and maintenance costs of their vehicle or second car. In addition, the offer is rated as cheaper than a rental car. Respondents also see carsharing as an inexpensive alternative (especially compared to commercial providers, but also compared to public transport) due to the predominant association structure under which the carsharing offers are operated. As a rule, providers also offer special discounts, e.g., for all-day or evening bookings.

> *"So compared to a second or third car, it is cheap. Because for these few trips a week, for which I need it now, if you had to buy an extra car for it now, the costs would be considerably higher and completely disproportionate."* – P9

4.2.3 User Experiences

Overall, the assessment of the use of the carsharing service among the study participants is very positive. As a rule, no problems arise when using the service. The respondents state that they are delighted with the service. The carsharing stations are often located at central points within the towns and are therefore easy and quick to reach (on foot). The stations are equipped with a charging function for electric cars. This is also reserved for the sharing service. The vehicle can be booked at short notice if required, with a few exceptions. The capacities are sufficient for the current user group, so the vehicles are generally available. Nevertheless, the respondents rated the possibility of long-term booking in advance as positive. This ensures that the vehicle is available for necessary, planned appointments or that an alternative can be found quickly. Overall, the price is perceived as very reasonable. Depending on the offer, use can be charged on a time or mileage basis. In addition to this usage fee, the association makes an annual contribution. There is also a willingness to accept additional costs, e.g., compared to using a bicycle, as the carsharing service is generally rated very positively.

> *"But as far as availability is concerned, everything is wonderful. This overview in the online portal is excellent. I have never really been annoyed that I did not get a car, that the car was not fully loaded, or anything else. It's always worked out somehow."* – P9

The respondents have only noted negative experiences of using the carsharing service in isolated cases. Minor technical problems with the vehicle were mentioned in this context, such as a vehicle battery failure or an electric vehicle not fully charged at the start of use. In this context, the currently still relatively poor charging infrastructure in the surrounding area was also mentioned, which makes it much more complex and costly to use the e-cars over longer distances. At the beginning of the respective projects, there were also isolated errors when booking (the vehicle was booked incorrectly by one user and was then not available for another user) or during use (the key was deposited incorrectly after the end of the rental and could not be found again at first, the vehicle was left dirty). Another point mentioned by respondents without their car in the household is the sometimes more complex planning required to organize the use of the carsharing service. As these participants do not always have their vehicle at their disposal and are therefore more dependent on the carsharing service, they have to plan and book their appointments and regular

errands in advance or, if necessary, bundle trips so that the sharing vehicle is not occupied by someone else.

> *"It has happened two or three times now that the charging cable was not plugged in properly, and the battery was not fully charged. However, even then, it is usually the case that the vehicles have driven short distances, the battery was not empty, and I usually only had to drive short distances. So, it has not been a problem so far."* – P3

4.2.4 Role of the Carsharing Provider

As a rule, the respective offers are made available to members via an association or at least a provider that operates on a non-profit basis. The association's activities make offering users a low-cost service possible, as the pricing is not aimed at making a profit but is primarily calculated to cover costs. In addition, there are hardly any personnel costs, as many employees are voluntarily involved in the respective projects. This active participation also creates a greater sense of belonging, not least due to the joint creation and development of the carsharing offers. The interviewees state that regular meetings (regular table meetings) ensure a good atmosphere and a continuous exchange of ideas for project improvement. The interviewees who do not actively participate in the services consider the (voluntary) commitment to setting up and operating the carsharing service very appealing. They also believe that in such a village or community network, the vehicles are left tidier and treated with better care. A small and primarily known circle of users ensures responsible booking (e.g., no constant blocking and short-term cancellation). It creates trust among them (e.g., when dealing with vehicle keys), which a commercial provider cannot achieve. According to the study participants, this trust is also essential in the event of damage claims, which can be dealt with in a less bureaucratic, almost informal manner within the association.

> *"This is a village club here, so it is not a large provider that now offers nationwide services. I think that is another difference to some of the larger providers. These are two cars from the village community, and they pay attention to that and consider it."* – P3

The association-based organization was also connected to local rules of fair use. Participants did not describe the shared vehicles as freely available assets that could be appropriated individually for any purpose. Rather, use was embedded in expectations of responsibility toward other members. For example, one participant explained that the association had prohibited renting the shared vehicle for several weeks for holiday trips, because the vehicle would then no longer be available to others, and this would not be considered fair.

> *"We have prohibited, as an association, that someone rents this car for weeks and takes it on holiday, because during that time the others could not use it, and that would not be quite fair."* – P7

The study participants think that a carsharing service would not be possible in their town if the club provider did not make it available. They justify this with public funding and cooperation with cities or companies, which ensure that the services can

be created at all from a financial perspective. Parking spaces are often provided free of charge by the local authorities. Private individuals in the association network are also more willing to provide private parking spaces free of charge or to contribute their vehicles (P2P carsharing) to the service. In addition, volunteers and honorary staff ensure the ongoing operation of the respective projects. The fact that the projects incur lower costs and do not have to generate profits ensures that the carsharing service can continue to operate even in economically challenging times.

> *"I think a profit-oriented provider would not be profitable here in the village. It only works in the village like we have done it now. People know each other; they trust each other, and the car returns in a reasonable condition. If someone drives in with damage, it is reported. It is simply a matter of trust. The car is also in the middle of the village; there is a small safe, which I think could be cracked with little effort. So, it takes a relatively large amount of trust, and something like that only really works in the village. I do not think a commercial provider would succeed here in the village."* – P6

The respondents see rather negative aspects in organizing carsharing services as an association activity regarding data protection compliance. They believe that the protection of sensitive data cannot be adequately maintained within the existing user groups. The small, primarily known user base ensures that accidents or improper handling can automatically become known. Nevertheless, the trust that the stored data will not be misused is significantly greater with local association providers than with anonymous providers.

> *"(...) of course you have to put up with the fact that at the annual meeting, it is reported that there were two accidents and of course someone always knows who might have done it and the circumstances and that is enjoyed, that is just the way it is.".* – P4

Resources within the associations could also lead to challenges in the future. Participants noted that organizational development may slow down when necessary knowledge, time, or voluntary capacity is limited. This does not mean that commercial providers were seen as an immediate substitute for association-based provision. Rather, the findings point to the limits of purely volunteer-based operation when organizational or technical demands increase. In such situations, local associations may depend on external support without necessarily giving up their community-based character.

> *"And then, of course, it is inflexible for us because it is for people in the village. They would first have to get in touch with the volunteers here in the village. Then, you probably reach your limits when people say, I may be a volunteer, but I have my capacity limits."* – P2

At the same time, participants considered it unlikely that commercial providers could operate a carsharing service profitably under current rural conditions. They assumed that the low number of users would make profit-oriented operation difficult and that prices would increase if external providers took over. Municipal support, free or low-cost parking spaces, and local acceptance were instead seen as important

conditions that made association-based carsharing feasible. External providers were therefore considered conceivable mainly if user numbers increased substantially or if local associations required additional support beyond their voluntary capacities.

> *"The problem is that it will not be 100% profitable for the large providers to park such a vehicle somewhere in the countryside because it would then be used too rarely, at least at the moment.".* – P5

4.3 The Role of ICT

4.3.1 Booking and Utilization Process from a Technical Perspective

To use the carsharing service, a driving license authentication is required at the start of membership in the association. Once the data has been successfully entered, booking the shared vehicles can be started. To do this, the study participants select an available time slot via the booking calendar on a website or an app. The start and end of the booking must be specified. Some respondents said they book the time slot rather generously to avoid running out of time during use. The amount due is displayed directly for some users, while others only receive this information when the invoice is issued at the end of the month. The amount is automatically debited from the account after use. The booking is sent next and stored and preserved in the system. Cancellations at short notice are possible. Users gain access to the vehicle via the vehicle key, which is stored in a box at the carsharing station. With some offers, the key box is opened with a transponder, which users receive in advance or via a fixed numerical code. If the vehicle is parked in a garage, the garage is also opened using a numerical code. Before the vehicle can be started, the charging cable must be removed from the electric car and stowed in the vehicle. Some providers also require the starting mileage (and the final mileage at the end of the journey) to be entered in writing in the logbook, which is stored in the vehicle. The receipt must also be entered in the logbook if the car is refueled during use.

> *"So if I want the e-car tomorrow, I go to our homepage on the Internet, to our page where the e-car is. Or where the databases are. I check the calendar to see if it's available. And then, I logged in and registered with my name as a user because my driver's license had been checked once. And then, if the time frame is free, I can book it via the Internet as normal."* – P8

4.3.2 ICT Support

FUNCTIONALITY Overall, users rate the functionality of the website or app as very positive, easy to use, and satisfactory. They see the technology, especially the online booking system, as an essential prerequisite for use: a booking can be made and/or adjusted at any time, which would not be possible via a telephone booking system. In addition, vehicle occupancy times can be checked at short notice at any time. This enables bookings to be made at short notice, reducing the need for long-term planning. Technology is vital because it simplifies the booking process faster and more cheaply than the telephone. According to the interviewees, certain functions can only be mapped with the appropriate software, such as the community function or automatic blocking after using the e-vehicles for a charging time slot. In addition, the technology enables booking with a cell phone. This means bookings can be made

anytime while on the move, or the profile with all the information can be called up. Users consider booking via mobile devices necessary, as only some households have PCs.

> *"We can access it, and nobody has any work to do with it and has to manage it somehow or bring the car by. It couldn't be better, even with the access options."* – P7

SIMPLICITY Simple handling of the technology is critical to the respondents. Processes such as the debiting of usage costs should be carried out automatically. Issuing keys must be secure but still simple. The technology should work smoothly and not cause any problems. The app or website must be easy to use and understand, which is particularly important for older users, and must also work on older cell phones. During the booking process, the individual steps should be easy to understand and uncomplicated to carry out, the calendar view should be displayed, and it should not be possible to duplicate bookings for a time slot. Potential sources of error should be excluded from the outset and eliminated immediately if discovered during operation to ensure an error-free booking process. One example mentioned was the initial booking via a Google calendar, in which other users' appointments could be accidentally deleted or overwritten. With a functioning and easy-to-use website or app, respondents believe that this will increase general user acceptance. In this context, a service point should also be set up to be contacted in case of technical problems.

> *"Technology or technique or type of vehicle, whatever it may be, naturally makes it somewhere palatable. If it all works smoothly, involves hardly any effort, and is always available, at least as far as possible, then I think it will be accepted."* – P3

DATA PROTECTION The issue of data security is an essential aspect among respondents that must be taken into account in the technology. The system should always be secured against hacker attacks to guarantee data protection. The information on the website or in the app should only publish the most relevant data. For example, it is not desired that live vehicle tracking within the application would be visible to all users. Users should also be anonymized within the app. In the early days of some carsharing services, the names and destinations of users could still be viewed in the app/on the website to offer carpooling opportunities. Furthermore, users would like to see the logbook, which is still openly stored in the vehicle in some offers, and has to be filled in manually with the name, made anonymous. Respondents are currently uncertain about access to the data: who can access the data and how the collected data is used. This creates a feeling of observation and tracking of individual mobility use.

> *"Well, it was mishandled at first. But they took it seriously and then changed the provider for the app and the booking platform. And at the moment I think it's perfect. Although yes, with this journey logbook, you can always see who has booked from when to when. So, yes, it's okay, but it's not ideal either, so I would say it's not permissible regarding data protection."* – P12

IMPROVEMENT SUGGESTIONS To continuously improve the user experience, the study participants were asked about their ideas for improving the technology and additional desirable functions within the system. The users who can only use the carsharing service via a website are in favor of switching to an app or at least being able to use an app. They consider this more convenient and more accessible to display when using a smartphone. They would also like an automatic login. Integrating a complete overview of all bookings and occupancy times is essential for a less time-consuming booking process. Currently, some participants in the study can only request their desired booking period by trying it out in the system, and cannot see in advance whether the period and the vehicle are still available for the desired time frame. The booking interval should also be more flexible, so that cars can be rented not only for full hours but also for shorter time slots. Otherwise, increasing the number of users could lead to capacity utilization problems. Participants also wanted to be able to change existing bookings, as currently only canceling and rebooking are possible in some schemes. Participants also wanted the expected price of a booking to be displayed directly in the system. In some schemes, this information was not available during booking and had to be calculated by users themselves or was communicated later with the invoice.

> *"No, really, just book this forward. Or even book half an hour. Sometimes you're back after an hour and a half, and you can only ever book whole hours."* – P1

According to the respondents, another point that could improve usability is the integration of app and vehicle data. The vehicle automatically registers in the app when connected to a charging station. This could enable users to end a booking with one click or indicate that the vehicle is only temporarily parked while the booking continues. If the charging cable on the electric vehicle has not been connected correctly, an error message could appear in the app and alert the user to the problem. If users return a vehicle earlier than planned, the app could allow them to release it for subsequent bookings. At the same time, users should be able to indicate when the vehicle is only temporarily parked and the booking is still ongoing. In case of a delay during use, storing this in the app is helpful so that the following user is automatically informed. Switching to an automatic logbook and automatic fuel recording would also be desirable to simplify and anonymize these processes. However, it is assumed that such devices are considered too cost-intensive given the current low utilization of the services, and cannot be implemented.

> *"As far as the booking is concerned, as I said, you can extend the cancellation history forwards or backwards, for example, perhaps simply release it backwards. Cancellation always means that I expect the costs to be waived. Perhaps the system can also independently recognize that the vehicle is now at the charging station, i.e., theoretically available again. If it wasn't just web-based but was available as an app, the app could pop up on the smartphone simultaneously and say to release or not release the car."* – P3

4.3.3 Evaluation of Digitization

INTEGRATION OF TRANSPORT MODES The interviewees believe that digitization measures are a sensible further development of the carsharing offer. The integration

of different transport modes, such as shared mobility and public transport, was described as desirable to support intermodal routes. In this context, participants also mentioned the integration of carpooling options to bundle routes. In addition, participants discussed closer cooperation between carsharing providers in surrounding villages. To enable access to carsharing vehicles across regions, cooperation between different providers would be necessary. The interviewees saw potential advantages not only for individual mobility, but also for vehicle utilization if different mobility services were better integrated. According to the interviewees, the acceptance of carsharing could increase if more mobility options were available and if routes, especially in rural areas, could be organized more independently of private cars. According to the study participants, this option of using transport could encourage a reduction in motorized private transport in the future.

> *"It has to be holistic. In other words, I start here with the train somewhere and then have the corresponding connection (...) that has to merge seamlessly. So, I think that's missing somewhere in our landscape."* – P3

> *"What I would like to see now, on a huge scale, is something that would somehow bring all mobility under one roof. So also carpooling from A to B."* – P9

App-based Integration The participants considered app-based integration of different transport modes particularly relevant. Such integration could simplify the use of different transport options across regions and make intermodal mobility more attractive. Different mobility options could be displayed on an interactive map according to their locations. Everyday mobility could be organized more quickly and easily. Having to use several separate apps for one route was described as a potential barrier. For electric vehicles, participants considered it helpful to integrate information on available charging stations into the same app.

> *"I think it would be a great added value if it were somehow integrated into the Deutsche Bahn app. That would be a quantum leap, and I think it would increase the user base many times. So very, very soon, there will be self-driving vehicles, and that will also be an important offer to make the journey from the destination to the station somehow possible."* – P12

> *"A standardized app would, of course, be great, also for charging, but of course, it would also be great for booking if there was something standardized."* – P6

Challenges of Integration Despite these perceived advantages, participants also described challenges of integrating mobility services, particularly in rural areas. The current carsharing offer by the association was perceived as highly local and therefore difficult to integrate with other providers. The organizational and/or legal hurdles would be too significant. In addition, participants were concerned that integrating external providers could weaken the trust basis of the village association. Carsharing stations in different villages are difficult or impossible to reach in rural areas. There are currently too few mobility services in rural areas that could be meaningfully integrated. Participants also pointed to potential parking problems if several providers were integrated and the number of shared vehicles increased.

> *"It's a huge amount of work to set this up contractually in the first place. Suppose I have a limited liability company, association, or commercial use. In that case, we can get away with it, but it still has to be regulated in each case, the cross-uses, to what extent possible, and how we do that with the regulation."* – P4

THE NECESSITY OF DIGITIZATION Digitization measures are rated as necessary overall in the study. They can increase security, e.g., through keyless access to vehicles, where the key cannot be lost or stolen. In addition, hardware components such as the key box and its transponder, for which there are no longer any spare parts in case of doubt, can be replaced. Digitization measures can make the carsharing service less complicated and more convenient, thus attracting more users to the service. However, it must function smoothly, according to the interviewees. The booking process can be simplified by digitizing individual processes. For example, billing could be determined automatically based on the vehicle data. Automating the logbook is necessary for data protection and more straightforward handling. Automatic fuel registration ensures that refueling is noticed (compared to a receipt, which can get lost), so that the user is compensated for the effort accordingly. Automated processes increase acceptance within a networked user group.

> *"And something like an electronic logbook, because you just said that's another point, you have to fill out a logbook by hand somehow, if that would happen automatically in the background, there are such small devices that can do that in the car."* – P10

However, some participants in the study point out that digitization is optional for the carsharing service. There is no need for further digitization measures for the currently still small user group and the design of the service with fixed stations. There are currently no problems with the use of technology. This simplicity should be maintained. Further digitization measures and changes in technical processes could lead to excessive demands, especially for older users. The interviewees assume that the user group of the carsharing service generally consists of older people, as younger people depend on their vehicles for work and leisure in rural regions.

This suggests that digitization was not evaluated as an end in itself, but in relation to the scale of the local scheme, the existing user group, and the practical effort required to maintain the service.

> *"I'm thinking of these scooters, where it was possible to go straight to them and unlock them via the app and cell phone. Something like that would be great, of course, but it would make less sense here in the village, as older people also use these vehicles, and I think they would be overwhelmed in some cases."* – P5

5 Discussion

5.1 Community-based Carsharing as a Situated Rural Mobility Practice

The results show that users' requirements in rural areas differ significantly from those in urban environments. Regionally specific needs play a central role in

less-densely populated areas. For the participants, a private car is indispensable, as a more sustainable mobility infrastructure and a multimodal offer are often poorly developed in rural areas, both in terms of time and location. This supports the argument that rural carsharing cannot be understood as a simple transfer of urban shared mobility models, but needs to be examined in relation to the everyday mobility arrangements in which it becomes relevant (Leroy et al., 2023; Maeder et al., 2023; Rotaris and Danielis, 2018).

Carsharing is a flexible supplement for certain, less everyday occasions, such as major shopping trips, leisure activities, or family visits. Rather than replacing private car ownership altogether, it occupies a situated role between established mobility options: bicycles remain important for reachable short-distance routines, private cars dominate longer or more time-sensitive trips, and carsharing becomes relevant when household mobility arrangements are temporarily insufficient. In this sense, carsharing operates as a complementary mobility practice and, in several cases, as an alternative to maintaining a second car.

From an ecological point of view, carsharing is often associated by participants with a reduction in motorized private transport through better car utilization. The use of electric cars is also emphasized, which supports the sustainable aspect of carsharing. However, there are concerns about the range of electric vehicles, which can be problematic, especially for long-distance journeys. These findings underline that sustainability is not experienced as a general property of carsharing alone, but is negotiated through practical considerations such as vehicle availability, trip distance, charging, and the continued need for reliable mobility.

At the same time, some mobility accounts need to be read in light of the pandemic context in which the interviews took place. Statements on commuting, leisure mobility, public transport avoidance, and vehicle availability may partly reflect temporary changes in everyday routines during COVID-19. However, the central patterns discussed here, limited public transport, private car dependence, household-level mobility arrangements, and the role of local providers, refer to structural conditions of rural mobility that go beyond the immediate pandemic situation.

The participants emphasized associations and cooperative arrangements as key success factors in rural regions because they make carsharing services affordable and accessible through voluntary operation. The findings suggest that small user bases and limited profitability make non-profit association structures particularly relevant for rural carsharing. Such structures can provide an affordable service while strengthening social responsibility, local commitment, and a sense of community. This, in turn, can increase identification with the service and support responsible use of the vehicles. Grassroots organization should therefore not be understood merely as an ownership model, but as a form of local operating capacity as it helps to coordinate access, maintenance, responsibility, and trust under conditions where commercially scalable provision is difficult.

These findings connect the three strands of the related work. From a mobility-practice perspective, rural carsharing becomes meaningful not as a general modal shift, but as a situated reconfiguration of specific routines and household arrangements. From an organizational perspective, grassroots provision functions as local operating capacity that compensates for low-density demand and limited commercial viability. From an infrastructuring perspective, ICT does not simply add

convenience, but mediates access, coordination, accountability, and trust. The contribution of the study therefore lies in showing how these three dimensions of practice, organization, and digital coordination, come together in community-based rural carsharing. This also suggests that rural carsharing should not only be discussed as a service-design problem, but as a question of governing shared socio-technical resources.

5.2 Governing Rural Carsharing as a Socio-Technical Commons

Community-based carsharing in rural areas can be interpreted not only as a mobility service, but also as a socio-technical commons. The shared vehicles are collectively used resources whose viability depends on locally accepted access rules, shared responsibilities, monitoring, trust, and conflict handling. This resonates with Ostrom's work on commons governance, which shows that durable common-pool resource arrangements often rely on clearly defined boundaries, rules adapted to local conditions, collective-choice arrangements, monitoring, conflict-resolution mechanisms, and nested governance structures rather than on market provision or state control alone (Ostrom, 1990). At the same time, rural carsharing differs from classical natural-resource commons because the shared resource is socio-technical, as vehicles, charging infrastructure, booking systems, data practices, and voluntary labor have to be governed together. Later work on commons has extended this perspective to knowledge and digital infrastructures, which makes the transfer to platform-mediated mobility arrangements plausible (Hess et al., 2008).

Access to the shared vehicles is not simply open to an anonymous market of users, but is locally bounded through membership, association structures, and a manageable user group. Such boundaries are not merely restrictive as they help define who may use the vehicles, under which conditions, and with which responsibilities. In rural carsharing, this is particularly important because the vehicle stock is small, alternatives are limited, and individual overuse or irresponsible use can immediately affect other members. Implementation should therefore not only focus on expanding access, but also on supporting locally legitimate rules for access, booking, cancellation, damage reporting, and fair use.

The commons perspective also makes visible a tension between accountability and privacy. On the one hand, local carsharing depends on responsible use, vehicle care, charging, damage reporting, and reliable return practices. On the other hand, small user groups make mobility behavior socially visible, especially when booking histories, logbooks, or incidents can be associated with individual members. Digital systems should therefore not simply maximize transparency. Rather, they should support accountable coordination while limiting unnecessary exposure of personal mobility data. This includes role-based access to booking and incident data, anonymized or privacy-sensitive logbooks, clear rules on who can view what information, and technical support for reporting problems without turning local trust into surveillance.

Finally, rural carsharing should be understood as a nested governance arrangement rather than as a purely bottom-up initiative. Local associations contribute situated knowledge, trust, and voluntary labor. Municipalities, funders, or local partners may support parking spaces, charging infrastructure, or initial financing. Platform providers contribute software, hardware, billing, access

management, and technical reliability. This connects to Ostrom's later work on polycentric governance, which emphasizes that complex collective-action problems are often addressed through multiple, partly autonomous but interconnected centers of decision-making (Ostrom, 2010). For community-based rural carsharing, this means that successful implementation should not place all responsibility on volunteers. Instead, governance should distribute responsibilities across local associations, municipalities, funders, and platform providers.

Digital artifacts are therefore not merely technical support systems, but part of the governance infrastructure through which rural carsharing is made workable in practice. Booking calendars, access technologies, billing functions, logbooks, charging-status information, and communication channels help organize shared vehicle use, distribute responsibility, and reduce coordination work for local associations. At the same time, such systems should not replace the local relations of trust, responsibility, and mutual accountability on which community-based carsharing depends. The central challenge is therefore to support small, locally governed mobility commons under conditions of low density, limited public transport, scarce voluntary resources, and high dependence on reliable everyday mobility.

5.3 Limitations and Future Work

This study is subject to several limitations. The empirical material is based on 12 semi-structured interviews with active users of seven community-based carsharing schemes in Germany. While appropriate for exploratory qualitative research, the findings are not statistically generalizable and should instead be read as analytically transferable insights into specific rural carsharing contexts.

The sample includes only users who had already adopted the carsharing service. This focus allows the analysis to examine actual use practices and service requirements, but it excludes non-users, former users, and residents who reject carsharing. Future research should include these groups to better understand barriers to adoption, non-use, and long-term retention.

All participants were recruited through local carsharing operators connected to the same platform. Although the seven schemes differ in size, vehicle types, membership numbers, settlement contexts, and booking patterns, the findings may still reflect platform-specific organizational and technical arrangements. Comparative research across different platform providers, organizational models, and national contexts would help assess the transferability of the findings.

The interviews were conducted between September and November 2020, during the COVID-19 pandemic. This may have influenced accounts of commuting, leisure travel, public transport avoidance, and short-term mobility routines. At the same time, several participants had used the service for multiple years before the interviews, and the analysis focuses on structural and organizational aspects of rural carsharing that are not reducible to the pandemic context: limited public transport, private car dependence, household mobility arrangements, community-based service provision, and ICT-supported coordination.

Finally, this paper does not analyze fleet expansion, local demand development, scaling, or P2P integration in depth. These issues remain important for future research, particularly through longitudinal studies of how grassroots carsharing

schemes stabilize or transform over time.

The commons interpretation developed in the discussion should also be understood as an analytical lens rather than as a claim that all studied schemes fully correspond to Ostrom's design principles. The empirical material allows us to identify relevant patterns of membership, local responsibility, trust, accountability, and platform-mediated coordination, but it does not provide a full institutional analysis of rule-making, sanctions, conflict resolution, or long-term governance dynamics. Future work could therefore examine rural carsharing schemes more explicitly as socio-technical commons, including the perspectives of local coordinators, municipalities, platform providers, and non-users.

6 Conclusion

This paper examined what requirements active users identify for community-based carsharing systems in rural areas and what implications can be derived for successful implementation. Based on 12 qualitative interviews across seven carsharing schemes in Germany, the findings show that rural carsharing should not be understood as a direct transfer of urban shared mobility models. Instead, it primarily functions as a situated complement to existing mobility practices: bicycles remain important for shorter everyday routes, private cars continue to dominate longer and more time-sensitive journeys, and carsharing becomes relevant when household mobility arrangements are insufficient or when maintaining a second car is not desirable.

The study further shows that community-based organization is central to rural carsharing provision. Local associations and cooperative arrangements help make services affordable, trustworthy, and locally embedded under conditions where commercial provision is difficult. At the same time, ICT plays an important mediating role. Booking systems, digital access, vehicle information, payment functions, and data protection mechanisms support the coordination of shared vehicles and help integrate carsharing into everyday routines.

Overall, the paper contributes to rural shared mobility research by showing how community-based carsharing emerges at the intersection of everyday mobility practices, grassroots organization, and digital coordination. Successful rural carsharing therefore depends not only on providing vehicles, but on supporting the local organizational, technological, and governance conditions through which shared mobility becomes usable, reliable, and meaningful in everyday life.

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