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A Study on the Factors Influencing the Use of Station-Flexible E-Car Sharing Models in Rural Areas in Baden-Württemberg, Germany

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Abstract. This research analyzes the distribution of station-flexible e-carsharing offers in the rural space of Baden-Württemberg through an analysis of the sociological and demographic characteristics and use cases related to the population. The attention is on the customers and potential customers of a regional company that has specifically developed a business model for rural space. Using an online survey with a sample of 374 individuals, univariate and bivariate statistical methods were employed in order to obtain meaningful results. The results demonstrated that household size mattered little in determining if respondents would participate in carsharing. Men used station-flexible carsharing more than women, this relationship was found to be statistically significant. However, older respondents made no difference in their interest in e-carsharing. The positive association between higher education and usage was particularly striking; college educated respondents had a greater willingness to use the service, they were significantly different than the others. Vehicle availability was less so. Notably, leisure activities and excursions was the most cited reason for usage by users; e-carsharing is appealing for leisure purposes for vegetative nature in rural space. Thus, sociological and demographic factors including education and gender bond together to be more important than household size or vehicle access to determine use cases. This study, shows a solid level of allied positive information for sustainable development of mobility solutions, revealing various opportunities that are regions specific for rural space.

Keywords: Station-flexible e-carsharing, Sociodemographic analysis, Rural mobility, Rural transportation behavior, Sustainable mobility solutions, carsharing acceptance.

Introduction

Electric vehicles are regarded as vastly climate friendly when compared to internal combustion-engined vehicles, as the overall climate impact of e-vehicles is enhanced because they are more efficient and produce less CO_2 emissions. Thus, evehicles are part of the solution to some present-day global problems such as climate change and resource depletion. At the same time, a considerable proportion of the population continues to prefer combustion-engined vehicles (Canzler & Knie, 2012). The reason for this according to Canzler & Knie, (2012), is principally because of the high purchase price of electric vehicles and concerns of an insufficient driving range.

DOI: 10.2478/picbe-2025-0364

One avenue towards alleviating this concern is through mobility concepts such as, e-carsharing, where costs can be shared by several users. Furthermore, e-carsharing can be coupled with public transport to reduce range anxiety (Wappelhorst, et al., 2014). However, in the moment, nearly all sustainable mobility concepts are discussed primarily as mega-cities (Proff et al., 2012). In Germany, the spread of carsharing has rapidly increase over the last few years, especially in urban areas, while in rural areas it has mostly remained as isolated peer-to-peer models (Nehrke & Loose, 2020). The problem in rolling-out or expanding carsharing services is clearly identified as being consistently high upfront investment vs. initially low demand and low return on investment. To make a carsharing network affordable to operate, a large number of constant users are needed, with the caveat that a user base can only be established from a larger, well-positioned network, with ideally high availability at launch (Efthymiou et al., 2013; Abouelela et al., 2024). This entanglement of factors makes it much more difficult to develop or implement new carsharing services. Many cities are already saturated carsharing markets, thus companies are shifting towards rural areas. Therefore, a larger numbers of companies are looking for new opportunities to promote mobility concepts, such as carsharing. In particular to improve and increase the often poor connection with public transport. In Germany, one in three, reported being dissatisfied with the public transport offer, particularly in rural areas. Furthermore, the target group was much more likely to experience mobility poverty as a consequence of limited transport options or accessibility, significantly limiting the access to important destinations, such as workplaces, medical services, or everyday needs (Alliance for Rail, 2024). This study aims to examine the sociodemographic aspects and availability patterns of the rural population in Baden-Württemberg, to increase availability of e-carsharing services. Special focus will be made to a regional located business in Baden-Württemberg.

Review of the scientific literature and research questions

Research has grown in carsharing on a range of disciplines. For example, there are research studies describing hybrid business models that link electric shared cars to energy markets that offer the prospect of ecological and economic advantages (Kahlen et al., 2018). A large group of researchers have focused on user attitudes and behaviours that facilitate acceptance and dissemination of carsharing models. Of particular concern are sociodemographic characteristics - for example, age, income, and car ownership that are important determinants of carsharing adoption (Burkhardt & Millard-Ball, 2006; Wappelhorstet al., 2014; Abouelela et al., 2024). The decision to switch to carsharing may depend on many sociodemographic and attitudinal characteristics. Younger individuals had a much higher willingness to use a carsharing service versus older generations would be less likely (Efthymiou et al., 2013; Abouelela et al., 2024). Furthermore, individuals with a higher level of education used the service more than individuals with lower education levels. Higher education is often associated with being more receptive towards innovative mobility solutions (Abouelela et al., 2024). Household size is also an important factor in the uptake of carsharing services. Although carsharing service use decreased with household size (Kim et al., 2015), smaller households and individuals are more willing in contrast to larger households, specifically those with children, who rely on car ownership. Finally, one of the most significant motivations for using carsharing services is to save money (Abouelela et al., 2024) Transportation and traffic use behaviour analysis applications offer numerous viable prospects for sustainable services. Understanding transport behaviour supports the initial potential use of non-owned mobility. The ability to use public transport appears in the favourable factors, as carsharing is likely viewed in union with the use of buses and trains (Efthymiou et al., 2013; Abouelela et al., 2024).

Environmental awareness plays an essential role as many users consider carsharing as sustainable alternative way to not own a private vehicle (Burkhardt & Millard-Ball, 2006; Efthymiou et al., 2013; Abouelela et al., 2024). Income plays a differentiated role in carsharing use; while higher income individuals use the service more often, it is a financially viable form of mobility for lower income groups (Nehrke & Loose, 2020). Therefore, a typical carsharing user profile is: young, educated, environmentally conscious, and ready to adopt new ways of mobility (Burkhardt & Millard-Ball, 2006). This profile marginalizes that carsharing appeals mainly to users considering sustainable or innovative alternatives to typical mobility. Several studies have identified variables that predict the use and spread of urban carsharing. There is also appropriate differences between carsharing operating models and sociodemographic variables. For instance, individuals in free floating carsharing services tend to be more likely younger, men, and have higher income levels than other carsharing models while for round-trip carsharing users tend to have average lower educational levels while they appear to have higher sustainable and efficient lifestyle. The work by Amirnazmiafshar & Diana (2022) has stressed the significant role of differentiating development options depending on context and existing carsharing models. The models such as flexible systems like free-floating, stationary systems like a station-based, peer-to-peer model with personal vehicles, and service type with business models (B2B, B2C, and B2G) which engaged companies, private customers or public body. Each model was found to engage a core target group and may attend to multiple mobility needs. Notably, the review as well as this study will not address the station-flexible context. The station-flexible model recognises and hybridises the previous two use cases, of a customer being able to complete a full journey in stations much like outstation model but with the option to pick up one charged vehicle from one station, and drop it off at potential any other station in Germany! Despite this being the described theory and as potentially promising development in the carsharing landscape, it has been left unquestioned in the analysis.

The subsequent sections will attempt to define and understand the target group of the customer and potential customer of a station-flexible e-carsharing model in the rural context of the Baden-Württemberg context. As the analysis is focused on a group of rural Baden-Württemberg individuals we hope to get a better understanding of mobility patterns that may help promote the spread of a new station-flexible model in the rural context. That is, to hopefully create a more precise understanding of the target group needs, so the service can be refined to their needs, and greatly improved likelihood of success for the model. We can thereby create the following questions:

- What are the target group sociodemographics?
- What factors vary the use of the station-flexible e-carsharing from rural respondents?
- To what extent may potential rural or urban respondents attitudes and use of e-carsharing differ?

Research methodology

An online survey was conducted from October 11 to October 24, 2024 to study e-carsharing in rural areas. The participants were current customers and employees of a company located in Baden-Württemberg and had to be over 18 years old. The survey provided several opportunities for respondents to participate. The survey was distributed by either trained facilitators using formatted emails or sent via their social media networks (such as Facebook) in their group. The survey was sent to 1,000 people, 494 people responded, and after that, 374 were classified as individuals living in rural areas of Baden-Württemberg based on their postal codes. The Ministry for Rural Areas and Consumer Protection defines rural areas as low population density areas where density values for

population and dwelling and employment were significantly below the regional averages. These areas usually have higher proportions of open spaces and agricultural land, thus are normally the most difficult areas for the development of infrastructure. There is about 69% of the land area of Baden-Wütternberg is classified as rural, 35% of the people in Baden-Wütternberg are in these areas, while only 30% of the people in insured employment. Conversely, urban agglomerations constitute only 17% of the state area, but facilitate half of the total people and 59% of all the jobs. The peripheral zones, found at the outer edges of urban agglomerations, have medium density of population and high density of settlements (State Development Report, 2005).

With a 49.4% participation rate the survey was remarkable, after all, the participants were studied from a non-probability sampling method, in this case self-selection polling. Participants were not randomly drawn from the overall population but could choose to participate in the study. Recruitment was done through formatted e-mails and social media, meaning it was largely conducted among individuals with either a pre-existing connection to the company (e.g., former participants in e-carsharing) or those who generally had an interest in e-carsharing. The primary advantages of this sampling method included relatively cheap and efficient data collection efforts and the potential for a high response rate. The drawback of this method is that it involved self-selection bias, in the respect that people with a generally positive attitude towards e-carsharing were more likely to participate, potentially limiting the representativeness of the sample for the entire population of Baden-Württemberg. In this respect people with no interest or prior experience of e-carsharing probably were under-represented. That said, there is still value in understanding the opinions and experiences of a relevant user group, particularly with respect to potential customers and employees of the company. The study used a quantitative-empirical approach which aimed to summarise the complex relationships detailed in the body of this report into usable key figures based on averages, percentages and frequencies. We wanted to explore the stats of respondents based on socio-demographic characteristics (gender, age, household size, education, place of residence etc. and connect these with usage behaviour. The statistical analysis was evaluated using SPSS to test the null hypotheses for statistical significance.

The quantative questionnaire was employed in the study for hypothesis testing. At the start of the survey, the participants were welcomed and told about the purpose of the study and data anonymity. E-carsharing is quite a recent technology, so the study provided a basic introductory explanation to ensure that the respondents all had a basic understanding of the concept before beginning the questionnaire. The questionnaire began with a dichotomous question asking whether the respondent had ever used e-carsharing. If no was indicated, the reasons for not using e-carsharing were evaluated. The respondents were able to select from multiple pre-defined options. Thereafter were questions about important factors for e-carsharers and about their intended uses of e-carsharing, and they answered these with several answers allowed, in order to capture the aspects like cost, flexibility, customer service, availability of vehicle, etc. Following this, the potential reasons for their e-carsharing were surveyed with multiple-choice answers. Another critical section of the survey considered the temporal aspect of using e-carsharing, asking respondents to share when they felt they were likely to use e-carsharing, which took place on an ordinal scale with options “occasionally”, “daily”, and “only on weekends.” The next section considered whether the respondent could see themselves using e-carsharing in the future; and if they were interested in e-bike sharing or e-scooter sharing. These questions were done in nominal scale with response options "Yes" or "No." Another significant aspect of the survey was whether they were willing to pay (in euros) to use e-carsharing for either an hour or for a full day, at which point it was given the opportunity to enter a self-defined amount in euros. Following this, the importance of

e-carshairng was assessed using a four-point Likert scale of "1: very important" and "2: rather important" and "3: rather unimportant" and "4: unimportant." In addition to perceptions related to their own use, the survey also assessed their perceptions of the spacial and temporal availability of public transport at the respondents' local points. This was measured on a five-point Likert scale where the respondents responded "1: very good", "2: good", "3: neutral", "4: poor", and "5: very poor". The survey assessed availability of public transport for the respondents at different points: on weekdays, on weekends, during vacation periods (weekdays), and on public holidays. At the end of the questionnaire, socio-demographic variables were captured including gender, age, household size, household income, highest level of education and postal code. While some of these variables were categorical such as gender on a nominal scale and income on income brackets, others were open-ended, such as age and postal code. Overall, the structure of the survey allowed for a complete assessment of key variables influencing the use and perceptions of e-carsharing, providing important information about people who already use the service and to identify possible barriers to use.

Results and discussions

1.Socio-demographic characteristics of the target group

Table 1 provides an overview of the sociodemographic characteristics of the entire sample (n = 374). Based on the literature, which highlights gender, age, household size, household net income, and educational attainment as key influencing factors on mobility behavior (Amirnazmiafshar & Diana, 2022), these characteristics were analyzed in greater detail

Table 1. Socio-demographic characteristics of the target group (n=374)

Gender	Age	Household Size	Household Net Income (EUR)	Educational Attainment
Male: 64.7%, Female: 24%, Not specified: 11.3%	18-24 years: 21.4%, 25-34 years: 23.4%, 35-44 years: 11%, 45-54 years: 22.7% 55+ years: 29.4%	1-person: 18.7% 2-person: 29.7% 3-person: 24.1% 4-person: 26.2%	<1,000: 11.5%, 1,000-1,900: 13.9%, 2,000-2,999: 16%, 3,000-3,999: 14.4%, >4,000: 23%, Not specified: 21.1%	University degree: 40.1%, Completed apprenticeship: 30.7%, Currently studying: 19.8%, Other: 9.4%

Source: Authors' own research.

2. Univariate target group analysis

To detect various attributes in the sample, univariate analyses can involve frequency counts and the use of measures of central tendency and measures of dispersion. The following descriptive statistics will focus on the most essential attributes of the respondents. This will include measures of the arithmetic mean, relative and absolute frequency, frequencies of the statistical mode, and any form of standard deviations. Generally for the usage attributes, there is no necessity to group or categorize respondents. The n=321 non-users will only be highlighted when the analysis is of the reason for non-usage (non-users) and will act as a cruder base of all respondents. Less than one in be respondents will use carbuilding (85.5%) as a large percentage own a vehicle (64.02%). Also, it can generally be assumed that non-users who own a vehicle and are from a rural community will most likely see having a car as a necessity and for convenience. Another study noted the highest agreement with the statement non-users use a car and do not think, implying habits regarding how regularly they use a car. This habit and convenience orientation diminishes their inclination towards

car sharing as they view sharing cars as not only sub-optimal, and lean towards the ease of ownership. What is really disconcerting to them is about car sharing is that they have to plan the situation, and have to reserve it, and car sharing is not framed as more efficient alternative (Nehrke & Loose, 2020).

Another important point is the lack of availability of this service in their area (46%), which was identified as a reason for non-usage. Furthermore, there should be attention given to the fact that people with the potential to use carsharing are unaware of how this established service operates, so they do not use it. In order to gain insight into the conditions under which e-carsharing could be used, the participants of the study responded to the query: "What conditions, in particular, are important for you when it comes to the e-carsharing proposal?" The participants stated, as most important: temporal and spatial flexibility (70%), prices (65%), and easy reservation (65%). Similar findings have been reported by Kapser and Abdelrahmen (2020) as to price being the strongest predictor of intention to use. A qualitative design by Söhner et al. (2024) likewise report effort expectancy, facilitating conditions, and cost-benefit are primary categories for acceptance of carsharing services.

As for the question around the rationale for using e-carsharing, respondents predominantly envisage e-carsharing as being used for spontaneous short trips (68%). This preference is consistent with the study by Nehrke and Loose (2020), which shows that in free float carsharing of cities, the modal is often stimulus-based and distance short. In fact, users of station models prefer carsharing for more developed and long distance travel. Therefore, for people living in rural fashion, station flexibility generally offers higher flexibility. Approximately half of the respondents (50%) stated they could envision using carsharing for shopping trips, while 38% said they would consider using it for vacations or outings. The willingness to use carsharing as a means to commute is low, with only 21.4% of respondents considering using carsharing as a means to commute. Once again, Nehrke and Loose (2020) have found no evidence that free-floating or station-based carsharing users in urban areas use carsharing as a means to commute or travel to educational services. Rather, carsharing is primarily used for planned irregular activities (bulk shopping or family visits) or leisure.

The survey identifies that carsharing services are sporadically used as well-64.02% of users indicate that they would only use the service occasionally. Only 15.05% of users would only use the service once or several times a week on weekdays and only 14.07% of users will use carsharing during weekends. Nehrke and Loose (2020) reached similar results: the majority of carsharing users would only use the carsharing service once a month or less, and sometimes as infrequently as once every six months. These results reinforce the sporadic and purposeful reason for using a carsharing service even for users of a station-flexible system in a rural area.

The overall importance of a carsharing service is rated on a four-point scale with an average value of $\bar{x} = 3.23$ ($s = 0.851$), indicating a tendency towards unimportance. A similar result is reported in their study (Nehrke and Loose, 2020). Carsharing services only play a minor role in mode choice in cities generally in Germany as public transport (ÖPNV) generally dominates. Additionally, one-third of respondents reported being able to imagine someday using e-bike or e-scooter sharing, while the other respondents remain either actively opposed to the idea or are skeptical to the point of not being able to imagine using those forms of travel mode. This is not surprising, as research such as Nehrke and Loose (2020) has shown that carsharing users have the highest willingness to try different travel modes. Moreover, the majority of respondents are not existing carsharing users, which accounts for this lower level of willingness to try e-bike or e-scooter sharing.

Price sensitivity is by far considered to be the strongest predictor of intention to use carsharing services (Kapser & Abdelrahmen, 2020). Therefore, a strong understanding of willingness to pay is very important. In terms of willingness to pay for station-flexible e-carsharing on a per-hour basis, the 317 respondents indicated an average willingness to pay of €7.20 an hour (s = €6.75). Most often mentioned was €5.00 (the mode). For daily willingness to pay, the average value was €35.10 and the most common was €50.00. Compared to the average value, the high standard deviation of s = €29.46 points to a strong variability in preferences from respondents on how much they are willing to pay. In comparison with urban carsharing services, station-based carsharing will cost €6.20 for a two hour trip covering 10 km while free-floating carsharing will cost €17.90. Similarly, the cost for the day tripfare (8 hours, 120 km) is €34.20 in a station-based model, but €76.10 in freefloating (Nehrke and Loose, 2020). The willingness to pay of potential rural carsharing users is therefore, understood to be mid-market.

A good public transport (ÖPNV) offering is also generally considered an important factor contributing to carsharing use (Nehrke & Loose, 2020). Therefore, it makes sense to consider transport availability. The results indicate that spatial availability of public transport is generally rated positively - 11% rated very good, 31% rated good, a quarter rated neutral, and 22% rated public transport as poor. The average value of $\overline{x} = 2.85$ lies between good and neutral. With regard to time availability of public transport, evaluations are much more critical as it is rated as neutral on weekdays with an average of $\overline{x} = 2.67$. The ratings predictively did not vary according to respondents (i.e., the standard deviation was low at s = 1.082). On weekends ($\overline{x} = 3.37$) and holidays ($\overline{x} = 3.16$), the assessment worsened even further. On public holidays, time availability of public transport was assessed as poor ($\overline{x} = 3.59$), which is unsurprising; rural areas may at least one bus stop, but the frequency of connections is limited.

The target group of respondents was further segmented as part of the analysis to enhance precision of analysis, the segmentation was guided by a key starting question to distinguish user versus non-user. Respondents who answered a "Yes" to the question of previous use in a carsharing service were classified as 'users,' while those who answered "No" were classified as 'non-users.' Once established, the groups were further differentiated based on the question, "Could you imagine using an e-carsharing service in the near future?" The results reveal an astonishing level of potential demand for e-carsharing services: out of respondents who could imagine it, 43%, 41.1% (n=161) considering it in future, only 15% ruled it out. The group of "potential users" (n=161) will be analysed in separate sections.

The target group is 63.1% male, average age is 41 years old, lives in a 2.7 person household, has a net monthly income of €2800, and 44.4% hold a university or technical college degree. Using the service, 20.6% are frequent users of carsharing services. Among non-users 50% of users state that they do not use the service due to the lack of the availability of an e-carsharing service in their area and 39% already own a car. The target group place strong importance on the affordability of prices (63.8%); a simple booking procedure (68.8%); and the temporal and spatial flexibilities (68.1%). The service is predominantly used for excursions (54.9%) and to often take spontaneous short trips (74.4%); temporal flexibility is important to (61.9%). Willingness to pay is roughly €7 per hour and €34 per day. However, the service was rated overall as less important to their mobility. Only 43.8% of the target group indicate they are willing to use alternative business models such as e-bike sharing. The availability of public transport in their locale is rated neutral; while temporal availability is assessed much more critically. Potential users (n=161) show no statistically significant differences compared the full sample (n=374). This suggests expectations and preferences in regard to e-carsharing are largely consistent between both groups.

3. Bivariate target group analysis

An overarching goal of this research is to better understand the mobility habits of individuals in the rural context in order to facilitate the introduction of an innovative station-flexible carsharing service in these geographical areas. In order to draw well-founded conclusions, the findings of studies relating to carsharing in urbanized contexts and comparisons with data from respondents that live in rural areas are therefore used. An important study is the one carried out by Nehrke and Loose (2020) exploring usage and outcomes of different carsharing variants and different characteristics between users and non-users that included the German cities, Frankfurt am Main, Cologne, and Stuttgart, with a focus on sociodemographic characteristics, mobility behavior and attitude variables. Another relevant comparison source is the international work by Amirnazmiafshar and Diana (2022) examining sociodemographic variables impacting demand of different carsharing models, specifically as they relate to differences across carsharing operating models in international metropolitan areas such as Zurich, Shanghai, Portland, and San Francisco. The hypotheses framed in this study are derived from the assumptions made in the above-mentioned urban studies and were tested compared to the empirical data collected in the rural survey to explore spatial differences.

Multiple studies report smaller household sizes are associated with carsharing use; for example, Nehrke & Loose (2020) report an average household size of 2.14 persons for carsharing users. This leads to the first hypothesis:

Hypothesis 1*: If the respondent lives in a two-person household, they are more likely to be willing to use a station-flexible e-carsharing service.*

As the beginning of a dependency analysis, the characteristics were first described on a descriptive level. The characteristics were included in a contingency table and cell and marginal frequencies were calculated. The results indicate that respondents living in the largest households (four or more persons) exhibit the highest likelihood of using an e-carsharing service (88.8%). The probabilities for the use of e-carsharing for other household size categories all had probabilities over 80%, but were closely spaced. However, the difference in household size categories is statistically significant at the 1% level. A chi-square test was conducted to see if these results could be generalized to the population. It was found (not reported) in this test that four-person households did not statistically differ from other household size categories in their willingness to use e-carsharing. As a result, the first hypothesis we proposed could not be supported. Characteristics measuring symmetric measures were also provided (e.g., Phi and Cramér's V) to help understand the strength of the relationship. All three measures were below 0.3 indicating there was a weak relationship between household size and willingness to use e-carsharing. Values of 0 represent no relationship and 1 represents a perfect relationship. Accordingly, we found there was only a weak relationship between household size and tangible e-carsharing service. Additionally, as reported in the study by Efthymiou & Antoniou (2013) that married people are typically not as likely to substitute their private car for carsharing; a possible contributor could be that married people most frequently commute to different workplaces and as a result, are both dependent on their own cars. As such, the second spouse usually takes on the role of either driving the other spouse to the closest public transport station or directly to work, foregoing a carsharing vehicle.

In the second step, we look at the possible influence of gender on demand for station-flexible e-carsharing respondents make. Many studies show that carsharing users are generally higher proportions of male. Nehrke & Loose (2020) study showed that carsharing users were 56.3% male, which is higher than the average of 48% in general in the studied cities population. So, the second hypothesis is as follows:

Hypothesis 2*: If the respondent is male, they are more likely to use station-flexible e-carsharing.*

In the statistical analysis, it was found that men (15.3%) use station-flexible e-carsharing significantly greater than women (10.2%). The difference in proportions of use was statistically significantly different at a level of 5.1% and the chi-square test, p-value of 0.00 and significantly differed. Our results indeed supported our originally fromulated hypothesis, and in line with previous studies also found that even in rural areas, men are greater users of a station-flexible carsharing service. Phi and Cramér's V effect sizes were below 0.5 indicative of a weak relationship between gender and frequency of use. It is possible the weak correlation can be accounted for sample size or by studying rural regions.

Many studies find that carsharing is chiefly used by younger people (Burkhardt & Millard-Ball, 2006). The significance of car ownership has decreased for many people, and as a result, carsharing is only attractive to mostly younger members. Users using the free-floating model are younger on average (25–34 years) compared to older users who are station-based users (44 years). For all carsharing users, the average is 46 years (Nehrke & Loose, 2020) while the average age in Germany is 44.6 years (Turulski, 2023). Therefore, anyone who is under 45 years of age is categorized as young for the sake of this study. This leads us to our third hypothesis:

Hypothesis 3*: If the respondent is younger, they will likely consider using a station-flexible e-carsharing service.*

To validate this statement, a t-test was performed. The t-test shows that the potential customers that can imagine using a carsharing service are on average younger (43 years) than those who did not consider using the service (46 years). However, due to the p-value of 0.096, the difference may not be statistically significant. Moreover, the Levene test shows that there is no homogeneity of variances, thus supporting that Hypothesis 3 cannot be confirmed. One explanation is that a purely electric carsharing service may appeal to older people as well. Carsharing may be just as attractive as it is to younger users living in rural areas who are looking for alternative solutions (inexpensive and flexible) to, for instance, a second car. One supporting argument is Kim et al. (2015) which indicates that older people are more likely than younger people to change from private cars to an electric carsharing. Conversely, one could postulate that younger users in rural areas find carsharing arrangements less appealing than in urban areas because they typically want to own a car in the long-term. For them, owning a car often means being 'independent' and 'having freedom'.

According to Burkhardt and Millard-Ball (2006), the variable most strongly positively correlated with actual usage in the carsharing literature is education. Holders of a college or university degree make up a vast majority of carsharing members. Nehrke and Loose (2020) also state that 72% of their surveyed members hold a college/university degree. Free-floating carsharing members include an even higher proportion of students, which reduces the average age of that group in contrast to other types of carsharing. This leads to the following fourth hypothesis:

Hypothesis 4*: If the participant has a university degree, they are more likely to consider using a station-integrated e-carsharing service.*

Descriptive statistics show that 89.1% of participants, with a university degree, would be able to imagine using an e-carsharing service in the future. This group also had the highest propensity and had a statistically significant difference from the other groups (at least 3% difference). According to the chi-square test, there was significant enough significance ($p = 0.041$, $p < 0.05$) to support Hypothesis 4, and it is clear that people in rural areas who would use a station-integrated e-carsharing model are disproportionately more likely to hold a university degree.

Higher vehicle availability would seem to increase the likelihood of non-users adopting station-flexible carsharing. Forsa's (2016) survey determined that 36% of non-users would consider carsharing should vehicle availability improve. The study by These components are necessary to implement an economically sustainable model. This leads us to the fifth hypothesis:

Hypothesis 5: *If the respondent is a non-user, high availability of (electric) vehicles is significant to them.*

The results show that 46.4% of non-users (n=321) think high vehicle availability is significant and 49% of users also think high vehicle availability is significant. Thus, there is no objective distinction between these groups. Moreover, the test results are classified as non-significant with a p-value of 0.938. Thus, hypothesis 5 cannot be confirmed. No significant association among user group and significance of high availability of vehicles exists (Phi/ Cramér's V = 0.019). A possible explanation could be that individuals who reside in rural areas accustomed to limited availability of mobility options thus have lower expectations of availability. It is also conceivable that ÖPNV plays much more role for users of carsharing. As Nehrke & Loose (2020) conclude, it is more feasible for individuals to use carsharing when almost all of the trips can be complemented with ÖPNV public transportation in between. This is worth studying further in the future.

As 54.9% of potential users cited outings as the primary rationale for use, it is very likely that these users would utilize station-flexible e-carsharing primarily for this purpose. This is supported by findings that carsharing trips in Garmisch-Partenkirchen, a largely rural area, are often for tourism (Wappelhorst et al., 2014). With this we can conclude the sixth hypothesis:

Hypothesis 6: *If the respondent is a user, outings are typically the primary rationale for them.*

A noticeable difference is observed among users (n=51) as opposed to non-users, as only 35.5% thought initiatives for outings would be rationale for them. The chi-square statistical test classifies as high significance with a p-value of 0.016 ($p<0.05$), confirming the hypothesis. However, the magnitude of the relationship of between user status and use rationale is small (0.149) but still present. Thus, we can conclude that users from rural areas manifest a similar rationale for carsharing use as station-based carsharing users in urban areas do, in terms of the objective of carsharing trips. As identified from the analyses by Nehrke & Loose (2020), carsharing trips were often for bulk shopping, weekend excursions, visit of relatives or friends that resided in other towns/cities, and outings in good weather - rarely every day or short trip trips, like commute, casual or necessity-based shopping, or even daily grocery shopping.

Table 2. Hypotheses and statistically based findings

Hypothesis	Statistical Values	Confirmation
Hypothesis 1	Chi^2: p = 0.01; Phi/Cramer-V: <0.3	Not confirmed
Hypothesis 2	Chi^2: p = 0.00; Phi/Cramer-V: <0.5	Confirmed
Hypothesis 3	T-Test: p = 0.096; Levene-Test: No homogenity	Not confirmed
Hypothesis 4	Chi^2: p = 0.041; Significance level: 3%	Confirmed
Hypothesis 5	Chi^2: p = 0.938; Phi/Cramer-V: 0.019	Not confirmed
Hypothesis 6	Chi^2: p = 0.016; Phi/Cramer-V: 0.149	Confirmed

Source: Authors' own research.

Conclusion

This study explores possible success factors for implementing a station-flexible e-carsharing model in rural Baden-Württemberg by investigating sociodemographic characteristics, attitudes, and behavioral patterns of a rural target group, in turn, the results offer valuable guidance for developing a mobility service for the rural population. The survey results provide a starting point

for developing informed recommendations on the business model of station-flexible e-carsharing and understanding the target group of existing and future users. This has social relevance particularly when looking at the topic of 'mobility poverty', which is pronounced more in rural areas. The study indicates that different factors affect the acceptance and use of station-flexible e-carsharing in rural locations. Similar to urban carsharing users, men use the station-flexible e-carsharing median than women, and this finding is statistically significant. While unlike urban carsharing users, respondent age was not an important factor, as older respondents are definitely interested in using e-carsharing. A similar group of education in respondents are likely to use the e-carsharing with high level of education included university degree and e-carsharing use was significantly greater. Willings to pay rates for station-flexible e-carsharing was between the costs of both station-based and free floating urban carsharing, at 7.20 euros an hour and 35.10 euros a day. Price, however, was shown to be less decisive for vehicle availability. In our study, respondents primarily indicated leisure activities and recreation as the primary reasons for use with e-carsharing indicating the strength in appeal for rural areas. Commuting or daily trips were less relevant indicating the situational and flexible nature of the model was an important element. With respect to the statistical analysis, the majority of our hypotheses were unable to be confirmed, with some noted distinctions between potential users in rural (likely) context and their counterparts in urban would be scenarios.

Importance of sociodemographic variables may influence the use of e-carsharing differently than availability of household vehicles or number of households. Despite the limitations of the research there are key insights to the interpretation of the findings. The targeted sampling and use of quota sampling and self-selection is not representative but does give insights into the rural target group in Baden-Württemberg. Additionally, the one-month timeframe as a research period limited the analysis to mostly univariate and bivariate analysis. Further, we only administered a cross-sectional study which allows for a cross-section sample of a given period of time rather than longer time developments. Thus, the findings can only be to a certain degree generalized, and the research should be interpreted in conjunction with long-term, multivariate studies.

This research was focused on public station-flexible carsharing, while the present study will not include as part of the scope, further areas of integrative carsharing in rural areas should be explored. The integration of a station-flexible carsharing model that operates (at least in part) from a real estate project can offer a unique opportunity to enable users to overcome mobility barriers while integrating sustainable mobility directly into residential areas. Not only can housing be combined with carsharing, but these embedded opportunities of mobility also facilitate sustainable developments in real estate. A study found evidence that sustainable practices in real estate projects that outline sustainable design by means of ecological, social, and economic framework, deliver long-term benefits including operational cost savings, social equity, and environmental protection and conservation (Pitz, et al., 2024). The value of sustainable projects leads to a better quality of life for residents and has a profound effect on the residential project's ecological footprint through reduced strategies of future low or no carbon emissions.

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