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Debordered Materiality and Digital Biographies: Digital Transformation in Rural-Peripheral Areas

Julia Binder & Ariane Sept *

Abstract: »Debordered Materiality und Digitale Biografien: Digitale Transformationen in ländlich-peripheren Räumen«. Our paper addresses the interplay between digitalization and spatiality, asking how digital transformation processes are affected by peripheral spatial location. The short-term processes of digitalization and its implications for spatiality are widely addressed, especially with regard to urban development and planning, but rural-peripheral areas and periods of medium duration are only rarely the subject of research. Therefore, from a spatial planning perspective our central question is: What role is attributed to materiality in digital social transformation processes in rural-peripheral areas? Employing a multi-sited methodological approach – a sample in two rural regions and two villages in Eastern and Western Germany – the focus is placed on individual digital biographies related to physical, information, and communication technology artefacts. Against the backdrop of Karen Barad’s concept of materiality as a constant intra-activity, we discuss digital transformation at the margins with respect to the aspects of newness, specificity, and qualities. This allows us to show different sequences of digitalization that are characterized by specific roles for materiality and spatial location, the changing importance of peripherality, and increasing debordered materiality.

Keywords: Digital transformation, digital biographies, rural-peripheral areas, New Materialism, spatial development, Germany.

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1. Introduction

In recent years, many scholars have dealt with the transformative impact of digitalization that is reflected in an increasing number of academic knowledge productions (special issues, political funding programs, and transdisciplinary formats). Digital processes describe dynamics with multidimensional effects, both manifested in space and time. Although the temporal processes of digitalization are broadly addressed, less attention is given to the spatial dimension.

By digitalization, we understand “the structuring of many and diverse domains of social life around digital communication and media infrastructures” (Brennen and Kreiss 2016, 560), which are also driving current socio-spatial transformation (Knoblauch and Löw 2020). In our conceptual understanding, we follow Brennen and Kreiss (2016, 560) and Porsche (2021, 158), according to which digitization refers to a change in the modus from an analogue to a digital format, while digitalization is understood as the process of implementation and use of information and communication technologies (ICT), including digital communication and media infrastructures.

Placing a particular emphasis on temporality, many interesting questions emerge, such as the radical, disruptive potential of new digital technologies to transform society, or the historical-structural perspective of the Braudelian concept of *longue durée*. With this paper, we focus on the interplay between the digitalization and spatiality of a *moyenne durée* of around 40 years, asking how spatial location affects digital transformation processes. Against the backdrop of peripherality as a central methodological characteristic, this paper draws on two data sets that were generated between 2019 and 2021 and were thus partly affected by COVID-19 restrictions and transformations.

Understanding sociotechnical upheavals as transformation periods that generally extend over a period of up to 30 years, it is clear that transformation does not occur as a rapid collapse of existing sociotechnical orders or their radical replacement (Dolata 2011). Moreover, digital transformation is characterized by a spatial non-simultaneity, meaning different speeds in the implementation and use of digital technologies in different places. To elaborate further on this aspect, we address ICT with respect to digital biographies, understanding transformation as a socio-spatial process within the interplay of planned and undirected transformation (Kollmorgen, Merkel, and Wagener 2015). With this in mind, digital social transformation can be viewed as a disruptive process that is closely interlinked with the socio-material environment and its technologies. Nevertheless, the sociologist Armin Nassehi describes the everyday experience of digitalization as a “disruptive technology” due to its character of invisibility (Nassehi 2019, 244). We take his idea into the discussion of the empirical section of this paper, providing a contrasting

argument with reference to physical information and communication technology artefacts.

Uneven spatial development in Germany with respect to digital technology was already addressed in 1987, but with a different terminology (“teleinformatics,” ARL 1987; Floeting and Grabow 1998). At that time, it was assumed that suburban and even rural areas would benefit as companies increasingly moved their headquarters out of cities due to cost advantages and employees increasingly engaged in telework. These scenarios did not initially materialize; instead, the provision of digital infrastructure was to become a game changer. The technological infrastructure, abbreviated to information and communication technologies, is not a public realm, but subordinated to a liberalized market. Thus, digital transformation in rural areas is less influenced by tech-companies setting up ICT infrastructure (Porsche 2021, 166), as there is less demand and hence less data volume in sparsely populated areas. With these different spatial conditions in mind, our paper, with its empirical approach, aims at reflecting on the heterogeneity of digital transformation in rural peripheral areas.

Current research on rural areas acknowledges the growing importance of digitalization for rural development (Naldi et al. 2015; Williger and Wojtech 2018; Hosseini et al. 2018; Weith and Köhler 2019; Meyn 2020) without, however, looking in detail at material aspects within digital social transformation as part of the interface between digitalization and rural development. Moreover, most of these spatial analyses focus on the period when the Internet was also becoming increasingly widespread in private households, i.e., from the early 2000s onwards. Rural areas, especially with the rise of mobile applications and devices, received increasing attention, for example with regard to digital multilocality (Bürgin et al. 2022), digital social innovations (Sept 2020; Zerrer and Sept 2021), or rural coworking (Hölzel and de Vries 2021; Mariotti and Di Matteo 2022). Earlier digitalization experiences, however, are rarely included in these spatial studies. To address these gaps, our central question is: What role has been attributed to materiality in digital social transformation in rural-peripheral areas since the 1980s?

The Internet is considered a major component of digital transformation. In Germany, the first email was received in 1984 by the researcher Michael Rotert at the University of Karlsruhe, who was sent a message of greeting from Laura Breedon in Cambridge via the US platform CSNET. After the U.S. National Science Foundation decided to make the Internet available for commercial purposes in 1990, it was given a rapid boost in 1993 by the World Wide Web (WWW), when the first graphics-capable web browser, named Mosaic, was released and made available for free download. In 1994, the number of commercial Internet users exceeded that of scientific users for the first time.¹

¹ <https://www.uni-giessen.de/fbz/svc/hrz/org/mitarb/abt/3/zms/schulung/webtechniken/internet/historie> (Accessed January 21, 2022).

In 1997, a well-known search engine went online under the name Google, the social media app Facebook began in its current form in 2004. Between 2002 and 2020, the proportion of private households in Germany with Internet access rose from 46% to 96%. The introduction of high-speed Internet via DSL or glass fiber cable became a new technological marker. In international comparison, rural areas in Germany were particularly poorly connected to high-speed Internet for a long time (BMVI 2016, 7). Even though broadband expansion is making increasing progress, in 2020 the gap between urban and rural areas was still highly relevant, especially in relation to high-performance broadband, with a 56.5% discrepancy between the urban and rural spatial categories (BMVI 2020a, 10).

From a material point of view, the spread of the personal computer primarily spurred digitalization. Starting with the professional use of computers in companies and universities, this was followed in the 1980s by computer games, which played a special role in bringing the devices into private households. In addition to the aforementioned WWW, the development of digital telephony and Voice over Internet Protocol (VoIP) also represented a major step into the digital age. Here, it was the introduction of nationwide digital mobile communications networks (D-Netz in Germany in the late 1980s/early 1990s) that drove the spread of mobile devices. Both developments culminated in 2007 with the introduction of the iPhone, which finally combined the WWW and mobile telephony in a single device. Today, smartphones are omnipresent and strongly linked to everyday practices. Overall, digital technologies and media have been introduced into all areas of social life, and with them everyday practices have changed (Krotz 2001; Hepp 2013; Hepp and Krotz 2012).

The short-term processes of digitalization and its implication for the restructuring of everyday life are widely addressed, especially with regard to urban development and planning, e.g., new forms of mobility (Nadler and Fina 2021), governance (Kaczorowski 2017; Bauriedl and Strüver 2018; Soike and Libbe 2018), and economy (Busch et al. 2021). Rural regions, on the other hand, are often viewed as deficient with respect to digital connectivity (Bürgin and Mayer 2020) and an urban-rural digital divide is posited (Townsend et al. 2017; Salemink, Strijker, and Bosworth 2017; Wiechmann and Terfrüchte 2017; Cowie, Townsend, and Salemink 2020). As Porsche (2021, 164) states for the German context, the smaller and more peripheral a settlement is characterized, the less broadband connectivity it enjoys.

To answer the aforesaid question regarding the significance of materiality in digital social transformation in rural-peripheral areas since the 1980s, the paper is structured as follows: Section (2) addresses the theoretical background from a New Materialism perspective to describe the link between materiality and digitalization. In section (3) we discuss the multi-sited methodological approach and reflect on the specific conditions of digital

transformation in rural-peripheral areas, followed by section (4), which reflects on the empirical data of the sample. In the final section (5), we highlight the aspects of specificity, newness, and qualities of digital transformation, and conclude with reflections on the pitfalls of multi-sited digitalization research.

2. Digitalization and Materiality

Current research on digitalization and materiality suggests their theoretical framing as radical innovation. Paying reference to Geoff Mulgan's definition of social innovation (2019, 10), we define radical innovations as "innovations that are radical both in their ends and their means." We highlight two perspectives of Science and Technology Studies (STS) and Radical Feminist Geography, namely Thomas Peter Hughes's "The Evolution of Large Technological Systems" ([1987] 2012) and Karen Barad's "Agential Realism" (2003). It is Hughes's integrative sociotechnical approach and Barad's dynamic conception of materiality that enables digital transformation to be thought of as radical in its end and its means.

Three aspects of special interest will be addressed in our analysis: What is *specific* about social changes regarding digital transformation, what is *new* about the modus of digitally induced social change, and what are the specific *qualities* of digital technologies.

The American historian Thomas P. Hughes was a pioneer in linking technical development to sociohistorical processes. Digitalization can be described as a sociotechnical system that is characterized by reciprocal relations: "Technological systems contain messy, complex, problem-solving components. They are both socially constructed and society shaping" (Hughes [1987] 2012, 45). Hughes addresses a broad conceptual definition of a "system" that includes physical artefacts, organizations, and legislative artefacts interacting with each other. These components are so-called "system-builder creations," which means that they were invented and developed by individual or collective actors. Technological systems have practical implications for solving problems or fulfilling goals (Hughes [1987] 2012, 47), such as a changed conception of space and time in terms of digitalization. The first aspect that leads to the question of what is *new* about the modus of digitally induced social change is the role of the user. Hughes states, "Modern system builders, however, have tended to bureaucratize, deskill, and routinize in order to minimize the voluntary role of workers and administrative personnel in a system" ([1987] 2012, 48). What can be framed as *new* is the central position of the user within the system. Taking user-friendly applications (as system components), design thinking (as organizational process), or intelligent artefacts (such as the intelligent i-Phone or the intelligent i-Pad), what they

all have in common is a changed positioning of the user within the system: users become prosumers. Digitalization as a sociotechnical system introduces the active element in the entanglement between actor and artefact. For example, the user is both consuming and producing in creating a tailored product in the webshop that is adapted to the user's needs. With regard to the Web 2.0, "prosumers simultaneously consume and produce ideas" (Ritzer, Dean, and Jurgenson 2012, 383), knowledge, or user-generated content. Nevertheless, our statement on the transformation of the user into the prosumer, that will be explored in reference to the empirical data in section 4, is not sufficient to reflect on the constituting role of materiality within this process. Here, we can point to the limits of Hughes's reflection, and instead need to turn to the New Materialism and Karen Barad's non-binary, non-arbitrary concept of materiality.

"Language matters. Discourse matters. Culture matters. There is an important sense in which the only thing that doesn't seem to matter anymore is matter." This is one of the key sentences in Barad's essay that formulates a critical stance towards the representational and linguistic turn (Barad 2020, 7). The American physician and geographer Karen Barad underlines the dynamic force of materiality, addressing questions of practices and agency in proposing a different understanding of transformation. According to Barad, materiality is not consistent, not given, not a product, but an intra-active agent and productive force (2020, 90). Understanding transformation as a constant de-limiting of borders is relevant for answering the question of the specific *qualities* of digital technologies. It is exactly the constant de-limiting of borders that characterizes digital transformation. Taking materiality as a constant intra-activity that is not determined through time and space, Barad proposes a radical new understanding of how to conceptualize transformation. It is understood as iterative intra-action, which constitutes and figurates materiality. In such a conception, intra-action is manifested within a phenomenon as an internal, mutual constitution of materiality and subject (see Garske 2014, 115). It is the concept of intra-actions that constitutes and reconfigures time and space (Barad 2020, 92). What Barad labels as "Posthuman performativity" (2003) is the relational approach to materiality that can be described as a relational ontology: human and object are not considered as separate entities, but as mutually constituting. Calling into question particular binaries and the very notion of the binary, Barad's approach helps us to think about the specific qualities of digital technologies as a dis/continuity that describes entangled spatial reconfiguration (Barad in: Juelskær and Schwennesen 2012, 19). Materiality itself is a factor in materialization, as we further argue in describing the specific moments of ICT-entanglement in digital biographies in rural-peripheral regions.

Highlighting digitalization as a socio-technical system that is both socially constituted and society-shaping, and stressing the transformation of the user

to the prosumer, our paper aims to describe digital transformation with reference to objects in individual narratives. These intra-relations in digital biographies will be traced through an integrated research design introduced in the next section.

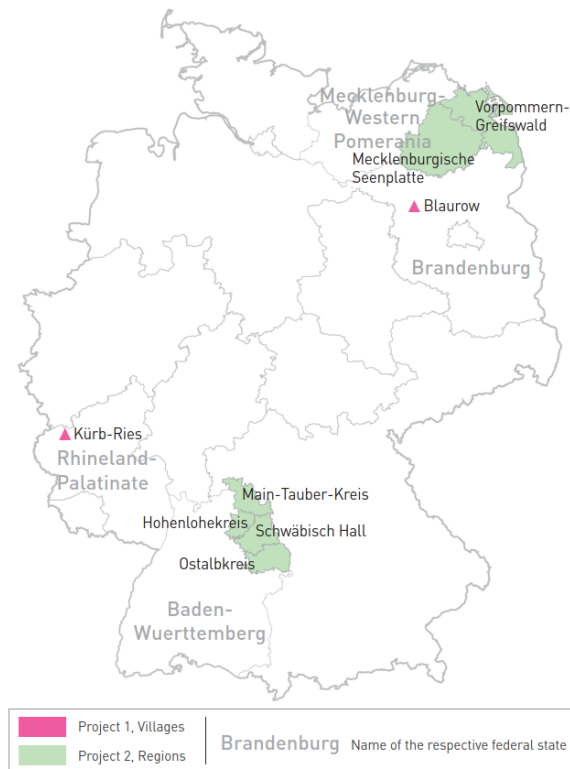
3. Methodology

Empirically, this paper relies on two data sets that were generated by two digitalization research projects in rural-peripheral areas: an analysis of two German villages and a study in two regions in Eastern and Western Germany.

Peripherality is defined as a specific spatial condition at the margins that is characterized as a non-central location in relation to a center. As de Souza (2018, 27) highlights, a “periphery indicates the outer ring of the hinterland defined by a center, or a kind of intermediary zone, distinct from the outer periphery.” Peripherality as a relational concept is defined through a spatial relation. The distance to the center is a key issue regarding peripherality at the local, regional, national, or global scale. For example, Popescu, Soaita, and Persu (2021, 2) point to the dynamics of unequal socioeconomic development between core and non-core regions. The authors name variables to address the characteristics of peripherality, including population decline, migration, economic dependence, and other processes of social polarization, focusing on the Danube region of Romania. With the common interest in the specific spatial condition at the margins, defined as “rural-peripheral” by the regional statistical spatial typology RegioStaR (BMVI 2020b), and as “very rural” with “aggravating and hindering socio-economic conditions” by the Thünen typology (Küpper and Milbert 2020; Thünen-Institut 2021), the sample employed in this paper is merged in accordance with its characteristics as rural-peripheral in both eastern and western parts of Germany (see Figure 1). In other words, we deal with sparsely populated areas, which means less agglomeration and a lower level of resources (de Souza 2018, 35). Figure 1 shows a mapping of the sample.²

² The villages’ and the villagers’ names are pseudonyms.

Figure 1 Mapping of the Sample (Own Elaboration)



The common spatial focus on digitalization processes in rural areas promises interesting new insights regarding the role of materiality in digital biographies. By digital biographies we mean narratives of one's own biography with reference to digitalization, especially along the dimensions of temporality, motivation for digital activities, formality, and sociality on the use of ICT, and types of devices (Calderón Gómez 2020). With our methodological approach, we do not follow the Calderón Gómez idea to categorize digital literacy related to the individual perspective, nor refer to biographic interviews and "life writing" (Arthur 2009, 74). Instead, we focus on narratives entangled with ICT within digital biographies to address the question of how digital transformation processes are affected by spatial location.

Inspired by the idea of a "multi-sited individualizing comparison" (Tuvikene, Neves Alves, and Hilbrandt 2017; Hilbrandt, Neves Alves, and Tuvikene 2017) in *Urban Studies*, we bring together distinct research projects across the common interest in rural-peripheral areas and their socio-spatial development in relation to digitalization. The basic idea of this approach is

that “bringing individual research projects into comparative reflective interaction fosters initially unintended but meaningful insights” (Tuvikene, Neves Alves, and Hilbrandt 2017, 284). Similar to Tuvikene, Neves Alves, and Hilbrandt, we do not aim to compare individual cases, but to take them as examples in order to discuss the common research interest in the role of materiality in digital social transformation in rural-peripheral areas. Furthermore, we refer to the claim of Baur, Mennell, and Million who suggest “scholars have to analyze social processes across different spatial scales and time layers” (2021, 18). While we refer to a period of about 40 years in both projects, the spatial level of reference constituting the sample – also within the individual narratives – varies between the local village and the region.

The data from the first project (P1) used here refers to two villages, Blaurow in Brandenburg and Kürb-Ries in Rhineland-Palatinate (see Figure 1). These data are based on expert interviews (with local and external experts), problem-centered interviews with local actors and residents, and document analyses. The fieldwork in the villages, including face-to-face interviews and participant observations, was carried out between July 2019 and February 2020. Due to the COVID-19 pandemic, further interviews were conducted by telephone or as video conferences between March 2020 and January 2021. The core material employed for this paper consists of 24 interviews, some of them part of the expert interviews, the others independent interviews with residents (13 in Blaurow, 11 in Kürb-Ries). As problem-centered interviews (Witzel 2000), the main aim of these interviews was to reconstruct digital biographies in rural areas via the individual narratives of the interviewees. We asked, for example, about early experiences with digital technologies, the digital devices they currently use, the first villagers with a computer, how our interview partners think village life has changed due to digitalization, or how they rate themselves in terms of digital technology use compared to other village residents along a scale from “digital pioneer” to “rather cautious.”

The second data set (P2) was collected in two rural-peripheral regions in the states of Baden-Württemberg and Mecklenburg-Western Pomerania (see Figure 1). To analyze cooperation and the networks of key figures in the private and public sector, we conducted 43 qualitative interviews with so-called “digital pioneers” that were named as such in the research design.³ The sampling was based on desk research followed by contacting approximately 190 regional multipliers (digital experts from administration, mayors, LEADER manager, head officials) and a call via social-media channels. This double approach also helped to identify hidden champions from the private sector. The qualitative part of the interviews focused on the interface between ICT and the regional scope of action, and the network analysis tool was used to answer

³ 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 (see Binder and Witting 2022, 269).

the question of spatiality in digitalization processes in rural-peripheral areas. Our paper refers to the first part of the dataset, e.g., the qualitative interviews. Hence a number of the questions were directed at reconstructing digital biographies with respect to ICT and the individual scope of action.

While in project 1 digital pioneers were defined as such in the field and by the interviewees themselves in terms of digital literacy, project 2 developed a proper definition in advance, monitored the two regions and composed the sample with key actors defined in this way. For the present paper, we have circumvented this problem of two differing approaches to the status of digital pioneer insofar as we have concentrated on those parts of the interviews in both projects in which the individual perspectives of the interviewees regarding their personal digital biographies come to light.

We will show in the next section how ICT-materiality frames digitalization sequences in rural-peripheral areas. In describing the role of the ICT-artefacts for digital biographies, we seek to understand ICT as intra-active entanglements that change the role from consumer to prosumer and the relationship of the residents to their location in the rural periphery. In order to describe digital transformation as an iterative reconstitution, we have introduced the term of debordered materiality, challenging the conception of object/subject as binary entities.

4. The Increasing Matter of Spatial Location: Depicting Digital Transformation in German Rural-Peripheral Areas

The research design charts digital transformation through individual references to specific moments in time (temporality) linked to physical artefacts (devices). Four temporal sequences can be derived from this: In the 1980s and early 1990s, the focus is primarily on experiences with the first computers or cell phones (4.1), and from the mid-1990s onwards, it is increasingly linked to places and digitization (4.2). With the final spread of the Internet from around the 2000s, spatial location as village or peripheral space also increasingly becomes part of the digital narratives (4.3). From the 2010s onwards, with the proliferation of mobile applications and devices, a new meaning of the users' role and peripheral location have become increasingly apparent (4.4).

Asked about their earliest digital experiences, interviewees mostly referred to the 1980s and to specific digital devices. However, there are differences between the Eastern and Western German communities. References to ICT-objects in the East German Blaurow do not begin until the early 1990s. In fact, computers spread somewhat later in the former GDR than in West Germany. Older villagers in the West German Kürb-Ries, who consider themselves

digital pioneers, and digital pioneers in Baden-Württemberg, begin their digital biographies as early as the 1980s – a time when companies were increasingly using computers, and personal computers were slowly entering private households.

4.1 Physical Artefacts in Digital Biographies since the 1980s – The Relevance of Haptic Encounters

With respect to their first digital experiences, villagers recall either computers, mainly at work, or computer games, mentioning both their own experiences and those of other villagers. Early experiences with digital technology are also often associated with emotions ranging from curiosity and excitement to fear and resistance. Christa, the chairwoman of the local history society in Kürb-Ries, remembers her first computer experiences during her training period:

Well, I started my training in 1982 and I was already working with computers then [...] All invoices, all incoming items, everything was microfilmed. [...] I also found it exciting, I thought it was great to work with it back then. It was quite terrible to control the microfilms. [...] And when you do it for the first, second, third time, you have to vomit, because everything goes round and round. [...] After that, I did the European computer passport. And then, after my parental leave, I worked in the parish office and only got the job because I was computer literate. (P1_D4_I09)

While Christa locates her early experiences in her own professional life, Florian, a member of the municipal council, primarily remembers others in the village who had early exposure to computers and perceived the spread of computers as a disruptive development:

I can remember the Commodore C64 at that time [...] That was somehow at the beginning of the 80s. [...] Then beyond that, I can remember someone else of my age who worked with a PC in the mid-eighties. [...] So, in the middle of the eighties it developed abruptly. Then a lot of people got computers. (P1_D4_I10)

For Helmut from Baden-Württemberg, who links the evolution of digital technologies to the transforming processes and organizational structures in the private sector, digitalization also means a radical transformation that started in the 1980s and was closely embedded in digital-affine family networks:

Then, in the 1980s, there emerged the computerized control systems. One did not spin oneself, but told the machine where to go and to produce the product. And then, it went another step further, then one produced the product digitally on the computer, this means, the construction was changed. Today, one builds a whole plant that might cost several million euro digitally. [...] My father founded the company, of course I experienced the whole transformation as a child. With the digital production of products and the computer-aided manufacturing, this popped up in the 1990s. [...]

The digital is just a tool [...]. I personally believe that the revolution we are facing is as big as the revolution of the steam engine. (P2_D01_I02)

In Blaurow, too, early experiences with digitalization are associated with computers in one's work life, but primarily with the early 1990s. Daniela, the volunteer layout artist at the village newspaper, remembers her digital empowerment in reference to the materiality of a computer:

That was right after the reunification, yes, at work. The thing [the computer] was there and then I said, "No way, I'm not doing that!" Yes, but you had to, and at first you had great respect, of course, and you were always afraid you'd do something wrong. But that's nonsense, and that's how it always developed. (P1_D1_I06)

In contrast to Daniela, who associates her first digital experiences with emotions such as resistance, fear, and uncertainty, Ulrich, a farmer in Blaurow, remembers, above all, the technical features of his early devices with detailed descriptions of the material components of the ICT-object:

And I actually had a computer since 1991, still such an old 2-86, then the 3-86, then the 4-86 and every year with a new processor in it, and when the old Intel Pentium came [...] That's why I say I've actually had a computer in my hands since 91, operationally. (P1_D1_I09)

When asked about early digital pioneers in the village, several interviewees in Kürb-Ries mentioned the entrepreneur Ivo and his father. However, there was less reference to fixed computers in the household than to the (mobile) car phone visible to all in the village, because "he [Ivo's father] still had a box in his car with a receiver on it and a dial and so on. There was a huge antenna on the car" (P1_D4_I08). Ivo himself also confirms this perception, linking the receiver on the car roof to his position as digital pioneer:

I don't need a PC. Why do I need a PC? Well, at some point I had one on my desk. But with the cell phone, I was ... I already had... When was that? Eighty-seven, I already had the first cell phone." (P1_D4_I11)

Overall, these examples show that individuals link the memory of their first experience with digitalization to material devices. For Daniela, the computer becomes a "thing," and Ulrich emphasizes that he had a computer "in his hands" for many years. Christa even remembers physical reactions when viewing the microfilms, and Helmut links materiality with digital processes. So, it is primarily the haptic and physical impressions that establish a link to a specific time and less to a specific place. The spatial (peripheral) location does not initially appear in these memories. Technical artefacts represent elements in the digital biographies which function to rebuild and reorder memories (Binder 2015, 64). Although other villagers had already had earlier and sometimes more frequent experiences with computer work, it is primarily the mobile object (antenna on a car roof) that leads to its owner being perceived in the village as a digital pioneer. Altogether, these first individual

experiences with physical artefacts constitute an initial sequence in digital biographies that is characterized by haptic memories tied to physical artefacts.

4.2 Place-Attachment and Digitization since the Mid-1990s – Spatial Location Matters

From the mid-1990s onwards, digitalization also exerts a stronger influence on spatial development. Although still tied to specific devices with material memories, concrete places and products in which analogue and digital combine are now becoming more significant. Thus, following the technical evolution of ICT, spatial location becomes more relevant in digital biographies.

For instance, Mark from Baden-Württemberg describes his digital biography in reference to his early experiences at school in the mid-1990s:

Yes, I have been a web and software developer since 1996, since my schooldays, since then I have organized several projects [...]. Since 1999 at the latest I have been doing it professionally and work as a software architect [...]. (P2_D02_I06)

In Kürb-Ries, for example, Ingo, a member of the voluntary municipal council, had the opportunity to re-use decommissioned computers from his employer, which the villagers then also used for joint product creation:

And I know that I took one with me and also one for the mayor of the village at the time, so we were certainly among the first private people here in the village, in the mid-90s [...] when this village chronicle has been written [...] on the first PC. Because I remember, the first 20 pages were written by Rosi without her saving them. (P1_D4_I04)

Several interviewees proudly mentioned the village chronicle of Kürb-Ries (published in 1997), which contains more than 400 pages. This book can be understood as a material artefact for local identification in which digital and analog materiality come together. While Ingo describes it as a product of the first computer in his house, the book is still displayed in the village hall and can be purchased to this day. Here, so to speak, with the help of the digital technology that was new at the time, a collaborative analog product was created that still contributes to identification with the village and place-attachment. The stories of other villagers also display such a linkage between analog products and digital technology, which we describe as digitization. One couple, for example, highlights the wedding newspaper that another villager had created for them with his first computer in 1995, which generated great excitement about the new technological possibilities for creating a professional product in a private context, even in the village. Here, materiality alludes to the symbolic dimension of place-attachment and spatial location.

4.3 Peripherality in Digital Biographies since the 2000s – The Relevance of Place

With increasing digitalization and the spread of the internet from the 2000s onwards, not only spatial location in general, but peripheral location specifically and a lower level of resources in rural-peripheral areas, appear to increase in relevance. In Blaurow in particular, reports of the 2000s speak of how the non-existent Internet, digital infrastructure, and poor mobile phone connections structured daily practices. To download emails, people drove to the Internet café in the nearest small town, processed them at home, and drove to the Internet café again. Cell phone conversations were mostly made on the street, as there were only a few points in the village with reception. With the connection of the villages to the DSL network in the early 2010s this changed, and for some of today's villagers, living in the village only became an option because of the broadband connection, e.g., digital infrastructure. Before that, Werner and his wife, for example, could not imagine turning their second home in Blaurow into a primary residence:

I don't remember exactly when these DSL connections came, I think in 2012 or 2011. That's when the possibility of living here and staying active actually first arose. (P1_D1_I02)

Therefore, it is hardly surprising that another villager is convinced that the dissemination of digital technologies in the village "actually started later, when smartphones came along" (P1_D1_I08). Norbert, who programmed a website for Blaurow and helps residents with technical problems, sees digitalization only actually arriving in the village with the spread of mobile internet-enabled devices:

So, this digital technology pretty much started here in the village with the smartphone or tablets. And concerning the normal people here, who sit on a tractor during the day or drive back and forth all day because they work in [...], of course not all of them had a PC. So, back then, it was actually the smartphone and then the tablet that made it possible. (P1_D1_I08)

Werner and Norbert both see a big leap in the digitalization of their home region only occurring from the early-to-mid 2010s. They attest to a certain backwardness of their region compared to less peripheral areas, both with regard to digital infrastructure (broadband connection) and with regard to digital devices (smart phones, tablets, computers). Different temporalities are perceived compared to central locations with respect to both the later introduction of Internet connections and devices, as well as high-speed and broadband connectivity, as for Sebastian in Kürb-Ries:

I have friends or acquaintances in [...] with whom I work well and gladly, or in [...], yes, but pushing large amounts of data there quickly is not possible. Sometimes I really do that at night. (P1_D4_I08)

The quote from Sebastian also clearly shows changed everyday practices due to the spatial location in the rural periphery. To avoid peak time, he performs the up- and downloading of data, even in 2020, at night. At the same time, with the increasing connectivity, the perception of peripherality has changed. While on the one hand the quality or speed of digital equipment is seen as lagging behind, on the other hand the sense of connectivity is increasing. Thanks to this feeling of being place-independent with the help of ICT, the sense of peripherality simultaneously decreases. Several individual narratives show this, for example, when Daniela relates the following:

Or now I've made a flyer, 30,000 of which are printed at the print shop in [...] and sent to the individual trade journals. I always think: Wow, that's crazy. Yes, created here in the small village of [Blaurow] and it appears all over Germany. (P1_D1_I06)

Werner describes it similarly:

I still work for a company in Finland, for a company in Holland, for a company in Romania, [...] and I'm based in [Blaurow]. And that works perfectly and I can talk to them via Skype, I can exchange all data and once a month I fly there. Whether I'm in the village or in [...] or in [...], it doesn't matter. (P1_D1_I02)

It is not only the remote workers themselves, but also other villagers who used these people as an example to show that they are not "out in the sticks." However, although the significance of location can shift through digital transformation, place still matters for rural areas as a location for small and medium-sized enterprises. This is especially true when it comes to attracting or retaining technically trained people in peripheral regions. As Michael from Baden-Württemberg states, spatial location also plays an important role in reference to entrepreneurial responsibility. Once a technology or digital company is located in a peripheral rural region, it requires effort to convince professionals with arguments concerning a location's quality of life:

In rural areas, there is not a technology company round every corner. It is very important to offer the appropriate culture and fairness, you don't just have to work hard to acquire a good reputation, you also have to do something to retain it. (P2_D02_I06)

Hence, being located in the periphery might offer new paths for local innovation, following the statement of Mark:

That you can develop your region brings many advantages in many directions. That you have the chance to develop pilot projects that we need to support other regions. This is also our vision; we want to develop good working locations that are necessary to sustain rural areas [...]. (P2_D01_I21)

Overall, our data reveal that with the spread of the Internet, an increasing connectivity has made it possible to work digitally in rural-peripheral regions, but that this has not led to a mitigation of unequal spatial development.

On the contrary, people seem to realize in everyday practices that they are located in the periphery, either because they can transmit data less quickly or because they are surprised to learn that they can work “even from here” and are not isolated. In this context, small- and medium-sized enterprises in particular have an additional responsibility to contribute to the development of the region as digital pioneers. Moreover, our data suggest that the digital divide only gained importance with the spread of the Internet and has been perceived as such from the 2000s. This is evident, not least, in the fact that the digitalization narratives now increasingly refer to the situation in the village, in the region, or in the periphery. Thus, the digital divide is not about different access to digital devices, instead it means unequal access to digital networks and the Internet as such, in relation to the spatial location in rural-peripheral areas.

4.4 Debordered Materiality and Digital Biographies from the Mid-to-Late 2010s – The User as Prosumer

The huge proliferation of mobile Internet devices and applications from the mid-to-late 2010s has led to a new relationship to materiality characterized by the intra-action of devices and agents with place, as well as use and production. This is what we call debordered materiality. A transformation of the users' role with respect to ICT has also become evident in the digital biographies of the sample. The Village App in Kürb-Ries exemplifies the link between peripherality, materiality, and the new role of the users as prosumers. This app was a central point of reference in many digital biographies where villagers connected digitalization to their location. As in many rural-peripheral areas, increasing numbers of community-building places of communication such as pubs, club houses, village halls, and stores have disappeared over the years. At a future search conference in 2017, initiated by the municipal mayor, the residents decided to tackle the problem of the lack of informal communication with the help of a digital tool. In their search for a suitable tool, they found a research institute that, as part of a pilot project, was in the process of developing a village app that would address their problems. They were primarily concerned with informally exchanging information with each other, but also with a “search and bid function, i.e., things that will be offered, but which should actually remain in the village” (P1_D4_I10). A few months after the first contact, the village app was launched, and soon more than half of the villagers had installed it. In a way, the app is linked to the location of the village, tackling concrete problems of the specific rural-peripheral area, and yet it can be used from anywhere in the world. In order to fulfil its purpose, users must feed in information via a digital device. Since the very beginning, there has also been a close connection between the users in the

village and the developers, so that the users' needs can be integrated into the technology, as described by Ingo for example:

And as soon as we notice something, we communicate that directly to them and we also monitor the app. [...] Well, they're still programming the app. Yes. So, we tell them how it operates live and where there are weaknesses. (P1_D4_I04)

Even if regular user surveys can be considered part of marketing strategies and product development, here we tend to be dealing with collaborative development between the private sector and civil society, as it is a constant exchange process within the framework of a non-commercial product that demands proactive involvement. Thus, we interpret such collaboration between developers and users, together with the production of content by the users, as a new role for users as prosumers. While this type of collaboration generally refers to a digital product and digital knowledge, the users' new positioning in the system is simultaneously reflected in an increased need for networking among actors to bring together the digital and the material. This can be seen, for example, in Helmut's narrative about ICT-related processes in his company that is located in the machinery supply sector:

This means, we work with digital models and create our products this way. To do this effectively it is important to provide the information to all those who are involved in the process and to network. This means, for example, if you need a special tool you need to document it from the procurement process through to its application, and also store the parameters digitally so that next time you can refer to a database that somebody has already investigated or developed. (P2_D01_I02)

Finally, an especially pertinent demonstration of the specificity of digital transformation with respect to materiality in rural areas is provided by agriculture. This economic sector, mainly predominant within rural areas, and discursively often associated with "rurality," is now pervaded by digital technology and new material arrangements have since consolidated, as Ulrich the farmer from Blaurow recounts:

When the combine harvester drives over the field, I can read out in the evening where and when and what I have harvested and how much. At the same time, it steers all by itself, I only have to sit on the seat, so I have time to play on my cell phone [...] It's not for nothing that we can run the farm with two full-time employees where normally 10 would have to work. [...] And I can look at my tablet or cell phone to see where my employee has been at what time, when he's taking a break, how fast he's going, whether he's driving in a loop, diagonally, or straight, and you can track all that. And then you can sit down in the evening and look at what you've been playing all day. That's why I say I don't need games on the computer, that's what the company is for. (P1_D01_I09)

Similar to Ulrich, the farmer Anni refers to precision farming when describing the entanglement of materiality and everyday work practice:

We are conducting very, very intensive precision farming in our company. This means we work with GPS-driven machines. It starts with steering and then continues with data that are transmitted to the machine to create the specific maps for sowing and maps for applications that are transmitted to the machine that take over the tasks automatically, to relieve the driver and to make possible a certain sow and application. I can't do it so accurately just by eye. (P2_D02_I03)

Ulrich refers here to a whole range of digital and analogue material devices, from combine harvesters to tablets, with which he enters into intra-action, mediated via invisible digital networks. Through the automatic employee data acquisition and the farmer's movements, the users simultaneously produce a spatial and temporal image of their work during the day. This constellation not only leads to debordered materiality but also to a dissolution of boundaries between previously separate activities such as work, gaming, and leisure in a firmly delimited space (Ulrich's farmland). Anni points to the next dimension of intra-active entanglements, referring to Artificial Intelligence that takes over human tasks in precise farming. Guided by the principle of effectiveness, not only do the boundaries between work and leisure become blurred, as has been shown from Ulrich's perspective, it is also accompanied by the substitution of human work by automated work.

Linking the technical evolution of ICT with digital biographies in rural-peripheral regions, the transforming role of the user as a prosumer has been highlighted with empirical insights. Thus, referring to digital transformation as related in individual stories, it can be seen that there are differences in the perception of such a transformation. In order to clarify this, we further point to the aspects of newness, specificity, and qualities.

5. Conclusion

This paper reflects on digital transformation, referring to digital biographies in German rural-peripheral areas. Regarding spatiality, it has often been stated that there is a growing digital divide between urban and rural areas with respect to the evolution of digital technologies, especially in the case of broadband connectivity. In reconstructing individual digital biographies on the micro level following the *moyenne durée* period of 40 years, this paper reveals growing spatial disparities (digital divide) together with the evolution of network-based technology and access to high-speed connections, followed by a slow reduction in the disparities. Although the individual stories linked to materiality in the 1980s and 1990s reveal place-attachment and different affinities to technology or equipment within the sample, a growing disparity within the technical evolution of information and communication technologies can be identified with respect to location and place, especially from the

2000s onwards. Thus, the use of digital technology has evolved from being a personal narrative to acquiring a spatial dimension. Ultimately, however, spatial location in peripheral regions no longer seems to be as important, as long as there is digital infrastructure, e.g., broadband connection. Digital infrastructure, again, seems to be an *a priori* for providing “equivalent living conditions.”

From a methodological point of view, our chosen approach of a multi-sited individualizing comparison helped us to identify the importance of materiality for digitalization in rural-peripheral areas. Building on the common research interest in digital biographies in rural digitalization processes, it was precisely the interplay of the two research projects that enabled us to clearly elaborate the significance of materiality over time. The different spatial focuses of the projects (villages in P1 and regions in P2) were less problematic than initially assumed, as the interviewees tended to link their individual digital biographies to materiality rather than place. However, the different presuppositions of the two projects, in our case with respect to the understanding of digital pioneers, remain critical. By focusing on the similarities in our projects, this approach allowed us to draw conclusions about materiality and the rural periphery in the context of digitalization processes, but not about the significance of pioneering behavior by actors in different areas of rural life. Thus, the lack of reflection on the potentially special role of digital pioneers in the rural periphery is a clear limitation of the present paper. More generally, the biggest pitfall of multi-sited individualizing comparisons probably lies in the different preconditions and basic assumptions of initially separate cases that are only linked together after data collection. In order to compensate for this as far as possible, numerous discussions are needed between the researchers involved, but also an open attitude to the data collected in each case.

Turning back to our three lines of argumentation, asking what is *specific* about social changes with respect to digital transformation, this paper provided a discussion on the intra-relation between actors and artefacts, e.g., the mutual constitution of the actor and materiality like the farmers Ulrich and Anni with their digital devices. Asking what is *new* about the modus of digitally induced social change, we reflected on the new role of the user as a prosumer whose everyday practices become entangled with information and communication technologies. Examining the specific *qualities* of digital technologies, our paper aimed to link physical artefacts to four temporal sequences in order to reconstruct digital transformation as a constant process of de-bordering. These four sequences are characterized by the specific role of materiality and spatial location in the periphery, the increasing and decreasing importance of peripherality, and a constantly developing debordered materiality. Even though these sequences roughly follow each other, they are not self-contained phases, but overlap in time and space. Starting in

the 1980s, physical artefacts, especially computers, and individual work experiences are the central elements in digital biographies. Both elements remain central, but with a view to the period from about the mid-1990s onwards, digitally created analogue objects are increasingly narrated and connected to the concrete location in the rural area. With the increasing spread of the Internet, but at the latest with the beginning of the 2000s, it is no longer just the place as such that appears in the narratives, but above all the location in the periphery, where digital connections are often difficult – or the other way around – digital work is now also possible. Finally, the spread of mobile devices manages to level out this perception of the periphery again somewhat and create new spatial references. For example, typical difficulties of the rural periphery are addressed with the help of specific apps, or agricultural production work extends into digital space and blurs boundaries. Despite the constant importance of digital devices, we observe a new -debordered – materiality in which object and subject, and in the future perhaps periphery and center, become indistinguishable.

Overall, bearing in mind that social digital transformation varies in terms of space and time, our paper focused on everyday practices in the periphery and related them to ICT for the period of the 1980s to the 2010s, identifying the role of the new prosumers as an intra-relation between the actor and the physical artefact. Taking peripherality as a transforming marker in the process of digital change, it remains for future research to conduct a long-term monitoring of spatial disparities with respect to ICT, digital infrastructure, and digital literacy. In other words, it is the dimension of the *longue durée* that needs to be addressed in future digitalization research in rural-peripheral areas. Furthermore, there is hardly any research on the digital divide with regard to different generations, even in the dimension of *moyenne durée*. The digital biographies approach makes it possible, for example, to take a closer look at younger and elderly people in urban and rural areas and to investigate the extent to which the digital divide between urban and rural also has a generational component.

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Digital Transformation(s)

Introduction

Stefanie Büchner, Jannis Hergesell & Jannis Kallinikos

Digital Transformation(s): On the Entanglement of Long-Term Processes and Digital Social Change. An Introduction.

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Contributions

Ole Hanseth

When Stars Align. The Interactions and Transformations of e-Health Infrastructure Regimes.

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All articles published in HSR Special Issue 47 (2022) 3:
Digital Transformation(s)

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