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Vera Spitzer, Maria A. Wimmer

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User needs for a mobility app to support living in rural areas

Vera Spitzer^[0000-0002-5866-2694], Maria A. Wimmer^[0000-0002-8460-1027]

University of Koblenz-Landau, Institute for IS Research, Koblenz, Germany
{vesp91, wimmer}@uni-koblenz.de

Abstract. Among the biggest challenges rural areas currently face are the impact of demographic change and limited mobility offers. While younger people tend to either move to urban areas or have their own car at hand for satisfying everyday needs, elderly or people with compromised health suffer most from these challenges. They prefer to live in their habitual and familiar environment and remain mobile for as long as possible. To enable self-determined living in rural areas and to make rural areas more attractive as places to live, municipalities and regions with substantial rural character need to develop concepts and modern digital solutions to achieve these objectives. In this paper, we introduce stakeholder-driven requirements elicitation for a mobility platform, which supports local communities and citizens in remaining autonomous in their living. The aim of the mobile app is to intelligently match offers of different mobility providers (e.g. voluntary drivers, public transportation services, taxis drivers etc.) with citizens' mobility demands in rural areas. Citizens needing a ride can find, book and pay the best offer for their journeys through the app. They can also rate the mobility service after its use. In the paper, we present the findings from 60 semi-structured face-to-face interviews with elderly in rural areas, thereby applying qualitative and quantitative content analysis. The empirical results were transcribed, categorized and analyzed quantitatively and qualitatively. We conclude with recommendations for the design and implementation of the mobility app.

Keywords: Digital transformation, mobility, rural areas, user needs, mobility app

1 Introduction

Demographic change is noticeable throughout Germany and represents a challenge for public administrations, especially for municipalities in rural areas due to the low population and settlement density [1]. Over the years, the population in urban cities increased, while the rural population declined [2]. According to a recent comparison by [3], the figures of Germans living in rural regions vary between 23 % and 66 %. The

German Federal Statistical Office estimates a decreasing and aging population in Germany in the next 20 years¹. In addition, more and more younger people decide to move to the cities due to the still poorly developed infrastructure and public transportation or partly non-existent internet connection in rural areas [3]. Elderly or those with limited mobility are often no longer able to reach groceries, doctors or sports clubs themselves, so they have to rely on carpooling with family or neighbors [4]. In order to guarantee citizens a high quality and self-determined life in familiar surroundings for as long as possible, the municipalities are challenged to develop and offer new solutions by the use of ICT [5, 6] to meet the expectations and needs of people living in rural areas. While people in cities and urban areas benefit from fast internet connection and smart city solutions to use digital tools in daily life, citizens in rural regions suffer from limited broadband access and lack of high-speed internet. The deployment of broadband access develops very slowly, and only 50 % of rural areas can offer broadband with a bandwidth of 50 Mbits/s.² Therefore, the German federal state currently funds digital transformation with programs like “Ländliche Entwicklung” and pilot projects like “LandZukunft” and “SmarteLandRegionen”.³

Among the projects co-funded in one of the aforementioned programs is SWiA of the district Cochem-Zell Germany. The aims of SWiA are to conceptualize and implement a digital solution, which offers mobility on demand based on the needs of the citizens in the rural part of the district. The objective of the mobile app is to match the most appropriate offers of mobility service providers (such as public transportation, taxi or voluntary drivers) and the mobility needs of citizens. The project applies a co-creation approach [7], involving the citizens in the analysis of needs, in the conceptual design, and the evaluation of the solution.

The paper at hand focuses on the analysis of the user needs of such a mobile app that supports mobility on demand in rural areas. The ultimate goal is therefore to investigate the user needs – especially those of elderly that seek sustained self-determined living in rural areas – for a mobile app that supports citizens in finding, booking and rating the most suitable mobility service that meets their needs. The re-search aims to answer the following two research questions:

1. What are the needs of citizens living in rural areas for a digital mobility app?
2. What motivates users, especially elderly, in using a digital application for finding and booking mobility services to meet their needs in rural areas?

To answer these research questions, we apply qualitative content analysis according to Mayring [8]. Section 2 reviews the situation of mobility in rural regions. Section 3

¹ Statistisches Bundesamt (2021): Bevölkerungsvorausberechnung. https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bevoelkerung/Bevoelkerungsvorausberechnung/_inhalt.html

² BMVI—Bundesministerium für Verkehr und digitale Infrastruktur (2018) Breitbandatlas <https://www.bmvi.de/SharedDocs/DE/Publikationen/DG/breitband-verfuegbarkeit-ende-2018.html>

³ Bundesministerium für Ernährung und Landwirtschaft (2019). Modell- und Demonstrationsvorhaben. https://www.bmel.de/DE/Laendliche-Raeume/BULE/zukunftsfelder/zukunftsfelder_elder_node.html

provides an overview of digital transformation in society through a review of existing literature, followed by a summary of the co-creation and co-production approach in section 4. The methodology of qualitative content analysis and the category system applied thereby are presented in section 5. Subsequently, section 6 presents the results and interpretation of the user needs based on the qualitative and quantitative analysis. Section 7 concludes with a discussion of the findings and with further research planned.

2 Mobility in rural regions

Rural regions offer beautiful opportunities to live, which includes strong communities, affordable housing prices and many open and green spaces [9]. In the European Union (EU), 28 % of the population lives in the countryside. However, depopulation and social exclusion have led to an aging population in many rural areas, and mainly elderly choose to stay and live in these regions [10, 11]. Therefore, for the elderly population, mobility is a crucial asset in maintaining autonomy and independence in their self-determined lives. This particularly includes car ownership, which plays a significant role in enabling social inclusion, employment as well as the completion of everyday affairs [12]. Consequently, sustainable mobility management calls for a flexible transport system (which goes beyond the traditional ownership of a car to get around) to improve transport services in rural areas, which allows for a wider choice in mobility services such as public transportation, taxi or car sharing [13–16]. Beyond that, environmentally friendly and sustainable alternative mobility services like public transportation and car sharing or voluntary driving support municipalities in reducing the local pollutant and CO₂ emissions. To realize this transition, municipalities seek new strategies that embark on digital services to improve mobility and quality of life for citizens while reducing the mass of car use.

In the past decade, society started to support new models of a sharing economy and of utility services such as Airbnb and Uber. In the transport sector, the concept of the sharing economy is also evolving into the transport paradigm of “Mobility as a Service” (MaaS) [17, 18]. The idea of MaaS is to assemble all potential mobility providers (e.g. public transport, bike sharing, car sharing, taxi etc.) and bundle them into a single service [19], with a digital platform to manage the mobility services. The platform enables users to book and pay for the mobility services through a single account. Nevertheless, bundling is not a new concept, but it is used to increase consumer acceptance of underutilized products and services. Less popular transport systems, like car sharing could be bundled to increase and drive demand for them. The use of MaaS can be seen as a soft mobility management tool to reshape the face of the existing travel services and the way services are perceived by individuals [20]. In rural areas, different public transport services and different user groups with their particular needs could be managed with intelligent digital solutions [15]. For this purpose, the SWiA project investigates user needs and develops a MaaS that matches the mobility needs of the users with the offers of mobility providers in rural environments based on a co-creation approach. By applying qualitative content analysis of Mayring (2000), the first step is to review relevant literature, which is outlined in the next two sections.

3 Digital transformation in society

Digital transformation is one of the key contemporary terms characterizing the change and implementation of digital technologies in organizational structures. In the public sector, the term was coined along digital government and e-government. Advances in ICT are leading to an increasingly digitized world in which data, information and knowledge need to be made more and more available for citizen, companies and subordinate agencies. Digital landscapes are emerging in which society finds various media platforms and intelligent technologies so that digital services and processes can be demanded and used [21, 22]. Through the use of ICT, public facilities and digital services become more accessible to society and customer-oriented solutions can be offered [23]. This should improve the quality of public services and the relationship and trust of citizens [24, 25].

According to Charalabidis et al, e-government has evolved from Government 1.0 to Government 3.0, with Government 1.0 referring to ICT mainly used as a tool to improve communication of citizen with most common methods like local, national or one-stop portals as well as internal digitalization efforts [26]. The same authors characterize Government 2.0 as the use of Web 2.0 technologies e.g. social media, social networks, blogs, wikis and RSS feeds to strengthen participation and collaboration in society. Government 2.0 also encompasses Open Government, as the use of social media enables the transformation of services. Furthermore, public information and Open Government Data can be provided through social media channels [21, 27]. In contrast to Government 1.0, Government 2.0 is characterized by bidirectional communication as different stakeholders are able to contribute in decision making and policy modelling processes in public issues [28]. With Government 3.0, disruptive technologies such as artificial intelligence, machine learning, big data analytics, inter-net of things or blockchain are employed to offer customized solutions, governance as well as data-driven applications and evidence-based decision and policy making are realized [26, 29]. The challenge of using disruptive technologies in context of public services is to strengthen society's trust in the use of smart ICT while at the same time meeting ethical standards such as data protection, inclusion and accountability [30]. Especially in e-government, projects are challenging in the implementation due to legal, technical or organizational issues [31]. On a legal level, the protection of personal data plays a crucial role as concerns about data protection can lead to a loss of user trust in the acceptance and use of public services. Society's trust and understanding are essential to the success and adoption of new processes and technologies in public sector [32]. Security concerns about information systems and web applications often lead to unused digital services [33]. On the technical level, the implementation of e-government projects often lacks IT-experts in combination with a lack of knowledge about e-government in general or the use of outdated infrastructure in public organizations. Organizational challenges include a lack of support of political or administrative staff, or insufficient collaboration between administrative bodies [34].

Successful implementation of digital services in the public sector depends on the collaboration of users. In case of the SWiA project, the acceptance and trust is necessary for the success and sustainable use of the application. Therefore, the concept of co-

creation is applied for the mobile app development. Co-creation is explained in the following section.

4 Co-creation and co-production

The development of the SWiA application is driven by a co-creative approach and the contribution of users' expectations and requirements in order to ensure citizens' acceptance of such a smart technology in the long term.

According to the European Commission (2013), co-production is generally understood as improved, more user-friendly and innovative public services which can be offered to meet users' needs. Definitions of co-production vary between "the mix of public services agents and citizens who contribute to provision of public services" to "a partnership between citizens and public service providers" [35]. Stakeholders can assume different roles and profiles in a co-production context: Public authorities, citizens, businesses or NGOs can take part and provide information, knowledge, data or services to solve and improve a social challenge [36].

Co-creation is seen as another concept for user participation in the design of public services [7]. Governments should provide incentives to ensure processes in co-creation to integrate citizens in the design of e-government services [37, 38]. Especially the field of Smart Governance as key dimension of a smart city development emphasizes the importance of stakeholder collaboration to increase public value and to adapt more innovative users' requirements [39, 40]. The method of co-creation has its origin in the software development and has been implemented in the form of three main practices: Participatory design, user-centered design and user innovation [38]. In participatory design, users can act as assessors of prototypes or they represent a specific user group. In this process, users are seen as equal partners. On the other hand, user-centered design describes the influence of user needs in the user interface. In user innovation, the problem identification and the design solution are done by the users. In a federal system, co-creation can contribute public services on all levels, especially on local government level. Preferred methods for the use of co-creation are questionnaires, interviews, workshops, test of a prototype or crowd-based requirements engineering. In the context of e-government projects, stakeholder participation is much more difficult than in traditional software development projects, as services have to be developed for large, homogeneous user groups. In this case, individual requirements and ideas must be considered and analyzed for the holistic project design [25]. In [35] co-creation is also referred to as co-governance, as people from the third sector are involved in the development public service. Older people in particular pose a special challenge due to a lack in ICT and a lack of acceptance in the use of digital public services. With co-creation, these citizens can be involved in the process at the beginning and strengthen their trust in public administrations. Moreover, co-creation does not only consider citizens as users, as social and democratic rights in particular are considered [39].

The SWiA project adapts the co-creation approach to involve citizens in every step of the application development – from the elicitation of user requirements to the match-

ing of mock-ups to the prototypical implementation and piloting of the SWiA-application. The next section outlines the methodological approach for determining the user requirements of a mobility application and thus clarifies the first stage of the co-creation approach.

5 Methodological approach and category system

In order to analyze the user needs and to involve the users directly in the co-creation process, qualitative content analysis was conducted according to the approach of Mayring [41] to study initial material from the project scope and to develop a structured interview, which was used for the investigation of the user needs. The stepwise approach applied is as follows:

1. Selection of the material to be analyzed e.g. the whole text or text passages to be studied. In this research, literature and project material were analyzed. The deductive approach is based on previously developed research questions and aspects which need to be connected with the text. Along this, the initial category system was specified for the deductive analysis as well.
2. Based on the initial deductive analysis, a structured interview was constructed with open and closed questions. The structured interview included 17 questions and was developed along the objective of the project scope and mobility app to identify the needs of the users. For example, users were asked if they need a walker or wheelchair for mobility services; if they use mobile devices or if they need help and introduction into IT services etc.
3. The target group (older people aged 60 and beyond) was interviewed in person by project members. The participants received materials about the project in advance and were informed about the survey context. The actual interview took place in the home environment of the users and was documented by written notes and recordings. In total, 60 interviews with citizens from 6 villages in the district Cochem-Zell were collected. Supplementary notes were also taken during the interview process.
4. The recordings of the interviews were transcribed and analyzed along the category system. Following the procedure, the material was looped through, by reducing categories into main and sub-categories. Besides qualitative aspects, quantitative results were also taken to answer the research questions, by analyzing frequencies or categories in the transcript [41–43].

Table 1 presents the category system derived from the project material to examine the transcriptions of the empirical research [8]. The first two columns spot the main categories deduced from the project material and the evaluation criteria to highlight whether the qualitative results are to be evaluated as a benefit, barrier, challenge, need or a requirement. The last column provides a short explanation of the categories or sub-categories.

Table 1. Category system

Category (Evaluation criteria)	Sub-category (Evaluation criteria)	Definition
1. Self-determined life in old age/social participation	1.1 Living in your own flat or house (benefit)	Citizen want to live at home as long as possible
	1.2 Decreasing own mobility (challenge)	Citizen want to use their own car for as long as possible
	1.3 Mobility offers from others (need and challenge)	Use of alternatives such as public transport, carpooling etc.
	1.4 Leisure activities/activities that are regularly pursued (benefit) or not used (challenge)	Leisure activities such as club activities fire department, carnival, choir etc. and how those activities are reached.
2. Conditions (need)	2.1 Deteriorated conditions in rural areas / higher dependencies on existing structures (challenge)	Organizations or small shops close because the catchment area in rural areas is too small.
	2.2 Disintegration of traditional rural family communities (challenge)	Migration of children from rural communities to urban centers;
	2.3 Demographic change (challenge)	Need for mobility services for the elderly that meet their needs
3. Enabler (requirements)	3.1 Broadband infrastructure (requirements)	Supportive building blocks; Digital services require a stable internet connection.
4. Project requirements (need, benefit)	/	Targets for user needs of elderlies e.g. doctors, pharmacy, shopping; Development of smart applications.
5. App requirements (need, benefit)	/	Easy-to-use virtual platform considers all defined needs of customers
6. Requirement for Social Change/Digital Transformation (Requirements, need, challenge, benefit)	/	Supporting technical aids; use of digital devices; use of the internet, Operating experiences in the use of digital devices;

The categories roughly reflect the structure of the interviews and were entered into the MAXQDA program. A category includes all components of the transcripts that represent a requirement or need for the app as well as aspects that could influence the success of the app. The results could then be classified using the evaluation mechanism described above. Subsequently, the findings from the structured interviews are presented.

6 Findings from the structured interviews

Below, the main results of the interviews are presented and explained along the established categories. They are grouped along the defined evaluation criteria (see Table 1). Due to limited space, only those questions and answers are summarized that reflect the needs of the users in relation to the mobile app. As indicated before, sample size is 60.

Category 1.1 and 2.2, Question 1: *“You live in a relatively rural community. Do you have family members living in your immediate vicinity and do they support you when needed?”*

43 citizens indicated that family members either live in the house or in the same place or in neighboring communities. 17 citizens rely on the support of family members.

Challenge: Differences could be found between the places considered: In villages with poor public transport connections, lack of internet connections and the remoteness of the regions, more family members move away.

Category 1.2, Question 2: *“What basic means of transport do you use to reach e.g. a supermarket or a doctor?”*

At the time of the interviews in autumn 2019 to spring 2020, 51 citizens still use their own car. 13 people rely on private carpooling e.g. by the husband, family members or neighbors, 8 use taxi or public transport and 17 people use other options (bike, on foot...).

Need and Benefit: The respondents predominantly use their own car, but they have realized that such a smart solution could help meet future mobility needs. By connecting many voluntary mobility providers, more individual mobility needs can be met.

Category 1.3 and 2.3; Question 3: *“Are there any barriers to the use of the means of transport and if so, what are they?”*

26 citizens out of 60 stated that they face barriers using transportation. Barriers: Public transport in rural regions is not geared to the needs of elderly, even though their population will be the majority in the long run due to demographic change. The user interface of digital services is not geared towards older people.

Category 1.4 and 2.1, Question 4: *“What [leisure time] activities do you regularly engage in and how do you achieve them?”*

50 citizens reach their leisure activities on foot, 35 by own car, 9 each by bike or carpooling, 5 via public transport and 2 use other opportunities.

Benefit: Major activities the citizens engage with are club activities in the immediate vicinity such as hiking, church, voluntary fire brigade etc. These are reached on foot or by own car or carpool.

Barriers and challenges: Activities such as church or club activities were found to be limited by closures in the vicinity in the future. Carpooling is the most frequently chosen option next to using a car to reach such activities at more distant locations. While communities already exist in rural areas, they however lack efficient communication networks to organize themselves in the communities.

Category 1.4, Question 5: *“Are there any activities you would like to do but cannot achieve?”*

Barrier: Elderly do no more want to drive longer distances on their own. Frequent public transport connections are not available in many villages.

Need: Public transport systems need adaption to the challenges of demographic change and rural structures.

Category 4, Question 6 and 7: *“Which digital device do you use and how easy do you find it to use?”*

11 citizens do not own a smartphone, tablet, laptop or computer. The majority, however, have such a device, some of the respondents even own several devices. Of these 48 citizens, 40 use their smartphones daily and 30 users have no difficulties in using a digital device. When asked if they like to try new apps, 20 of these 48 respondents denied. The users argued that they only use apps that are absolutely necessary for their daily needs. The majority of citizens that use a digital device answered that it is not cumbersome (37 of 48). Overall, 48 of 54 people said that they needed help in operating new digital devices.

Challenge: Elderly only use the functionalities and apps of the devices that are taught to them by other people.

Need: Users need training on the use of additional functionalities of the devices.

Need: Training in IT should be offered free of charge in villages. This is the only way to overcome tentativeness in dealing with digital applications in the long run and to take individual needs into account, e.g. online banking, online public services, etc.

Category 4, Question 9: *To what extent do you use the devices and how easy is it for you to operate them?*

50 citizens use digital devices for private contacts and 37 for obtaining information. 21 of the respondents use them for online shopping and 19 for online banking. Just 4 people do not use such devices at all.

Challenge: Lack of understanding the potentials and social networking possibilities of devices and infrastructures in the personal environment.

Category 6, Question 16 *“What recommendations would you give the project team?”* and 17 *“Could you imagine using an app like this beyond organizing mobility?”*

Need: Additional mobility offers are needed and there is a demand for citizen buses in the municipalities.

Barrier: Digital solutions (timetables and bookings) of public transport are too cumbersome for elderly.

Need: The app must be easy to use and adaptable to individual needs.

Need: The app should offer additional functions beyond matching mobility offers such as home and garden care, ways to increase pocket money for young people, scheduling and booking club activities etc. A kind of community platform is desired so that everyone can contribute according to their possibilities and needs.

The results of the empirical research address different responsibilities and issues: On the one hand, the results highlight and reinforce the current challenges in rural areas. Public transport is not available or difficult to access in many places, so citizens have to resort to their own cars. If elderly do not wish to drive longer distances any more, self-determined living in their habitual environment is at risk, because the citizens concerned face the severe challenge of reaching individual places. Therefore, public transportation should be available with regular connections in all villages. However, service providers argue that such services cause high costs and deficit.

The insights from the results show that mobility barriers can be overcome by the use of private cars and by voluntary driver services that are organized through a mobile app as a MaaS. A precondition for mobile digital services to work is sufficient broadband coverage in rural areas. Without stable internet connections, seniors cannot and do not want to use digital devices and apps. Most of the respondents still have doubts or substantive reservations about the content of digital functions and applications. The loss of data autonomy is one of the most common reasons for elderly not to use digital services. Training should be provided so that elderly learn and understand how digital services work and how they can use digital devices and apps properly. In this way, shyness about the technology should be overcome and user acceptance of both the app and e-government services should increase in the long term. Because most digital public transport services are not designed to be user-friendly, elderly refrain from using such solutions. The ease of use and simplicity of the SWiA app functions are particularly important to senior citizens and can be achieved by using a large font and symbols. Data scarcity and simplicity are further requirements, i.e. only the most relevant information should be displayed on the user interface (which corresponds to the aim of the project scope). Co-creation is a crucial approach to co-design the interaction, the functionality and the user navigation with the citizens. Therefore, the design of the SWiA app will be done in close collaboration with the senior citizens living in the region of Cochem-Zell.

Another important user need is the implementation of voluntary carpooling. Some users already offer carpooling among their friends, but there is no central platform available to manage such requests. By developing a central digital platform to bundle ride offers and communicate needs, mobility offers can be displayed in a user-friendly way and booked much faster by the MaaS users. A further aspect to be considered is that, while one might expect that elderly are more hesitant to use services of people they do not know in person, this aspect is less crucial in rural communities, where people know each other such as for SWiA. This aspect may need further investigation when expanding the MaaS to a wider geographical area beyond local communities.

7 Conclusion

To understand how a mobility app can be used in rural areas, this paper investigated key barriers, challenges and needs for such an app by applying qualitative content analysis. First, a literature review was conducted and coded along a category system to derive relevant findings. Subsequently, 60 citizens in rural areas were interviewed to gather empirical insights. Regarding RQ1, we found that user needs vary from user-oriented platforms to training in digital devices, services and apps to regional specifications, which need to be addressed by the responsible regional or local authorities. The results of RQ2 showed that citizens welcome the participation and collaboration in the development of a mobility app.

While not all user needs are directly related to the design and development of a mobility app, these are necessary to ensure the successful use and user's satisfaction of the overall MaaS solution. To ensure this, a crucial strategy in the project is to enable elderly to participate in the digital transformation process. Through the co-creation approach, users will be directly involved in the development of the app from the very beginning. In addition, the SWiA app should be promoted through various channels to draw attention to the new digital offer and to encourage its use.

Based on the insights from the qualitative content analysis of user needs for a MaaS in rural areas, the mobile app is currently developed by applying the co-creation approach through involving the citizens along the design and testing of the app. Along this step, interactive workshop sessions are used to discuss design options with the citizens. Due to the COVID-19 pandemic, however, these sessions take place online. We will report the findings of these interactive online co-creation sessions as well as on the technical concept of the SWiA app in future publications.

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