Digital pioneers in rural regional development: A bibliometric analysis of digitalisation and leadership

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Abstract

While research into digitalisation in cities has grown strongly in recent years, rural areas have now also clearly shifted into the focus of attention. An important strand of research into digitalisation in rural areas can be described as agency perspectives. Current studies point to the driving, transformative force of key figures, for example social entrepreneurs, smart villagers or spatial pioneers. At heart, these studies propose that paths for collective action can be developed via key figures, thus generating ways to change established rules and norms. This paper represents a methodological contribution to this strand of research by subjecting the debate on leadership through key figures to a quantitative, bibliometric analysis, on the basis of which a heuristic is proposed in order to develop relevant research questions. Based on different strands of discourse, our results show that unequal spatial development is manifested in an urban bias, but also demonstrate the potential of the growing research field in rural regional development.

Keywords: Digitalisation ▪ regional development ▪ digital pioneers ▪ leadership ▪ bibliometric analysis

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Digitale Pioniere in der ländlichen Regionalentwicklung: eine bibliometrische Analyse zu Digitalisierung und Leadership

Zusammenfassung

Während das Forschungsfeld zu Digitalisierung in Städten zuletzt stark angewachsen ist, rücken nun auch ländliche Räume deutlich in den Fokus. Ein wichtiger Forschungsstrang zur Digitalisierung in ländlich geprägten Räumen kann als agency perspective beschrieben werden. Aktuelle Studien verweisen auf die treibende transformative Kraft von Schlüsselfiguren, beispielsweise social entrepreneurs, smart villagers oder spatial pioneers. Sie vertreten im Kern die Annahme, dass über Schlüsselfiguren Pfade für gemeinschaftliches Handeln entwickelt werden und es so zu Veränderungen in den bestehenden Regelwerken und Normen kommen kann. Dieser Aufsatz leistet einen methodischen Beitrag zu diesem Forschungsstrang, indem er über eine quantitative bibliometrische Analyse die englischsprachige Debatte zu leadership durch Schlüsselfiguren analysiert und daran folgend eine Heuristik vorschlägt, um Fragen zu entwickeln. Unsere Ergebnisse zeigen anhand unterschiedlicher Diskursstränge die ungleiche räumliche Entwicklung im Sinne eines urban bias, aber auch das Potenzial eines wachsenden Forschungsfeldes in der ländlichen Regionalentwicklung auf.

Schlüsselwörter: Digitalisierung ▪ Regionalentwicklung ▪ digitale Pioniere ▪ leadership ▪ bibliometrische Analyse

1 Introduction

In recent years, research on the impact of digitalisation on rural areas has gained much attention. In particular, it is rural areas where digitalisation is called upon to contribute to the goal of regional development. Studies with spatially

differentiated scales aim to explore digital transformation in sparsely populated rural areas, adopting the notions of smart country (Wiechmann/Terfrüchte 2017) or smart villages (Zavratnik/Kos/Stojmenova Duh 2018; Patnaik/Sen/Mamoud 2020). The notion of smartness in this context is used to describe the normative vision of a digitalisation process in which resources, knowledge and skills are used in an effective and innovative way by means of territorial development.

Since rural areas differ in resources, socio-economic conditions, innovation and digital connectivity (Salemink/Strijker/Bosworth 2017: 368), digitalisation is proposed as conducive in mitigating disparities in rural development. Naldi, Nilsson, Westlund et al. (2015: 91) describe the conditions for smart growth in peripheral, rural areas characterised by low accessibility and less potential for endogenous development. Meyn (2020: 112) highlights a lack of focus on rural communities and their transformation in terms of benefits from digital solutions that address local needs and argues in favour of place-based approaches. Porsche (2021: 165) argues that due to the lower densities, digitalisation in rural areas requires place-specific digital solutions and new cooperation practices with local actors. However, current literature acknowledges the driving force of key figures in regional development (Sotarauta/Beer/Gibney 2017; Döringer/Eder 2020a, Grillitsch/Sotarauta 2020). Consequently, we introduced the concept of digital pioneers in our empirical research. With respect to this perspective, our paper addresses the following research question: Which characteristics for digital pioneers within rural regional development can be deduced from current research literature on digitalisation? With this paper, we aim to add a twofold perspective to the debate of rural regional development, firstly by documenting and contextualising the "smart" territory discourse on place-based leadership, secondly by deducing from the discourse characteristics of the key players that spearhead this process.[1]

Following Hughes (1987: 51), we understand digitalisation as the long-term transformative process of a "large technical system" which is socially constructed and has socio-spatial effects.[2] The relation between proximity and distance, the function and meaning of spatiality in actor-centred co-operations and networks are important when addressing digitalisation in rural peripheral areas.[3] From a planning-related perspective, the potential of digitalisation as a "large technical system" is to be found in exploring new paths for solving problems and achieving goals by means of information and communication technology (ICT). According to the European Union's vision to achieve the goal of smart development in rural areas, "traditional and new networks and services are enhanced by means of digital, telecommunication technologies and the better use of knowledge for the benefit of inhabitants and business" (Zavratnik/Kos/Stojmenova Duh 2018: 3). These spatial challenges can be described in terms of demographic change, the dismantling of amenities and public services, poorer accessibility and a shortage of skilled labour (Williger/Wojtech 2018: 4–5, Meyn 2020: 100, Vitale Brovarone/Cotella/Staricco 2021: 3). The primary goals of current policy strategies in rural areas are equitable living conditions[4], together with the reduction of territorial inequalities. Numerous agendas and strategy papers at the German national and European levels address these goals through digitalisation on the basis of policies (BBSR/BMUB 2017, BMWi 2021; European Commission 2010; European Commission 2020).

An important criterion for the development of regional digitalisation strategies is the central idea of sustainable spatial development. Top-down approaches, such as state

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[1] The research project "Digitale Pioniere in der ländlichen Regionalentwicklung" (Digital Pioneers in Rural Regional Development) at the Regional Planning Department of the Brandenburg University of Technology Cottbus-Senftenberg is part of the BULE (Federal Programme for Rural Development) research programme "Ländliche Räume in Zeiten der Digitalisierung" (Rural Areas in the Age of Digitalisation), funded from April 2020 to March 2023. We applied a double sampling strategy. The two regions are located in the federal states of Baden-Wuerttemberg and Mecklenburg-Western Pomerania, both characterised as "very rural" according to the Thuenen typology (Küpper/Milbert 2020), but with different positive and negative conditions for digital solutions. Secondly, based on our online research, both regions feature a wide range of digital pioneer activities.

[2] The understanding of digitalisation as a temporal process with consecutive sequences, reflecting different phases of technological development and degrees of digitalisation, is not examined further here (for discussion on digitalisation and temporality from a sociological perspective, see Nassehi 2019). The constitutive tangible and intangible elements of digitalisation are described as information and communication technologies (ICT), which encompass various physical or non-physical artefacts and processes.

[3] Our study analyses the co-operations and networks of digital pioneers in a comparative research design that methodologically builds upon telephone interviews with the software EgoWeb 2.0 that were conducted in summer/autumn 2021. This data will be employed to approach the questions of spatiality in digitalisation, e.g. what are the socio-spatial conditions necessary for digital pioneers to mobilise resources in these regions? What can be learnt from this in regard to sustainable regional development? Can the positive impact of digital pioneers be enhanced by collaborative planning approaches?.

[4] See https://www.bmi.bund.de/SharedDocs/downloads/DE/veroeffentlichungen/themen/heimat-integration/gleichwertige-lebensverhaeltnisse/kom-gl-massnahmen.pdf?__blob=publicationFile&v=4 (23.02.2022).

financing programmes, articulate the necessity of examining the particular measures with respect to their effects in economic, social and ecological contexts. The need to shape, design and monitor digital transformation with regard to sustainability in the municipalities is articulated in the Smart City Charter (BBSR/BMUB 2017). Highlighting an integrated perspective, the charter aims at linking different sectoral measures. Furthermore, attention is given to the so-called open systems, whereby data sovereignty, transparency and participation play a central role. Here, Matern/Binder/Noack (2020) and others point to new problems resulting from a lack of social consensus in deploying digital methods in regional development. The authors criticise digitalisation as a black box which exhibits shortcomings with respect to participation and surrenders digital data resources to private actors (Kitchin/Lauriault/McArdle 2016: 19). Compared to other spatial contexts, digital transformation in rural areas is less a product of the corporate interests of large digital technology companies in setting up the regional infrastructure through information and communication technology. This opens up possibilities for new cooperation practices (Porsche 2021: 166). In this context, our research highlights the leadership role of key figures in regional development.

With this paper, we aim to document and contextualise the smart territory discourse on leadership in rural development and deduce from it characteristics of the key players that spearhead this process. The article is structured as follows: Section 2 distinguishes different types of figures in leadership roles, followed by an analysis of Web of Science data (Section 3) that quantifies and compares contributions to each discursive strand that address leadership in the context of digitalisation (Section 4). Building on a summary and discussion of the results, key questions are deduced (Section 5), on the basis of which the characteristics of key figures in rural regional development can be systematically described and compared. Finally, the results are critically examined with reference to the bibliometric methodology, followed by the identification of needs for future research.

2 Typologies of actors: social entrepreneurs, smart villagers and digital pioneers

Current research assumes that transformation in rural areas is closely linked to the performance of key figures and their networks (Döringer/Eder 2020b: 7). They employ resources such as knowledge about regional scope for action. With their activities, these key figures and their networks deliver impulses for digitalisation processes in the region. In this section, we compare the different notions of key

figures that are related to regional rural development, with a special focus on the German debate, in order to highlight differences and similarities in conceptual research designs.

Because of its impact on transformation processes, the term "innovation" takes on an essential role in the literature on rural digitalisation. The notion of innovation is closely linked to a positivistic-technological perspective (Howaldt/ Schwarz 2010: 88). Technological changes and growth determine the persistence of the (technological) concept of innovation in national research agendas (Mayntz 2009). Consequently, new technologies, processes and products can be described as central elements of innovation research. The broad field of innovation research exhibits a special interest in the analysis of spatial-temporal interactions between innovations and institutions, and innovation in permanent and temporary settings (Bathelt/Cohendet/Henn et al. 2020). This also forms the starting point for critical innovation research. By virtue of the fact that "new" does not automatically describe a technological innovation, but may equally well describe a process which places something "old" in new contexts, the positivistic concept of innovation acquires additional meaning through social practices (Howaldt/Schwarz 2010: 89). From the perspective of economic geography, there is a special interest in the study of the dissemination and spatial concentration of innovations. It is not just spatial patterns that are examined with respect to innovation diffusion, research is also conducted into temporal and thematic samples. Zerrer/Sept (2020: 78) point to an increased interest in the study of social innovations in rural regions, which is reflected in differentiated methodologies (Christmann 2019; Noack/Federwisch 2019; Christmann 2020, see also Mulgan 2019: 142–144). Our approach to the innovation concept is derived from Mayntz's (2009: 108–109) understanding of the term. Thus we see innovation as a policy field and key technology (Mayntz 2009: 116), which means it must be considered in the context of governance and the "interplay of different regulatory forms" (Mayntz 2009: 105).

Based on "little knowledge of the acting of social entrepreneurs in the context of regional development" (Christmann 2014: 51), Christmann observes alliances which can be traced back to the initiative of a small group. These alliances initiate need-oriented solutions and act locally. According to the author, these groups operate as social entrepreneurs who promote digitalisation in the region using the resources available to them (financial resources, contacts or professional knowledge). They operate as mediators of social, political, cultural, ecological or even economic transformation processes, acting as catalysts for future bottom-up approaches. Here, social innovations are understood as social practices generating new solutions in order to address local needs. Social entrepreneurs are thus charac-

terised by their intermediary role in empowering civil society. With proper entrepreneurial knowledge, they are described as supportive in developing local bottom-up initiatives und thus generating process innovation. Hence, the typology of social entrepreneurs alludes to their position as a "bridge between bottom-up and top-down initiatives" (Christmann 2014: 52). Nevertheless, Christmann critically reflects on the adscription of the "entrepreneur" terminology due to the fact that the acquired financial resources mostly rely on public funds.

While Christmann's definition places emphasis on the entrepreneurial dimension of key figures and their respective social practices, Zerrer and Sept (2020) opt for a spatial reference in their typology of smart villagers. In analysing digital social innovation in rural regions in Brandenburg and North Rhine-Westphalia (Zerrer/Sept 2020), they highlight the role of small groups of volunteers led by older community members (with their principle or secondary residence in the region). These smart villagers share an interest in the improvement of local public services by means of digital solutions. Smart villagers support digitalisation processes in the region through their knowledge in the fields of technology, management and communication. They are described as key actors who link up with regional actors with the professional knowledge or financial resources needed to drive digitalisation processes forward. The notions of smart villagers and social entrepreneurs differ in their level of reference and mediation, as the typology of smart villagers also entails the application of digital tools to support established processes for empowering rural communities (Meyn 2020: 112). Both studies share an interest in the impact of civil society actors in regions with a particular need for renewal, building on cooperative relationships between actors from civil society and public institutions.

The role of the state and the public realm are conceptualised differently, using the term "pioneer" as a basis for our argumentation. As a main characteristic, the pioneer is understood as a transformative agent and visionary, open to renewal.[5] Conscious of the ubiquitous ambivalence of the term "pioneer", our understanding ties in with the discourse of spatial pioneers that is rooted in the eastern German debate of shrinking cites. So-called urban pioneers were characterised through their temporary use of post-industrial areas, infrastructure or wasteland. By creative appropriation, spatial pioneers became agents of urban development through interim use (Senatsverwaltung für Stadtentwicklung 2007; Matthiesen 2011; Faber/Oswalt 2013; Faber 2013). Against the backdrop of failed urban development, research on the new role of these urban catalysts in strategic planning processes pointed out their potential as incubators for long-term processes (Oswalt/Overmeyer/Misselwitz 2013). Social practices were characterised by informality and unplanned activities in the light of the crisis in urban planning procedures. When transferred to the rural context, Faber (2013: 162) describes spatial pioneers who campaign for improved access to public service provision like healthcare, education or culture, motivated by the dismantling of public services in demographically shrinking rural areas. Spatial pioneers can be comprehended in relation to spaces of "self-responsibility". So, we follow Matthiesen's (2011: 60) explorative claim to conceptualise the digital pioneer as an open concept to search for and identify innovative networks and co-operations.

Hence, we define digital pioneers as private, civil society or public individual or collective actors with digital literacy who identify new paths for collective action in rural-peripheral areas.[6] The sample of digital pioneers was defined by the ability to enhance life quality, to distribute knowledge by means of information and communication technologies as a transformative potential for social innovation.[7] Digital pioneers, we propose, play a new role in regional governance constellations, thus promoting a bottom-up approach with fewer participatory shortcomings.

3 Contextualising the smart territory discourse on leadership

In an initial step towards a closer examination of digitalisation and regional development, we first carried out a bibliometric analysis. Bibliometric analysis is a method for surveying available data in its complexity and filtering it

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[5] The adscription "pioneer" refers to something new. For instance, pioneer plants are the first plants to grow in difficult environmental conditions. Human pioneers are referred to as settlers who occupy space. Accordingly, pioneerdom implies the displacement of the autochthonous population. In the German Democratic Republic, the youth were organised in the Young Pioneers association. In this context, the pioneering spirit also refers to the political dimension of creating something new.

[6] Experiences of digital change have also been analysed in reference to limits and risks. Bürgin and Mayer's (2020) study on digitalisation efforts in Swiss Mountain Regions points to contradictory developments in digital connectivity. The authors employ qualitative data to show that digital connectivity is experienced heterogeneously among private actors, with smaller and medium-sized companies struggling more due to greater competition, a higher workload, speed and stress than larger businesses.

[7] The sample was constituted primarily of actors with a regional scope of action due to the chosen methodology of network analysis. For further research on digital literacy, see e.g. Rundel/Salemink (2021).

according to thematically defined criteria. This involves the counting and analysis of publications and citations, generally applied in the context of science management (Ball/Tunger 2005). Thus bibliometric analyses provide insights into the development of a science landscape (Ball/Tunger 2005: 15). They contribute to understandings of development trends on the basis of quantifiable results. Bibliometric analyses are also suitable for judging the international reception of research. As bibliometric analysis represents a method for measuring scientific discourses, it enables us to make empirically verifiable statements on development trends in specific discourses.

To this end, all the bibliographic entries for the English language texts from the Web of Science Core Collection published before January 1 2020 which meet the search request were loaded (N=10,251).[8] Central to the identification of relevant texts were the various semantic markers which, in the discussion on digitalisation in spatial development, describe frequently employed geographical references in connection with smart*: "city", "urban", "metro-area", "region", "territory", "rural", and "village". For each of these word combinations a strand of debate was defined.

Through the employment of various filter mechanisms[9] 146 titles were subsequently identified for our analysis of leadership through digital pioneers, representing approximately 1.4 percent of the 10,251 texts identified in the Web of Science dataset. The results of this methodological ap-
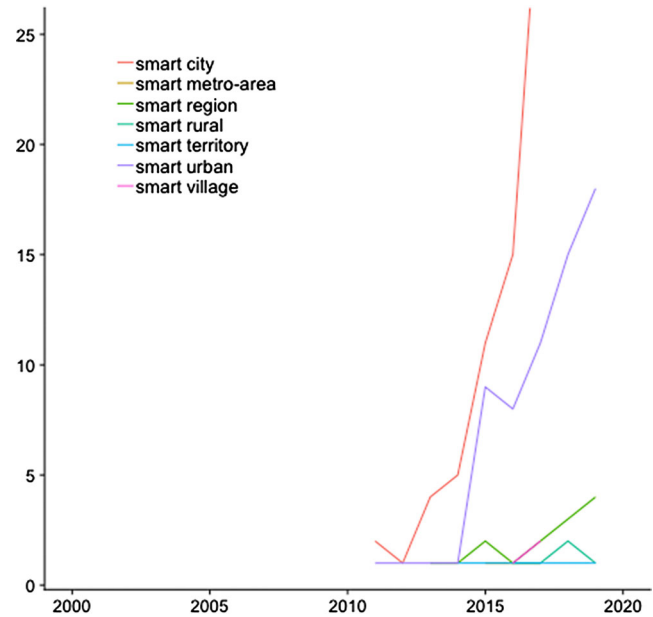

Figure 1 Temporal development of the debate strands (created with R-package dplyr)

proach were compiled into five figures which are presented in more detail in the following section.

Figures 1 and 2 display a clear upward trend with respect to both the number of articles as well as the citation of these articles. The majority of these articles were published in 2019 (min = 2011, 1. Quartil = 2016, median = 2017, 3. Quartil = 2019, max = 2019). The first publications we recorded were from 2011. Initially, development was dominated by articles on "smart cities", subsequently replaced by studies with "urban" or "region" as geographical references (Figure 1). Studies on digital pioneers outside the metropolises are almost completely absent from this sub-branch. Thus it can be seen that articles on smart villages only appear sporadically in the period 2016-2017, and are then replaced by articles on "smart rural". In contrast, the citations with respect to smart city and smart urban display continuous growth, which allows conclusions to be drawn on the development of the discourse. This tendency is also reflected in the citations, i.e. the cities are the primary geographical reference in the discourse (Figure 2). The citations with respect to smart region, smart territory and smart rural appear much later, beginning in 2013, and display far weaker growth.

Correlation tests show that, with respect to content, the debate strands are all developing in the same direction. The numbers 1 and -1 refer to 100 percent correlation and zero overlap in the use of the terms respectively. The positive correlation is represented in Figures 3 and 4 by means of blue points whose overlap also varies with the geographical
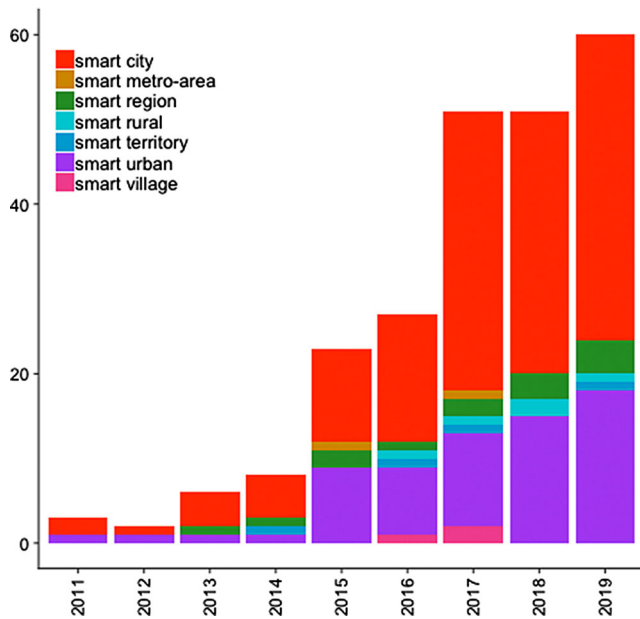
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[8] To this end the bibliographical entries for all the English language texts from the Web of Science Core Collection published before January 1 2020 (indexes: SCI-EXPANDED, SSCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, CCR-EXPANDED, IC) were loaded into one dataset ("Web of Science dataset"). The analysis concentrated on the following search algorithms:.

TS = ("smart+rural" OR "smart+village*" OR "smart+region*" OR "smart+territor*" OR "smart+cit*" OR "smart+metrop*"+"smart+urban") *AND*LANGUAGE: (English).

The "Web of Science dataset" encompasses the following variables: authors (AU), year of publication (PY), title of the publication (TI), abstract (AB), key words (ID), publisher (J9), reference to scientific disciplines (SC), funding (FU) and debate strand (DS). The first eight variables were adopted unchanged from the Web of Science. The last variable classifies the individual publications according to seven geographical references, i.e. entries in which the word "village" occurs in the abstract are ranked under "smart village".

[9] The first search request concentrated on key terms relating to leadership in the abstracts of the respective publications in the Web of Science dataset, in particular "influential", "pioneer*", "broker*", "facilitat*", "mediat*", "entrepreneur*". In a second step the resulting dataset was filtered for publications which contain the terms "digi*", "ICT", "IoT" as well as "internet" in the abstract (in the following summarised under the term "digital pioneer dataset").

Figure 2 Temporal distribution of the citations of articles in the respective debate strands (created with R-package dplyr)

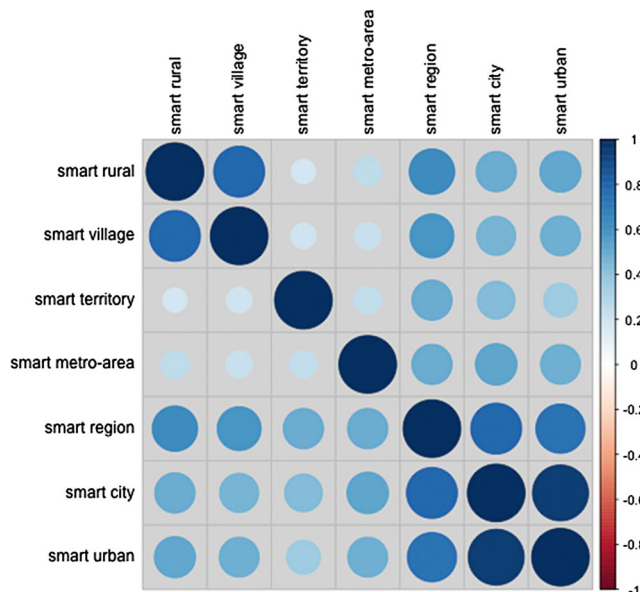**Figure 4** Tendency of the choice of words in the title (created with R-package dplyr)

Figure 3 Tendency of the choice of words in the abstract (created with R-package dplyr)

focus (brightness and size of the circles). The results point to the polarisation of the discourse along the city-country continuum (Figures 3 and 4). For example, Figure 3 displays combinations of the debate strands "smart village" and "smart rural" on one side, and the combinations "smart urban", "smart city" and "smart region" on the opposite side. This enables us to draw the following conclusions. The discourse has become spatially differentiated in terms
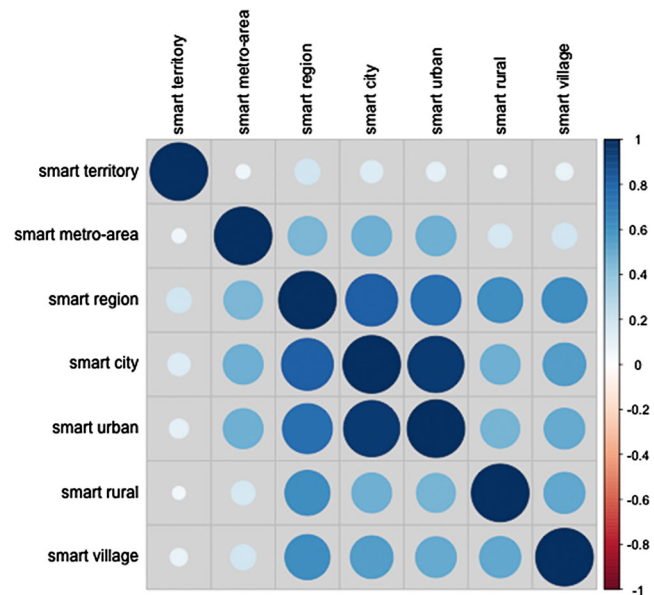
of research desiderata, and accordingly, scientific articles have become increasingly specific.

The visualisation of the most frequently mentioned terms in the abstract and the title (Figure 5) highlights that articles in the debate strands "smart city" or "smart urban" tend to address purely technical questions that apply to a multitude of problems. For example, terms such as "IoT" or "ICT" appear frequently in the abstracts from the debate threads on "smart city" or "smart urban". Terms associated with smart rural include "dairy", "village", "industry", "local", "sharing", "regions" and "innovation". Terms associated with smart villages include "rural", "dairy", "mapping", "maps" and "local". The selected methodology does not allow any further conclusions to be drawn with respect to content. The analysis of the content of the abstracts also shows that in fact there are only three texts which explicitly address the issue of regional development in regions of a rural character.[10] Nearly all of the studies examine urban phenomena.

In this first step, scientific publications were evaluated on a spatially differentiated basis and compared with respect to the number of articles and citations. In this context, attention was focused on the respective tendencies in the leadership research strand and its sub-branch on leadership through digital pioneers. By employing the quantitative

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[10] In terms of content the publications focus on the Internet of Things (IoT) (Marlintha/Irawan/Latuconsina 2017) WildNet (Kenyon/Mickelson/Anderson 2016) and e-governance (Vuppalapati/Kedari/Ilapakurthy et al. 2017).
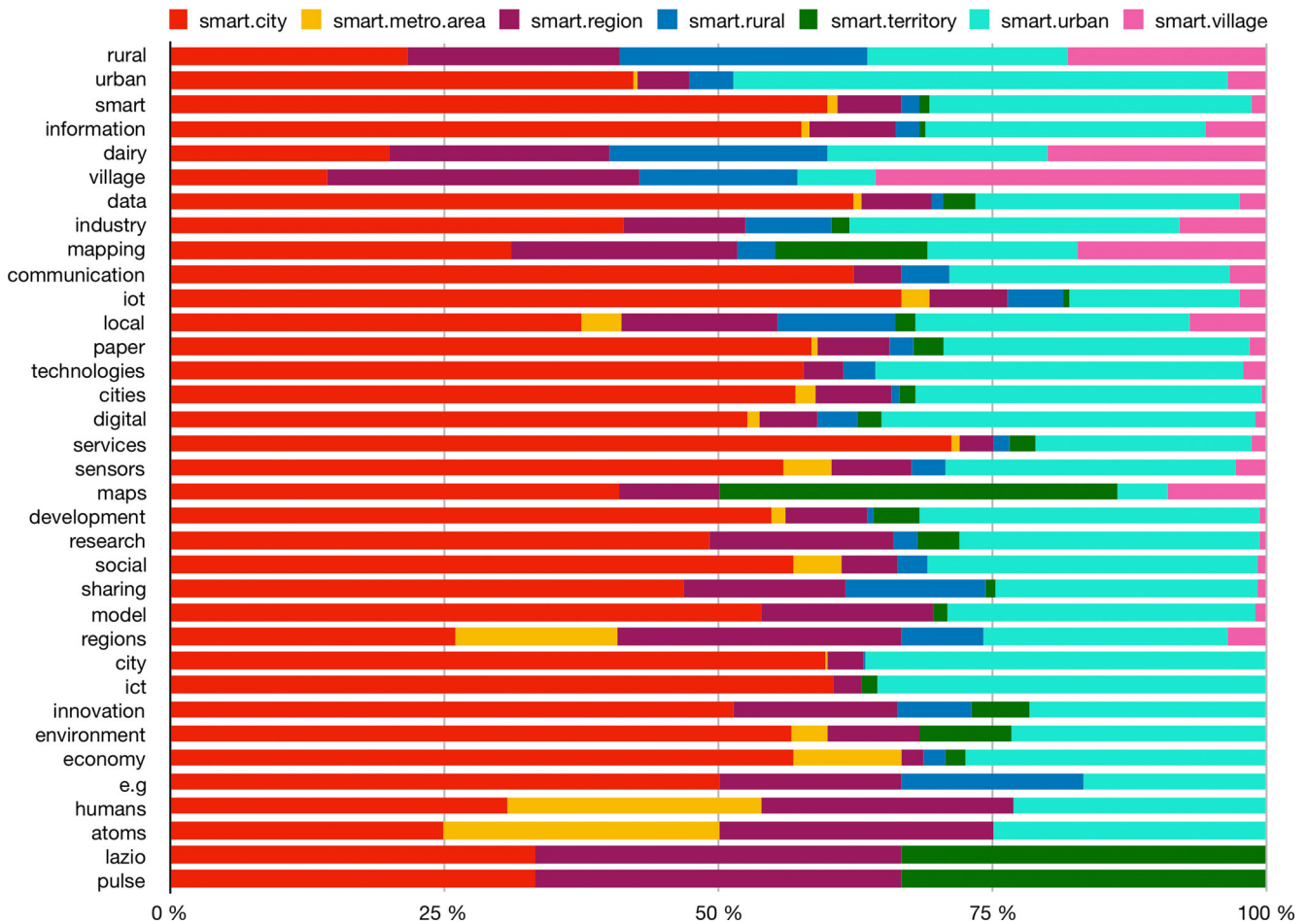
Figure 5 The top ten terms in the abstracts: Summarised for the individual debate strands (percentage of the total number of articles that mention the term in the abstract)

bibliometric method, it was possible to differentiate the discourse spatially.

4 Characteristics of digital pioneers through the place-based leadership debate

In order to establish variations in the approaches and findings in the discourse strand of leadership through digital pioneers via a qualitative analysis of the content of the abstracts, key questions were first derived from the leadership literature. Of fundamental importance here are the assumptions, to be reconciled with our initial hypothesis, that through leadership (a) paths for collective action are developed, (b) as a result capacities are generated which make it possible to grasp complexities and develop common visions for the future (Beer/Ayres/Clower et al. 2019) and (c) this enables changes in the existing rules, norms and value systems to be driven forward, with the goal of opti-

mising the capacities for leadership, and consequently social innovations (Sotarauta 2017). The preconditions for this include the will to change (Beer/Clower 2014) and the ability to expand capacities through a strategic approach (Bryson/ Hamilton Edwards/van Slyke 2018) in order to mobilise the corresponding resources (Sotarauta/Beer/Gibney 2017).

Leadership can be exercised by both individuals and collectives. According to Budd and Sancino (2016), both informal as well as institutionalised constellations of actors, e.g. networks or organisations, can assume a leadership role. Behind the concept of leadership lies the assumption that change cannot be effected by a linear, top-down directed process (Grint 2010: 365). Instead, leadership is characterised by an agency perspective, enabling potential locally active stakeholders to be identified and mobilised. For example, Beer, Ayres, Clower et al. (2019: 173) argue that leaders are seen to be responsible for developing pathways in collective action, and hence provide support for actors to broaden their capabilities to understand complexity, clarify vision and construct shared mental models. Thus, through

leadership, paths for collective action are developed in order to generate common visions for the future.

In addition to these actor-specific characteristics, the debate also addresses the socio-spatial contextual conditions for leadership (Gailing/Ibert 2016; Benner 2020; Grillitsch/Sotarauta 2020; Sancino/Hudson 2020). Leadership is not based on the activities of a single, rational (all-seeing) key figure who operates outside of any system (Uyarra/Flanagan/Magro et al. 2017: 563). The discourse on leadership within urban and regional research builds, to a large extent, on the sociological debate on leadership in socio-political transformation processes (Grint 2001; Jackson/Parry 2008; Grint 2010).

In order to provide a systematic description of the characteristics of leadership situations, we developed a set of variables drawn from Gailing and Ibert (2016). The social contextual conditions can be summarised under the categories person, process and purpose. Process encompasses all those characteristics which define the field of action within which leadership operates, for example the networks, relationships and rules via which key figures exchange resources (including knowledge) regarding specific content and challenges with other actors. The concept of the person addresses individual or collective configurations for a leadership role (Budd/Sancino 2016). This is also connected to characteristics which describe the participation process pursued by the person in a leadership role (e.g. bottom-up or top-down). Orr und Bennett (2017) point to the category of purpose, i.e. the normative legal and moral arguments which leadership uses to justify the existent or non-existent need for specific actions in order to mobilise collective actions. What is at stake here, amongst other things, is the strategic design of policy content with the goal of initiating collective transformation processes (Gailing/Ibert 2016). These categories are mutually dependent. For example, process for leadership in top-down decision-making processes distinguishes itself from process for leadership in local bottom-up decision-making processes with respect to the composition of the network. In the first case it is primarily composed of a small number of civil actors, in the second case it is a large trans-departmental or trans-sectoral group. Furthermore, process is also distinguished by the type of interaction, i.e. is it a one-off top-down exchange of information (e.g. citizens' assembly) or repeated consultation on an equal footing (e.g. professional consultation).

The immediate spatial contextual conditions which influence leadership can be summarised under position (Budd/Sancino 2016; Sotarauta 2017), which is why one of the goals of leadership is to strengthen their position through institutional changes (Tama 2017). For example, clear sets of rules can be used to prevent conflicts over the purpose of leadership. Also of importance here are the informal

structures which can determine the position of leadership in an action context. In socio-political structures based on uniform moral values and clear laws it is easier to communicate the purpose and the position of leadership (Benner 2020). Thus it is possible "to establish the roles of key figures in dealing with these spatial constructs" (Gailing/Ibert 2016: 401).

In this context, Bryson, Hamilton Edwards and van Slyke (2018) also emphasise the variability of these institutional framework conditions with respect to the affected department and political field of action (e.g. education, transport). Here reference is made to the performance of the leadership. Rodríguez Bolívar and Meijer (2016) point to the various impacts of performance. It can refer to instrumental changes, such as a more effective configuration of information flows in an established network. Fundamental changes can basically alter the socio-spatial contextual conditions for leadership, e.g. strengthen interaction with civil society via participative formats, and also generate visible changes in the respective socio-spatial context (e.g. economic growth, social integration, ecological performance and well-educated citizens). Furthermore, change occurs over different temporal ranges, which can also alter the preconditions, and thus the effectivity of leadership (Gailing/Ibert 2016). For example, leadership can adjust its position at time Y by means of changes in purpose at time X in order to initiate the necessary institutional changes and thus proceed from an advantageous institutional position at time Z (Sotarauta/Beer/Gibney 2017). In individual cases, transformations can also occur in a punctuated fashion via rapid transformation processes. This is especially the case when a window of opportunity opens which leadership knows how to strategically exploit (Uyarra/Flanagan/Magro et al. 2017; Benner 2020).

It is possible to derive a set of variables, and thus associated key questions (Table 1), from this leadership debate, on the basis of which leadership situations can be systematically described and distinguished from one another.

We identified initial approaches to the definition of leadership types within urban and regional research into leadership. For example, Gailing and Ibert (2016) distinguish between the socio-spatial conditions for leadership at the local level (defined as "leadership") and leadership in complex, multi-dimensional constellations (defined as "governance pioneers"). On a similar basis, Grillitsch and Sotarauta (2020) distinguish between place-based leadership and institutional entrepreneurs. To date, these heuristics have existed side-by-side. Consequently, it remains unclear, for example, the extent to which the institutional pioneers and the global brokers constitute two equivalent units of analysis and whether empirical findings based on these heuristics can be compared.

Table 1 Categories and key questions for the description of leadership

Category	Characteristics	Key questions for the definition of the characteristics	Source
Person	Individual	Is the transformation process under study driven forward by an individual or a group?	Budd/Sancino (2016); Beer/Ayres/Clower et al. (2019); Sancino/Hudson (2020)
	Network	Informal group: Is it an informal, i.e. voluntary association of individuals?	
	Institution	Formal group: Is it an association subject to a contractual, legal structure?	
	Will	The person is willed to actively shape the transformation and	
	Knowledge	has the necessary specialist knowledge, i.e. skills relevant to the situation;	
	Creativity	has multifaceted knowledge enabling them to think and act outside the established structures;	
	Competence	has the capacity to grasp, pass on and apply existing knowledge?	
Process	Forums and their characteristics	Who does the person want to include?	Sancino/Hudson (2020)
		In which form does the person want to include these actors (e.g. on the basis of hierarchical principles (top-down) or equality (bottom-up))?	
		How frequently does the person want to include these actors?	
	Characteristics of the relationships	Are the actions of the person benefited by certain relationships (e.g. interaction with the mayor)?	Hambleton/Howard (2013)
	Network structures	Are the actions of the person benefited by their position within the network of relationships (e.g. broker position)?	Sancino/Hudson (2020)
Place	Infrastructure	Are the actions of the person benefited by their access to infrastructures (transport connections, educational institutions)?	Gailing/Ibert (2016)
	Spatial structure	Which socio-spatial structures should change, are changing, will be transformed (timeframes, content, geographical range)?	
Purpose	Explanatory model	On the basis of what explanatory model does the person justify their actions?	Hambleton/Howard (2013); Orr/Bennett (2017); Sancino/Hudson 2020
	Rules	Are the actions of the person obstructed or promoted by written rules (e.g. does the person operate within the framework of a mandate)?	
	Norms	Are the actions of the person obstructed or promoted by unwritten, culturally mediated rules?	
Performance	Duration	What changes are actually effected by the person – instrumental changes (e.g. a more effective configuration of information flows)	Rodríguez Bolívar/Meijer (2016)
		– fundamental changes (e.g. changes to the socio-spatial contextual conditions) for the optimisation of leadership	
		– generally ascertainable changes (e.g. economic upswing)	

The review of our 146 abstracts and title texts makes it clear that the most frequently examined characteristics are person and performance (Figure 6), with place as an intermediate variable. Accordingly, concepts decisive for leadership such as process and purpose are hardly addressed in the contemporary discourse. We intend to address this research gap and make a contribution to this issue with our project.

To sum up, the bibliometric analysis of the status of research until December 2019 shows that there is a positive correlation between urban and rural smartness research, but that it is not possible to talk of a single strand of discourse. More precisely, it is possible to identify two strands of discourse (urban/rural) here (Figures 3 and 4). Of the 10,251 publications from the Web of Science dataset examined, only 2.1 percent contain indicators which point to a re-

search focus on rural regions. This difference is greatest at the lowest level (digital pioneer dataset, N=146). Here the rural publications make up less than 1 percent of the dataset. In terms of content, the urban strand tends to concentrate on solutions based on information and communication technologies and the Internet of Things as applied in the areas of energy and transport, while there is no such focus on specific content in the rural strand of smartness research. The focus on information and communication technologies and the Internet of Things solutions can also be observed in the subordinate strands of the debate. However, what is less evident are the corresponding areas where these solutions are to be applied. The qualitative analysis of the content of the 146 publications on leadership through digital pioneers confirms this tendency. It also shows that texts, despite the presence of corresponding indicators, do not nec-
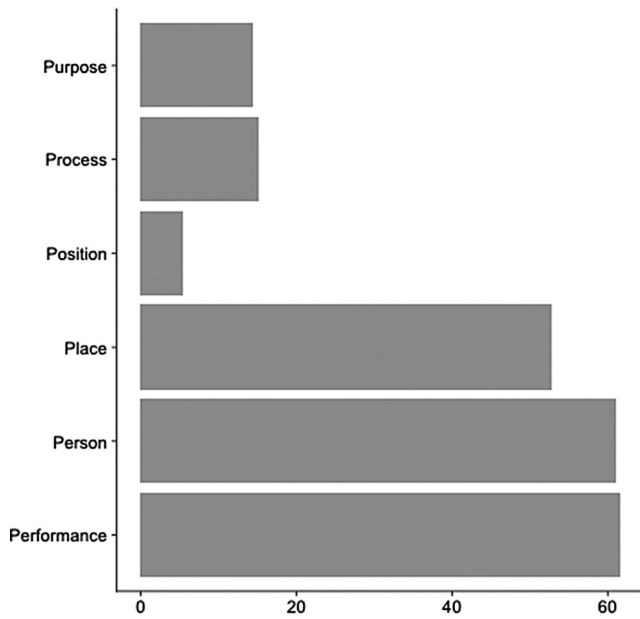
Figure 6 Qualitative analysis: Proportion of all the texts, which address the examined leadership characteristics in the abstract or the title (created with R-package dplyr)

essarily involve a rural research focus. For example, small and medium-sized towns are associated with "rural", as exemplified by the article by Hosseini, Frank, Fridgen et al. (2018). In other words, the rural smartness research in the discourse is effectively even less developed than one would expect from the results of the quantitative analysis. An example of a rural study is Gugerell, Penker and Kieninger (2019). The authors examine the performance of "cow sharing". The majority of the 146 publications examined proceed from the assumption that the pursued changes can only be achieved by means of information and communication technologies or Internet of Things solutions. In this approach, the human factor is ignored. Rose (2017: 779) also speaks of "posthumanist philosophies to theorize the agency of the technological nonhuman". Although individual studies refer to the need to develop strategies to ensure that the results of this transformation are socially just, they do not directly address the driving forces that could bring about such a paradigm change. In other words, the persons or institutions behind the technologies or their spheres of action are not examined here at all. A rural example of this

is Kenyon, Mickelson and Anderson (2016). The authors evaluate the concept of the performance of Wi-Fi Long Distance (WiLD) and Television White Space (TVWS) in rural regions of Papua New Guinea, however without directing their attention to agency.

A relatively small number of studies address the issue of digital pioneers (146 publications). The findings presented here also point to the need to examine relationships between people and technologies as characteristics of leadership under the category place, especially in studies on leadership through digital pioneers. Accordingly, the list of key questions in Table 1 is supplemented with two questions under the category place (Table 2).

5 Conclusions

Three lessons can be taken away from this discussion. First, the quantitative bibliometric analysis has shown that research into digitalisation primarily refers to the spatial dimension of the city. Furthermore, our analysis of the key terms employed in the abstracts makes it clear that digitalisation research has a core interest in the application of information and communication technology to the improvement of the urban metabolism. Finally, the analysis of the scientific reception of leadership shows that the characteristics of key figures can be systematically pursued via key questions relating to person, place, process, purpose and position, but that to date this has been hardly addressed (Figure 6). As initially noted, a systematic description of the characteristics of leadership is a precondition for comparative studies and thus the development of theory.

With its meta-analysis of the bibliometric data, this study has exposed this research gap. The methodological limits of this approach are clear to see. The bibliometric analysis, with its inclusion and exclusion of semantic markers, failed to provide any definitive statements on the substantive strands of the discussion. For example, the selected terms territory, region and metroregion remain vague. Urban-rural relationships are not represented, and the selected methodology also proved unable to integrate hybrid understandings of space into the discussion. Accordingly, the potential of future research into rural regional development is to be found in the overlaps and correlations between the two

Table 2 Additional key questions for the definition of leadership through digital pioneers

Category	Characteristics	Key questions for the definition of the characteristics	Sources
Place	Information and communication technologies (ICT)	Are the actions of the person benefited by ICT solutions?	Qualitative analysis of abstract contents
	Internet of Things (IoT)	Are the actions of the person benefited by IoT solutions?	

discourse strands. It is here that qualitative research must be applied, with the goal of understanding the interfaces. The nexus of the urban-rural continuum must be the focus of attention. The research on digital pioneers attempts to address this hiatus. With its emphasis on agency and regional development, it aims to understand the strand of research on rural areas via a dedicated socio-spatial approach. Thus, in a further step, digital pioneers from two German regions will be interviewed concerning their co-operations and networks (see footnote 3). The results promise to provide far-reaching insights, facilitating an understanding of the role of digital pioneers in regional governance.

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