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Challenges and Potentials of Digitalisation for Small and Mid-sized Towns: Proposition of a Transdisciplinary Research Agenda

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1 Introduction: New Concepts for Smart Towns

Digitization is understood as a social process that leads to a fundamental transformation of existing structures in cities. This process implies a stronger networking of services, goods and trade as well as of individuals and organizations (Linkov et al. 2018). The ever-increasing networking of information and processes, thus, also affects the thinking and actions of individuals and organizations, so that digitalisation in this sense is not to be seen solely as the conversion of analogue values into digital data formats (often-times referred to as *digitisation*), but rather as the sum of all the resulting consequences for society and the individual (often-times referred to as *digitalisation*).

Under the label of *smart cities*, an increasing body of research investigates the potentials of digitalisation that arise for the development of cities and – mostly – metropolitan regions (Hosseini et al. 2018). While no agreed-upon definition of smart cities has emerged so far, researchers agree on the multi-dimensionality of this concept (Yerden et al. 2020). In this view, smart cities (and also smart towns and smart villages) are those cities (towns, villages) that connect technology, institutions, and people in order to increase the efficiency and effectiveness of processes, improve the liveability of cities, and render them sustainable (Nam and Pardo 2011; Yerden et al. 2020). With the same pace at which research on this topic has developed, smart cities have been implemented in many countries. Recently, practitioners and researchers have pointed to the need to not only focus on metropolitan areas and large cities when investigating the potentials of digitalisation for city development, but to also include more rural areas and villages in this debate (Cvar et al. 2020; Zavrtnik et al. 2020). Not surprisingly, various projects have been initiated that address the particular challenges of villages in rural areas such as the large-scale project *Digitale Dörfer* (digital villages) that aims at exploiting the potentials of digitalisation for villages in rural areas of Germany (www.digitale-doefer.de).

However, as much congruency in challenges there might be for larger cities, small towns, and villages, there is as much discrepancy and these discrepancies have been largely neglected by current research. Even the differentiation between smart cities and digital villages in rural areas suffers from ignoring mid-sized towns that function as centres for smaller towns and villages in the region (Hosseini et al. 2018) – an oversight that has recently been recognized also in more general terms (OECD and European Commission 2020). These mid-sized towns, typically ranging in size between 30.000 and 100.000 inhabitants (Federal Statistical Office 2020) and being only semi-densely inhabited (OECD and European Commission 2020), face numerous challenges that neither existing concepts for smart cities nor for digital villages address. We observe a dearth of literature on the challenges and potentials of digitalisation for mid-sized towns and, thus, set out to propose topics for future research on this particular issue. The presented topics are, however, by no means exhaustive and designed as a starting point for an on-going scientific debate on the impacts of smart initiatives and digitalisation on mid-sized towns.

The remainder of this article summarises existing concepts for digital cities, towns, and villages and critically reflects the scope of these concepts (section 2). Section 3 presents selected facets of current research in the area of smart cities and highlights research gaps with regard to smart *towns*. This section is structured along the concept of liveability as many definitions include increased liveability as a goal of smart initiatives. We conclude this article with some final remarks on future research in this area.

2 Smart Cities, Towns, and Villages – Commonalities and Differences

Although being a defining characteristic of any civilisation, no universal definition of a *city* exists (Scott and Storper 2015) and the same applies to the linguistically different terms *village* and *town*. The lens through which a city is defined – and towns and villages, that is – is mainly shaped by disciplinary considerations, for example highlighting the size of settlements as the defining characteristic or the settlement's location and function in a larger areal setting (e.g., OECD and European Commission 2020). Within this article, we aim for a transdisciplinary view on settlements that accounts for economic, spatial, political-administrative, and social aspects of cities, towns, and villages. This perspective is mainly a vehicle to better understand and classify existing research on the smartness of these settlements and forms the basis for deriving a transdisciplinary research agenda. To delineate cities, towns, and villages, we suggest that towns or mid-sized cities i) have 20.000-100.000 inhabitants and, furthermore ii) form regional centres in which they act as focal point for surrounding smaller towns and villages, iii) provide an infrastructure to the region with a) a central and public energy provider, b) public primary and secondary schools, c) an independent public administration, and d) a cultural programme. Cities, in contrast, are understood as larger settlements with more than 100.000 inhabitants and a vibrant orbit (or commuting zone as defined by the OECD and European Commission (2020)). Finally, villages are those settlements with typically less than 20.000 inhabitants that form the catchment area for towns and do not provide the aforementioned infrastructure to their inhabitants.

2.1 Cities and Smart Cities

The term *smart city* is similarly controversial as the term *city* and the confusion increases when *smart* is replaced by other variants (Albino et al. 2015; Nam and Pardo 2011). Considering more recent overviews of smart city concepts, three main foci can be identified along which definitions are made: technology, human resources, and management of existing structures (governance) (Meijer and Rodríguez Bolívar 2016; Albino et al. 2015; Nam and Pardo 2011). Smart cities are those cities that connect these areas in innovative and intelligent ways to digital ecosystems that drive efficiency and effectiveness of various processes on the one hand and increase the liveability for citizens on the other hand (Nam and Pardo 2011; Albino et al. 2015; Meijer and Rodríguez Bolívar 2016).

It is apparent, however, that across these three perspectives, research efforts almost exclusively refer to metropolitan areas (e.g., Shapiro 2006). These metropolitan areas oftentimes have large infrastructures and resources at their disposal to actively push digitalisation and innovation efforts. These densely populated settlements furthermore attain benefits such as a higher perceived well-being of its inhabitants, higher employment rates and incomes, and citizens' better access to public infrastructures and services (OECD and European Commission 2020). Smart cities can, as compared to smart towns and smart villages, function on their own and create a digital ecosystem that is solely focused on one city. Consequently, the smart *city* concept oftentimes considers the specific characteristics of cities and metropolitan areas, suggesting solutions that are transferable to towns and villages only to a limited degree (Hosseini et al. 2018).

2.2 Towns and Smart Towns

Towns or mid-sized cities outside of metropolitan areas, on the other hand, are given less consideration. *Smart towns* are settlements outside metropolitan regions that use digital technology to achieve improvements for people, business and administration in the town and region (Hosseini et al. 2018). Although towns in rural regions often face similar challenges to metropolitan areas, they also have to deal with specific problems for which solution strategies of large cities do not fully apply. This phenomenon is aggravated by the fact that research and political initiatives related to rural regions focusses on the agricultural sector (Roberts et al. 2017). In contrast, rural regions in particular are considered to have great economic potential (Hosseini et al. 2018). The question arises whether the findings gained in these contexts can be applied to rural areas and to towns (Hess et al. 2015).

While metropolitan cities have more resources and more extensive infrastructures at their disposal, they are also characterised by looser social structures than mid-sized towns. With the increasing distance from metropolitan areas, specific characteristics of mid-sized towns and the wider region gain importance in that the identity of and identification with the region increases (Reuber 2012). At the same time, resources are often more limited both in terms of human resources and financial resources, and towns outside of metropolitan areas are more intensely affected by demographic and economic changes (Junkernheinrich and Lorig 2013). Furthermore, towns are often characterised by a stronger local patriotism that tends to hinder intercommunal learning and cooperation with neighbouring municipalities, whereas cooperation between cities and metropolitan areas is oftentimes easy to achieve (Kersting 2020). However, towns hardly have the resources to generate their own (new) identities through city marketing and city branding (Rößler 2018). Against this background, the creation of smart towns is more dependent on the existing structures than compared to cities, and any digital ecosystem needs to account for the specific spatial, social, and political setting of towns. One of these specific characteristics that needs to be considered is the role of a town within the region. Whereas smart city initiatives can focus on one case, i.e. one city, concepts for towns need to consider both the town itself and its surrounding smaller towns and villages, because they oftentimes function as centres for surrounding small towns and villages, and thus have strong social structures that must be preserved and linked through digitalisation.

2.3 Villages and Smart Villages

Villages are those settlements that have typically less than 20.000 inhabitants and form the catch area of towns. Villages, in this view, are characterised more than other settlements by the surrounding countryside, by a lack of infrastructure, and, thus, a higher dependency on nearby centres, i.e. towns, that provide administrative, cultural, energetic, and educational facilities (Zavratnik et al. 2020). While villages oftentimes even lack administrative independence, they are – at the same time – characterised by far stronger communities that are based on personal interactions and close encounters. Thus, for villages to become smart, the focal point is less the technology but rather the community around which digital solutions are built (Zavratnik et al. 2020). Smart villages face particular challenges that are different from those in towns and cities when aiming for digital transformation. While cities benefit from a wide range of existing infrastructures and a certain spatial density, towns and even more villages are characterised by spatial distance (Cvar et al. 2020). Any digital ecosystem that shall be established needs to

account for the oftentimes remote villages that are to be connected and that – each on its own – form strong communities. Furthermore, when dealing with smart villages, one needs to consider the villages locations and the question whether they have basic infrastructures at their disposal, such as electricity and water supply (Zavratnik et al. 2020; Cvar et al. 2020).

3 Research Agenda for Smart Towns

3.1 Liveability as a Guiding Framework

As defined earlier, smart towns are those towns that connect technology, institutions, and people in order to increase the efficiency and effectiveness of processes, improve their liveability, and render them sustainable. Liveability is the degree to which a town can be described as worth living in (Antognelli and Vizzari 2016), although this concept does not consider individuals' perceptions and assessments. Rather, liveability refers to the environmental factors of a town and the extent to which these factors correspond to the needs and abilities of its citizens (Veenhoven 1996). In this sense, liveability refers to the attractiveness of a place and its environmental conditions for living, working and business (Giap et al. 2014). If one summarises the multitude of existing indicators for liveability, four superordinate areas emerge, along which this article is structured. We address gaps of research on the challenges and potentials of digitalisation for towns and regions in four areas: *economy, labour and energy, government and administration, education and culture, and society and social services* (see Figure 1).

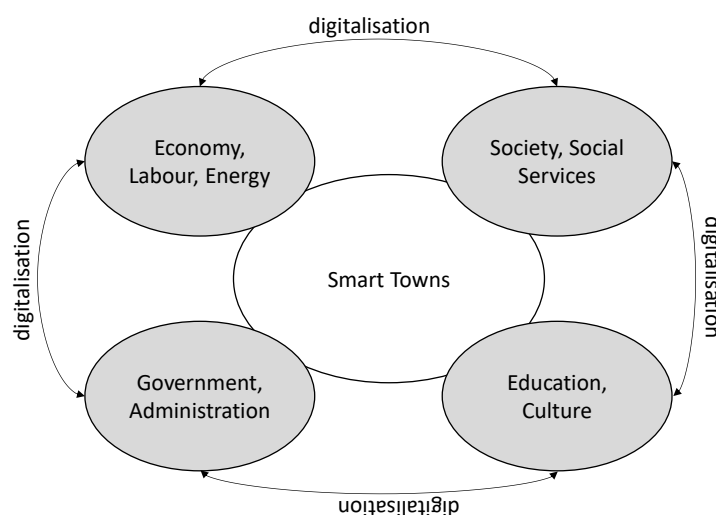


Figure 1. Smart Town Framework

3.2 Economy, Labour and Energy

This area of liveability refers to the economic competitiveness of a town or region. However, not only the economic performance is summarised in this category, but also a town's or region's economic potential and existing infrastructures (Giap et al. 2012). Thus, in this category, liveability refers primarily to the provision of material, services, and energy infrastructures (Antognelli and Vizzari 2016), and the creation of good working conditions. Towns should create conditions for economic growth, good work, and basic energy supply – both for private and commercial purposes – to ensure their attractiveness.

The behavioural economics literature on digitisation, energy use, and sustainability deals intensively with the effects of information provision. For example, Tiefenbeck et al. (2018) find

that constant digital feedback can lead to large reductions in energy use during showering. Jessoe and Rapson (2014) deal with the effects of price variations on behaviour in the energy market and find that accurate information about current consumption is especially important for finding behavioural adjustments towards price changes. Meanwhile, Brülisauer et al. (2020) find that detailed consumption information at the level of individual consumers within a household can greatly facilitate energy saving. Löschel et al. (2020) test whether energy savings can actually be achieved through apps in which customers can set targets for energy savings and find that the distribution of the app to the population proves to be very difficult while generating hardly any savings.

Creating smart towns through digitalisation implies an informationalisation and a huge amount of data. Often, this data yields valuable information, e.g., usage statistics of electrical power or current emergency capacities of police and firefighters. Securing this data is a key factor for digitalisation, protecting data privacy against misuse as well as hardening smart systems against attacks, e.g., directed hacks or malware threats. A failure of a town's smart systems may lead to real-world incidents, like an outage of the power grid or a malfunction in a traffic control system. Thus, cyber security is an essential part of digitalisation and necessary to keep up the public order of smart towns. They need to provide their own, independent infrastructure that enables and supports local businesses and firms to exploit digitalisation. At the same time, they can benefit from an overall stronger identification of businesses and citizens with the town and region and stronger community structures. Yet, against the background of the constant and worldwide observable urbanisation, towns in remote regions need to actively increase their economic attractiveness.

Regional energy and sustainability. One aspect that has received little attention so far is the effect of information on the regional origin of energy and the regional effects of sustainable behaviour. Diederich and Goeschl (2018) and Löschel et al. (2021) are exceptions for the latter in that they investigate how the place where CO₂ is compensated influences the willingness of people to compensate. Here, expected regional co-benefits of compensation seem to be relevant (see also Schwirplies et al. 2019; Gallier et al. 2019 for related observations in public good provision and carbon-emissions compensation behavior). Important factors in future research will be further effects of regionality for sustainable behaviour. This may include regional co-benefits but also regional electricity production and regional identity as crucial factors.

Impact of local digital business on existing (infra)structures. Digitalisation can be viewed as both a challenge for towns and an opportunity. On the one hand, digitalisation increases the competition between businesses and pressures local and small businesses to make digital offerings to their customers (Wichmann et al. 2021). This process is aggravated when local businesses in remote towns face additional challenges such as changing demographics and rural depopulation. On the other hand, towns and rural areas are said to have great economic potential (Hosseini et al. 2018). While the impacts of digital businesses on existing infrastructures in smart cities are well-researched, similar research on smart towns is yet to be conducted.

Impact of regional energy supply on economy and economic attractiveness of regions. As laid out earlier, sustainability is a cornerstone for smart town concepts. Although sustainability not only refers to environmental sustainability, sustainable energy demand and supply are in focus. Considering that especially more rural regions are increasingly used for sustainable energy

production such as wind energy, this topic gains importance for the development of smart towns. Although more and more energy providers offer regional energy to their customers, it is yet unclear how customers perceive (and accept) regional energy. Especially for smart towns with dense social structures and a higher regional identity, smart local energy supply needs to be investigated further.

Impact of regional energy supply and digital businesses on liveability of a town. The creation of smart towns is oftentimes associated with benefits for all affected stakeholders and – by definition – said to increase the liveability of a town. However, empirical evidence for smart towns is scarce and even for smart cities, scholars raise criticism about the overall effects of smart city initiatives on the liveability of these cities (Glasmeier and Christopherson 2015). Thus, future research should explicitly deal with the effects of the implementation of smart concepts on a town's actual liveability.

Security of local and regional (IT) infrastructures. The IT security of critical infrastructures is of particular importance and the question arises how critical infrastructures, e.g. in energy supply, can be secured with IT instruments without endangering the privacy of citizens by collecting, storing, and processing sensitive data. For towns and more rural regions, securing critical infrastructures is a pressuring topic as oftentimes necessary resources are not available.

Malware. Recent cases of hospitals being victims of malware, more precisely ransomware, revealed the difficulty of securing digitalized infrastructure against IT threats. The fast evolution of malware with new variants every day especially raises the complexity of malware detection. Current approaches of signature-based and anomaly-based detection both have shortcomings which need to be addressed in order to be prepared for upcoming threats.

Targeted attacks. As smart towns process valuable data, e.g., of its citizens and management systems, these are attractive targets for hacking attacks. Other than undirected threats like malware, these attacks are addressed to the target system only with the specific goal of data retrieval or sabotage. Consequently, attackers invest a high amount of energy and time to penetrate their target which makes it necessary for smart towns to keep the security measures up-to-date. Still, it is a current research question which attacks exactly may be feasible and how they can be prevented.

3.3 Government and Administration

This area includes all measures that manage and change the environmental factors of a town (Antognelli and Vizzari 2016). This category summarises the design and implementation of policies and the existing administrative and governmental system (Giap et al. 2012) that form the environment for any smart town initiative. Hereunder fall aspects of participation of relevant stakeholders in decision making processes (Geissel and Kersting 2013), transparency of processes (Norris 2018), and mutual trust among relevant stakeholders (Trutnev and Vidasova 2019). In order to increase the liveability of the town, government and administrative actions should be as transparent, responsible, and trustworthy as possible. In towns in particular, the proximity between the government and its citizens allows that government and administrative actions can be directly experienced (Gabriel and Kersting 2014) and the change processes

triggered by digitalisation have a direct impact on life in towns through direct democratic and deliberative processes.

Urban innovation in the last decade was strongly influenced by a new role of the civil society. This is visible in a paradigm shift from government to governance. The reforms in the 1990s were not only influencing the citizen-administration relationship (customer). Innovation championed third sector-strategies which included citizens in the service provision (co-production). But more importantly, innovation was defined by new participatory instruments that included citizens with consultative, yet strong participatory instruments that were added to the representative democracy (co-decision) (Kersting et al. 2009; Vetter et al. 2016). Smart towns can be regarded as the latest administrative reform and as digital democratic innovation in most towns around the globe. In smart town initiatives as well as in former urban New Public Management modernization and Post Weberian reforms, the important role of the citizens in planning as well as monitoring has been highlighted (Gil and Navarro 2013; Chourabi et al. 2012). Online and offline participation can reinvigorate town planning and policymaking as well as policy monitoring processes at the local level. Here, digitalisation comes in the form of creating new sustainable technologies that pave the way for smart towns and digital neighbourhoods to arise. One major challenge is that smart towns need to be inclusive. This becomes more relevant in the Covid-19-pandemic, where digitalisation and reliable broadband (fibre) is a base for all policies and the role of the state is re-defined (Kersting 2020). Successful digitalisation relies on the integration of IT systems of the different involved public organizations (Scholl and Klischewski 2007). Data should be exchanged and integrated to implement the once-only principle (Krimmer et al. 2017) and enable an easier communication with citizens. Digitalisation has the potential to fundamentally change the way public organisations interact with their citizens in the course of public service delivery (Lindgren et al. 2019).

Open data and open government in smart towns. Smart towns are confronted with demands for more open government data and open government. Both create chances and possibilities for open innovation and inclusion of the citizen. At the same time, open data and open government initiatives may become a burden in terms of a higher demand of resources. Here, towns are an important but so far under-researched topic. In particular, towns are oftentimes reluctant to implement open government programmes (Kersting 2018, 2019). Thus, future research on smart towns needs to address goals aimed for in a smart town, its inherent structures and institutions in order to better understand the contextual factors that impact open government initiatives. Furthermore, we need to better understand by which indicators smart towns can be successfully evaluated.

Governance and public policy in smart towns. Currently, many researchers focus on the technological innovations that surround the implementation of smart towns (Camero and Alba 2019). They investigate the potentials of the Internet of Things (von Lucke 2017), big data analytics, and open data for the creation of smart towns. Apparently, less attention has been paid to the question how smart town initiatives should be governed (Rodríguez Bolívar et al. 2020) and how public administrations as executors of public policy are affected by and prepared for the changes that smart initiatives bring about.

Impact of smart initiatives on democracy and participation in towns. Under the labels 'e-democracy' and 'e-participation' much knowledge has been accumulated of the effects of technology and IS on democracy, participation in democratic processes, and democratic

innovation (Smith 2009; Kersting 2008). However, smart initiatives go beyond singular actions and aim for a digital ecosystem that connects various areas of a town and as many stakeholders as possible. As such, it becomes necessary to investigate the conditions and attitudinal patterns of towns for democratic and administrative innovations. This implies analysing the actor constellations that are necessary for sustainable democratic innovation and analysis of how relevant stakeholders interact and can be included in any smart initiative. In this context, further research is needed on how individual towns and municipalities can work together and exchange experiences and, thereby, facilitate intermunicipal learning.

In the cities a deliberative turn (Dryzek 2002) is obvious. Participatory budgeting, randomly selected citizen assemblies, and other democratic instruments are seen as an innovation and addition for mainstream traditional representative democracies. They are demanded by citizens and accepted by most politicians (Kersting 2016). However, it still remains unclear whether these instruments can actually enhance legitimacy and whether they are able to channel growing political protest. Direct and deliberative participatory instruments rely on electronic democracy and both use a mix out of online and offline engagement (blended democracy). Especially in the context of smart towns, there is a need to better understand whether and which types and sequences of these instruments matter and how towns can institutionalise them. Furthermore, we need to better understand and define the role of oftentimes local political parties and social movements in these processes and identify the relevant local actors who could support the use of digital instruments

Innovative public service delivery in smart towns. Public organisations should develop new ways of delivering public services to their citizens to unfold the potential of digitalisation. One example is the implementation of a no-stop shop to proactively deliver public services such that citizens do not need to perform any action to receive such services (Scholta et al. 2019). The realisation of a no-stop shop constitutes a shift from the pull- to push-paradigm (Linders et al. 2018) and requires future research activities. For example: How to implement such a no-stop shop in a smart town? What aspects need to be considered? How to organize the communication with citizens in a no-stop shop? In order to enable the establishment of a no-stop shop, governments should reorganise their internal processes and improve their information management. Further innovative approaches are necessary for the reuse of information in public organisations of smart towns, for instance, using the reference model concept (Scholta et al. 2020).

3.4 Education and Culture

Education and culture form the third area of the liveability concept and are a cornerstone of smart towns. This category includes all services provided by a town that address the non-material needs of its citizens, i.e. to which a non-monetary value is attached (Antognelli and Vizzari 2016). These encompass educational infrastructures, including tertiary education, and the creation of cultural offerings. In addition, equality, existing local structures, and housing conditions are core elements of this area (Giap et al. 2012).

Digitalisation and its impact on education and culture are being studied extensively, albeit disparately in terms of meaning, relevance and implications. On the one hand, digitalisation is viewed as a technical/technological change that amplifies the processes (and the effects) of learning, working, and communicating with positive (Boler 2010; Castells 2012; Gil de Zúñiga and Chen 2019) and negative (Spitzer 2014) implications. On the other hand, the impact of

digitalisation is taken to be of a more profound nature, changing not only the means (media) of learning, working, communicating, but also bearing importance for the ends and objectives of education and culture. Among these more fundamental interrogations, scholarly work questions how digitalisation and big data change the world as we view it, how they change ourselves and our most fundamental (self-)relations and what implications this has for our social, legal and political coexistence (Baecker 2017; Allert et al. 2017, 2018; Iske et al. 2020; Jörissen 2015; Precht 2020; Nassehi 2019).

Education research on digitalisation has focussed on issues related to content, skills, and competences (Verständig et al. 2016; Pietraß 2011); here, attention was devoted to how the latter shifted attention from a more substantial/normative understanding of education to a more functional/technical definition of the term, that is not directed at the individual but is instead oriented towards the requirements of the use of digital media (Pietraß 2011; Jörissen and Marotzki 2009). Furthermore, attention was placed on the changes digitalisation entails for individuals and educational organisations in terms of processes and routines, but also in terms of efficiency and effectiveness (Ladel et al. 2018).

As a newer research strand, educational informatics concentrated on examining the potentials of data analysis and its application to pedagogy, making learning analytics the centre of attention in research (Slade and Prinsloo 2013; Greller and Drachsler 2012; Ebner et al. 2013; Jülicher 2015). As Rebecca Ferguson (2012, p. 3) noted, the Society for Learning analytics Research defined the term as “the measurement, collection, analysis and reporting of data *about learners and their contexts*, for purposes of understanding and optimising learning and the environments in which it occurs.” Also well-documented is the increasing relevance of data-based policies, the appearance of new sites of education data production, centralized databases and new data experts or mediators at different levels – from individual to supranational (e.g. Hartong and Piattoeva 2019; Hartong 2018, 2016; Lingard and Sellar 2013; Piattoeva 2015; Williamson 2016, 2017). Currently, digital (data) infrastructures in the field of education are mainly seen in the context of new educational governance tools (e.g. education monitoring and school inspection) aimed at increasing the effectiveness of school processes (Gorur et al. 2019; Hartong 2019; Hartong and Förschler 2019). Related to the latter, an important line of research focusses on changes in political power and domination associated with the monopolized possession of data, monopolized access to data and with the possession of evaluation routines and algorithmic systems (Danaher 2016) but also on issues of inequality and equal opportunities (Eubanks 2018; Piattoeva 2018).

Again, the need for more research in this area arises through the specific characteristics of towns outside of metropolitan areas that often lack the needed resources to profit from digitalisation and that are characterised by regional structures and specificities.

Impact of digitalisation on local educational infrastructures. While cities often have the resources to provide a rich educational environment to their citizens, the depopulation of towns and villages and the simultaneous aging of the regions’ population create challenges for providing educational offerings locally – both at the basic and at the advanced level. Thus, digitalisation and remote-education become more important to better use existing resources and infrastructures, while at the same time providing a well-balanced educational programme to the town and its region. This has different implications and requirements, e.g. the need for a powerful and reliable digital infrastructure is evident, even more than in urban structured where nearby-offers of education

institutions is easier to reach. Furthermore, the need of co-operation is getting more and more important for towns and municipalities in rural areas. Thus, research on inter-communal educational services as well as (digital) infrastructures is necessary.

Imparting digital competences and retaining workforce. Public organisations and governmental agencies as executors of public policies and, thus, smart initiatives, are suffering a dearth of digital competences (Ogonek and Hofmann 2018), i.e. socio-technical and soft skills that enable organisations to realise the digital transformation (Distel et al. 2019). Here, towns are facing a two-fold challenge. On the one hand, they often lack resources and the necessary digital vision to impart digital competences on public servants. On the other hand, the overall environment may be perceived as less attractive as vibrant metropolitan areas with manifold vocational opportunities and – at least in for-profit organisations – more attractive salary schemes. Against this background, research needs to address the question of how digital competences can be imparted in public administrations and the local for-profit organisations in (smart) towns. Here as well, the aspect of co-operation is a crucial aspect to be taken into account. On the one hand side, towns are facing more and more challenges of competing with their neighbour towns in the same area and thus are aiming to differentiate. On the other hand, the need of collaboration is obvious as only this will give enough power to create results that matter in comparison to bigger cities. Here innovative concepts are necessary to create the difference.

Providing a rich and vibrant cultural environment. Retaining a (skilled) workforce is not only a question of organisational settings and offerings made by the employer. Depopulation is also a result of a perceived lack of attractiveness of rural areas and towns. Thus, towns could benefit from a sophisticated digital educational and cultural environment in that it may increase the perceived liveability of a town and its region. This notion pertains not only to primary and secondary education, but also to tertiary education and trainings on the job. Thus, a broad and elaborated educational infrastructure, e.g. organised by a community college incorporated by an administration union of several towns or comparable structures are important elements for such offerings. Although generally speaking this is an established construct, digitalization and digitized education force changes in the way such unions are built and in the way such unions provide their offers.

3.5 Society and Social Services

Digitalisation and digital transformation impact not only businesses, administrations, the society and the economy, but influence citizens' everyday life as well. Accordingly, liveability can also be defined by the existence of social services that address intangible societal needs (Antognelli and Vizzari 2016). In addition to basic health care and access to medical services, these include aspects such as security and stability, community life or child and youth work, which enable civil society life and social coexistence in (smart) towns. Moreover, liveability in this area includes less-tangible aspects that enable and influence society, such as participation in public discourse, public communication, and the relationships between social actors. Here, digitalisation can change existing and create new structures. Unlike in metropolitan regions, however, the identity of and identification with the region often lies outside of digitalised spaces and, thus, creates a unique context with both various untapped potentials and constraints for digitalisation.

With a view to region-specific capacities of digital networking, current research focusses on the capacities and agencies of citizens for political and administrative participation in local political and region-specific developments (Grundmann 2018). It is assumed that social cohesion, i.e. identification with the town, depends on how region-specific experiences of social changes, such as the climate change or demographic changes, and upheaval along the lines of participation and marginalisation, (re)traditionalisation and individualisation, support and control (e.g. by the administration) are communicated and shaped by citizens in a participatory manner (Güngör 2008). It is also assumed that the network of regional actors can be strengthened by means of digitalisation processes and that marginalisation of certain societal groups can be prevented.

Digitalisation and identity-building. In the context of (smart) towns two important research foci arise, the impact of digitalisation on identity-building activities and on neighbourhood networking. Digitalisation processes are usually associated with technological capacities of information processing, which impacts co-existence in highly complex and differentiated social systems (such as metropolises and medium-sized cities). This is accompanied by contradictory assumptions of the benefits or incidental costs of any technological innovation: On the one hand, the danger of a social division of society and the emergence of new social inequalities through the use of digital technologies is thematised, mainly under the label of digital divides (Cruz-Jesus et al. 2016). On the other hand, the potential of the digital transformation for social networking and the public exchange of information is emphasised. Accordingly, future research needs to address both the constraints and innovation potential of the digital transformation of towns and citizens.

Digitalisation and social networks. While current research assumes a considerable impact of digital transformation on citizens' everyday life, we need to ask about the capabilities that enable or hinder citizens to connect digitally in their way of life and in this way to help shape new and sustainable social networks as well as communication and information channels. This also includes trust in the administration and political participation opportunities as well as the possibility of reducing technological and socio-structural or socio-cultural obstacles or barriers to digitalised participation. The aspect of opportunities and capabilities also encompasses the conditions under which digital infrastructures are perceived and accepted in everyday life. This is because new types of opportunity structures and enabling potentials (such as civil society networking and communalisation), which are driven by digitalisation processes, are also sometimes associated with this.

Digitalisation and civil society initiatives. In addition to the study of individual capabilities, a need arises to focus on social networks and regional actors, such as civil society initiatives. These regional actors commonly identify with the region and the town, while at the same time creating a greater identification with the region through their network and through promoting the quality of life in the town and region either on a political level (e.g. citizens' initiatives) or on a cultural level (e.g. cultural associations). As of now, there is little knowledge on the question to what extent these actors use digitalised information channels or resist them; whether and how they communicate with the other actors in the town and region, and coordinate their activities. Digital transformation may impact the existing networks and increase their cooperation; yet at the same time, the networks might operate on structures that are hard to digitalise, wherefore actors might refrain from extensive technology use.

Strategic trust management in smart towns. Furthermore, as the relationship between actors and within and across actor networks changes, the relationship of these actors to local institutions changes fundamentally. For example, this process can be observed between public administrations and citizens. Compared to higher administrative units, towns and their administrations are met with a comparatively high level of trust (Biggart et al. 2015; Denters 2002; Fitzgerald and Wolak 2016). Thus, the question arises to what extent an increasing digitalisation of interactions between citizens and local administrations changes the existing relationship of trust. In this context, digitalisation is seen as an opportunity to strategically use existing trust relationships without, however, jeopardizing the vigilance and digital sovereignty of citizens through such trust management. From the citizens' point of view, an uncritical and excessive trust in the administration is not desirable because it reduces vigilance towards the actions of others and undermines control mechanisms (Bouckaert 2012). This tension is exacerbated by digitalisation, because interactions are now only mediated and the protection of personal data is becoming increasingly important. Trust management in local administrations must ensure, on the one hand, efficiency gains achievable through far-reaching digitalisation and, on the other hand, the preservation of vigilance and digital sovereignty.

4 Concluding Remarks

In this article, we set out to propose an agenda for research on smart towns. Based on the observation that many scholars focus their attention on metropolises and cities in urban areas, we see a need to also investigate consequences of the digital transformation in more rural areas. Characteristics of large and densely-populated settlements make the application of solutions one-on-one for smaller towns outside metropolitan areas difficult and requires scholars to focus on these regional specificities when investigating digital transformation. Based on the (non-exhaustive) review of current trends in research, we derive four characteristics of smart towns that require special attention of future research endeavours.

A smart town requires a secure and sustainable energy supply. Thus, research could address the following research questions:

- What are effects of regionality on sustainable behaviour?
- What impact does digitalization have on existing infrastructures in towns?
- How can customers be encouraged to use regional energy?
- How can the IT of critical infrastructures be designed securely and keep the citizens' privacy?
- How to prevent attacks of IT systems in smart towns?

A smart town requires a citizen-centred and innovative government:

- How can open innovation be realized in the administration of a smart town?
- What are the effects of smart devices on public administrations?
- What the conditions and prerequisites of democratic innovation in smart towns?
- How can no-stop-shops be designed in a smart town?
- How can the intergovernmental information management be improved?

A smart town requires continuous education and vivid cultural offerings:

- How can smart towns provide up-to-date education despite their limited resources?
- How can digital competences be distributed in the administrations and for-profit organisations in smart towns?
- How can smart towns be made more attractive through diverse service offerings?

A smart town requires coherent networks built of trust-fuelled relationships:

- How can smart towns use existing social structures and networks and intelligently connect various actors?
- How can public administrations strategically manage citizens' trust?
- Which capabilities do the actors in a town need to tap the potentials of digitalisation?
- Which specific opportunities do towns provide in order to become smart?

By proposing the research agenda, we strive to advance this research topic further and look forward to disruptive activities in the future.

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