Rural Areas on Their Way to a Smart Village - Experiences from Living Labs in Bavaria

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Abstract This paper presents an overview of the approaches and experiences from existing living labs: german rural villages in which several digital solutions had been developed and implemented. The test villages have been selected based on a competition and are funded by the Bavarian state government in the project "Digitales Dorf" (Engl. digital village). Started in 2016 several measures had been taken to push digitalization in these rural areas with the goal to create equivalent living conditions to urban areas. The research question is how digitalization enhances the value of rural areas and which methods can be used to overcome the digitalization gap with a transferable and simple approach. This paper focuses on the transformation process rather than digital solutions, and presents requirements and best practices to promote digitalization in rural environments, their municipal processes and traditional approaches in everyday life.

1   Introduction: the need of pushing smart rural areas

A country's society does not digitalize on its own, and certainly not equally among different geographical structures. According to an annual study on the digital society in Germany conducted by the Initiative D21, around 15% of the population still does not use the internet (Allianz pro Schiene e.V., 2019). Further, regional diversities become clear: metropolitans (500,000 inhabitants and more) use digital applications more frequently and competently than the rural population (up to 20,000 citizens in a municipality) and are more open to technological change. (Initiative D21 e.V., 2019) This attitude is not necessarily inherent, but can be attributed to different structural conditions: Despite well-intended governmental support for broadband expansion (Bundesministerium für Verkehr und digitale Infrastruktur, 2019), rural areas are at a disadvantage, which is reflected in lower transmission speeds and poorer mobile phone coverage, particularly in border regions (Bundesamt für Kartographie und Geodäsie, 2016). This makes it more difficult to implement digital innovations with higher transmission requirements, but must not lead to rural areas being disadvantaged and consequently left behind.

Despite trends such as urbanization and rural exodus, the following conditions illustrate the significance of rural areas for Germany with its 83.1 million inhabitants: (Statistisches Bundesamt, 2020) rural areas represent more than 90% of Germany's territory, but are the habitat for less than 60% of its citizens, which illustrates the increasing overload in big cities like Munich. Digitalization can play a significant role to stop rural exodus, if it is not used in urban areas only but if it also serves rural areas to meet the challenges there. Aside from "Smart Cities", society needs "Smart Villages", too.

This paper aims at sharing information gained from the living labs in the project "Digitales Dorf Bayern"[1] (digital village Bavaria). The objective of the research is to determine which digital solutions can be used to make living conditions in rural areas more attractive. In this context, the living labs are municipalities participating in the funding project, which offer space and use cases for field tests for digitalization measures in rural areas. For this purpose, an overview of digitalization and rural areas including their challenges builds the theoretical basis. This is followed by a short

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description of the pilot project "Digitales Dorf" and a view onto a successful and sustainable digitalization respective transformation process in rural areas. In addition, it is shown how demand-oriented digitalization in rural areas can work in practice and which benefits these "living labs" bring.

2 Methodical Approach

An intensive dialogue with citizens and the monitoring and support of the communities in the digital transformation are essential elements of the project realization in the pilot regions. Together with the citizens, practical digital everyday helpers are to be developed and tested. Dialogues with citizens and inventories of the initial situation in the communities are being carried out continuously across various topics. The evaluation aims to gain a general overview of the current use of digital offers and citizen services in the municipalities. The experience and requirements gathered will be taken into account for the development of a digitalization concept and will also be included in the solutions. Implemented measures are repeatedly re-evaluated. The experience gained in this project describes the process and can be used as a guideline for future digitalization projects. For the pilot regions this should result in a boost of the digital offerings in the communities.

3 Digitalization in rural areas

3.1 The term "rural area"

Even if a common, approved definition of rural areas in politics, science and society is still missing (Maier, 2008), various quantitative and qualitative criteria or characteristics apply (Magel, 2007). Rural areas define as village and small town structures with low building and population density. The townscape is shaped by agriculture and forestry as the economic sector. Rural areas are poorly accessible and tend to have inadequate infrastructure and supply facilities. In addition, rural areas suffer from low job density with resulting negative commuter balance. Citizens are more likely to have closer and more manageable interpersonal relationships. The rural landscape is characterized by natural and semi-natural elements.

Thresholds for the metric indicators that would clearly describe rural areas are missing. At least the criteria allow a categorization and thus a comparison. Initiative D21, on the other hand, uses the number of inhabitants below 20,000 in a municipality as the criterion for "land" (Initiative D21 e.V., 2019). This applies to 96% of municipalities in Bavaria. (Deutscher Städtetag, 2019) Also in practice, it proves difficult to define "the one" rural area. Instead, there are many different types of rural areas with special potentials and challenges. (Wiechman & Terfrüchte, 2017)

3.2   The digital challenges faced by rural areas in Bavaria

The terms digitization and digitalization are often mixed up in their meaning. Digitization is the transformation of an analog process into the digital form of zeros and ones (Gartner, 2020a), and therefore a subtopic of digitalization. The latter is well described in Gartner's glossary:

> "Digitalization is the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business." (Gartner, 2020b)

Despite the fact that rural areas have many benefits such as a high sense of belonging, a healthy environment and lower rent or land costs (Maier, 2008), it still suffers from disadvantages: The lack of medical specialists (Bertelsmann Stiftung, 2015), accessible mobility (Allianz pro Schiene e.V., 2019) and modern equipment in schools (Deutscher Bundestag, 2018), for example, does not measure up to the offerings in the cities. Citizens therefore face long travel distances to everyday services, which come along with limited mobility offerings (Stentzel, U., Piegsa, J., Fredrich, D., Hoffmann, W., & van den Berg, N., 2016). The economic structural weakness leads to a high number of commuters leaving rural areas to get opportunities in job offerings in urban areas. (IHK Niederbayern, 2017) For the local companies in rural areas, this means that skilled labor potential is lost, which further aggravates the already tense situation. In the long term, this closes the circle of migration from the countryside into the cities and their agglomerations (rural exodus). In contrast to the modernized urban infrastructures, as well as better hard- and software conditions that already exist in the cities, a technological modernization of the systems in rural authorities and a change of mindset is largely necessary to support the adjustment from conventional processes to a digital everyday life. In

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contrast to cities, digitalization is rarely present in the everyday life of citizens. The rural aging of society means that the proportion of citizens actively participating in digital life is low (Currie and Philip, 2019). The lack of urge to try out new things, partly due to the very traditional social structure, makes the introduction of new technologies considerably more difficult in rural areas than in cities. Statistics from the IW-Report 2019 (Burstedde & Werner, 2019) show that the proportion of academics in rural areas is very low, which suggests that, from a professional point of view, there is very little knowledge of modern technologies. The scope of challenges of digitalization often differs between rural, peripheral localities and urban areas. The term "digital divide" or "digital gap" refers to the fact that different access to information and communication technology causes kind of a gap between demographic regions. (Steele, 2019) However, one should treat this term and corresponding statement with caution: Not all rural communities likewise need the same fundamental preparation in digitalization. The term "gap" should also not suggest that city residents are all digital experts in contrast to the rural dwellers. Namely, digitalization and its usage are more distributed in cities because of better conditions like network access and (public) infrastructure. (Bundesamt für Kartographie und Geodäsie, 2016) Nevertheless, there are also city residents that have no or few touchpoints with digitalization, and there are simultaneously rural citizens, which are more technology-oriented.

4   The project "Digitales Dorf Bayern"

4.1   Overview: context and aim of the project "Digitales Dorf Bayern"

Under the leadership of the Bavarian State Ministry of Economic Affairs, Regional Development and Energy (StMWi), the project "Digitales Dorf Bayern" deals with the consistent mastering of given problems with the help of modern communication and information technologies as the key to sustainable rural areas and social life. The aim of the "Digitales Dorf Bayern" project is therefore to work together with local citizens to find adequate solutions for even better living together in the community, with transferability to other municipalities with little effort and without in-depth expertise. (StMWi, 2019) The project takes - under consideration of comparable initiatives - the digital potentials and developments of the last years as an opportunity to test new technologies and, if necessary, to use and evaluate already existing solutions in the communities, if available. Selected scientific institutions support the

pilot areas. The Deggendorf Institute of Technology (DIT) is responsible for three pilot villages respective regions in Southern Bavaria. If one considers the specific context in this work, digitalization has to be understood as kind of a digital revolution caused by the implementation and increasing use of the internet, digital technologies and devices in public life, business and private everyday life. The digital revolution has therefore different dimensions: a social, a political, an economical, a technical and an ethical. For the project "Digitales Dorf Bayern" the focus is on the social one, since research concentrates on the interaction between digital technologies and citizens respective their participation. In the presented paper, digitalization in rural areas is therefore specified as follows:

> Digitalization is the use of digital technologies to improve municipal services of general interest and social interaction. It affects primarily the social dimension in the process of implementing and using digital technologies and services, and learning how to deal with it. Its aim is to improve social interaction and everyday life for citizens in challenging rural areas. Indeed, rural areas cannot be compared to each other since they suffer from different structural problems and they all have a different initial situation regarding their digitalization knowledge.

This derived definition aims to help understanding the actual hurdles in rural areas in order to be able to use digital measures in a more tailored and targeted way. A special requirement is the transferability from one municipality to another. The definition has emerged from the general conditions of the living labs. It has turned out that it can be used as a guiding principle in all communities participating in the project so far. The difference to the approaches in smart cities is particularly clear, as digital solutions in urban areas are mostly alike due to structural similarities.

4.2   The two keystones of the living labs

Two aspects illustrate the successful approach in the project "Digitales Dorf Bayern": the holistic approach and the living lab-approach. Holistic in this context means finding digital solutions for all areas or spheres of life. This is important because real and sustainable benefit for the citizens is only created if the developed solutions are connected in order to provide a fully comprehensive service. Therefore, during setup of the project by government, the decision was pending which topics in everyday life should be considered. Being aware of the fact regarding

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the generated added value through linking the spheres of life, various fields of action were examined for potential to catch up and for digitalization options to achieve improvements for citizens in rural areas. Figure 1 shows the selected spheres of life in the project "Digitales Dorf Bayern", all digitalization activities in the pilot villages and their state of development. Digitalization alone cannot solve all problems: Analogue togetherness is still essential for a healthy, functioning society. Further, all developed solutions are already today easily and digitally accessible with one account for the citizens via the so-called *Dahoam 4.0®* platform, distributed as a web-application and several mobile apps. The project strives to develop solutions according to the citizens' needs. This is done through the bottom-up approach, in which concepts are developed and mutually created in direct dialogue with the citizens. This is important, because many digital innovations suffer from a significant problem, if they are oriented exclusively to the technical possibilities. The following section emphasizes the living lab-approach when explaining the project's roadmap.
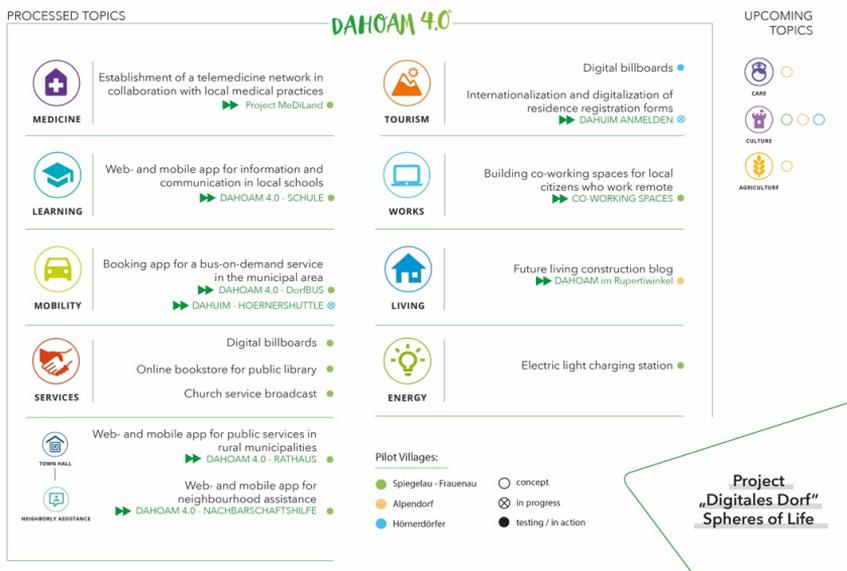

Figure 1: Defined topics aka spheres of life in the living labs
source: own illustration

4.3 Approaches of the living lab "Digitales Dorf Bayern"

In the following, the process steps for developing and implementing digitalization measures presented in Figure 2 will be described on the basis of the experiences from the three pilot villages. Positive evaluated methods are equally reflected.

One should distinguish between two roadmaps, the "macroeconomic" one, which aims to transfer the living lab tests and results, and the "microeconomic" one, how the projects are successfully and sustainably implemented within a pilot village.
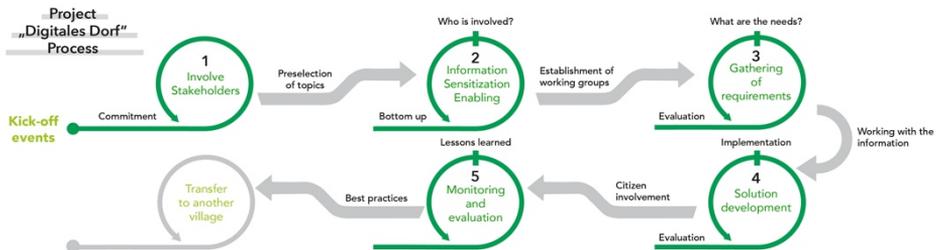

Figure 2: Digitalization process in the living lab "Digitales Dorf Bayern"
source: own illustration

Step 1: Involve Stakeholders

All pilot villages provide a so-called core team, which works together for the entire duration of the project and is formed by three stakeholders. These are made up by the mayor of the municipality, the scientific advisors and the caretaker on the spot. The mayor of the municipality supervises and takes care of the final decisions throughout the duration of the project. The monitoring function by the scientific advisors, in this case the Deggendorf Institute of Technology, proves to be an advantage for the project regarding the guarantee of professional input concerning digital innovations, advice and overall help with hard- and software implementation. Additionally, the caretaker on the spot represents the interface between the local citizens and the scientific team. He or she is familiar with the pilot village, can coordinate on site at short notice and supports the core team with organizational skills.

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Step 2: Information, sensitization and enabling

To raise awareness to the project and to generate motivation it is important to have an official "kick-off". These events attract public attention and illustrate the importance of the topic by the presence of political celebrities. An official kick-off shows the commitment to the project and the willingness to meet the challenges. After the kick-off, the working groups can be formed on basis of the previously defined fields of action. Their task is to identify the respective challenges in the region and to develop measures with the support of the scientific team. All citizen groups get the chance to be part of a working group and to inform them about suitable technological possibilities to create concepts with the other stakeholders. This requires again public relations work. This step needs several repetitions to raise citizens' awareness of the use of digital media by sensitizing them with implemented prototypes and services.

Step 3: Gathering of requirements

The project research shows, that measures should not base on technical possibilities, but rather on the region-specific challenges. Instead of high-flying, low-threshold solutions are required for the success of such projects: they can be implemented quickly, are visible to the citizens and associated with immediate benefits. In addition, this illustrates how the gathering of requirements should be addressed. If one starts from specific challenges and problems, solutions are created that offer real benefit. This is why the actively moderated bottom-up approach is so essential: it guarantees that the people who are most affected by the challenges are involved in the generation of ideas and therefore benefit directly from the solutions. This has positive impact on acceptance and usage of the solutions later on.

Step 4: Solution development with citizen involvement

All solutions in this project are developed according to the following criteria:
   a) Use of already proven existing solutions over in-house programming
   b) Building upon existing structures to avoid parallel or isolated applications
   c) Easy-to-use for users: 1) Development by requirement, not by possibility 2) Design follows function

d) Low-cost transferability (regarding time and money) to other municipalities: The purpose of testing the measures in the pilot regions is not to implement specific solutions for unique problems. Ideally, it should be possible to transfer the solutions to many other rural areas with similar situations.

Step 5: Monitoring & evaluation

Monitoring and evaluation can assume different proportions. The usage of the digital solutions can easily be reviewed by analytics systems. However, if one wants to learn about detailed cost- and time-savings, more effort is necessary. Not only needs the developed solution itself monitoring and evaluation. The scientific team at DIT started to record steps and techniques of software development in order to make it easier to reproduce the creations when changes and further developments are required. This is also important in case of changes of employees or assuming responsibility by a third-part company. Learning from mistakes is one of the best options for further development and getting better. To gain from these benefits in a long term it is necessary to record also these issues as lessons learned.

4.4   Overview of the learning effects

The project periods described above turned out to be crucial to a long-term successful digitalization project. As trivial as it might sound, underestimating the significance of these easy steps might doom the project to failure. Undertaking a digitalization project that strongly influences the social and everyday life in rural areas needs to involve affected people. Interdisciplinary stakeholders with different backgrounds in sectors like informatics, socio-economics and local citizens prove to be valuable for a holistic project team. The caretaker on the spot turns out to be a key contributor to the projects' success. The ability to identify root problems in daily life of the locals and discussing them continuously simplifies the identification of requirements. The research shows that open to public participation platforms in form of working groups tend to pave the way to an open dialogue around the topic. To this point, created solutions within the living labs are tailored to the citizens' needs. It is important to keep the residents informed and updated about the developments to ensure that problems, misunderstandings or worries by the citizens are settled in an early stage. There will be always critical opinions of people who are

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scared and / or avoid topics of digitalization. In addition, there is often a lack of awareness for improvements and modernization. Simple explanations can usually solve that. Technologies and solutions should be introduced and promoted by adequate communication channels according to target groups. This includes the usage of material in digital and - even if it seems obsolete in modern times - analogue form. If software solutions are not available on the market and have to be developed, particular attention should be paid to use systems that provide simple and barrier-free interfaces in order to produce a holistic application for the citizens: low-threshold solutions are required. In addition, the solutions should be easy to maintain and be able to operate without knowledge in software development for the municipalities. Still, established software or general technological solutions are in the need of care. It is recommended to appoint a responsible person in the community to deal with this issues, which is sometimes a problem in small municipalities due to limited staff.

5   Summary

This paper is about the research approaches in the project "Digitales Dorf Bayern" in order to determine which digital solutions can be used to make living conditions in rural areas more attractive. The results of the research project highlight the fact that digitalization is not only about technical novelties, such as robotics and artificial intelligence, but in context of everyday life and conquering infrastructural challenges especially in rural areas, it is about the people: About citizens that are affected by specific challenges and, as a consequence, the resulting digitalization measures. Living lab results show that interaction with the citizens throughout the entire process is crucial to a successful implementation. Mayors are mostly not aware about the unconditional meaning of the citizens' dialogue and therefore appreciate the projects strategy. To generate ideas, one should ask for the challenges the watched area and its inhabitants are faced, not for their "digitalization wishes". It's very important to consider the individual digitalization level which differs among urban and rural areas, and inside these groups, too. Not only people are individual, but also rural areas in terms that they have all their special initial situation, challenges and needs. The government should support rural areas not only with workforce, but also with sufficient infrastructure (e.g. broadband rollout, mobile phone network) and funding not only to create the basic requirements for digitalization, but also to develop digitalization measures and then to maintain them. To gain real benefit for

citizens, the project members should strive for connecting them across various spheres of life and with analogue infrastructure.

References

Allianz pro Schiene e.V. (2019). Schweinfurt bei Bahn und Bus auf Platz eins. Allianz pro Schiene. Retrieved February 06, 2020, from https://www.allianz-pro-schiene.de/presse/pressemitteilungen/schweinfurt-bei-bahn-und-bus-auf-platz-eins/

StMWi - Bayerisches Staatsministerium für Wirtschaft, Landesentwicklung und Energie (2019). Digitales Dorf Bayern. Bayerisches Staatsministerium für Wirtschaft, Landesentwicklung und Energie. Retrieved February 06, 2020, from https://www.stmwi.bayern.de/fileadmin/user_upload/stmwi/Publikationen/Themenblaetter/2019-01-17_Themenblatt_Digitales_Dorf.pdf

Bertelsmann Stiftung (2015). Ärztedichte Neue Bedarfsplanung geht am Bedarf vorbei. Bertelsmann Stiftung. Retrieved February 06, 2020, https://www.bertelsmann-stiftung.de/fileadmin/files/BSt/Publikationen/GrauePublikationen/Spotlight_Gesundheit_Thema_Aerztedichte_03-2015.pdf

Bundesamt für Kartographie und Geodäsie (2016). Breitbandmessung - Kartenansicht Funkloch. Bundesamt für Kartographie und Geodäsie. Retrieved February 06, 2020, from https://breitbandmessung.de/kartenansicht-funkloch

Bundesministerium für Verkehr und Digitale Infrastruktur (2018). Von der digitalen in die Gigabitgesellschaft. Bundesministerium für Verkehr und Digitale Infrastruktur. Retrieved February 6, 2020, from https://www.bmvi.de/SharedDocs/DE/Dossier/Breitbandausbau/topthema01-bundesfoerderprogramm-zum-breitbandausbau.html

Burstedde, A., & Werner, D. (2019). Von Abwanderung betroffene Arbeitsmärkte stärken. Institut der Deutschen Wirtschaft. Retrieved February 06, 2020, from https://www.iwkoeln.de/fileadmin/user_upload/Studien/Report/PDF/2019/IW-Report_2019_Binnenwanderung.pdf

Deutscher Städtetag (2019). Gemeinden nach Ländern und Gemeindegrößenklassen am 01.01.2019. Deutscher Städtetag. Retrieved February 06, 2020, from http://www.staedtetag.de/imperia/md/content/dst/extranet/16_statistik/gemeinden_nach_laendern_gemeindegroessenklassen_2019.pdf

Deutscher Bundestag (2018). Bildung in der digitalen Welt Strategie der Kultusministerkonferenz. Deutscher Bundestag Ausschuss f. Bildung, Forschung u. Technikfolgenabschätzung. Retrieved February 06, 2020, from https://www.bundestag.de/resource/blob/573130/dc077848746f559f19b7735856e158a0/Vorlage_ADrs-19-18-34-data.pdf

Gartner Inc. (2020a) Digitisation. Gartner Glossary. Retrieved February 06, 2020, from https://www.gartner.com/en/information-technology/glossary/digitisation

Gartner Inc. (2020b) Digitalization. Gartner Glossary. Retrieved February 06, 2020, from https://www.gartner.com/en/information-technology/glossary/digitalization

IHK Niederbayern. (2017). Pendlerströme 2017: Mobilität in der Arbeitswelt, IHK Niederbayern. Retrieved February 06, 2020, from https://www.ihk-niederbayern.de/share/flipping-book/3842646/flippingbook.pdf

Initiative D21 e.V. (2019). D21-Digital-Index 2018/2019: Jährliches Lagebild zur Digitalen Gesellschaft. D21-Digital-Index. Initiative D21.

Maier, J. (2008). Definitorische Abgrenzung peripherer ländlicher Räume und inhaltliche bzw. regionale Auswahl der Beiträge. In J. Maier (Hrsg.), Ziele und Strategien einer aktuellen Politik für

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periphere ländliche Räume in Bayern: Entwicklungsperspektiven ländlicher Räume, Teil 1. Hannover: Verl. d. ARL.

Magel, H. (2007), Dorferneuerung 2020. Zukunftskonzeption und -strategien der Dorferneuerung in Bayern. Teil 1- Das Dorf im Wandel der Zeit. Forschungsauftrag des Bereichs Zentrale Aufgaben der Verwaltung für Ländliche Entwicklung Bayern, München.

Statistisches Bundesamt (2020). Bevölkerungsstand. Statistisches Bundesamt. Retrieved February 06, 2020, from
https://www.destatis.de/DE/Themen/Gesellschaft-
Umwelt/Bevoelkerung/Bevoelkerungsstand/Tabellen/zensus-geschlecht-
staatsangehoerigkeit-2019.html

Steele, C. (2019). What is the Digital Divide?. Digital Divide Council. Retrieved February 06, 2020, from http://www.digitaldividecouncil.com/what-is-the-digital-divide/

Stentzel, U., Piegsa, J., Fredrich, D., Hoffmann, W., & van den Berg, N. (2016). Accessibility of general practitioners and selected specialist physicians by car and by public transport in a rural region of Germany. BMC Health Services Research, 16 (1), 587.

Wiechmann, T. & Terfrüchte, T. (2017). Smart Country regional gedacht – Teilräumliche Analysen für digitale Strategien in Deutschland. Bertelsmann Stiftung. Retrieved February 06, 2020, from https://www.bertelsmann-
stiftung.de/fileadmin/files/Projekte/Smart_Country/SCRegional_Juni2017_final.pdf