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RESEARCH PAPER

Do Not Forget About Smart Towns

How to Bring Customized Digital Innovation to Rural Areas

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Abstract To date, research on smart cities has primarily focused on urban congested areas. As this paper points out, it is becoming ever more important to look at intermediate and thinly populated regions like towns and rural areas as arenas for digital innovation. By following a multi-phase research process, the authors examine towns' highly individual needs in an exploratory way, derive key aspects from recent literature that can serve to mitigate or solve their problems, and present an open innovation process by way of integrating local context factors, local stakeholders, and suitable information and communication technology solutions. The objective is to develop a first digital innovation approach in a field that has so far been scarcely considered. The authors conduct a case study, which demonstrates the applicability and effectiveness of their innovation approach in a small town in southern Germany and derive first important lessons learned. Thereby, the concept of an innovation ecosystem reveals a promising solution to face the challenges of the investigated town.

Keywords Digitalization · Open innovation · Open innovation framework · Innovation ecosystem · Rural areas · Smart city · Smart town

1 Motivation

In a world of ever-changing (corporate) environments, disruptive digital technologies, and highly diverse citizen needs, the concept of smart cities has become a broadly discussed subject (Hollands 2008). In general, smart cities are deemed to be a promising answer to urban challenges of the 21st century, such as air pollution, immigration, and socio-demographic problems (Klein et al. 2017). The penetration of smart cities by digital technologies affords this generation the unprecedented chance to fundamentally reorganize urban infrastructures, be it transportation or food and water supply, in much smarter ways (Ramaswami et al. 2016). Accordingly, the use of modern information and communication technologies (ICTs) fosters the exchange and connectedness of people, which can provide manifold opportunities for innovative business models (Schaffers et al. 2011).

According to the statistical office of the European Union, urban areas can be depicted by the so-called degree of urbanization (DEGURBA) dividing urban areas into cities (densely populated areas), towns and suburbs (intermediate density areas), and rural areas (thinly populated areas) (Eurostat 2017). So far, research on smart cities and smart solutions has predominantly focused on densely populated areas, leaving towns, suburbs, and rural areas behind. Roberts et al. (2017, p. 372) point out that "digital technology remains a niche topic in rural studies".

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Furthermore, research on rural areas and development takes a strong agricultural focus and hardly considers digital technologies from an overall community and business perspective (Roberts et al. 2017). Low research and development levels in predominantly rural areas (Tödtling and Trippl 2005) aggravate this problem although digital technologies and smart solutions might provide promising solutions for future developments of towns (Roberts et al. 2017).

Nonetheless, recent literature even highlights the paramount importance of smart strategies and innovation in rural areas (Provenzano et al. 2016). This new focus on the social periphery is becoming increasingly important, for instance, a significant proportion of the European Union's population lives in thinly populated areas (in the following referred to as towns). According to the DEGURBA, 28% of the European residents live in such thinly populated areas (Eurostat 2017). As Porter et al. (2004) state, these towns have enormous economic potential, though the gap between thinly and densely populated areas is widening. Further studies have revealed that the recent success of populist candidates in democratic elections can at least in part be attributed to determinants such as economic distress (Rothwell and Diego-Rosell 2016; Monnat 2016), as there is a measurable relationship between personal economic well-being and election outcomes (Glasgow and Weber 2005).

Of course, towns require innovation to make use of the potential of digitalization. Yet much like cities, towns are also facing a complex range of locally specific challenges predicated on their diverse characteristics like geographic, economic, social, and ecological conditions. Neirotti et al. (2014) summarize such variables as local context factors that are crucial for the development of all kinds of urban areas. However, solutions based on innovative digital technologies are discussed in the broad context of smart cities, which is to say they do not necessarily fit the requirements of towns as well. Hess et al. (2015) argue that towns, when compared to smart cities, have their own future challenges as, for instance, they are not equipped with a wide availability of infrastructure services which brings along individual challenges to different application domains like logistics, mobility, or education, therefore the context has to be understood. Furthermore, in contrast to towns, cities exhibit more complex structures in terms of the numbers of different stakeholders from various domains which have to be involved in smart projects (Nam and Pardo 2011). But then again, cities can better profit from economies of scale and manifold opportunities for business models by the connectedness of many participants and stakeholders (Schaffers et al. 2011), while towns are characterized by smaller sizes and sparser populations.

Similar to activity- and context-based design (Gay and Hembrooke 2004), it is important for towns to understand in which way a certain digital technology should be applied in order to act "smart". Analogous to designers who should not start with a preconceived idea of what users should do (Gay and Hembrooke 2004), but rather have to first obtain a precise understanding about what users actually do, smart town "designers" must grasp how relevant stakeholders and context matter, and how technology could be used rather than pushing and enforcing the "smart" dimension on it (Bélissent 2010).

A further challenge is that, especially in towns and rural development, it is common practice to follow and operate a "one-size-fits-all" technological solution approach – although local-specific requirements are highly required – which is why such solutions often fail when they are applied to rural areas with different properties (Roberts et al. 2017; Stratigea 2011; Tödtling and Trippl 2005). As rural development and regions are at disadvantage when it comes to competitive positioning in the new era and digital age (Stratigea 2011), a more "integrated approach that helps them find the usefulness of such technologies for their individual purposes" is required (Roberts et al. 2017, p. 381). In this regard, there is a need for improvements and extensions in the way information systems are applied in order to yield more successful and predictable innovation outcomes in towns, which is why this paper addresses the following research questions:

RQ 1	How should an innovation process be designed for smart towns to better leverage the potential of digitalization?
RQ 2	To adhere to the individual needs of smart towns, can information systems themselves enable town-specific innovations?

The extant literature provides a multitude of ideas on how to design innovation processes in general, and recent research has indicated that open innovation is an effective and efficient way to meet demands of smart cities (Paskaleva 2011). So far, however, no attempt has been made to examine how open innovation approaches could be applied in the field of smart towns. On this understanding, we carry out an exploratory study and draw on open innovation as a promising strategy for towns. Yet, since towns often do not have sufficient resources to apply green-field approaches, we develop a generic innovation process that can serve as a "one-size-fits-all" solution approach and can still allow for developing context-tailored digital innovations to meet challenges of the 21st century.

Throughout this paper, we adopt a problem solving perspective (Nickerson and Zenger 2004) to answer the above questions. More specifically, we follow a multi-phase research process inspired by design science research

(Hevner 2007; Hevner et al. 2004) that consists of three phases. We identify the relevant problem by analyzing the state of the art in Sect. 2 and introduce our research method in Sect. 3. In Sect. 4.1, we identify justificatory knowledge of "problem-adjusting factors" in previous scientific work on the subject. In Sect. 4.2, we develop an innovation process that can stimulate digital innovation in smart towns. Finally, in Sect. 5, we apply the process to a small town in southern Germany and derive first important lessons learned in the field of smart towns. Finally, we conclude the study in Sect. 6 by summarizing key results and limitations, which indicate implications for future research.

2 Smart Cities and Smart Rural Areas

Smart city research can be regarded as an umbrella term that covers divergent trends with respect to (information-related) city research (Barth et al. 2017). There is a plethora of various definitions of the term "smart city" and there is no common understanding of what a smart city actually is. Barth et al. (2017) argue that by focusing on specific facets of smart city research, prior research has led to important, but isolated and scattered pockets of understanding the whole (interdisciplinary) story. To better comprehens and integrate these pockets, we draw on recent studies such as Neirotti et al. (2014) and Albino et al. (2015) that provide literature reviews on smart cities as a starting point to gain a resilient knowledge base of smart cities.

The label smart city first occurred back in the 1990s, when it carried strong technical connotations, as it denoted the application of new ICT to cities. Yet, over the years, personal and communal needs have come to the fore, so ICT have been applied with the objective to improve urban systems and thus quality of life (O'Grady and O'Hare 2012; Batty et al. 2012; Albino et al. 2015). The term "smart city" has since been synonymous with "intelligent city" or "digital city", but as a result of such loose wording, Albino et al. (2015) find that ideas relating to smart cities are applied not only to "hard" domains (e.g., mobility, energy grids) but also to "soft" domains (e.g., education, policy innovations). Here, we use the term as defined by Giffinger et al. (2007, p. 11) who state that a smart city is "a city well performing in a forward-looking way in economy, people, governance, mobility, environment, and living, built on the smart combination of endowments and activities of self-decisive, independent and aware citizens. Smart city generally refers to the search and identification of intelligent solutions, which allow modern cities to enhance the quality of the services provided to citizens." In accordance with this definition, a socio-technical view on smart cities is required (Nam and Pardo 2011) to solve various challenges and problems encountered in modern cities. The extant literature on this issue therefore focuses on such well-known problems as air and water pollution, energy efficiency, public transportation and mobility, as well as unemployment (Nam and Pardo 2011). Going forward, however, there is a need for "initiatives and strategies that create the physical-digital environment of smart cities, actualizing useful applications and e-services, and assuring the long-term sustainability of smart cities through viable business models" (Schaffers et al. 2011).

Importantly, politics and research must not only consider the challenges and problems of smart cities on the large scale. According to the DEGURBA, one-fifth of the German population lives in thinly populated areas. This corresponds to a total of 17 million people (Eurostat 2017). A broad range of public (research) projects has illustrated the importance of digital innovations in regions where residents are spatially more dispersed. Exemplary research projects include "Smart Rural Areas" (Hess et al. 2015) or the Living Lab initiatives (Schaffers et al. 2011). It is worth noting, though, that rural areas differ from cities with regard to their specific characteristics, challenges, and problems. These comprise (but are not limited to) significantly reduced amounts of research and development, as well as the consequent grievances of little to no innovation, poorly developed industries, missing knowledge carriers, and hardly any assistance for innovation by administrations (Tödtling and Trippl 2005). Furthermore, when having a look at digital policy agenda, rural areas tend to be more "passive and static, set in contrast to the mobility of urban, technological and globalization processes" (Roberts et al. 2017, p. 372). Various "domains like telecommuting, health-services, logistics, mobility, farming, commerce, or education" (Hess et al. 2015, p. 164) are bedeviled by such issues. Thus, our definition of a smart town refers to Giffinger et al. (2007) as a town or rural area that is intermediate or thinly populated, but nonetheless provides appropriate and future-oriented ICT solutions to improve various domains regarding economy, people, governance, mobility, environment, or living.

There is, then, a manifest need for innovation in the interest of social as well as commercial benefit. Yet the range of solutions presented in recent discussion on smart cities is rather generic. Most of the contributions are limited to a high level of abstraction (cf. Khan et al. 2012) or offer mutually exclusive solutions (Zanella et al. 2014; D'Asaro et al. 2017), due to the great diversity of local characteristics. As a result of this, frameworks that provide clear guidance to identifying context-tailored innovations are missing, because the characteristics of cities are too individual, and even more so those of towns. This means that local administrations and governments have to activate

"cities and urban areas as well as rural and regional environments as agents for change and as environments of 'democratic innovation'" (Schaffers et al. 2011, p. 432; von Hippel 2005).

To summarize, smart towns must offer intelligent solutions to the challenges of contemporary urban and rural life, solutions that improve the quality of their citizens' life as well as the town's economic viability. Thus, it is not sufficient to apply modern ICT to towns to make them smart. Efforts must be extended to the improvement of a given town's capability to attract and advance its own innovation potential.

3 Research Method

To tackle the above issues, we adopt a problem solving perspective (Nickerson and Zenger 2004). We take the problems and challenges of smart towns as the basic unit of our analysis. In line with Nickerson and Zenger (2004), as well as Felin and Zenger (2014), we argue that a reasonable method of solution can be determined by understanding and scrutinizing a problem's complexity. We therefore follow a multi-phase research process (Fig. 1) inspired by design science research (Hevner 2007; Hevner et al. 2004). It consists of three phases: (I) we consider justificatory knowledge of our problem domain and encounter "problem-adjusting factors" within the current scientific work on the subject, (II) we develop an innovation process to derive a suitable solution following an exploratory search process, and (III) we evaluate the applicability and effectiveness of the resulting innovation process by applying it to a small town.

In a preceding step, we already demonstrated the relevance of our work (Sect. 1), following Hevner (2007), as valuable research "often begins by identifying and representing opportunities and problems in an actual application environment". By analyzing the situation in a small town in southern Germany, we discovered initial indications for our hypothesis that there is a need for digital solutions which stimulate innovation in smart towns. However, so far the literature on this subject has not provided an appropriate process on how to cope with challenges in smart towns that are highly individual due to local context factors (Neirotti et al. 2014). Thus, we apply a suitable multi-phase research method to gain first promising and valuable insights to digital innovations in towns.

In a first phase (Sect. 4.1), we gain justificatory knowledge of the problem domain from scientific literature that provides foundation for our research (Hevner 2007). For identifying problem-adjusting factors, we draw on literature reviews of smart cities and rural areas and their current challenges to derive three core items that have to be well accounted for in order to ensure sustainable smart solutions.

In the second phase (Sect. 4.2), we follow Hevner et al. (2004) who recommend "design as a search process". We develop a suitable innovation process. By way of reviewing literature, the innovation process is carved out and enhanced so that it is applicable by local administration and institutions. To this end, however, the process must be pragmatic and prevent these administrations from repeating common, well-known mistakes. On the basis of this

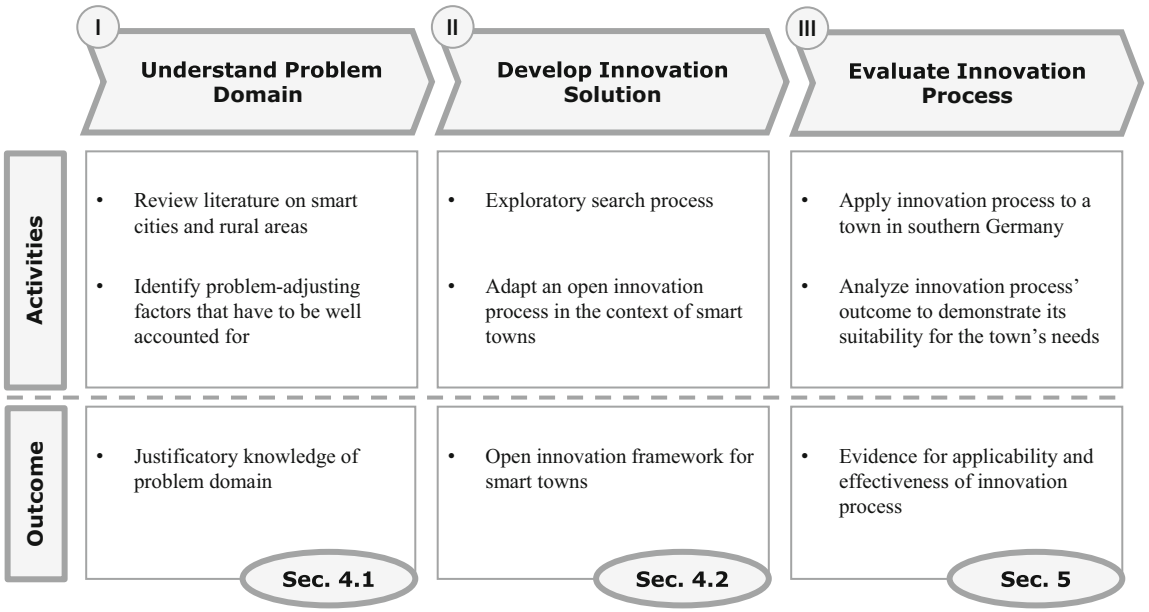

Fig. 1 Multi-phase research process with three phases (sec refer to the paper's sections)

justificatory knowledge, we develop and refine our open innovation process. In doing so, we further discuss how to design an appropriate solution that enables digital innovation and contributes in transforming towns toward smart towns.

In the third and last research phase (Sect. 5), we demonstrate the applicability and effectiveness of our innovation process. Referring to Hevner et al. (2004, p. 75), we argue that "knowledge and understanding of a problem domain and its solution are achieved in the building and application of the designed artifact". Since "the goal of design science research is utility" (Hevner et al. 2004, p. 80), our focus lies in demonstrating the applicability and utility of our artifact, i.e., the innovation process. Therefore, we evaluate our artifact in accordance with Venable et al. (2012) by use of a case study. What makes this evaluation suitable is the fact that the major risk is user-oriented. After all, it is a vital goal that our process is beneficial in real situations (Venable et al. 2016). Since we have access to real users, a real problem, and a real system (Venable et al. 2012), we apply our innovation process prototypically to a small town and demonstrate its effectiveness in a real situation and for the benefit of heterogeneous groups of stakeholders.

4 Solution Development

4.1 Problem-Adjusting Factors

In the following, we elaborate on the main problems and challenges that need to be considered when implementing smart solutions in towns, among them mainly the importance of considering local context factors, ensuring local stakeholders' involvement as well as gathering solution information and identifying and aligning suitable ICT solutions. Research regarding (smart) towns in the digital age is yet in an early stage and rather immature as "digital technology remains a niche topic in rural studies" (Roberts et al. 2017, p. 372). Therefore we primarily infer from literature on smart cities which challenges occur when ensuring sustainable smart solutions, and why they become all the more relevant with respect to towns. This does not imply that these factors are of no importance in smart cities but rather that they may require higher attention in smart town settings.

4.1.1 An Accurate Understanding of the Challenges and Needs of Towns by Understanding Their Context

Smart solutions must begin with the town itself, not with the "smart" aspect, as they must be grounded in the real context of a town (Bélissent 2010). Cities and towns come in different shapes and sizes and thus reveal different innovation characteristics.

Research on smart cities posits that generic smart city concepts are so far not sensitive to the local context of a city (Zygiaris 2013). Within an empirical analysis of 70 cities, Neirotti et al. (2014) investigate the role of various context variables (e.g., economic, urban, demographic, and geographical variables) and their impact on the development of a smart city. They reveal that the evolution of smart cities largely depends on its local context factors. Similarly, Barca et al. (2012) highlight the importance of more place-based approaches for regional development, rather than place-neutral approaches, meaning that context – in terms of social, cultural, and institutional characteristics – really matters. Therefore, smart cities should be analyzed from a contextualized interplay perspective (Nam and Pardo 2011). Cities require better guidance on how to best grasp relevant context factors, determine the most appropriate domains of actions, and subsequently define a suitable smart city strategy (Neirotti et al. 2014). Other empirical studies have likewise shown that different types of cities and regions reveal different preconditions for innovation activities and processes. The specific strengths and weaknesses in terms of their economy and innovation potential, however, are all too often not taken into account sufficiently. There is no "one-size-fits-all" approach without consideration of the context (Tödtling and Trippl 2005). Certainly, gaining the right context knowledge and identifying the relevant needs are important first steps, but this alone is not sufficient. Smart cities have to be able to set smart priorities in terms of domains of actions, priorities that are in line with the city's overall development plan and innovative outlook (Zygiaris 2013; Schaffers et al. 2011).

Hence, we argue that, while understanding the context of smart cities already constitutes a major challenge when implementing smart solutions, this becomes even more relevant and difficult when addressing smart towns. The digital development of smart towns by means of applied innovation depends, to a large extent, on its local context factors, e.g., economy, geographical variables, or density of population, and other specific impact factors (Neirotti et al. 2014). Towns therefore require stronger guidance on grasping relevant context factors and defining appropriate smart strategies.

4.1.2 Ensuring Stakeholders' Involvement and Establishing an Innovation Community

Cities and towns are entities that can be regarded as an overarching system of stakeholders (Bélissent 2010), while the "citizens and communities are the human engine" (Zygiaris 2013, p. 221). Such entities must ensure the

ability to engage constructively with relevant local stakeholders, while also ensuring community participation (Zygiaris 2013). Within an innovation process it is important to understand roles and the dependencies of involved stakeholders as they constitute a critical factor in smart projects and smart city development (Pierce and Andersson 2017; Stahlbröst et al. 2015). Furthermore, there is a clear need for leadership in terms of orchestrating and monitoring the entire innovation and smart city solution process (Zygiaris 2013). The existence of various stakeholders with competing interests can lead to cancellation of smart projects (Bélissent 2010). Cities, as well as towns, must therefore facilitate a smart vision in holistic terms – specific operations and processes within a city must be synchronized and aligned to its smart vision so as to meet the identified challenges in its given context (Zygiaris 2013). Here, different aspects of collaboration need to be considered (Schaffers et al. 2011). On the one hand, an innovation process for coming up with smart solutions should allow an "ongoing interaction between research, technology and applications development and validation and utilization in practice" (Schaffers et al. 2011, p. 441). On the other hand, it is important to nurture a collaborative approach to foster an innovation ecosystem that is "based on sustainable partnerships among the main stakeholders from business, research, policy and citizen groups" (Schaffers et al. 2011, p. 443). Thus, an integrated approach that connects various facets of a given community becomes even more important (Nam and Pardo 2011). In order to prevent poor innovation results, it is of key importance to identify the relevant stakeholders and the right extent of their incorporation as well as how to establish meaningful collaborations between decision-makers and other actors in smart initiatives (Pierce and Andersson 2017; Tödtling and Trippl 2005). Similarly, Barca et al. (2012) point out that policies should not only be place-based but also people-based, if it is the intention to foster innovative ideas through the interaction of endogenous and exogenous actors and thus to foster the improvement of regional development efforts.

In conclusion, neither a smart city nor a smart town should be considered solely as an object of innovation, but rather as an "innovation ecosystem empowering the collective intelligence and co-creation capabilities of user/citizen communities" (Schaffers et al. 2011, p. 432). Active involvement from various domains is essential and should be ensured so as to achieve synergy effects (Nam and Pardo 2011). However, with respect to stakeholder involvement, towns have an advantage over cities as they are characterized by smaller sizes, sparser populations, and more interlinked relations between citizens and communities. Respectively, cities with more complex structures, in terms of the number of different stakeholders (and their interdependencies) to be managed, might require different approaches to ensure the involvement of a plethora of relevant stakeholders (Nam and Pardo 2011).

4.1.3 Gathering Solution Information and Identifying Smart Solutions

In general, any smart city concept depends on the correct and meaningful application of ICT and digital technologies to city life (Bélissent 2010; Nam and Pardo 2011). The same applies for smart towns. Each technological innovation is an important means to such a smart entity, but not an end in itself (Nam and Pardo 2011). Once the context of the city or town with its individual characteristics, strengths, and weaknesses has been scrutinized and understood, the "smart" dimension becomes key to problem-solving and smart solutions. In this regard, digital technologies and IT infrastructures can be seen as important prerequisites, but, without acute engagement and collaboration of relevant stakeholders, there is no smartness (Nam and Pardo 2011). The common gap and mismatch between technology orientation and actual needs of cities constitutes a major challenge of smart cities (Schaffers et al. 2011). Despite the diverse and individual challenges of cities, smart city solutions emerge rather from a vendor push than a city pull perspective (Bélissent 2010). Tech vendors are pushing their technologies into cities and the public sector, although "for smart city initiatives to be sustainable opportunities, tech vendors must ground their strategies and solutions in the context of the cities and the systems within them" (Bélissent 2010, p. 20). The challenge, then, is to recognize the needs and underlying service provisions. Based on these opportunities, smart solutions of tech vendors have to be aligned with the overall goals and initiatives of smart cities (Bélissent 2010). Nam and Pardo (2011) point out that smart cities can be regarded as a large organic system, which is to say that smart systems and solutions should not operate in isolation but rather as an "organic whole – as a network, as a linked system" in order to make the emerging systems smarter (Nam and Pardo 2011, p. 284). Sustainable smart initiatives call for smart ecosystems that illustrate a smart town as a large organic system. IT should thus facilitate the establishment of new types of innovative environments.

Hence, we argue that with a view to cities and towns, the pure application of scattered digital technologies and partially considered smart solutions does not suffice. Smart towns have to be able to evaluate and monitor the potential benefits of such partial solutions with regard to the bigger picture. The challenge is to assess smart ideas and technologies and to understand which ideas may prove to be most effective in terms of fulfilling the needs of citizens, users or other stakeholders. A smart policy, then, must be

designed to provide decision support and reduce uncertainties (Anttiroiko et al. 2014). The use of smart solutions can provide manifold opportunities for business models by fostering the exchange and connectedness of many participants and stakeholders (Schaffers et al. 2011). However, as the extent of participants and stakeholders in towns, when compared to cities, is generally more restricted, towns are at disadvantage with respect to economies of scale and when making business cases for digital solutions - may it be to citizens, the local government, or local businesses. This problem gets aggravated as towns are confronted with generally low research and development levels making it harder to establish and push smart solutions (Tödtling and Trippl 2005). As rural literature so far takes a strong agricultural focus with respect to digital technologies – although there is promising potential from an overall community and business perspective in towns – this constitutes a major challenge to overcome (Roberts et al. 2017).

4.2 Innovation Process

In the following, we will elaborate on how an innovation process can be designed in order to better leverage the potential of digitalization in smart towns. We thereby include literature on smart cities and transfer findings to towns where reasonable. We draw on the three aforementioned problem-adjusting factors: considering local context factors, ensuring local stakeholders' involvement as well as gathering solution information, and identifying smart solutions. We show how elements from the open innovation paradigm can bring these factors together and provide a suitable solution for smart towns.

4.2.1 Open Innovation in the Context of Smart Towns

Open innovation is an innovation approach that has its origins in industrial innovation management and has become an essential paradigm of innovation management at large. The term "open innovation" was coined by Chesbrough (2006, p. 2) and defined as "the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the market for external use of innovation, respectively". As opposed to traditional innovation management, which has a strong in-house focus, companies that favor open innovation can tap into external sources of ideas to develop new innovative products and services (King and Lakhani 2013). To gain a better understanding of how multifaceted open innovation truly is, Enkel et al. (2009) has deconstructed open innovation into three categories: the outside-in, inside-out, and coupled process.

The outside-in process refers to the use of external knowledge to obtain new sources for innovative ideas. Different innovation practices – such as the integration of customers, customer communities, research institutions, or suppliers – can be applied here in order to increase a company's innovativeness (Chesbrough et al. 2006). In contrast, the inside-out process of open innovation denotes the external exploitation of a company's unused or underused technologies and ideas, e.g., by leveraging these in new markets (cross-industry innovation) (Enkel et al. 2009; Enkel and Heil 2014). The third process, known as the coupled process, comprises collaborative and co-creative activities among different stakeholders and innovation parties in order to jointly leverage innovation, e.g., by the means of collaborative networks or innovation communities (Enkel et al. 2009; West and Bogers 2014). The core processes represent different elements of an open innovation strategy that can vary depending on the concerns of each company.

We argue that, similar to organizations which have to pursue a more open strategy to utilize innovation communities and ecosystems for achieving competitive advantage (Chesbrough and Appleyard 2007; Rohrbeck et al. 2009), smart towns should likewise follow a new and more open approach to increase innovativeness and bring digital innovation to their stakeholders. There have been first attempts to apply the concept of open innovation to the public sector and smart city research (Hilgers and Ihl 2010; Paskaleva 2011; Schaffers et al. 2011). We draw on the seminal work of Enkel et al. (2009) and focus on the different types of open innovation, namely the coupled, outside-in, and the inside-out process. By doing so we aim to better understand and examine how the different elements of open innovation could be used as a means of increasing innovativeness and to provide guidance when identifying digital innovations in the context of smart towns.

4.2.2 Coupled Process

When it comes to industrial innovation management, it is crucial that a company is able to select suitable innovation partners with the maximum potential to (co-) create value (Emden et al. 2006). The same applies for smart towns. Whereas companies must be able to develop a specific partner relationship in which they can carefully select external innovation partners in possession of the relevant knowledge (Hosseini et al. 2017), towns have to be able to constructively engage with relevant local stakeholders and ensure community participation (Zygiaris 2013). To jointly leverage innovation, it is essential that towns develop a collaborative approach towards an innovation ecosystem based on sustainable partnerships among relevant stakeholders (Schaffers et al. 2011). Here, the coupled process

of open innovation can help to provide an integrated approach and facilitate connectedness as well as knowledge exchange within communities (Nam and Pardo 2011). Smart towns should involve citizens and other local stakeholders as valuable input sources and innovation actors in order to understand the town's unique context and needs, and to subsequently evaluate and derive smart solutions and strategies. As elaborated in Sect. 4.1, it is of vital importance that smart towns ensure the stakeholders' involvement and the establishment of an innovation community. By ensuring active involvement from various domains of the town, the coupled process can allow the town to act as an overarching system of stakeholders and achieve essential synergy effects among these (Nam and Pardo 2011; Bélissent 2010). By integrating relevant stakeholders into the innovation process, this generally allows them to consider people's (tacit) knowledge regarding need information (Haller et al. 2011; von Hippel 2005). In this context, such need information may refer to all types of information regarding preferences, wishes or satisfaction factors of a town's stakeholders.

4.2.3 *Outside-in Process*

The outside-in process of open innovation generally creates an opportunity to generate and identify external ideas and technologies that might lead to increased innovativeness. Just as companies require open innovation decision-making capabilities and clearly defined roles and responsibilities in order to ensure well-defined procedures in the compilation of open innovation teams (Hosseini et al. 2017), smart towns require similar capabilities. Such measures can prevent the so called 'absorptive capacity problem' (the notion that there are so many ideas that one struggles to manage and select between them) and 'attention allocation problem' (the problem that ideas are not seriously taken into account or considered for implementation due to a surfeit of ideas) (Laursen and Salter 2006; Hosseini et al. 2017). In smart towns, there is an equivalent requirement for leadership in terms of orchestrating and monitoring the open innovation and smart solution process (Zygiaris 2013). King and Lakhani (2013) demonstrate how open innovation can be used for both generating and identifying well-suited ideas. By doing so, a smart town can seize valuable solution information which describes (technological) possibilities of how to best address the respective 'customer' needs in an effective and efficient manner and thus reduce failure rates and uncertainties (Haller et al. 2011; von Hippel 2005). Therefore, the outside-in process of open innovation can serve a smart town in identifying smart solutions and indicating how these solutions need to be aligned with the special requirements of a given town as established by way of the coupled process. By then combining these two elements, smart towns can prevent the common gap between the applied technologies on the one side and the actual needs of towns on the other side. After all, sustainable smart solutions should not emerge from a pure vendor push but rather from a pull perspective driven by the actual needs and requirements of the given city or town (Bélissent 2010).

4.2.4 *Inside-out Process*

The inside-out process of open innovation stems from – and has primarily been applied to – more basic research-driven companies such as IBM that try to transfer ideas to the market or sell and license knowledge and technology to the external environment (Enkel et al. 2009). In this sense, open innovation can be used to extend the market for external use of innovation (Chesbrough 2006). More and more companies are trying to improve their innovation performance and enter into new business fields by engaging in open innovation ecosystems. From a company perspective, an innovation ecosystem should be enlarged by including decentralized business units and other external stakeholders from various fields to increase overall innovativeness (Rohrbeck et al. 2009). When this rationale is applied to smart towns, the question arises how they can ensure market expansion and make better use of it for innovation. Efforts must be extended to the improvement of a given town's capability to attract and advance its own innovation potential. It is substantial for local stakeholders who want to bring digital innovation to towns, such as local administrations, to have profound knowledge about ICT solutions. The town itself does not necessarily have to be the initiator of all the innovations, but can provide a general set-up that serves as the basis for further external innovation – a notion which is in line with Schaffers et al. (2011) calling on local administrations and governments of rural and regional environments to provide environments for more democratic innovation. Still, it is a matter of common knowledge that at the same time there is a lack of clear understanding on the potential of digital technologies and solution information in towns and rural areas.

4.2.4.1 Innovation Process Artifact Referring to Hevner et al. (2004), the innovation process depicted in Fig. 2 constitutes our overall artifact. By drawing on primarily two research streams, namely smart city/town and open innovation, challenges and needs are identified from the first (Sect. 4.1), solutions how to address them from the latter (Sect. 4.2). In correspondence to Hevner et al. (2004), the problem-adjusting factors are means to identify the "towns' needs" (equivalent to "business needs" in a corporate context). The problem-adjusting factors are derived from literature and serve as input elements that

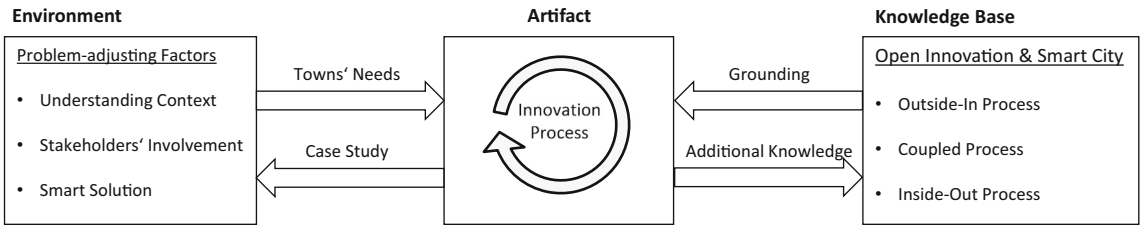

Fig. 2 Innovation process artifact

need to be specified when applying the innovation process in order to identify relevant smart solutions for towns. We also draw on open innovation as our knowledge base to apply and transfer within the context of smart towns. In particular, the outside-in, coupled, and inside-out process of open innovation can be leveraged to address and "operationalize" the problem-adjusting factors.

5 Evaluation

To evaluate the proposed open innovation process, while demonstrating its applicability and effectiveness in a real world context, we conduct an exemplary case study (Venable et al. 2012). A case study methodology fits our declared goal of creating a process that is beneficial in real situations and is especially suitable as the major risk is user-oriented (Venable et al. 2016). Furthermore, we have access to real users, a real problem, and a real system (Venable et al. 2012), which is to say we have a valuable opportunity to assess our process under real world conditions.

5.1 Case Setting

We apply the innovation process to a small town in southern Germany, a town mainly characterized by its strong dependency on tourism. The case study was conducted in the context of a research project within the scope of a national funded research initiative regarding future/smart cities and towns. The case study lasted for 9 months. Afterwards the results of the research project and innovation process were evaluated by an independent expert committee on behalf of the federal ministry of education and research to decide whether the research project should be funded in a second phase to support the town at hand in its transformation towards "smartness" in the digital age.

While the number of inhabitants only amounts to about 5000 people, the town can record up to a million accommodations per year. Tourism is accountable for about 80% of the town's full value creation and the sector offers about 1500 jobs. According to the DEGURBA used by the statistical office of the European Union, the town can be characterized as a rural area with thinly populated areas (Eurostat 2017) having a strong focus on agriculture and tourism. The town's demographic structure, therefore, is left skewed (Fig. 3). That is, about 45% of the residents are 50 years or older (Bayerisches Landesamt für Statistik 2015).

5.2 Role of the Researchers

During the case study, we as the authors of this article, guided and facilitated the process scientifically to guarantee a course of action compliant with the proposed innovation process in Sect. 4.2. That is, as depicted in Fig. 2, to assist identifying the town's needs with the help of the problem-adjusting factors by drawing on the different open innovation elements. Alongside the coupled, outside-in, and inside-out process several workshops were held. Within the workshops both individual and (cross-functional) group interviews were conducted to discuss the town's (interim) results and problem-adjusting factors. The group interviews were attended by at least one researcher and enabled to consult with different domain experts, citizens, and tourists. These group interviews provided opportunities for interaction and the development of ideas based on the domain experts' expertise and the other respondents' comments. The researchers' role was not to operate or dominate the workshops content-wise but rather to facilitate and ensure that the open innovation elements and innovation process were conducted correctly and all stakeholders participated in the process.

5.3 Coupled Process

As proposed by the innovation process, the first step for successful innovation in smart towns is to understand the specific context of the town in question. It is elementary to engage with relevant stakeholders and ensure communities' participation. In order to achieve connectedness and foster knowledge exchange within the community, we set up an expert panel containing representatives of the community's different sectors. Overall, the expert panel consisted of 12 persons. We aimed to cover diverse roles and responsibilities that are central to the town at hand. When

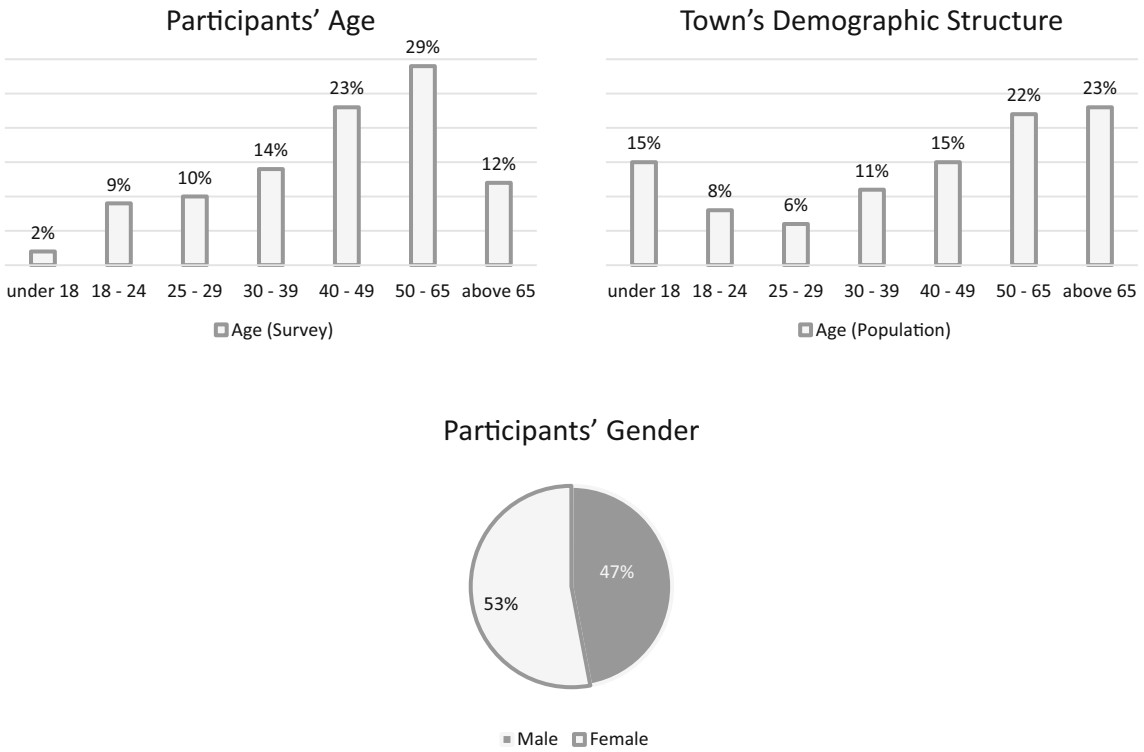

Fig. 3 Participant's characteristics and demographic structure of the town (Bayerisches Landesamt für Statistik 2015)

considering the composition of the expert panel, we took two aspects into consideration: On the one hand, we consulted literature regarding challenges and action fields that are unique to the context of towns (with a touristic focus) (Bundesministerium für Wirtschaft und Energie 2013), and on the other hand, we discussed the respective results and the composition of an expert panel with the town's second mayor and tourism director – under the assumption that they can best pre-assess, which roles and responsibilities to cover for the pre-identified challenges and action fields. Supplementary, the authors were also part of the expert panel to ensure scientific rigor throughout the innovation process. In particular, the expert panel consisted of the second mayor of the town, a councilman, the head of IT administration, the tourism director, the digital online manager, representatives of the food, retail and electricity industry and of the hotel business, as well as consultants who have long-term project experience with the town, and two researchers.

In doing so, we enabled the town to act as an overarching system of stakeholders and to achieve essential synergy effects attributed to the heterogeneous knowledge. This allows to consider people's tacit knowledge regarding need information. By following the lead user approach (von Hippel 1986) and involving lead users in an early phase of innovation projects, better results in cross-functional (innovation) teams can be achieved (Lüthje and Herstatt 2004). As lead users are highly characterized by expertise in their subject area and motivated to make substantial contributions to the development of an innovation (Lüthje and Herstatt 2004), two decisive factors should be taken into account for the selection of the expert panel's members. First, they have to be well accepted and valued for their expertise within their own occupational group. Second, they must have a high affinity to digital technologies, creativity, or at least an openness to new solutions. The right selection of panel members plays a crucial role for successful innovations, as creative innovators are of key importance to smart towns (Nam and Pardo 2011).

To guarantee that intended innovations are in line with the overall plan for the town, the second mayor of the town was also part of the expert panel (Schaffers et al. 2011; Zygiaris 2013). This way, the expert panel can ensure that priorities within the innovation process fit the need information regarding preferences, wishes or satisfaction factors of the exemplary town. The strong integration of and exchanges with the expert panel guarantee a better fit of the results regarding their advantageousness and feasibility within the town's context.

To obtain need information and to move from assumption to analysis and a better understanding of the town's individual demand, a citizen survey was developed. Subsequently, the members of the panel were responsible to ensure participation of respective members of sectors and residents in order to receive representative results. In order

to correctly classify the town's challenges, several context variables were incorporated into the survey. The researchers designed the survey as a questionnaire which contains questions regarding the satisfaction with the town's status quo in different domains of life and retrieves some socio-demographic information (Neirotti et al. 2014). To ensure the coverage of relevant domains of life, insights from different studies on the individual demands and characteristics of rural areas were combined (Schlechtriem et al. 2013; Bundesministerium für Wirtschaft und Energie 2013). The questionnaire was discussed within the expert panel. Feedback was incorporated that helped to further refine the questionnaire to suffice the town's specific context. Here, again, the expert panel provided inside knowledge to further specify the town's individual demands.

As a result, the questionnaire drew on a list of 18 different domains (e.g., mobility, energy supply, quality and quantity of available goods in town, educational offering). Further questions related to the domains in most urgent need of change and the potential of digital technologies to support such change. This is done to pre-evaluate potential fields of action. The questionnaire also recorded the participants' expertise in using digital technologies, so as to evaluate their capabilities to predict starting points for digital solutions. A 5-point Likert-Scale (with 5 denoting the best and 1 the worst degree of agreement with the respective question) is applied to enable a quantitative overall estimation of the status quo and the opportunities for improvement for each domain of life. Additional open questions allowed for a deeper understanding and explanation of the individual demand.

With the assistance of the expert panel, the survey was distributed to ensure wide-spread participation from all walks of local life (from citizens, butchers, bakers, and business people to visitors and tourists) and different ages to account for the town's characteristics. More than 200 participants (n = 212) replied to this survey. 41% of participants are older than 50 years, 56% are between 18 and 49, and 2% are younger than 18 (Fig. 3). Apart from the boundary values (under 18 and above 65), the results were in line with the town's population at large and helped to prioritize the most urgent domains for change (Fig. 3).

When it comes to the satisfaction of the participants with the status quo within the different domains of life, it was highest with regard to inner-town security (mean 4.59), the safety precautions in the nearby mountains (mean 4.45) and the tourist information offerings (mean 4.12). Lowest satisfaction was stated with a view to educational offerings (mean 3.13), entertainment offers (mean 3.23) and the available variety of goods in town (mean 3.30). The biggest potential – from a quantitative perspective – for change using digital technology was seen within the domains of leisure time (mean 3.49), educational offerings (mean 3.47), and mobility (mean 3.45).

Complementary to the survey, several citizen workshops were conducted to discuss and understand the key issues raised in the questionnaire. Within the expert panel we realized that it was quite difficult for the participants to understand the impact digital technologies might contribute to different domains of life. Subsequently, we decided to conduct additional workshops to gain a common understanding and to elaborate on the potential of digitalization. Those workshops were open for all stakeholders, and again the inclusion of the expert panel ensured the participation of at least one person from every stakeholder group. Within our workshops we conducted both individual and (cross-functional) group interviews to discuss our (interim) results. The group interviews allowed for consultation with different domain experts, citizens, and tourists. These group interviews provided opportunities for interaction and the development of ideas based on the results of the citizen survey. All group interviews consisted basically of two parts: The first part addressed the results from the citizen survey that had been prepared and presented by the researchers; in the second part the interviewees discussed the as-is status of the town in order to discuss and derive reasonable implications based on their expertise, research, and expectation about future developments. As a result, strengthening the local retailers was stressed as the domain of upmost importance.

5.4 Outside-in Process

Within the outside-in process of open innovation, we generated and identified external ideas and technologies to increase innovativeness and identify smart solutions for the town. With the specific needs and challenges as well as the regional and economical background of the town in mind, an innovation contest was set up subsequently. The aim of the innovation contest was to gather solution information on how digital technologies can contribute to improve the situation and overcome the town's specific problems. This contest, too, was open to all groups of the community, which ensured that innovative ideas are applicable to the town and improve its ways of dealing with specific challenges. To this end, we provided a form to be filled out with any innovative ideas and handed in either online or offline. The form consisted of two main sections. The first section provided the opportunity to write down the innovative idea, including an extensive description. In the second section, participants were asked to classify their idea according to the domains of life – analogue to the ones from the citizen survey – it supposedly affects. The expert panel orchestrated and monitored the outside-in process, trying to prevent the "absorptive capacity problem" and "attention allocation problem". On completion of the innovation contest, the expert panel examined the submitted ideas and

condensed similar ones. Then, the expert panel classified and prioritized the ideas in accordance with which domain of life are affected by each idea. The evaluation of the citizen survey served as basis for evaluating each single idea regarding its relevance. As a result of this consolidation and classification, 27 ideas constituted the basis for another workshop with citizens and tourists of the town (see Fig. A-1, Appendix; available online via springerlink.com). In order to produce a consensual and broadly accepted innovation plan, we formed a synthesis of need information and solution information together. The results of all parts – citizen survey, workshops, and innovation contest – were extensively discussed with citizens, tourists, and the expert panel. After all, the communication and collaboration between the different sectors of the community was of utmost importance to guarantee customized solutions and thus avoid "poor innovation results". By drawing on the local knowledge of the expert panel including the town's second mayor, we produced an innovation roadmap that fits the town's overall plan.

Specifically, this final workshop considered four domains for improvement of particular importance: first, "improvement of educational and entertainment offers", second, "improvement of mobility offers and barrier liberty", third, "strengthening of tourism", and fourth, "support of local agricultural products and retail stores". In this regard, we matched these overarching action fields with the innovative ideas of the innovation contest. It turned out that many participants have come up with their ideas in the contest with hope of making a positive impact on these four fields of action. An online marketplace for regional agricultural products, for instance, could expand and ensure a more solid customer base to increase sales volume. Furthermore, a breakfast delivery service for bread and sausages that offers the option to order online would enhance the offer of butchers and bakers. Digital terminals built in the town allow for better advertisement of cultural events and thus improve the perception of entertainment offers. Another idea raised in the competition was a smartphone app that guides tourists to available accommodations in line with their individual preferences. Several further ideas promised improvement in one or another action field.

These ideas are admittedly no ground-breaking innovation ideas. However, it is important to take into account the initial situation within the small town. The introduction of such digital solutions is a considerable improvement regarding the starting point and local background of the town. The main challenge is rather how to holistically approach and put the ideas into practice, as the effort required to implement all of those ideas separately would be massive. In this regard, the expert panel agreed that a fundamental ecosystem is missing to enable the identified smart solutions.

5.5 Inside-out Process

The inside-out process of open innovation can help to extend the market for external use of innovation. The results from the coupled and outside-in process have revealed several solutions to meet the specific challenges of the town. However, the realization of each idea in an isolated manner would not be a sustainable approach. Scale effects of an ecosystem would remain unused, and tourists and citizens would have to use a bunch of different applications which is not customer-oriented and does not satisfy the users. Hence, efforts must be extended to the improvement of the town's capability to attract and advance its own innovation potential. A solution is required that can address the most promising ideas in an integrated fashion and at the same time extend the town's environment for further innovation. In this regard, a smart (IS-enabled) innovation ecosystem can provide assistance as it can ensure basic digital infrastructure and allow for new types of innovative environments. It can empower co-creation capabilities of user, citizen communities and encourage other business entities to develop complements (Ceccagnoli et al. 2012; Schaffers et al. 2011). The town can create a fertile ecosystem, so that third party producers (e.g., companies, local stakeholders) can develop complements. The ecosystem approach can enable the town to arrive at a comprising solution, rather than multiple isolated smart solutions, which satisfies its challenges and needs.

An IS-enabled innovation ecosystem approach was discussed as a well-suited solution for the town. A retail expert of the town highlighted that customers often suffer from an information gap regarding the local town offers to meet their individual demand and therefore stated that "[…] a holistic solution must make it possible for customers to easily retrieve all the information required so that they are less likely at risk of being driven away to shops in neighboring cities. We do have many offers that customers need but they are simply unaware of them". As a result, the concept of an IS-enabled innovation ecosystem includes digital infrastructure, well-established standards, guaranteed data interoperability, open interfaces for ecosystem participants, and privacy by design concepts. Furthermore, it provides a multi-channel user interface (e.g., terminals, website, mobile app), which is highly customizable and enables various use-cases for tourists, citizens, administrations, and local companies. New business models can emerge from the interplay between different ecosystem actors such as local hotels, citizens, tourists, and farmers. The tourism director of the town emphasized these findings since "[…] no citizen or tourist is nowadays willing to research separated applications or websites to get an overview of the town's sights, leisure opportunities, shops,

restaurants and accommodations, instead we need one comprising solution that operates like an ecosystem which can be easily extended by new functionalities and offers". Within the expert panel as well as in further citizen workshops, the innovation ecosystem was evaluated positively by all participants and deemed to have been a great help in developing a concept for the town's customized digital solution to its specific demands. For instance, the second mayor saw the solution as particularly promising as "[…] the town center is on the brink of extinction since more and more shops are closing and the situation for local shops downtown is becoming worse and worse.", and new business models enabled by the ecosystem can increase the citizens' and tourists' willingness to buy and therefore the local economic growth.

As the research project was conducted within the scope of a nationally funded research initiative regarding smart cities and towns, the innovation process and results were likewise evaluated by an independent committee (experts with respect to the topic at hand) on behalf of the federal ministry of education and research to decide whether the research project should be funded in a second phase to further conceptualize and operationalize the presented results. Within the evaluation process, the federal ministry of education and research has put not only great emphasis on the achieved results from the town's perspective but also on the generalizability, transferability, and relevance of the results with respect to other towns in Germany. As the research project has received further funding to further operationalize the results, we are confident that the innovation process provides promising insights towards a digital solution. First steps towards this holistic concept have already been implemented within the town.

To conclude, the prototypical application of our innovation process in a small town in southern Germany demonstrates its applicability as well as its effectiveness. We demonstrate how the coupled, outside-in, and inside-out process of open innovation can be used to bring digital innovation to towns. Furthermore, the concept of an IS-enabled innovation ecosystem illustrates the overall performance of our innovation process for the given town.

6 Discussion and Conclusion

It is not sufficient to simply consider the impact of digitalization regarding smart cities, as recent literature has done. Rather, it is crucial to bring intelligent solutions to smart towns that improve the quality of their citizens' lives. However, it is also not enough to apply modern ICT to towns to make them smart. It is thus a major challenge to bring innovation capabilities to towns in order to make use of their digital potential. As illustrated, known solutions for smart cities will not necessarily suit towns, since they have highly individual characteristics and require a specific innovation process to handle various challenges and specific needs. Hence, an innovation process must take into account local context, local stakeholders, and smart solutions as problem-adjusting factors. Smart towns can use an open innovation approach to identify suitable solutions. To demonstrate this, we applied our innovation process to a small town in southern Germany. Results indicate its applicability and effectiveness for the small town and include interesting lessons learned for towns in general. While we exploratory investigated the problem domain, we came across reservations and acceptance hurdles. From this we deduce the need for academic guidance in the field of smart innovations for smart towns. For instance, the town at hand with a strong touristic focus is highly context-sensitive which confirms the need for our problem-adjusting factors. Solely pushing smart technologies from smart city research would not do justice to the unique characteristic of the town. The determination and operationalization of these problem-adjusting factors have turned out to be particularly decisive for grasping the town's individual context. The application of our proposed innovation process shows that an innovation ecosystem can assist the town at hand to better meet their individual needs and context. Furthermore, we can confirm prior literature highlighting that pushing and enforcing common smart solutions are not necessarily valuable in a specific town's context.

Our study entails several theoretical and managerial contributions. From a theoretical perspective, our exploratory research contributes to the body of knowledge regarding smart towns, specifically how to manage innovation processes and bring digital innovation to rural areas. There are, to the best of our knowledge, no frameworks or guidelines that deal with this issue from an innovation and information systems perspective for smart towns. We provide a definition of smart towns, three key problem-adjusting factors, and a blueprint of an innovation process. We illustrate how different elements from open innovation, namely the coupled, outside-in, and inside-out process can be used to bring these factors together and provide better guidance for innovation. Our results support the call of current research that digital technologies are becoming more and more vital to rural areas and therefore the focus should not merely be on traditional agricultural perspectives but rather on broader business and community perspectives (Roberts et al. 2017).

From a managerial perspective, our study provides towns with an innovation framework they should have in mind when engaging in smart solution initiatives. The research project was conducted within the scope of a nationally funded research initiative regarding smart cities

and towns, and received funding to further conceptualize and operationalize the innovation process since its nature provides generalizability and transferability to other towns. Practitioners may use the process and our lessons learned from the case study as a basis for structuring their smart town approaches and the use of information systems to foster specific innovation required for individual towns. This can help address the urgent need to bring digital innovation to sparsely populated areas by providing a best practice approach that guides local authorities.

As all research, our study comes with certain limitations that stimulate further research. Firstly, the town's digital innovation ecosystem has not yet been implemented in its entirety so that results in terms of the economic potential of the innovation process outcome cannot yet be measured. Secondly, the innovation process has only been applied to a single town so far which means that the generalizability of our results is limited. Further research is required to demonstrate the innovation process' applicability and effectiveness within other towns. Additional case studies can provide further insights allowing for benchmarking and more generalizable results. Future research to validate the results of our study and evaluate the transferability to other towns is highly recommended. To do so, we plan to expand our study to further towns. As our innovation process results from an exploratory research process in the context of smart towns, we cannot make a statement on its applicability in the context of smart cities. Rather, we assume that a city is more complex than towns in terms of the number of different stakeholders to manage and their interdependencies – which highlights that different approaches might be required and calls for future research.

Despite these limitations, we believe that the results of our study constitute an important first step on the journey of bringing digital innovation to towns, and we thus hope to encourage fellow researchers to further explore the digital potential for towns in their own research.

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References

Albino V, Berardi U, Dangelico RM (2015) Smart cities: definitions, dimensions, performance, and initiatives. J Urban Technol 22(1):3–21. https://doi.org/10.1080/10630732.2014.942092

Anttiroiko AV, Valkama P, Bailey SJ (2014) Smart cities in the new service economy: building platforms for smart services. AI Soc 29(3):323–334. https://doi.org/10.1007/s00146-013-0464-0

Barca F, McCann P, Rodríguez-Pose A (2012) The case for regional development intervention: place-based versus place-neutral approaches. J Reg Sci 52(1):134–152. https://doi.org/10.1111/j.1467-9787.2011.00756.x

Barth J, Fietkiewicz KJ, Gremm J, Hartmann S, Ilhan A, Mainka A, Meschede C, Stock WG (2017) Informational urbanism—a conceptual framework of smart cities. In: Proceedings of the 50th Hawaii International Conference on System Sciences

Batty M, Axhausen KW, Giannotti F, Pozdnoukhov A, Bazzani A, Wachowicz M, Ouzounis G, Portugali Y (2012) Smart cities of the future. Europ Phys J Spec Top 214(1):481–518. https://doi.org/10.1140/epjst/e2012-01703-3

Bélissent J (2010) Getting clever about smart cities: new opportunities require new business models, Cambridge

Bayerisches Landesamt für Statistik (2015) Markt Bad Hindelang, M 09 780 123: Eine Auswahl wichtiger statistischer Daten. https://www.statistik.bayern.de/statistikkommunal/09780123.pdf. Accessed 14 July 2017

Bundesministerium für Wirtschaft und Energie (2013) Tourismusperspektiven in ländlichen Räumen: Handlungsempfehlungen zur Förderung des Tourismus in ländlichen Räumen. https://www.bmwi.de/Redaktion/DE/Publikationen/Tourismus/tourismusperspektiven-in-laendlichen-raeumen.html. Accessed 14 July 2017

Ceccagnoli M, Forman C, Huang P, Wu DJ (2012) Co-creation of value in a platform ecosystem: the case of enterprise software. MIS Q 36(1):263–290

Ceccagnoli M, Forman C, Huang P, Wu DJ (2014) Digital platforms. Commun ACM 57(2):38–39. https://doi.org/10.1145/2556940

Chesbrough H (2006) Open innovation. A new paradigm for understanding industrial innovation. In: West J, Vanhaverbeke W, Chesbrough H (eds) Open innovation: a research agenda. Oxford University Press, Oxford, pp 1–12

Chesbrough H, Appleyard MM (2007) Open innovation and strategy. Calif Manag Rev 50(1):57–76

Chesbrough H, Vanhaverbeke W, West J (eds) (2006) Open innovation: researching a new paradigm. Oxford University Press, Oxford

D'Asaro FA, Di Gangi MA, Perticone V, Tabacchi ME (2017) Computational intelligence and citizen communication in the smart city. Inform Spektr 40(1):25–34. https://doi.org/10.1007/s00287-016-1007-0

Emden Z, Calantone RJ, Droge C (2006) Collaborating for new product development: selecting the partner with maximum potential to create value. J Prod Innov Manag 23(4):330–341. https://doi.org/10.1111/j.1540-5885.2006.00205.x

Enkel E, Heil S (2014) Preparing for distant collaboration: antecedents to potential absorptive capacity in cross-industry innovation. Technovation 34(4):242–260. https://doi.org/10.1016/j.technovation.2014.01.010

Enkel E, Gassmann O, Chesbrough H (2009) Open R&D and open innovation: exploring the phenomenon. R&D Manag 39(4):311–316. https://doi.org/10.1111/j.1467-9310.2009.00570.x

Eurostat (2017) Degree of urbanisation. http://ec.europa.eu/eurostat/web/degree-of-urbanisation. Accessed 15 Oct 2017

Felin T, Zenger TR (2014) Closed or open innovation?: problem solving and the governance choice. Res Policy 43(5):914–925. https://doi.org/10.1016/j.respol.2013.09.006

Gay G, Hembrooke H (2004) Activity-centered design: an ecological approach to designing smart tools and usable systems (acting with technology). MIT Press, Cambridge

Giffinger R, Fertner C, Kramar H, Kalasek R, Pichler-Milanovic N, Meijers E (2007) Smart cities. Ranking of European medium-sized cities. Final Report, Centre of Regional Science. pp 303–320

Glasgow G, Weber RA (2005) Is there a relationship between election outcomes and perceptions of personal economic well-being? A test using post-election economic expectations. Elect Stud 24(4):581–601

Haller JBA, Bullinger AC, Möslein KM (2011) Innovation contests. Bus Inf. Syst Eng 3(2):103–106. https://doi.org/10.1007/s12599-011-0147-7

Hess S, Naab M, Trapp M, Magin D, Braun S (2015) The importance of mobile software ecosystems in smart rural areas. In: 2015 2nd ACM International Conference on Mobile Software Engineering and Systems, pp 164–165

Hevner AR (2007) A three cycle view of design science research. Scand J Inf Syst 19(2):87–92

Hevner AR, March ST, Park J, Ram S (2004) Design science in information systems research. MIS Q 28(1):75–105

Hilgers D, Ihl C (2010) Citizensourcing: applying the concept of open innovation to the public sector. Int J Public Particip 4(1):68–88

Hollands RG (2008) Will the real smart city please stand up? City 12(3):303–320. https://doi.org/10.1080/13604810802479126

Hosseini S, Kees A, Manderscheid J, Röglinger M, Rosemann M (2017) What does it take to implement open innovation?: towards an integrated capability framework. Bus Process Manag J 23(1):87–107. https://doi.org/10.1108/BPMJ-03-2016-0066

Khan Z, Ludlow D, McClatchey R, Anjum A (2012) An architecture for integrated intelligence in urban management using cloud computing. In: 2011 IEEE 4th International Conference on Utility and Cloud Computing, pp 415–420

King A, Lakhani KR (2013) Using open innovation to identify the best ideas. MIT Sloan Manag Rev 55(1):41–48

Klein B, Koenig R, Schmitt G (2017) Managing urban resilience. Inform Spektr 40(1):35–45. https://doi.org/10.1007/s00287-016-1005-2

Laursen K, Salter A (2006) Open for innovation: the role of openness in explaining innovation performance among UK manufacturing firms. Strateg Manag J. 27(2):131–150. https://doi.org/10.1002/smj.507

Lüthje C, Herstatt C (2004) The lead user method: an outline of empirical findings and issues for future research. R&D Manag 34(5):553–568

Monnat SM (2016) Deaths of despair and support for Trump in the 2016 presidential election. Pennsylvania State University Department of Agricultural Economics Research Brief, pp 1–8

Nam T, Pardo TA (2011) Conceptualizing smart city with dimensions of technology, people, and institutions. In: Bertot J, Nahon K, Chun SA, Luna-Reyes L, Atluri V (eds) the 12th Annual International Digital Government Research Conference, pp 282–291

Neirotti P, de Marco A, Cagliano AC, Mangano G, Scorrano F (2014) Current trends in smart city initiatives: some stylised facts. Cities 38:25–36. https://doi.org/10.1016/j.cities.2013.12.010

Nickerson JA, Zenger TR (2004) A knowledge-based theory of the firm—the problem-solving perspective. Organ Sci 15(6):617–632. https://doi.org/10.1287/orsc.1040.0093

O'Grady M, O'Hare G (2012) Computer science. How smart is your city? Science 335(6076):1581–1582. https://doi.org/10.1126/science.1217637

Paskaleva KA (2011) The smart city: a nexus for open innovation? Intell Build Int 3(3):153–171. https://doi.org/10.1080/17508975.2011.586672

Pierce P, Andersson B (2017) Challenges with smart cities initiatives—a municipal decision makers' perspective. In: Proceedings of the 50th Hawaii International Conference on System Sciences

Porter ME, Ketels CHM, Miller K, Bryden R (2004) Competitiveness in rural US regions: learning and research agenda. US Economic Development Administration (EDA), Washington, D.C

Provenzano V, Arnone M, Seminara MR (2016) Innovation in the rural areas and the linkage with the quintuple helix model. Procedia Soc Behav Sci 223:442–447. https://doi.org/10.1016/j.sbspro.2016.05.269

Ramaswami A, Russell AG, Culligan PJ, Sharma KR, Kumar E (2016) Meta-principles for developing smart, sustainable, and healthy cities. Sci 352(6288):940–943. https://doi.org/10.1126/science.aaf7160

Roberts E, Anderson BA, Skerratt S, Farrington J (2017) A review of the rural-digital policy agenda from a community resilience perspective. J Rural Stud 54:372–385

Rohrbeck R, Hölzle K, Gemünden HG (2009) Opening up for competitive advantage—How Deutsche Telekom creates an open innovation ecosystem. R&D Manag 39(4):420–430. https://doi.org/10.1111/j.1467-9310.2009.00568.x

Rothwell JT, Diego-Rosell P (2016) Explaining nationalist political views: the case of Donald Trump. Working Paper

Schaffers H, Komninos N, Pallot M, Trousse B, Nilsson M, Oliveira A (2011) Smart cities and the future internet: towards cooperation frameworks for open innovation. Fut Internet 6656:431–446

Schlechtriem M, Muscheid B, Brösse K, Hess T, Schoegel K, Koob C (2013) LIFE—Digitales Leben. http://www.studie-life.de/wp-content/uploads/2011/11/studie-LIFE_digitales-leben.pdf. Accessed 14 July 2017

Stahlbröst A, Bergvall-Kareborn B, Ihlström-Eriksson C (2015). Stakeholders in smart city living lab processes. In: Proceedings of the 21st Americas Conference on Information Systems

Stratigea A (2011) ICTs for rural development: potential applications and barriers involved. Netw Commun Stud 25(3–4):179–204

Tödtling F, Trippl M (2005) One size fits all? Towards a differentiated regional innovation policy approach. Res Policy 34(8):1203–1219. https://doi.org/10.1016/j.respol.2005.01.018

Venable J, Pries-Heje J, Baskerville R (2012) A comprehensive framework for evaluation in design science research. In: International Conference on Design Science Research in Information Systems, pp 423–438

Venable J, Pries-Heje J, Baskerville R (2016) FEDS: a framework for evaluation in design science research. Eur J Inf Syst 25(1):77–89. https://doi.org/10.1057/ejis.2014.36

von Hippel E (1986) Lead users: a source of novel product concepts. Manag Sci 32(7):791–805. https://doi.org/10.1287/mnsc.32.7.791

von Hippel E (2005) Democratizing innovation. The MIT Press, Cambridge

West J, Bogers M (2014) Leveraging external sources of innovation: a review of research on open innovation. J Product Innov Manag 31(4):814–831. https://doi.org/10.1111/jpim.12125

Zanella A, Bui N, Castellani A, Vangelista L, Zorzi M (2014) Internet of things for smart cities. IEEE Internet Things J 1(1):22–32. https://doi.org/10.1109/JIOT.2014.2306328

Zygiaris S (2013) Smart city reference model: assisting planners to conceptualize the building of smart city innovation ecosystems. J Knowl Econ 4(2):217–231. https://doi.org/10.1007/s13132-012-0089-4