



Participating Citizens = Smart Citizens? Applying the Human-centered Design Approach on a Digital Care Platform

SARA NEUMANN, JELENA BLEJA, TIM KRÜGER, and UWE GROSSMANN, University of Applied Sciences and Arts Dortmund, Faculty of Business Studies

New digital innovations are becoming increasingly relevant in the healthcare sector of smart cities. Although the healthcare sector has not been the focus of smart city strategies so far, this sector offers a high potential to save resources. One such measure is the development of a digital care platform. A digital care platform is intended to counteract the shortage of skilled care staff through the targeted deployment of caregivers. To meet the needs of users and service providers, a target group-oriented, human-centered design approach is applied to evaluate the benefits of a care platform for users and service providers. The results are recorded with the help of a Benefit Model. During the surveys, it became clear that users and service providers benefit from the use of a care platform in technical, economic, and social aspects, among others. In the process, stakeholders not only save important resources but also can build valuable networks for healthy and successful aging.

CCS Concepts: • **Human-centered computing** → **Accessibility design and evaluation methods** • **Social and professional topics** → **Seniors** • **Security and privacy** → **Social aspects of security and privacy**;

Additional Key Words and Phrases: Care platform, human-centered design, smart cities, Benefit Model

ACM Reference format:

Sara Neumann, Jelena Bleja, Tim Krüger, and Uwe Grossmann. 2023. Participating Citizens = Smart Citizens? Applying the Human-centered Design Approach on a Digital Care Platform. *Digit. Gov.: Res. Pract.* 4, 3, Article 14 (September 2023), 13 pages.

<https://doi.org/10.1145/3604618>

1 INTRODUCTION

In a smart city there are various types of digital technologies that change the living environment with **information and communication technologies (ICTs)**, such as smart sensors. ICT aims to take a positive development in the community and support local groups of people [1]. There are various areas in a smart city where people can be supported by technology, including, for example, ensuring public safety [2], improving passenger transport in the city [3], or making cities resource efficient and sustainable [4]. In addition to these possibilities, research is also increasingly being conducted on platforms that offer an opportunity to ensure a better quality of life and be more efficient in the health sector [5]. ICT can be used by cities to provide smart healthcare, which in turn leads to a more efficient use of city resources. For example, a smart home can detect a resident's eating schedule

Authors' address: S. Neumann, J. Bleja, T. Krüger, and U. Grossmann, University of Applied Sciences and Arts Dortmund, Faculty of Business Studies; emails: {sara.neumann, jelena.bleja, tim.krueger, uwe.grossmann}@fh-dortmund.de.

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than the author(s) must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from permissions@acm.org.

© 2023 Copyright held by the owner/author(s). Publication rights licensed to ACM.

2639-0175/2023/09-ART14 \$15.00

<https://doi.org/10.1145/3604618>

and remind them to take their medication accordingly. By using such technologies, existing healthcare providers can extend their services to a growing city [6]. Health systems face increasingly complex challenges in meeting the changing health needs of patients [7].

In the joint project Smart Care Service,¹ the challenges of the healthcare sector are to be approached with the development of a digital care platform for people with assistance needs and care service providers. Accordingly, a central research aim of the Smart Care Service project is to ensure that a digital health platform also benefits people and reflects current developments for people with assistance needs. Therefore, the human-centered design approach was applied to scientifically accompany the development of a care platform and to identify the benefits of this digital health innovation. Human-centered design advocates the active involvement of end users and stakeholders in the development process but most importantly emphasizes an iterative approach to solution finding. In terms of artificial intelligence, the human-centered design focuses on humans and their place at the center of the entire process. The design thinking method has the potential to lead the development of applications that respect humans are practically useful and provide a pleasant user experience [8].

Furthermore, the human-centered design approach plays a central role in designing a city made for people, reinforcing the benefits and eliminating the drawbacks [9]. For example, Johnson et al. [10] note that the human-centered design approach can be a tool to implement effective health interventions that focus on people for improving access and usability. In addition, Flood et al. describe methods for the human-centered design approach in potential applications in health services research to improve user adoption [7]. Ippoliti et al. also use the human-centered design approach to establish a digital platform [11]. This led to important changes in the product, implementation process, and evaluation design of a digital health product for Rwandan youth.

Within the framework of the human-centered design approach, several surveys were conducted to scientifically accompany the development of a care platform, which will be explained in more detail later in the article. The three central research questions used for the surveys are as follows: First, it analyzed what opportunities a care platform offers for users and care providers. Second, it asked how users and care providers evaluate a care platform. Thirdly, it asked what challenges a care platform encounters. What opportunities offers a care platform for users and care providers? How can users and care providers evaluate a care platform? What challenges does a care platform encounter?

This article will especially focus on the benefits of a digital care platform within the smart city environment. The article will first describe different design thinking methods and the human-centered design approach that was used to collect the data. The Benefit Model is chosen to present the results of the human-centered surveys. Within the model, opportunities for a care platform for users and stakeholders are recorded. In the discussion, important aspects of the Benefit Model regarding each category are further discussed and concluded.

2 DESIGN THINKING

In the following, three different methodological approaches for the development of services and products will be compared. These methods include the humanity-centered design approach, the user-centered design approach, and the human-centered design approach. The approaches will be presented and compared.

2.1 The Humanity-centered Design Approach

The humanity-centered design approach is an aim-oriented process to find solutions to social problems on multiple dimensions and with different perspectives as well as to achieve previously set aims [12]. The humanity-centered design approach starts from the premise that social problems and challenges cannot be solved without the inclusion and participation of concerned communities [12]. The needs of communities are given priority

¹The Smart Care Service project is funded by the EU and the state of North Rhine-Westphalia (EFRE-NRW) as part of the European funding program for regional development.

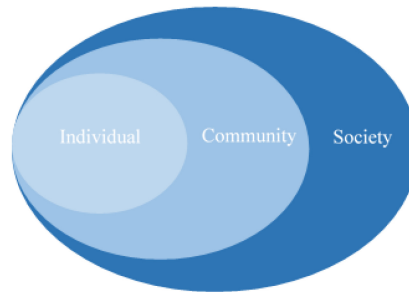


Fig. 1. Dimensions of the humanity-centered approach following [14].

over the needs of individual parties. The aim is to bring multiple stakeholders and communities together to find tailor-made solutions [13].

The humanity-centered design approach consists of three dimensions of engagement (see Figure 1). Combined, they intend to accomplish a successful implementation of innovation and to guarantee participation [14].

In the *individual* dimension, the target groups that are relevant to the development of a product or service are addressed. Furthermore, in the *community* dimension, the target groups as well as minorities (such as, among others, people with assistance needs, people with disabilities or impairments, or people with migration backgrounds) are specifically addressed as they are often disregarded in the development processes of services and products [14]. In the *society* dimension, people's views are addressed as a collective to include them in design processes [14].

2.2 User-centered Design Approach

When applying the user-centered design approach, the user and an individual, personalized user experience stand in the foreground [15]. The user-centered design approach is applied to include several user perspectives in the development of a service or product. These users include “organizational users providing the service, users responsible for the finances and direction of the service, and other users in the service ecosystem” [15]—allowing for holistic user participation. Kramer et al. recommend a multiple-step process in which the identification of the main target group is the first important step [16]. Additionally, aims, key factors, and key activities regarding user experience have to be identified. Projects, services, and products have to be designed according to the needs and wishes of potential future users [16]. User-centered design is applied in a wide range of disciplines, while many of these projects focus on digital innovations in health services [17]. The approach is solution and action focused and consists of user design strategies, such as the development of personas, engagement of iterative development, recruitment of users, definition of target groups, and definition of workflows, among others [17]. A key challenge in the application of the user-centered design approach is the prevention of using complex scientific terminology and the development of a shared language to enhance productive exchange with citizens [17].

2.3 Human-centered Design Approach

If the development of human-centered design is considered, we notice that it evolved from a technology-centered design but, unlike technology-centered design, focuses on the people for whom a product or service is to be developed [18]. The development toward human-centered design took place because innovations developed with this method could be successfully established by actively involving the target group concerned [18]. In addition, it is assumed that problems cannot be adequately solved without the participation of the people affected by potential change [12].

Human-centered design is an approach that incorporates the needs, concerns, desires, and attitudes of all stakeholders regarding a product or service into the development process while increasing the target group of the user-centered design approach [17]. The human-centered design approach considers shared values in the development of new technologies or systems [19]. Zhang and Dong discuss the differing definitions of human-centered design and emphasize the importance of distinguishing human-centered design from other design thinking approaches such as user-centered design. In summary, the authors emphasize that the human factor in the development process of new technologies has to be considered and that the human being is at the center of development. Therefore, human needs, capabilities, and limitations have to be considered [20]. Characteristics of a human-centered design approach include the centrality of human needs, a holistic understanding of people, multidisciplinary collaboration, stakeholder participation, and development of useful, usable, and desirable products and services [20].

The aim of using a human-centered design approach is to enhance human capabilities and technology acceptance and to overcome human limitations by taking different perspectives [19]. The human-centered design approach involves promoting a better understanding of the target group's practices, needs, and attitudes, for example, by analyzing the relationship between people and technologies. In addition, the research project should be carried out iteratively to be able to reflect on the solutions found with the target group [19].

The approach is similar to the human-centered design approach that is presented in the next section. Both approaches focus on future users of a product or a service, but the human-centered design approach considers human activities and routines as a way of implementing a product or service more sustainably. Furthermore, the human-centered design approach also includes users who only indirectly benefit from a certain product or service.

The human-centered design approach was used to conduct the surveys to accompany the development of a holistic care platform. The reasons for this are the possibility to involve potential future users of the care platform in the process of development and picking up on their wishes and needs. Due to the iterative process, insights gained in the beginning can be discussed with the target group later in the research process. The implementation of the human-centered design approach is described in more detail in Section 3.

3 METHOD

Against the background of the development of a care platform, the project team decided on a human-centered design approach. This has the advantage that, in addition to the users of the platform, such as people with assistance needs and their relatives, other stakeholders are also included in the development [21]. These stakeholders can be, for example, providers who also use the platform to inform about their services and to generate new customers, but also municipalities, non-profit associations, and counseling institutions.

The human-centered design approach is defined in the ISO standard 9241-210:2019 [20]. Within the framework of the ISO standard, the procedure for implementing the human-centered design approach in the context of projects is also presented in a differentiated manner [21]. Four main steps can be distinguished (see Figure 2).

The first step is a description of the context of use. This was roughly defined with the project participants at the beginning of the project as part of the project description. In addition, a competitor analysis was carried out at the beginning of the project. The analysis aimed to identify the strengths and weaknesses of platforms with a care context. Furthermore, it should be identified which contexts of use are already covered by existing platforms and in which areas there is a need for new implementation ideas [22, 23]. Methodically, the benchmark analysis according to Fleisher and Bensoussan was carried out [22]. The platforms to be analyzed in more detail were selected by the project team. A total of 12 platforms with a nursing reference were examined in a differentiated manner. For the analysis, categories were inductively identified covering the topic areas to be examined. The

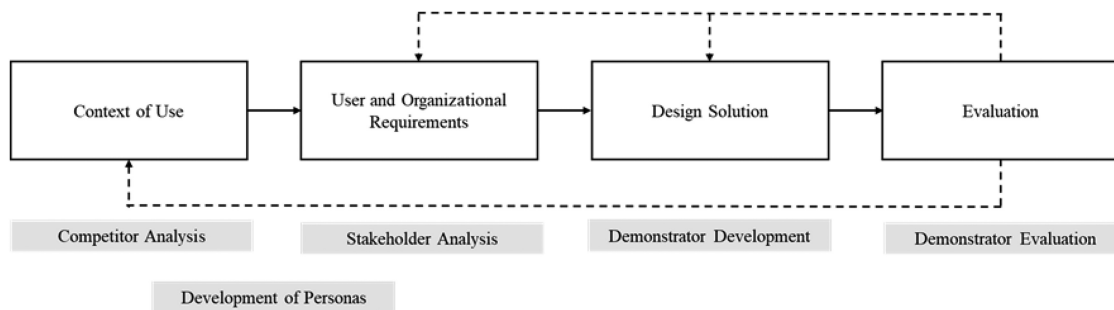


Fig. 2. Illustration of the use of the Human-centered Design process in a project context (own illustration based on [21]).

main focus was on the offerings of the portals, quality aspects, and marketing and financing measures. After the categories were created, suitable criteria were added to characterize and compare the competition.²

In the next step, the requirements of the users were identified and described within the framework of the human-centered design approach. For this purpose, a stakeholder analysis was carried out. The analysis aimed to identify wishes, needs, implementation ideas, and requirements regarding an innovative care platform [24, 25]. For this purpose, qualitative guideline-based expert interviews were conducted. The guideline was created according to the SPSS principle by Helfferich [26]. In selecting the experts, an attempt was made to take into account the heterogeneity of the research field and to include people from different fields in the study. A total of 15 experts were interviewed, mostly face to face. The interviewees came from the fields of care services, care and social counseling, health and care insurance funds, housing counseling, voluntary organizations, financial service providers, senior citizens' representatives, and mail-order pharmacies [24]. The duration of the interviews was between 45 and 90 minutes. The interviews were analyzed with the help of MAXQDA software and methodically with the help of content analysis according to Gläser and Laudel [27]. Accordingly, categories were defined a priori based on theoretical preliminary considerations and then supplemented with further categories during the evaluation process [27].³

Parallel to the competitor and stakeholder analysis, personas were developed. The creation of potential, exemplary users of the platform can help to create more transparency about the requirements of potential users of the platform [28, 29]. This makes them more tangible for the developers of the platform, and the platform can be developed more specifically to their requirements and needs [28, 29]. To create the personas, the first step was to evaluate the SOEP data [30] with a two-step cluster analysis. This makes it possible to derive clusters from the large amounts of data from the households surveyed [31]. In the second step, these were supplemented with detailed and authentic descriptions of the groups of people based on literature research and the results of the stakeholder analysis [32]. A total of eight personas were created.⁴

In the third step, the first solution approaches were developed based on the identified requirements, for example, in the form of demonstrators, mock-ups, or prototypes. Within the framework of the project, a demonstrator was developed based on the previously conducted analyses and identified requirements. This made it possible to demonstrate the platform interface for searching for care providers in the vicinity, various analyses for identifying the level of care, and various counseling functions via a chatbot and a voice assistant.

Subsequently, the developed solutions were evaluated within the framework of the human-centered design approach. Within the framework of the evaluation, five workshops were held with 68 stakeholders from different areas using the focus group method. Among the participants were potential users who could use the care platform

²For a detailed description of the competitor analysis and the results see [23, 24].

³For a detailed description of the stakeholder analysis and the results see [24, 25].

⁴For a detailed description of the analysis to create the personas and the results see [32].

for themselves, e.g., to book care services, or for relatives; people who could use the platform in the context of their voluntary work; people who are active in care counseling; and people who are currently being trained in different care service areas. After a short presentation of the project, the participants were first asked about their experiences with care platforms. They were also asked to discuss existing opportunities and challenges for the development of a care platform from their point of view. Afterward, it was briefly explained to the participants what a demonstrator is and which functions are already integrated with the demonstrator to be tested. This was followed by user tests, for which the participants were provided with tablets. Focus groups consisting of three to a maximum of five participants were formed for the test phase. The evaluation of the focus groups was carried out through participant observation and a final short survey using a guideline was created for this purpose with the help of the SPSS method [26]. In addition, the observers created Emotional Journal Maps to visualize the participants' emotional highs and lows during use [32]. Afterward, the results were recorded by creating a Test Capture Grid with all workshop participants. With the help of the Test Capture Grid, positive and negative aspects of the demonstrator as well as additional ideas of the workshop participants and further questions were collected and recorded in writing [33].

Overall, the human-centered design approach is based on an iterative procedure [21]. The input from the evaluations is used to continuously improve the solution approach. Furthermore, it can be useful to check again in the process whether the identified requirements or the user context should be supplemented if necessary [21].

In the following section, the results of the described analyses that were applied within the framework of the human-centered design approach for the development of a holistic care platform are presented and explained.

4 THE BENEFIT MODEL

The aim of the conducted research following a human-centered design approach was to analyze the efficiency of a care platform for users and care service providers. This can be done with the help of a cost-benefit analysis. Cost-benefit analyses have been carried out in the health and care sector for several decades and cover different levels and dimensions. These include the outpatient and inpatient areas of the healthcare sector, the micro and macro level, and various sub-areas of the healthcare sector, such as medicine, sociology, or economics [34]. In principle, the costs and benefits are compared and then evaluated [35]. Consequently, all costs and benefits incurred by the affected stakeholders are captured [36].

The funding of a care platform is difficult to analyze because there is currently no data on investment costs. Additionally, the funding of a care platform is dependent on the involved stakeholders and their investment choices. Therefore, the focus is particularly on the benefits of a care platform for care service providers and potential users applying the Benefit Model.

As the first step of a cost-benefit analysis, de Rus names the identification of the cost and the benefits [37]. The author emphasizes this to be an effortless first step, especially when identifying financial revenue as benefits [37]. It is somewhat more difficult to assess intangible benefits and costs, as these costs are not quantifiably measurable and include aspects such as enhanced quality in relationship work. Furthermore, the cost and benefits have to be aggregated, interpreted, and discussed with the help of several criteria [37]. For this step, the Benefit Model is useful as the different benefit types are divided into categories. The Benefit Model enhances the comprehension for both service providers and users, indicating that utilizing a product, application, or service promises numerous advantages. As a counterpart to the invested costs, highlighting the different types of benefits is supposed to make the attractiveness of a service or product clear and offer service providers the opportunity to differentiate themselves from competitors [38]. Because of the difficulty of identifying the cost of a care platform, only the benefits of a care platform are identified in the following section.

5 RESULTS

In this section, the research results are presented with the help of the Benefit Model. Table 1 shows this model following Menthe and Sieg [38]. The entries within the model are results from surveys following a human-

Table 1. Results of the Human-centered Design Approach within the Benefit Model

Product/Service Benefits	For Care Service Providers	For Users
Technical	–Provision of system services –Data usage concepts (health data maintenance)	–Interface easy to use –Compact overview of care offers on one platform –Easily understandable data protection
Economic	–New business models –Presentation on the platform (advertising costs) –Problem-free handling –Time savings –Resource-saving (financing) –Collaboration between several care service providers –Better management of employee absences –Refinance of consultation –Cost transparency –Fair distribution of efficiency gains	–Time savings –Cost-effective (financing)
Commercial	–Innovation –Unrivalled product –High quality –Booking via platform	–Local service providers –Personal support –Reliable appointments –Help with financing issues –Short delivery time
Image	–Quality management –More time for relationship and care work –Evaluation systems to prevent dubious service providers and products –Care and nursing profession is valorized	–Brand product –User-friendly design
Application	–Expansion of the customer base –Establishment of AAL innovations –Reduction of complex bureaucracy	–All-in-one product (“guide” through complex care market) –Living longer in one’s own home –Enhancement of autonomy
Additional Utility	–Information database –Quick help –Establishment of collaboration networks	–Customer service –Information, tips, and references to important service providers –A better understanding of legal texts –Improvement of quality of life

centered design approach and summarize the benefits of digital innovation in a smart city environment—a digital care platform for people with assistance needs. Those surveys include the aforementioned qualitative analyses, quantitative analysis, focus groups, and participatory observations. In the following sections, the results of the model are presented and discussed. This is done by assigning the results of the different research under the human-centered design approach into the categories of the Benefit Model, e.g., technical, economic, and commercial benefits, among others. Furthermore, the results are divided into the categories “care service providers” and “users” to clearly show the different benefits for the user groups.

5.1 Technical Benefits

Technical benefits of a care platform for service providers include the provision of system services that include the presentation of the offers on the platform and the takeover of communication with users. Furthermore, a technical benefit of a care platform is data usage concepts through which it is possible to safely maintain

personal user data and health data and therefore to improve services according to user data or user preferences [39].

On the other hand, users profit from technical benefits to the effect that with data usage concepts, it is possible to comprehend how personal data is processed and who accesses it. Furthermore, an easily usable interface or dashboard of a care platform is highly recommended to attract users to use a digital platform. This was clear in the conducted focus groups in which the participants strongly advocated for barrier-free platforms. A barrier-free care platform makes an overview of offered care services possible.

5.2 Economic Benefits

The economic benefits are numerous—especially for care service providers. For one, by accessing a digital care platform, a new business model emerges. Furthermore, service providers can save marketing costs because their products and services are promoted through the care platform. Additionally, they have high time savings as previous care and social anamnesis is done by the care platform or by the assessment of the user's profile on the platform. This saved time can be used for more care or relationship work. It is also possible to connect with other service providers on the platform and to form new collaborations that support the easy management of employee absences. Moreover, the efficiency gains achieved through the collaboration with other service providers can be fairly distributed by a decision support system that is part of a collaborative business model of a care platform. Using a care platform makes it possible to refinance care consultations.

Users benefit from using a care platform by saving time and costs. For one, the navigation through the unclear care market is facilitated by a care platform in the form of getting recommendations from artificial intelligence. Also, users may save costs. The participants of the conducted focus groups expressed that the usage of a platform is dependent on a low price for users. Therefore, for financing, a combination of financing methods is recommended [40].

5.3 Commercial Benefits

In this part, the commercial benefits of a care platform are presented. For service providers, a care platform is a unique selling point, an innovative and unrivaled service. A conducted competitor analysis compared the holistic care platform to already existing care platforms. This analysis emphasized the need for a care platform as existing platforms lacked a wide range of offers, **Ambient Assisted Living (AAL)** products, and the use of artificial intelligence [41].

Users benefit from local service providers and a timely and flexible booking process. Reliability is also an important factor and contributes to professional and trustworthy digital innovation. Furthermore, personal support may help with financing questions.

5.4 Image Benefits

For service providers, quality management is an important aspect of using a care platform. Evaluation systems, as well as the promoted service providers on the platform, have to be professional and reputable. A high-quality evaluation system promotes trust in the platform and prevents dubious care service providers from accessing the platform. Furthermore, having more resources for care and relationship work is an attractive aspect for users in choosing a suitable service provider, as the qualitative analyses have shown. Thus, the status of the care and nursing profession can be enhanced.

For users, accessing a trustable brand product with known and distinguished platform providers and care service providers represents a reason to use a care platform.

5.5 Application Benefits

The application benefits for service providers include the expansion of the customer base. Users and new customers can be made aware of service providers and their offers. Moreover, AAL products and innovations can be brought closer to potential customers. A key benefit of the application for providers is the reduction of complex bureaucracy and administrative burdens, such as documentation and anamnesis. These processes are intended to run through the platform and therefore reduce the workload of care staff [41].

The main application benefit for users is the all-in-one package they receive by using a care platform. The provisions of care services and usage of care products can lead to a self-determined, autonomous life at home and improvement in quality of life.

5.6 Additional Benefit

In the conducted focus groups of care service providers mentioned, the care platform can pose as an information database in case of a care-level analysis—posing as a quick help to providers and relatives of people with assistance needs at the same time. Furthermore, they can establish new networks with service providers in their vicinity to collaborate.

Apart from booking care services and products, users find a vast collection of information on the care-level analysis and legal representation of people with assistance needs or care directives. They receive important tips and can be redirected to suitable contact persons. The care platform additionally provides them with easy-to-understand legal texts and information, thus ensuring a higher quality of life.

6 DISCUSSION

The Benefit Model was created with the results of the surveys within the framework of the human-centered design approach. In the following, relevant categories of the Benefit Model will be discussed with the results already presented.

Concerning technical benefit and value, users and service providers participating in the conducted focus groups often mentioned the importance of easily understandable and comprehensible data security and protection measurements. Many services and products from the health and care sector are being digitized. The collection and processing of big and rapidly growing data volumes for the improvement of services and products from the health sector is an urgent challenge—not least on account of high levels of protection under data protection law [42]. Many participants of the conducted focus groups were deterred by the data privacy information and query at the beginning of the use of the care platform, which included the use of a care chatbot and a voice assistant. To provide the benefits of a care platform, a comprehensible data usage concept for users and care providers is recommended. This data usage concept shows transparently how user and service provider data is used and with which organizational and technical measures it is protected [43].

Concerning economics, saving resources and especially funding for the care platform was mentioned. In the conducted qualitative interviews and the focus groups, it is mentioned that people with assistance needs and their relatives would not use a care platform if they have to pay for it. There are several options to fund a care platform. On the one hand, the users could pay through monthly subscriptions or a one-time payment. On the other hand, care service providers could fund this platform by paying for system services. In order to not overburden one side and discourage use, a combination of payment options is favored and recommended [40].

One important economic benefit is the establishment of collaboration networks (see Table 1). Collaboration networks have grown in importance in the digitization of services as the need to combine individual skills and expertise across companies increases [44]. Collaborations are also recommended concerning a care platform, as this allows for better coordination of care for people with assistance needs. Especially in case of employee absence, care service providers can instruct other service providers to stand in to ensure nursing care for users. Care service providers participating in the qualitative interviews perceived this aspect as especially important. For a successful collaboration, the interested parties have to evaluate in the first step how individual skills and

expertise complement each other [44]. This is important to crystallize the value proposition and the benefits of collaboration. For the collaboration to continue to be successful, it is recommended that a contract be drawn up at the beginning containing the framework conditions of the collaboration [44]. To ensure the healthcare of users of a care platform, it is recommended to encourage collaborations between stakeholders and to clarify the synergies of these connections.

An application benefit is the establishment and spread of AAL solutions. The conducted competitor analysis emphasizes the limited offering of assistance systems on care platforms. The participants of the focus groups—elderly people and care service providers—did not know about assisted living solutions. Literature implied the limited exposure and application of innovations from the AAL sector, calling them “an emerging topic” and a “new trend” despite products being on the market for a longer time (e.g., [45, 46]). By disseminating knowledge about digital health and care innovations, corresponding AAL and **Internet of Things (IoT)** systems could enter further into the lives of people with assistance needs and enable them to live long, autonomous lives. A care platform can address this challenge by passing on information to users and care providers via the platform and making it possible to purchase corresponding products via the platform.

What is striking about the research results from the conducted focus groups are the differences in the statements and observations between the various user groups (service providers—people with assistance needs) as well as age groups (younger participants—older participants). The service providers see the potential of a care platform especially due to its “all-in-one” function for relatives, as the use of a tablet is unfamiliar to their clients. This was also visible within the focus groups. Older female participants in particular rejected tablet use or found it more difficult to operate the tablets. Overall, they favored the use of a voice assistant. The *Digital Index* states in this regard that digitalization is not part of the reality for people born up to the year 1945 [47]. People from this age group would rather see the risks than the opportunities of digital applications, as most of their life was not digitalized and current digitalization efforts present them with major challenges. However, the subsequent post-war generation already has a significantly higher level of digital literacy [47]. However, it is not recommended to exclude older people with assistance needs as a user group from the outset, as the majority of focus group participants tested the care platform with great interest and curiosity. The research literature also attributes a major role to the participation of older people so that the different needs of technology development can be taken into account [48]. Here, further digital training could educate the older user group (including older care providers) to make the digital care platform more attractive for them as well and to emphasize the benefits of a care platform for this target group.

7 CONCLUSION

In this article, the human-centered design approach was presented to scientifically accompany the development of a care platform for people with assistance needs, their relatives, and care service providers. Within the human-centered design approach, several surveys were conducted, including qualitative expert interviews, a competitor analysis, a scenario analysis, and focus groups. The aim was to identify the benefits of using a care platform for the different user groups. This was possible by applying the Benefit Model following Menthe and Sieg [38]. Through this, several benefits of a care platform were identified and further discussed.

In summary, offering training or workshops is a suitable method to involve people with assistance needs and care providers in the development of digital health and care innovations, such as a care platform. The results and discussion suggest that the costs should not only lie with the users and that a transparent and comprehensible data usage concept is an important factor in getting people to use and trust the platform.

The collaboration of different care service providers can be an important factor in addressing issues such as demographic change and the nursing shortage. A care platform could enable collaboration by bringing together local stakeholders and also promoting voluntary work. The area of AAL could be an important element in care platforms through targeted promotion and training to bring awareness to existing solutions in an aging society.

Promoting digital literacy can be an important step to engage and involve especially vulnerable target groups in active participation in smart city projects. The importance of easy access to smart city applications became evident in the current state of research presented and in the conducted studies of this article.

People-centric approaches such as the human-centered design approach continue to be important as the needs of diverse stakeholders can be taken into account with the help of target group-oriented processes. The iterative procedure of the approach allows development steps to be regularly reflected and adapted. Furthermore, data should be collected on the costs incurred by implementing the care platform.

REFERENCES

- [1] Chun Sing Lai, Youwei Jia, Zhekang Dong, Dongxiao Wang, Yingshan Tao, Qi Hong Lai, Richard T. Wong, Ahmed F. Zobaa, Ruiheng Wu, and Loi Lei Lai. 2020. A review of technical standards for smart cities. *Clean Technol.* 2, 3 (2020), 290–310. DOI: [10.3390/cleantechnol2030019](https://doi.org/10.3390/cleantechnol2030019)
- [2] Marcel Mendonca, Bruno Moreira, Jazon Coelho, Nelio Cacho, Frederico Lopes, Everton Cavalcante, Adelson Dias, Jose Lucas Ribeiro, Emiliano Loiola, Daniela Estaregue, and Brunna Moura. 2016. Improving public safety at fingertips: A smart city experience. In *2016 IEEE International Smart Cities Conference (ISC2'16)*. 1–6. DOI: [10.1109/ISC2.2016.7580772](https://doi.org/10.1109/ISC2.2016.7580772)
- [3] Christoph Pflügler, Maximilian Schreieck, Gabriel Hernandez, Manuel Wiese, and Helmut Krcmar. 2016. A concept for the architecture of an open platform for modular mobility services in the smart city. *Transportation Research Procedia* 19 (2016), 199–206. DOI: [10.1016/j.trpro.2016.12.080](https://doi.org/10.1016/j.trpro.2016.12.080)
- [4] Nicolás Pardo-García, Sofia G. Simoes, Luis Dias, Annamaria Sandgren, Demet Suna, and Anna Krook-Riekkola. 2019. Sustainable and resource efficient cities platform – Surecity holistic simulation and optimization for smart cities. *Journal of Cleaner Production* 215 (2019), 701–711. DOI: [10.1016/j.jclepro.2019.01.070](https://doi.org/10.1016/j.jclepro.2019.01.070)
- [5] Aamir Hussain, Rao Wenbi, Aristides Lopes Da Silva, Muhammad Nadher, and Muhammad Mudhish. 2015. Health and emergency-care platform for the elderly and disabled people in the smart city. *Journal of Systems and Software* 110 (2015), 253–263. DOI: [10.1016/j.jss.2015.08.041](https://doi.org/10.1016/j.jss.2015.08.041)
- [6] Diane J. Cook, Glen Duncan, Gina Sprint, and Roschelle Fritz. 2018. Using smart city technology to make healthcare smarter. *Proceedings of the IEEE. Institute of Electrical and Electronics Engineers* 106, 4 (2018), 708–722. DOI: [10.1109/JPROC.2017.2787688](https://doi.org/10.1109/JPROC.2017.2787688)
- [7] Michelle Flood, Mark Ennis, Aoife Ludlow, Fabian F. Sweeney, Alice Holton, Stephanie Morgan, Colleen Clarke, Pádraig Carroll, Lisa Mellon, Fiona Boland, Sarah Mohamed, Aoife de Brún, Marcus Hanratty, and Frank Moriarty. 2021. Research methods from human-centered design: Potential applications in pharmacy and health services research. *Research in Social & Administrative Pharmacy: RSAP* 17, 12 (2021), 2036–2043. DOI: [10.1016/j.sapharm.2021.06.015](https://doi.org/10.1016/j.sapharm.2021.06.015)
- [8] George Margetis, Stavroula Ntoa, Margherita Antona, and Constantine Stephanidis. 2021. Human-centered design of artificial intelligence. In *Handbook of Human Factors and Ergonomics*, G. Salvendy and W. Karwowski. (Eds.). Wiley, 1085–1106.
- [9] M. Poongodi, Ashutosh Sharma, Mounir Hamdi, Ma Maode, and Naveen Chilamkurti. 2021. Smart healthcare in smart cities: Wireless patient monitoring system using IoT. *J Supercomput* 77, 11 (2021), 12230–12255. DOI: [10.1007/s11227-021-03765-w](https://doi.org/10.1007/s11227-021-03765-w)
- [10] Tracy Johnson, Shilpa Das, and Nikki Tyler. 2021. Design for health: Human-centered design looks to the future. *Global Health, Science and Practice* 9, 2 (2021), S190–S194. DOI: [10.9745/GHSP-D-21-00608](https://doi.org/10.9745/GHSP-D-21-00608)
- [11] Nicole Ippoliti, Mireille Sekamana, Laura Baringer, and Rebecca Hope. 2021. Using human-centered design to develop, launch, and evaluate a national digital health platform to improve reproductive health for rwandan youth. *Global Health, Science and Practice* 9, 2 (2021), S244–S260. DOI: [10.9745/GHSP-D-21-00220](https://doi.org/10.9745/GHSP-D-21-00220)
- [12] Catherine M. Lawless Frank and Treavor Bogard. 2022. Developing cultural competencies in pre-service teachers through human-centered design and community-based learning. *International Journal of Educational Reform* 31, 2 (2022), 187–201. DOI: [10.1177/10567879211030485](https://doi.org/10.1177/10567879211030485)
- [13] Aaron Sklar and Sally Madsen. 2010. Global ergonomics: Design for social impact. *Ergonomics in Design* 18, 2 (2010), 4–31. DOI: [10.1518/106480410x12737888532921](https://doi.org/10.1518/106480410x12737888532921)
- [14] Sheng-Hung Lee, John Rudnick, Lin Lin, Liangtie Tang, and Deming Zhou. 2020. Apply humanity-centered design process to envision the future learning experience of public area – Use “redesign Shanghai library innovation space project” as an example. In *22st DMI: Academic Design Management Conference*. 1–19. https://www.researchgate.net/profile/Sheng-Hung-Lee/publication/346062044_Apply_Humanity-centered_Design_Process_to_Envision_the_Future_Learning_Experience_of_Public_Area_-_Use_Redesign_Shanghai_Library_Innovation_Space_Project_as_an_Example/links/5fb9b398458515b7975ff34f/_Use_Redesign_Shanghai_Library_Innovation_Space_Project_as_an_Example/links/5fb9b398458515b7975ff34f/
- [15] Kassandra Karpathakis, Gene Libow, Henry W. Potts, Simon Dixon, Felix Greaves, and Elizabeth Murray. 2021. An evaluation service for digital public health interventions: User-centered design approach. *Journal of Medical Internet Research* 23, 9 (2021), e28356. DOI: [10.2196/28356](https://doi.org/10.2196/28356)
- [16] Joseph Kramer, Sunil Noronha, and John Vergo. 2000. A user-centered design approach to personalization. *Communications of the ACM* 43, 8 (2000), 44–48. <https://doi.org/10.1145/345124.345139>

- [17] Alex R. Dopp, Kathryn E. Parisi, Sean A. Munson, and Aaron R. Lyon. 2019. A glossary of user-centered design strategies for implementation experts. *Translational Behavioral Medicine* 9, 6 (2019), 1057–1064. DOI: [10.1093/tbm/iby119](https://doi.org/10.1093/tbm/iby119)
- [18] Carla B. Zoltowski, William C. Oakes, and Monica E. Cardella. 2012. Students' ways of experiencing human-centered design. *Journal of Engineering Education* 101, 1 (2012), 28–59. DOI: [10.1002/j.2168-9830.2012.tb00040.x](https://doi.org/10.1002/j.2168-9830.2012.tb00040.x)
- [19] Mark Zachry and Jan H. Spyridakis. 2016. Human-centered design and the field of technical communication. *Journal of Technical Writing and Communication* 46, 4 (2016), 392–401. DOI: [10.1177/0047281616653497](https://doi.org/10.1177/0047281616653497)
- [20] Ting Zhang and Hua Dong. 2009. Human-centered design: An emergent conceptual model. In *Include2009 Proceedings*, Royal College of Art.
- [21] ISO 9241-210. 2019. *Ergonomics of Human-system Interaction - Part 210: Human-centred Design for Interactive Systems: ISO/TC 159/SC 4, Edition 2*.
- [22] Craig S. Fleisher and Babette E. Bensoussan. 2015. *Business and Competitive Analysis: Effective Application of New and Classic Methods* (2nd ed.). Upper Saddle River, NJ: Pearson.
- [23] Nadja Hatzijordanou, Nicolai Bohn, and Orestis Terzidis. 2019. A systematic literature review on competitor analysis: Status quo and start-up specifics. *Manag. Rev. Q.* 69, 4 (2019), 415–458. DOI: [10.1007/s11301-019-00158-5](https://doi.org/10.1007/s11301-019-00158-5)
- [24] Jelena Bleja, Sara Neumann, Tim Krueger, and Uwe Grossmann. 2022. A human-centered design approach for the development of a digital care platform in a smart city environment. In *Companion Proceedings of the Web Conference 2022 (WWW '22 Companion'22)*. 1237–1244. DOI: [10.1145/3487553.3524854](https://doi.org/10.1145/3487553.3524854)
- [25] Jelena Bleja, Tim Krüger, and Uwe Grossmann. 2022a. Development of a holistic care platform - A user-centered approach. In *Lecture Notes in Networks and Systems 319, Human Interaction, Emerging Technologies and Future Systems V*, T. Ahram and R. Taiar. (Eds.). Cham: Springer International Publishing, 378–385. DOI: [10.1145/3487553.3524854](https://doi.org/10.1145/3487553.3524854)
- [26] Cornelia Helfferich. 2019. Leitfaden- und experteninterviews. In *Handbuch Methoden der Empirischen Sozialforschung*, N. Baur and J. Blasius, (Eds.). Wiesbaden: Springer Fachmedien, 669–684. DOI: [10.1007/978-3-658-21308-4_44](https://doi.org/10.1007/978-3-658-21308-4_44)
- [27] Jochen Gläser and Grit Laudel. 2010. *Experteninterviews und Qualitative Inhaltsanalyse Als Instrumente Rekonstruierender Untersuchungen* (4th ed.). Wiesbaden: VS Verlag für Sozialwissenschaften.
- [28] John Pruitt and Jonathan Grudin. 2003. Personas. In *Proceedings of the 2003 Conference on Designing for user Experiences*. 1. DOI: [10.1145/997078.997089](https://doi.org/10.1145/997078.997089)
- [29] Lene Nielsen. 2019. *Personas: User Focused Design*. London: Springer. DOI: [10.1007/978-1-4471-7427-1](https://doi.org/10.1007/978-1-4471-7427-1)
- [30] Socio-Economic Panel (SOEP). 2019. *Data for Years 1984-2017: versio 34*. DOI: [10.5684/soep.v34](https://doi.org/10.5684/soep.v34)
- [31] Sara Dolnicar, Bettina Grün, and Friedrich Leisch. 2018. *Market Segmentation Analysis: Understanding It, Doing It, and Making It Useful*. Singapore: Springer Open. DOI: [10.1007/978-981-10-8818-6](https://doi.org/10.1007/978-981-10-8818-6)
- [32] Jelena Bleja, Lars Engelmann, Dominik Wiewelhove, and Uwe Grossmann. 2021. Smart care in smart cities - Scenario analysis for an innovative care platform. In *2021 11th IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications (IDAACS '21)*. 657–662. DOI: [10.1109/IDAACS53288.2021.9661023](https://doi.org/10.1109/IDAACS53288.2021.9661023)
- [33] Timo Dietrich, Sharyn Rundle-Thiele, and Krzysztof Kubacki. (Eds.). 2017. *Segmentation in Social Marketing: Process, Methods and Application* (1st ed.). Singapore: Springer Singapore. DOI: [10.1007/978-981-10-1835-0](https://doi.org/10.1007/978-981-10-1835-0)
- [34] Ludwig Bapst. 1986. Die mehrdimensionale kosten-nutzen-analyse als evaluationsinstrument im gesundheitswesen. In *Die Kosten — Nutzen — Analyse*, W. van Eimeren and B. Horisberger, (Eds.). Berlin: Springer, 1–49. DOI: [10.1007/978-3-642-70521-2_1](https://doi.org/10.1007/978-3-642-70521-2_1)
- [35] Stefan Müller-Mielitz. 2017. Kosten-nutzen-analyse und aspekte der ergebnisqualität von esource in der klinischen forschung. In *E-Health-Ökonomie*, S. Müller-Mielitz and T. Lux, (Eds.). Wiesbaden: Springer Fachmedien, 273–292. DOI: [10.1007/978-3-658-10788-8_15](https://doi.org/10.1007/978-3-658-10788-8_15)
- [36] Mareike Mähls. 2022. Erfassung der kosten und nutzen von e-health. In *E-Health-Ökonomie*, S. Müller-Mielitz and T. Lux, (Eds.). Wiesbaden: Springer Fachmedien, 121–136. DOI: [10.1007/978-3-658-35691-0_7](https://doi.org/10.1007/978-3-658-35691-0_7)
- [37] Ginés de Rus. 2021. *Introduction to Cost-Benefit Analysis: Looking for Reasonable Shortcuts* (2nd ed.). Cheltenham, Gloucestershire: Edward Elgar Publishing Limited.
- [38] Thomas Menthe and Manfred Sieg. 2013. Das nutzenmodell. In *Kundennutzen: Die Basis Für Den Verkauf*, T. Menthe and M. Sieg, (Eds.). Wiesbaden: Gabler Verlag, 121–127. DOI: [10.1007/978-3-8349-3740-7_8](https://doi.org/10.1007/978-3-8349-3740-7_8)
- [39] Sara Neumann, Jelena Bleja, and Uwe Grossmann. 2022. Data usage concepts for care platforms in smart cities: Opportunities and challenges. In *2022 IEEE International Smart Cities Conference (ISC2 '22)*. 1–6. DOI: [10.1109/ISC255366.2022.9922344](https://doi.org/10.1109/ISC255366.2022.9922344)
- [40] Jelena Bleja, Sara Neumann, Tim Krüger, and Uwe Grossmann. 2022. Collaborative business model structures for a digital care platform: Value proposition, partners, customer relations, and revenues. In *Proceedings of the 19th International Conference on Smart Business Technologies*. 111–119. DOI: [10.5220/0011143300003280](https://doi.org/10.5220/0011143300003280)
- [41] Jelena Bleja, Dominik Wiewelhove, Tim Krueger, and Uwe Grossmann. 2021. Achieving life in smart cities: Chances and challenges for a holistic care platform. In *2021 IEEE European Technology and Engineering Management Summit (E-TEMS '21)*. 72–75. DOI: [10.1109/E-TEMS51171.2021.9524856](https://doi.org/10.1109/E-TEMS51171.2021.9524856)
- [42] Pijush Kanti Pramanik, Saurabh Pal, and Moutan Mukhopadhyay. 2019. Healthcare big data. In *Advances in Healthcare Information Systems and Administration, Intelligent Systems for Healthcare Management and Delivery*, A. Moutmtzoglou and N. Bouchemal, (Eds.). IGI Global, 72–100. DOI: [10.4018/978-1-5225-7071-4.ch004](https://doi.org/10.4018/978-1-5225-7071-4.ch004)

- [43] *The Standard Data Protection Model: A Method for Data Protection Advising and Controlling on the Basis of Uniform Protection Goals*. Version 2.0b. Retrieved December 12, 2022 from https://www.datenschutzzentrum.de/uploads/sdm/SDM-Methodology_V2.0b.pdf.
- [44] Anmar Kamalaldin, Lina Linde, David Sjödin, and Vinit Parida. 2020. Transforming provider-customer relationships in digital servitization: A relational view on digitalization. *Industrial Marketing Management* 89 (2020), 306–325. DOI : [10.1016/j.indmarman.2020.02.004](https://doi.org/10.1016/j.indmarman.2020.02.004)
- [45] B. Ganesan, T. Gowda, A. Al-Jumaily, K. N. Fong, S. K. Meena, and R. K. Tong. 2019. Ambient assisted living technologies for older adults with cognitive and physical impairments: A review. *European Review for Medical and Pharmacological Sciences* 23, 23 (2019), 10470–10481. DOI : [10.26355/eurrev_201912_19686](https://doi.org/10.26355/eurrev_201912_19686)
- [46] Priscila Cedillo, Cristina Sanchez, Karina Campos, and Alexandra Bermeo. 2018. A systematic literature review on devices and systems for ambient assisted living: Solutions and trends from different user perspectives. In *2018 International Conference on eDemocracy & eGovernment (ICEDEG'18)*. 59–66. DOI : [10.1109/ICEDEG.2018.8372367](https://doi.org/10.1109/ICEDEG.2018.8372367)
- [47] Initiative D21 e. V. 2022. *D21-Digital-Index 2021/2022 - Jährliches Lagebild zur Digitalen Gesellschaft: Vertiefungsthema: Digitale Nachhaltigkeit*. Retrieved April 12, 2022 from https://initiatived21.de/app/uploads/2022/02/d21-digital-index-2021_2022.pdf.
- [48] Miriam Grates and Annette Krön. 2016. Partizipation älterer in der technikentwicklung. *Sozial Extra* 40, 6 (2016), 40–44. DOI : [10.1007/s12054-016-0106-0](https://doi.org/10.1007/s12054-016-0106-0)

Received 21 December 2022; revised 19 March 2023; accepted 11 May 2023