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Evolving Rural Life through Digital Transformation in Micro-Organisations

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Abstract:

The digital transformation of rural societies is in full swing. However, rural digital transformation is polarised into a slower one that transforms society, focused on improving rural residents' quality of life, and a faster industrial one. This participatory action research study is carried out in the four-year DigiBy project, based on the rural living labs approach, which operates in fifteen villages and three bookmobiles in rural Norrbotten County, northern Sweden. The project aims to adopt and adapt digital solutions to enhance rural retail services. Rural digital ecosystems like DigiBy aim to accelerate digital transformation so as to reduce the service gap and improve village living conditions. The key to such a transformation is an inclusive implementation of digital services, which seeks the active collaboration of various stakeholders, such as village associations, companies willing to adapt to rural situations, universities, municipalities, and residents. This article explores how low-tech digitalisation solutions in micro-organisations improve living conditions in rural societies by reducing the service gap between municipal centres and the surrounding villages. Our study is guided by social acceleration theory, providing a critical lens for understanding rural digital transformation.

Keywords: Digital Transformation, Rural Societies, Digital Retail Service, Adaptation, Action Research.

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1 Introduction

Rural societies are frequently explored within certain mental constructs of the "rural", namely that the "rural" is both peripheral and in crisis. This leads to a downgrading of the needs of the rural and reinforces a polarised understanding of rural societies (Arora-Jonsson & McAreavey, 2023). This polarisation is partly due to the formal representation of rural societies (Halfacree, 2006), which can be described as rural residents' perspective and their needs versus the urban perspective and view of the needs of rural societies. The concept of rural crisis emphasises rural societies' economic and social challenges and difficulties (Arora-Jonsson & McAreavey, 2023). Many rural societies exhibit common traits and challenges, such as sparse and elderly populations (Hodge et al., 2017; Räisänen & Tuovinen, 2020) and a significant service gap between villages and municipal centres (Erlingsson et al., 2023). Additionally, rural societies have their own ways of distinguishing their processes from those in central settings. The mental representations of "peripheral" and "in crisis" influence the everyday lives of the rural population, both on a personal and on a broader cultural level, often in line with the formal representation of the rural (Halfacree, 2006) and making the ways of the rural stand out as extraordinary (Arora-Jonsson, 2017). Consequently, instead of promoting a homogeneous digital transformation (DT) that connects people, we see growing digital polarisation (Lee, 2016; Morris et al., 2022; Roberts et al., 2017). This affects rural DT.

There are two distinct paths for DT in rural areas: one follows the needs and ways of the globalised society, and the other pursues the needs and ways of rural society, the everyday life in a village. The first concerns high-tech solutions transforming forestry, mining, and agriculture, including advancements in automated machines and digital work practices, leading to increased efficiency and productivity in industries and businesses (Mensah & Willén, 2022; Said et al., 2021; Srivastava et al., 2022; Stiernström, 2023). The latter includes social aspects, the service gap, digital skills, and place-based enhancement (Erlingsson et al., 2023; Hodge et al., 2017; Tillväxtverket, 2021), where low-tech, robust, and user-friendly solutions are important. Consequently, "…digital transformation cannot easily be isolated and limited to one organisation or as a driver merely for the business landscape; rather, it should be viewed as an all-encompassing trend that takes place everywhere around us" (Runardotter et al., 2020, p. 2). These two DT paths progress at different speeds and are characterised by distinct objectives and unequal investment in their realisation. When we conceptualise these paths as two subsystems, the industrial sector—governed from municipal centres with a globalised perspective—advances more rapidly than the subsystem of everyday life in rural villages, which operates under local governance with a rural perspective. This situation creates desynchronisation between these subsystems (Rosa, 2013). Change is often viewed positively when it leads to efficiency gains, such as faster production of goods, more efficient transport routes, and quicker information transfer (Kraus et al., 2021). Rosa (2013) describes the latter as technical acceleration, one of the three pillars of the theory of social acceleration. We show that technical acceleration occurs in villages as well, but the progress towards improved quality of life and culture on a broader level is not acknowledged to the same extent.

Kraus (2021) views DT through the lens of its technical, business, and societal impact, suggesting that DT reshapes not just business processes and organisational structures but also societal norms, and advocates using a holistic approach to understanding and leveraging the potential of DT to achieve societal benefits. It is therefore important to treat rural areas as a single system for DT, which means that the parts (villages) must be connected and interact (Wang, 2021), and the different subsystems must be acknowledged. The services and products must be developed and implemented in collaboration with stakeholders and users and provide support for those who are negatively affected by DT, emphasising empathy and collective decision-making (Chitrao, 2016). Kraus (2021) and Wang (2021) both argue for a comprehensive, inclusive, and integrated approach to DT, emphasising its potential to reshape societal norms and ensure social justice. Rosa (2013) advocates a critical approach that originates from people's experiences of inequality and takes account of their perceptions of a good life and the values guiding society. Rosa regards the ability to think and act freely—freedom as autonomy—as a fundamental value in modern society and puts it as follows: "Every critical theory poses the question of what the criteria for criticism are. What is a good life, and what is a bad one?" (Rosa, 2014, p. 9).

The present study focuses on DT in rural micro-organisations, such as retail stores and village associations, that connect local efforts to achieve comprehensive societal benefits by closing the service gap in sparsely populated areas. We explore DT in rural micro-organisations through the lens of social acceleration, a theory that describes how modern life speeds up through technical progress (technical acceleration), changes in activity patterns (social change) and expanded opportunities (acceleration of the

pace of life) (Rosa, 2014). Our focus is on how digital services used in rural retail stores and village associations can increase technical acceleration, i.e. acceleration in production, communication, and transportation, to reduce the service gap between municipal centres and the surrounding villages. We see society as a system of interdependent relationships that bind individuals together, governed by a common system of political authority (Giddens & Sutton, 2017). Thus, we emphasise the need to explore the possibility of aligning the technical advances driving DT with villagers' actual needs. Therefore, our research aim is to:

RA: Explore how low-tech digitalisation solutions in micro-organisations affect living conditions in rural societies.

We explore this issue by means of participatory action research (Bilandzic & Venable, 2011), utilising a rural living labs approach (Habibipour, 2021). In living labs with a research focus, it is important to distinguish between the research and the innovation processes, even though they are often intertwined and may be challenging to separate (Ståhlbröst & Holst, 2017). In the present case, the locus for the action was the DigiBy project, which tested digital solutions for rural retail. Nearly all the DigiBy services are still used almost two years after the project's completion. Furthermore, knowledge about how to enhance rural services through digital solutions continues to spread, with villages finding solutions through community collaboration. Our research process utilises social acceleration theory as its theoretical framework in order to explain the influence of urban norms of modern society on the DT of rural societies. This understanding is essential if digital services are to be adapted to the specific needs of rural communities, enabling them to participate in the transition towards more resilient and inclusive societies.

Before 2019, rural residents did not have access to digital services such as unstaffed rural retail stores, digital parcel boxes, co-working places, and digital support in bookmobiles. As such, Norrbotten provides a unique opportunity to understand rural DT by introducing digital services (Runardotter & Päivärinta, 2018). This is what the project DigiBy aims to challenge.

2 Theoretical Framework: Social Acceleration

Social acceleration is a critical sociological theory of modernity that highlights the centrality of time in modern society (Rosa, 2013). A critical theory considers social conditions, examining how and by whom the concepts of a good life and an inadequate one are defined. Modernity is defined by constant change, where growth and development are prioritised; as a result, acceleration and the scarcity of time become defining features of contemporary society (Eriksen, 2015, 2016; Rosa, 2013). Time is at the centre of acceleration, and we focus strongly on saving time. Aptly, Rosa (2013) has adopted Benjamin Franklin's famous motto "time is money" as one of three motors for social acceleration. We thus utilise the social acceleration theory to explain how rural DT, currently defined on the basis of an urban norm (Halfacree, 2006; Lindberg, 2024; Nyhlén & Gidlund, 2022), can be adapted to the context of contemporary society. We apply this theory as an explanatory framework (Gregor, 2006). Given the dominance of the urban norm in society, it is essential first to understand how DT manifests in rural areas before addressing the notion of a digital society for all (Runardotter et al., 2021). This aligns with what Gregor (2006, p. 624) describes as a "theory for understanding". This kind of theory helps us look at the world with other eyes and adds new perspectives to our understanding of it. The globalised perspective on rural areas is often indistinguishable from the industrial perspective (Stiernström, 2023), and this also shows in digital policy (Nyhlén & Gidlund, 2022). New technologies and services are being introduced with increasing specialisation to address specific applications and needs (Cowie et al., 2020). Our increasingly fast-moving society necessitates specialisation, which fosters competition and enables participants to operate within specific sectors. Specialisations within sectors share common goals, regulations, and laws, which create the potential for coordinated efforts to achieve common objectives (Brosing, 2023). This system is designed to function effectively in urban settings but proves less relevant or practicable in rural communities, where populations are sparse, and people live far from each other (Lindberg, 2024). In response we can see two subsystems of societal DT emerging in rural areas—one in villages and another in municipal centres. They are desynchronised and operate at different development rates. Rosa (2013) shows that societal systems have different development and acceleration rates. Faster systems put systemic pressure on slower ones, which risk becoming desynchronised. Erlingsson et al. (2023) describe this as a service gap and place its emergence in the period of municipal consolidations in Sweden, during the 1950s and 1960s. However, the two rural societal DT processes are often treated as a single entity by those representing rural communities (Nyhlén & Gidlund, 2022). While the theory of social acceleration helps us understand how human relationships are structured around information and communications

technology (ICT), it also reveals how ICT impacts society and people. We continuously seek more efficient uses of ICT and feel pressured to experience and accomplish more in a rapidly changing world. This pursuit of surface-level efficiency creates an illusion of progress but lacks depth in addressing more meaningful aspects of life (Eriksson, 2016).

The Swedish digitalisation policy has embraced the existence of a globalised society, where digitalisation increases competition, improves opportunities for comparison, and lowers prices. But it also brings challenges related to evaluating offerings, ensuring compliance with legislation, and maintaining consumer protection (Regeringskansliet, 2018). As a result, the policy focuses less on communication issues and more on the complexities of managing an overwhelming array of choices. However, for those living in rural areas, the digital benefits are far more restricted. A clear example of this disparity is the fact that rural residents often have to travel physically to access the benefits, for instance to a designated pickup point to collect their online orders. This was the case in Moskosel until the opening of their digitalised retail stores. Only the partly state subsidised postal company delivers “snail mail” and parcels to villages outside municipal centres. This is one of many examples illustrating how villages face significant limitations compared to the conveniences enjoyed in more globally integrated areas. These discrepancies could be said to amount to a democratic crisis (Rosa, 2013). The desynchronisation of societal DT further exacerbates inequalities between municipal centres and outlying villages, revealing that “efficiency” is aligned with urban norms and prioritises a comfortable urban life, while it constrains meaningful progress in rural society.

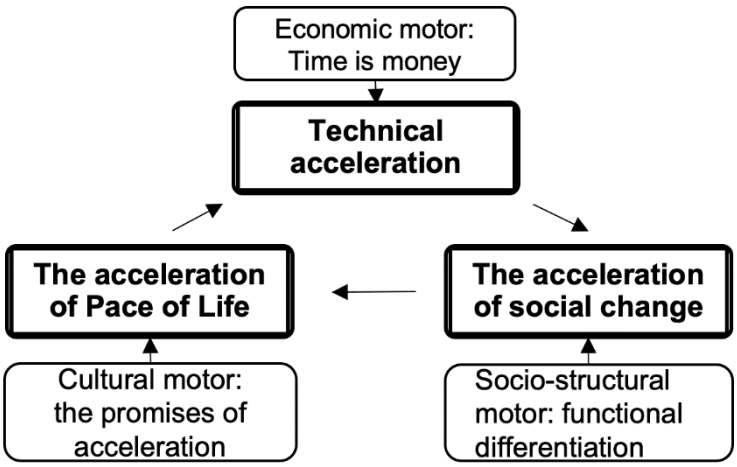

Figure 1. Circle of Acceleration, the Three Building Blocks that Construct an Ever-increasing Acceleration in Society, with its Driving Motors (Source: Rosa, 2013)

The theory of social acceleration encompasses three forms of acceleration: technical, social change, and the pace of life (Juge et al., 2022; Rosa, 2013; Rosa, 2022). These accelerations are related to each other and mutually reinforcing. Technical acceleration can be described as a deliberate increase in the speed of processes by the introduction of technologies that affect how we perceive time and space. As social and cultural change accelerates, traditional experiences and expectations quickly become obsolete, and the perceived duration of the “contemporary” is shortened. The increase of the pace of life is defined as an increase in the number of “episodes of action or experience” per unit of time, often accelerated due to a reduction in time resources (Rosa, 2014). The one-directional flow in the circle of acceleration reflects Rosa’s (2013) view of the systemic nature of modern acceleration. The starting point lies in technical acceleration, as its driver is primarily economic, such as maximising productivity and profitability. Social change follows, as technical advances reshape how society organises itself. The pace of life accelerates as individuals try to adapt to the constant societal changes.

Rosa (2013) discusses technical acceleration and how technology increases the speed of transportation, communication and production. As these processes accelerate, time shrinks, or space is compressed. The introduction of information technology into society speeds up all these processes, especially communication, as societal structures and our social connections/interactions change with the emergence of location-less communication.

In a rural context the motors of the circle of acceleration are key (Lindberg, 2024). The motor for technical acceleration "time is money" points to the possibility of buying the time it takes to acquire new knowledge of how to perform a certain task. We save costly time by purchasing knowledge (Burenstam-Linder, 1969). The problem in rural areas is that it is difficult to find specialised knowledge locally. In reality, villagers do not save time by purchasing knowledge, partly because of the effect of the socio-structural motor, functional differentiation (Rosa, 2013). In rural communities, efficiency mainly comes from collaboration, driven by a greater demand for resources and services compared to their limited availability. On the other hand, in globalised settings, efficiency is marked by a high level of specialisation, made possible by the abundance of resources and lower demand for each particular resource or service (Brosig, 2024). Today's production processes have become disconnected from social and cultural values, such as the "promise of acceleration" vital for rural retail stores and village associations.

3 Methodology

The present study uses participatory action research (PAR) (Bilandzic & Venable, 2011) and a rural living labs (LL) approach (Habibipour, 2021) to establish and execute fieldwork in rural societies in northern Sweden.

> "A rural living lab is a local innovation pilot that aims to solve rural challenges and contribute to inclusive digital transformation [DT] of society by engaging quintuple helix actors including rural residents and natural environments in real-life digitalization experiments." (Habibipour et al., 2021, p 68)

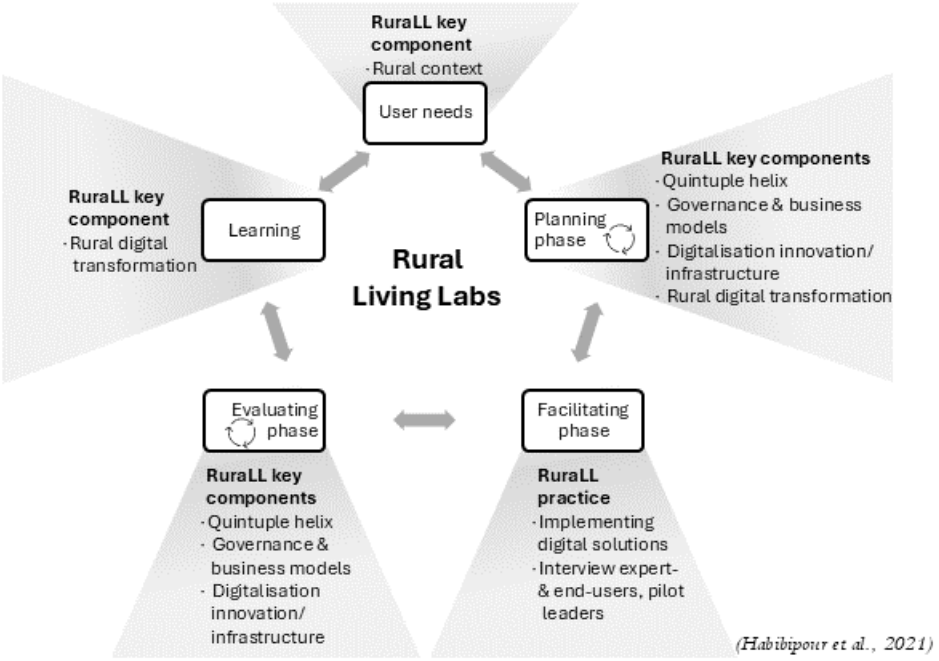

Figure 2. The Rural Living Labs Participatory Action Research Model

A rural LL approach builds on the PAR model of diagnosing, action planning, action taking, evaluating, and learning (Bilandzic & Venable, 2011). A rural LL approach mirrors the PAR model's five-step process: finding users' needs, planning, facilitating, and evaluation phases, and finally learning about rural DT. An LL approach enables villagers to engage actively as crucial contributors and co-creators in adapting digital services to their needs, with researchers participating as pilot leaders, knowledge providers, and facilitators. While a participatory action researcher would say they are "diagnosing", the LL approach would specifically focus on finding users' needs. Rural LL therefore starts with the key component "rural context" to understand users' needs. This is followed by the planning phase, where we examine four key aspects: quintuple helix, governance and business models, digitalisation innovation/infrastructure, and rural DT.

The PAR action-taking phase corresponds to the rural LL facilitating phase. In rural LL, we continually train contact persons in LL methodologies to facilitate addressing the key LL principles: value, sustainability, influence, realism, and openness (Ståhlbröst, 2012) with the aim of involving residents in the DT process. This approach represents the participation aspect of PAR and ensures that the implementation of services continues beyond the conclusion of the project. Such continuity is essential for securing tangible benefits for those involved in the project. The rural LL evaluating phase addresses the key aspects identified in the planning phase. Finally, observing the changes occurring during rural DT represents the learning phase.

To ensure the effective organisation of this geographically vast and long-term study, we have developed a heuristic set of 19 questions. These questions derive from the key components and aspects of rural LL: rural context, digitalisation, governance control and business models, quintuple helix actors, and DT. They are intended for iterative use during the planning and evaluation phases of the study. Data collection in the facilitating phase includes interviews with village associations, rural retail shopkeepers, and local villagers, providing a comprehensive view of the community's interaction with and reaction to the digital services that have been introduced. In this context, our rural LLs (villages and bookmobiles) constitute the society and serve as the primary unit of analysis. Below, we present our rural LLs (PAR sites), data collection process, and analytical lens.

3.1 DigiBy Rural Living Labs

To anchor the DigiBy project in lived reality we carried out a preliminary study that showed significant interest among villages and municipalities in Norrbotten (Runardotter & Päivärinta, 2018). During the project we have implemented a total of 18 rural LLs across ten municipalities in Norrbotten. Seven are in rural villages, five in peri-urban (see Gonçalves et al., 2017) villages, and two in municipal centres. Additionally, we have three mobile rural LLs using a bookmobile. The five peri-urban sites identified are either close to municipal centres or within commuting distance of the new industrialisation in northern Sweden. In each rural LL, we have adapted one or more digital solutions (pilots) to the specific setting. Using the LL concept for the study meant emphasising user involvement in a complex cross-sectoral rural digital ecosystem, thus facilitating the testing of digital innovations in real-life settings (Bergvall-Kåreborn & Ståhlbröst, 2009; Ståhlbröst, 2008). As the LL approach mirrors the PAR process, it ensures a well-structured design and methodical data collection throughout this large-scale project. DigiBy rural LLs are described in Appendix A and B, and Table 1 (full) outlines the most active villages that have served as rural LLs and adapted digital services to their own needs.

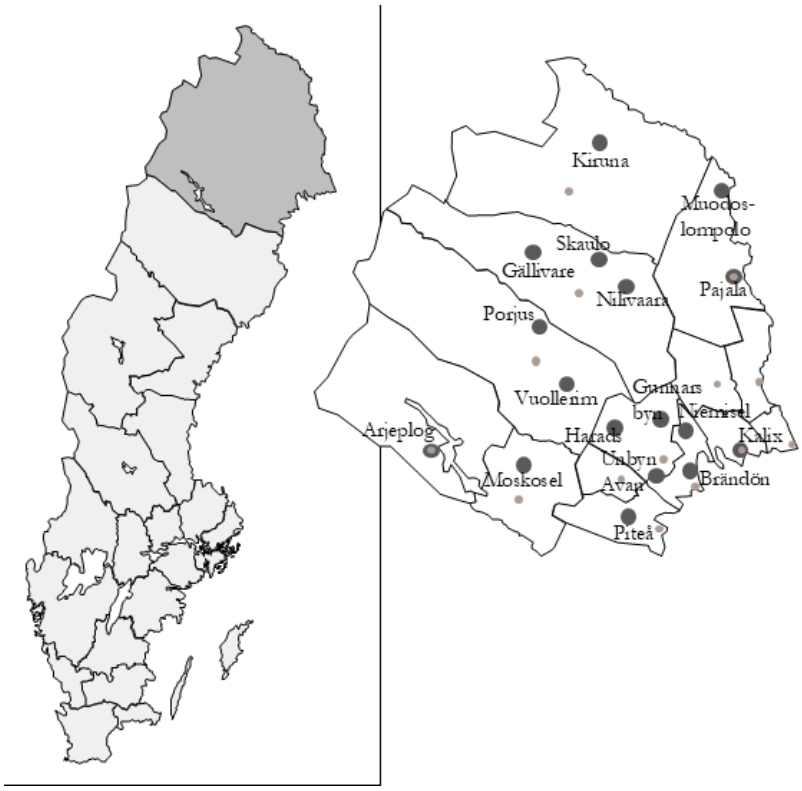

Figure 3. Map of DigiBy rural LLs in Norrbotten County, Sweden. Black Dots are Rural LLs, and Small Grey Dots are Municipal Centers

3.2 DigiBy Rural Digital Ecosystem

The DigiBy project has conducted comprehensive studies on digital solutions across Norrbotten villages, focusing on harnessing digitalisation to enhance local services. Wang (2021) refers to this as a digital innovation ecosystem. DigiBy has initiated eight "pilots" by implementing low-tech, robust, and user-friendly digital services to accelerate digital inclusion for residents. The pilots include: DigiBy venue, Digital lock, Parcel box, Digital support in bookmobiles, Digital service hubs, Digital newspapers and Smart society and the coordination of transport in civil society. Other projects have also tested such services (Gundu, 2020; LeBlanc & Shrum, 2017) but without using a coordinated approach like DigiBy. Table 1 shows all the technologies and digital services tested and remaining in use after the project, thus contributing to technical acceleration in rural societies and the DigiBy rural digital ecosystem.

Table 1. The DigiBy Rural Digital Ecosystem. Examples of Technology and Digital Services Implemented in the Most Active DigiBy Rural LLs. The Full DigiBy Rural Digital Ecosystem is Presented In Appendix B.

Rural LL: Physical location, Village, Municipality	**Rural/ peri-urban/ municipal centre**	**Pilots**	**Technical support Hardware / digital service**
1. Rural retail store, Muodoslompolo, Pajala	Rural	DigiBy venue Digital lock Digital parcel box	42" screen / PLAYipp licence fee Digital lock / Honesty box digital service Parcel box /Renz digital service
2. Village owned bakery, Brändön, Luleå	Peri-urban	DigiBy venue Digital lock	42" screen / PLAYipp licence fee, Digital lock / Honesty box digital service
3. Village centre, Moskosel, Arvidsjaur	Rural	DigiBy venue Digital lock	42" screen / PLAYipp licence fee Digital lock / Honesty box digital service
4. Rural retail store, Porjus, Jokkmokk	Peri-urban	DigiBy venue Digital lock Digital parcel box	42" screen / PLAYipp licence fee Digital lock / Honesty box digital service Parcel box / Renz digital service
5. Bookmobile, Piteå library, Piteå	Rural – sparsely populated	Digital support	Info screen/library and society services Gain antenna / No service tested Digital tablet/library society services

Appendix B presents the full Table 1 listing, including all 18 LLs. This article uses rural LLs no. 1-12 and 17-18 as examples; rural LLs no. 13-16 deviate from the living labs methodology and do not generate significant research data. These rural LLs failed to engage relevant stakeholders and thus overlooked the needs of rural residents.

3.3 Data Collection Planning and Follow-Up Phases

Understanding each village's geographical and demographic details, ICT infrastructure, active stakeholders, and visions for the future provides the basis for planning. Appropriate governance and business models are crucial for ensuring long-term DT, especially in low-profit rural areas due to their sparse populations. Rural LLs focus on user-centric digitalisation, emphasising user perspectives over those of experts, making the key components and methods that facilitate actor engagement important, prioritising quintuple helix networks and recognising the escalating environmental changes. Contrary to the earlier belief that digital infrastructure by itself will ensure DT, research indicates that digital services—to be successful—must be adapted to rural conditions (Grimes, 2003; Habibipour et al., 2022; Malecki, 2003).

A dedicated leader supervised every pilot to ensure that it satisfied the needs of rural residents. A project manager supported each leader, and researchers provided scientific guidance. Data about the pilots were collected through multiple uses of a rural LL heuristic question set and through interviews. Three of the five pilot leaders participated in interviews, while the other two interviewees were the DigiBy researchers who wrote this article and the interview guides. The DigiBy researchers conducted these interviews online, using a semi-structured guide (Lantz A., 1993), and recorded and transcribed the sessions (see Table 2)).

Table 2. Rural LLs Heuristic Question Set and Pilot Leader Interviews.

Data source	Who collected	No	Recorded
Rural LL heuristic question set	DigiBy Pilot leaders	21	Questions were asked during the entire project: visits, online meetings, and phone contact. It is documented in an Excel sheet (continuously updated).
Semi-structured interviews with Pilot leaders.	DigiBy Researchers	3	Conducted online, app. one hour. They filmed and transcribed.

3.4 Data Collection Facilitating Phase

The project maintained a continuous record by taking notes at bi-weekly meetings over three years, a total of 79 meetings. These notes serve to document the progress of the project. The structure of the notes has remained consistent throughout the project, covering general information, research updates, communication updates, reviews of ongoing pilots, and new pilot ideas. Open project meetings were held in different villages, and community events related to the project initiatives, such as the inauguration of digital hubs and training sessions for municipal personnel working with mobile libraries. Testing the digital services also promoted project engagement and activity and the researchers therefore developed a structured plan for the pilot leaders' interviews with users of the various digital services implemented in their respective villages (Lantz, 1993).

Table 3. DigiBy Bi-weekly Project Meeting Notes, Pilot Leader Interviews, and User Questionnaire

Data source	Who collected	No	Recorded
Bi-weekly project meeting notes	Project group	79	Focus: the progress of the pilots.
Structured interview users	Pilot leader	15	App. 15 minutes/interview By phone or physical meeting. Answers were written down, not recorded.
Open end-questionnaire users' DigiBy Venue	Pilot leader	6	Questionnaire in Google Forms. It takes 12 minutes to answer on average.

3.5 Analytical Lens

Theory can be used to help design an iterative data collection and analysis process, an approach reflected in our analytical lens (Walsham, 2006). We decided to employ social acceleration theory because we recognised a need to explore rural DT from a critical theory perspective, with society (villages

and bookmobiles) as the starting point. The main challenges facing rural DT are the three aspects of technical acceleration—communication, transportation, and production.

Time is crucial in addressing rural DT, as perceived in literature (Ahlmeyer & Volgmann, 2023) and observed in real life and discussed in this paper. In our analysis of rural DT, we will examine how social acceleration increases the speed of technological progress, social change, and the pace of life, particularly through technical acceleration in production, communication, and transportation (Rosa, 2013). As Rosa (2013) argues, technical acceleration means the advancement of technology, characterised by the continuous introduction of innovations into our daily lives. The aim of our project was to understand the real impact of DT in rural societies. The LL design provides structure and detailed information from our study sites. It brings out the reasoning behind the selection of interviewees based on their conditions and needs. We promote engagement by creating intrinsic value for the village (Habibipour et al., 2022). Our analysis is theory-driven.

Coding our empirical material, the following themes have evolved: digital and real-life interactions (communication), the phenomenon of shrinking distances (transport), and increased local consumption (production), see table 4. We interpret communication as “interactions”; the addition of “digital real life” stems from the empirical data, which show the importance of human-human and human-technology interactions. In the DigiBy material, transportation acceleration is represented by flipping the mindset and moving services to the village instead of transporting individual villagers to the municipal centre. We have equated increased production with increased consumption since consumption has shifted from the municipal centre to the village, thereby increasing technical acceleration in the village.

Table 4. The Analysis Process Based in the Goal-Oriented Processes of Technical Acceleleration (Rosa, 2013)

Rosa’s (2013) Example of goal-directed processes causing technical acceleration	**Analysis themes**	**DigiBy examples**
Communication	Digital and real-life interaction	The DigiBy Venue provides societal services and engages in discussions about the content
Transportation	The phenomenon of shrinking distances	The bookmobile provides service in villages. Flipped perspective, not faster transport, but rather no transport for villagers.
Production	Increased local consumption	Digital lock at partly staffed stores, moved consumption

4 Digital Solutions in Rural Retail Stores and Village Associations

Our empirical material has been analysed under the headings of each of the low-tech digital solutions that have added to the services of rural retail stores and village associations: DigiBy venue, Digital locks, Package boxes, Digital services in bookmobiles, and Digital hubs. These digital solutions are intended to drive technical acceleration and originate in the villagers' expressed need to improve the level of service in everyday life.

4.1 DigiBy Venue

DigiBy venue supports digital information dissemination in rural environments, on everything from village activities to regional and governmental information. Communicators convey information via strategically placed screens in village halls. The first DigiBy venue placements were managed by municipal officials who engaged with local retail shopkeepers. These officials plan municipal services and actively participated in the initial phases of DigiBy. Later in the project, village associations and storekeepers were asked to join the DigiBy venue network.

Although all DigiBy venue locations provide the same digital service, their administrative nature differs from village to village. For example, Gunnarsbyn and Niemisel present common village-related information, while their respective municipalities govern their own local information. Many authorities in Norrbotten already use the basic technology for this service; hence, it is a familiar digital platform. DigiBy venue locations customise local information, tailoring the displayed information to their immediate vicinity. As one user points out: “Previously, when we posted information about football matches around the

village, we had to go around and take down all the paper notes on the bulletin boards if the time changed and put up new ones. Now, we can quickly update the information directly on the computer."

In Moskosel, the DigiBy venue provides an extra layer of community engagement. A communicator interested in historical photographs of the district displays these on the screen, transforming the DigiBy venue from a mere information bank into a social venue where residents gather, reminisce, and discuss the visual history in front of them.

DigiBy venue locations root their operations in municipal commitment and monitor activities throughout the village to overcome dependence on individuals and ensure longevity. Throughout the pilot, the pilot leaders maintained an active dialogue with various stakeholders, from expert users to everyday consumers and municipal officials. These consultations initially meet with some hesitation but evolved into productive collaborations characterised by engagement. During one meeting, an editor commented:

> "Just a suggestion to highlight that there is media coverage. [Gazette] wrote about Gunnarsbyn when the screen was installed. ...One could insist... We have one in Niemisel and one in Avan, in Luleå municipality. Suggest that they write about it because it draws attention to the issue."

Another answer:

> "I could check with [Kim], who is the editor of [Bulletin] ... [They] are from the area, so [they] see the board when in the shop."

Of the seven municipalities testing the DigiBy venue within the project, six are currently paying for DigiBy venue, and the remaining municipality will shortly start paying. Its effectiveness has persuaded several municipalities to invest in additional screens, thus enhancing community outreach. They perceive the DigiBy venue to be a resilient digital channel promoting improved information dissemination in rural communities.

4.2 Digital Locks

This pilot has used digital locks as a link between modern commerce and accessibility. These locks either support a commerce-centric approach, such as digital payment systems for out-of-hours shopping, or focus on providing villagers access to various locations. The test applications include several different digital identification systems, such as the Nordic countries' BankID, along with applications such as credit cards, key fobs, and system-integrated locks. The digital locks must balance security issues with peoples' expectations. For example, one shopkeeper values customer accessibility and chooses a lock compatible with a wide range of bank cards despite compromising security. The decision is underpinned by the reasoning that losing international customers could potentially be more damaging than the consequences of a theft. Others chose bank ID to be able to see all individual interactions, which prevents access for users without bank ID.

In Moskosel, the DT began with the establishment of an unstaffed shop. Since its inauguration on 25 December 2021, this store has provided access 24/7. Reactions from the residents are divided. Many think it is innovative, but one man commented: "This is perhaps the worst thing that has happened to Moskosel. We cannot use digital services." Once up and running, this new shopping method was embraced by residents aged 26 to 90. Observation data show high levels of activity during daytime and early evening. The store has an average of 50 daily transactions, which aligns with access patterns, but transactions are increasing. Even the man who was negative in the beginning turned positive, when he was left without coffee one morning and realised that he could buy it at 5 AM in the village.

Knowing that there are no basic services nearer than 45 km, Moskosel residents see digitalisation as key to their renewal. Their digital awakening serves as a role model for other rural communities. For example, in Porjus, the rural retail store re-opened as a hybrid store and expanded, independently of the project, to include an unstaffed outdoor shop.

The pilot leader for digital locks comments:

> "This is what they have said: Well, it's a kind of freedom… If I were to have friends over, and we're having a great time. I don't have to think, 'Oh, now you have to go home because I need to shop before the store closes.' Instead, we can sit here and enjoy ourselves for as long as we want, and then I'll shop when it suits me. That's freedom, isn't it?"

4.3 Parcel Boxes

In In Muodoslomplo and Porjus, we integrated a system of independent parcel boxes. During the DigiBy project, local shop staff were still responsible for parcel handling. For them, digital parcel boxes provide a double benefit. A user of DigiBy parcel boxes says:

> "I commute for an hour to work. I don't have time to go to the store before it closes. I receive packages about once a week, and now I can go to the parcel locker and pick up my packages after closing time."

The parcel boxes serve as storage space for various items in addition to their primary function. An additional incentive was that the store still received its governmental parcel handling fee, as they continued to act as parcel recipient.

However, every service brings its challenges. One customer commented:

> "It is a good service for me. However, I can easily pick up a package without entering the store. I don't feel obliged to buy something when I pick up a parcel, as I might have done before. This is a disadvantage for 'Alex' [the storekeeper]."

To solve this, the storekeepers placed the box inside the unstaffed store, thus integrating the box system with the store lock via open APIs to create single sign-on access.

The conceptual seed for this pilot was the enterprise behind the boxes. Driven by a vision, expanding their business of smart parcel boxes in rural territories. The simplicity of the installation process was very clear in Muodoslompolo, where the storekeeper used her prior IT skills and succeeded in self-facilitating the setup. She extended her assistance to the Porjus installation as well. The real success story of these pilots is perhaps not the use of the boxes but rather the collaboration between companies. From its conception to realisation, this initiative exemplifies collaborative synergy, weaving together the contributions of rural storekeepers, box-manufacturing entities, digital lock enterprises, and project designers.

4.4 Digital Services in Bookmobiles

Libraries in Sweden have a mission to disseminate digital literacy to citizens. This pilot is a product of the collaborative efforts of the regional and municipal libraries. The municipal bookmobiles stop at 127 villages, bringing the residents books, digital skills, resources, and human interaction. Reinforcement antennas, the DigiBy venue, and tablets for borrowing books and movies and watching instruction videos, have been incorporated. Within these bookmobiles, the blend of technology and education is tangible, and technology is a tool to enhance digital skills among the users. The staff introduces users to literature and guide them to digital skills. The pilot leader explains that people feel such joy when the bookmobile arrives that they bring coffee and homemade cakes and cookies for the librarian. In one municipality, the cultural director joined the bookmobile tour, and "she shed a tear, as she saw the satisfaction and happiness felt by those who had access to the bookmobile's offerings".

The Covid-19 pandemic put the continuation of this pilot at risk. However, this was turned around, and this period was seen as an opportunity for a training interval. The project team enriched the staff's digital knowledge with training modules on everything from mobile device manoeuvres to cybersecurity issues. They also conducted surveys to learn more about users' digital needs. Antennas for better connectivity and screens to show educational content were installed in the bookmobiles.

Noticing the transformative impact of this initiative, the bookmobiles are now seen as providers of digital preparedness. They are integrated into the county council's long-term vision of creating a sustainable model for services in rural areas. The pilot leader started a discussion between the regional libraries, the National Library, the Swedish Armed Forces, and the Swedish Civil Contingencies Agency. As a result, the bookmobiles emerge as potential digital emergency relief stations, ensuring that, whether in times of calm or crisis, the digital age does not bypass anyone, even in the remote areas of Norrbotten.

An 82-year-old lady comments on the digital changes brought to her home village by the bookmobile:

> "I do not have to go to [the municipal centre] to shop, … [I can] sit at home and order from, for example, the pharmacy... clothing. I can read newspapers. BankID is the best. Swish is a good service. It makes people move to rural areas. You can do your job, studies, and other similar things. Take courses for the elderly in basic knowledge of data..."

4.5 Digital Hubs

In the DigiBy rural digital ecosystem, the most proactive villages push digitalisation to the extent that they establish digital service hubs, each unique in design but unified in concept. At the heart of each hub is the central element: the integration of digital services. This generates much enthusiasm among citizens and encourages them to immerse themselves in and embrace the digital era. Thanks to the digital hub, life is "simpler, saves time, and becomes cheaper" (49-year-old villager).

Moskosel has transformed a village centre into a modern digital hub. Equipped with a DigiBy venue showcasing tourist and societal information and a digital lock for an unstaffed rural retail store with a digital payment system, the hub emerges as a symbol of modernity.

They [an entrepreneur's customers] think it's really cool, right, a digital store, wow, so it's innovative, groundbreaking, and there's a completely different vibe being able to shop around the clock, so it's been really awesome.

In addition, rural residents can use workspaces with Wi-Fi, screens, and printing facilities, organised and financed by the village association.

Porjus's story about reopening the rural retail store attracted much attention. Two key factors contributed to the reopening. The shopkeeper, a mother of two, needed flexibility to accommodate her children's preschool schedule. The store's strategic location, 7 km from the start of a famous hiking route through national parks, ensures visitors. Strengthened by success, the shopkeeper went further and even opened an unstaffed outdoor shop together with a villager, demonstrating her new-found confidence: "Yes, now I know how to do it."

Both Moskosel and Porjus have become exemplary models, offering guidance and support to the digitalisation efforts of 15 additional rural retail stores in Norrbotten, beyond the scope of the DigiBy project.

Muodoslompolo tells a slightly different story. Before DigiBys' intervention, a rural retail shopkeeper envisioned transforming a nearby bakery. Following a municipal seminar on digital nomads, s/he envisioned the bakery evolving into a state-of-the-art digital hub. Therefore, the rural retail shopkeeper often emphasised in meetings that the time spent in the DigiBy was not extra time, but rather ordinary development work needed to be done for the survival of the shop. The digital hub was inaugurated during the Christmas holidays and Easter, clearly filling a need as parents work there while their children are cared for by their grandparents. Recognising the benefits and attractiveness of such hubs, the municipality of Pajala approved the establishment of four more digital hubs. Hence, Muodoslompolo pioneered this initiative, and Pajala's city centre followed.

Lastly, the bakery in Brändön underwent its DT with a digital lock and a DigiBy venue by the large baking table, which is now a popular community space. The villagers organise a book café in conjunction with the bookmobile visit. In addition, the residents found new ways to strengthen camaraderie among village youth using the bakery as a youth centre. Considering their unique circumstances, the bakery serves as a meeting place. Logging in via Bank ID means each visit is linked to an individual, and this person naturally takes responsibility for leaving the bakery in perfect condition.

5 Technical Acceleration in Villages

Our analysis employs an analytical lens based on the circle of acceleration (Rosa, 2013), focusing on the corner stones of technical acceleration: communication, transportation, and production – in our case, illustrated as digital and real-life interactions, the phenomenon of shrinking distances, and increased local consumption.

5.1 Digital and Real-Life Interactions

Digital and face-to-face communication promotes collaboration and meetings; one does not detract from the other (Kraus et al., 2021). In our case, the physical screen located in the service centre or retail store encourages people to gather around it, while the valuable information provided through the digital service captures their attention. Recognising each village's unique challenges, efforts were made to address the flow of information to and within these villages, which have often not received the same attention as municipal centres (Erlingsson et al., 2023). Leveraging the DigiBy venue and digital locks significantly

expanded communication possibilities and facilitated global connections while preserving the inherent value of in-person interactions. Rosa (2013) articulates that as countless new opportunities for services and communication continue to emerge, new options become available, leading to a fear of not being able to experience everything. The DigiBy venue and the digital locks show that the interplay between digital and real-life interaction is essential for navigating the interconnected nature of our contemporary world. Collaborative efforts among villages and authorities also play a crucial role in driving the implementation of the DigiBy digital services, fostering inter-municipal and regional communication in digital and real life. The DigiBy venues and locks are compelling examples of how digital solutions, which are neither cutting-edge technology nor innovative business models, have provided villagers with opportunities to adapt them to their needs through their user-friendly nature and widespread availability.

These screens function as community information points and business sales channels by providing easy access to flexible digital information tailored to the needs of the villagers. They take people down memory lane, discussing old photos shown on the screen, and also turn into TV receivers and digital meeting spot when needed. The digital locks for their part enable people to shop around the clock and provide access to meetings for shared morning coffee, hangouts for young people, and online study groups. Finally, the lively Facebook page has been an important factor in sharing success stories and information needed for interactions in the DigiBy rural digital ecosystem (cf Wang, 2021).

To sum up, by providing both digital and face-to-face interactions, DigiBy digital solutions improve communication (Kraus et al., 2021) and technical acceleration (Rosa, 2013), and promote DT through collaboration to meet various social needs by bridging the rural information gap and creating more strongly connected societies. We observe that the service gap (Erlingson et al., 2023), previously described as desynchronisation leading to a democratic crisis, has been reduced. This has resulted in the acceleration of social change, as the municipality now distributes societal information to villagers beyond just the municipal centre, and it has also increased the pace of life as people meet more frequently (Rosa, 2013). This acceleration, however, is not perceived as negative, neither by the villagers nor by the officials at the municipality.

5.2 The Phenomenon of Shrinking Distances

In DigiBy, the approach for spatial shrinkage to remove geographical barriers (Rosa, 2013) is to use bookmobiles to provide digital services and increase digital literacy, open unstaffed rural retail stores, place parcel boxes, and provide access to village halls for rural inhabitants around the county. Equipped with high gain antennas, bookmobiles can park where people live, which has eliminated the dependence on location-based connectivity. The digital locks gave access to the physical localities and parcel boxes. Notably, these pilots rendered results that illustrate how technical acceleration influences the acceleration of social change and the pace of life. Social change is reflected in regional policy documents, where the bookmobile is valued as highly as libraries in municipal centres. Additionally, the DigiBy digital solutions are highlighted as potential tools for reducing the service gap in regional strategies. The pace of life increases, as access to books, rural retail, increased digital knowledge, and meeting places are offered close to home, giving people the freedom to use their time in other ways than just driving long distances to access these services.

In short, the strategy for enhancing spatial shrinkage (Rosa, 2013) by using digital solutions to deliver the services residents asked for to a meeting point in their vicinity, rather than to their homes, accelerates the reduction of the service gap (Erlingsson et al., 2023). Social change accelerated because technology was able to “shrink space”. Because of the pandemic, in the case of the bookmobiles, the technology was not even tested before changes were made in policy. The incentive was not monetary but rather fulfilling the social aspects of sustainable development.

5.3 Consumption Moved to Villages

Within Increased consumption and increased production are typically seen as interconnected facets of the same phenomenon, technical acceleration. The circle of acceleration illustrates how technical advancements drive societal expectations, contributing to a faster pace of life and a growing demand for the accelerated production of goods and services (Rosa, 2013). However, in the context of rural villages, our focus is not on society-wide production and consumption, but rather on how technical acceleration impacts sales patterns locally.

Technical innovations, such as digital locks that enable 24/7 access to rural retail stores and parcel delivery boxes, make life easier for residents, second-home owners, and tourists by offering greater opportunities for local shopping. This shift reduces their need to travel to municipal centres, cutting travel costs and time spent shopping.

We do not argue that technical acceleration has led to higher production overall, as our research is limited to the rural retail sector and its impact on village consumption. Our findings show that technological advancements encourage villagers to consume locally, by showing that the rural retail stores are economically viable and contribute to increased social acceleration within the village itself. This, in turn, reduces the desynchronisation between villages and municipal centres, as villages become more self-sufficient and able to meet local demand.

In conclusion, the key point here is that we aim to increase local sales in villages, not to increase consumption overall, and our research focuses specifically on what technical acceleration does for villages, rather than for society at large.

6 Technical Acceleration of Digital Transformation in Rural Micro-Organizations

We argue that employing the theory of social acceleration to analyse the conditions for rural DT is crucial from a historical perspective (Erlingson, 2023; Salemink & Strijker, 2017). Urbanisation continues to pose significant challenges, prompting us to question its underlying causes. Rosa (2013) offers analytical tools that not only enhance our understanding but also challenge our assumptions. The motors of the cycle of acceleration create barriers to social acceleration in rural societies. The time-intensive challenges faced in rural contexts differ significantly from those encountered in urban areas. For example, the collaborative practices typical of rural communities do not necessarily equate to time-saving efficiencies in urban environments. The division of society into specialised functions, a key feature of urban efficiency and competitiveness, proves impractical in rural areas where there are too few individuals to fulfil these separate roles. The primary driver of the pace of life—the promise of acceleration—applies universally, yet its manifestations vary across urban and rural contexts. In rural societies, it is often easier to address the specific needs of a smaller community, whereas urban societies grapple with addressing the needs of a larger, more diverse population. Individuals shaping urban societies are rarely asked to articulate their specific needs; instead, they are presented with numerous choices, leading to a perception of acceleration that may be experienced differently.

Acceleration in the transportation sector has caused space to “shrink” and made it a function of time. The development of technology and the transportation revolution influences our perception of space and time (Rosa, 2013). We see the same logic in parcel boxes and digital locks, where the opportunity to pick up parcels or buy retail close to home at a time convenient for the customer reduces the distance between customer and commercial marketplace (Gundu, 2022). This “increased production” also adds to the availability and variety of products, influencing and driving the desire for increased consumption (Juge et al., 2022). However, as the changes in business models do not focus on nudging people to buy more, as seen in e-commerce, we do not, in our study, observe an increase in overall consumption but rather an increase in local sales.

In DigiBy, with pilots designed as rural LLs, the tested digital services significantly transformed rural residents' access to and utilisation of digital services (Habibipour et al., 2022). Consequently, adopting these “low-tech” technologies has changed people’s daily lives, routines, and behaviours on their own terms. It is important to recognise that technical acceleration goes beyond individual impact and permeates broader societal structures and systems. The villagers are now more actively engaged in technical development. We observe that villagers save time and money, allowing them to accomplish more activities within the same timeframe. As a result, they feel less stressed and have more time for other aspects of life. This aligns with what Rosa (2013, p. 160) describes as the motor of technical acceleration, illustrated by the expression “time is money”. We interpret this as a form of social acceleration that positively impacts the villages, reducing desynchronisation between villages and municipal centres. However, this change did not originate from technology; it stemmed from people's need for rural retail which would fulfil the promise of acceleration. This is a crucial democratic issue and reduces the risk of a democratic crisis (Rosa, 2013).

Implementing digital hubs in DigiBy was not a deliberate strategy within the project; we only aimed to introduce standard digital technologies to enhance village services. The digital hub initiatives emerged through the villagers' new insight that additional digital services would further improve their overall level of service. This is an example of mechanisms of acceleration having a cumulative effect (Rosa, 2013). As Rosa (2013) suggests, the interaction between phenomena associated with the heightened speed in transportation, communication, and production leads to a continuous acceleration of these processes, resulting in even faster rates of change.

This finding further strengthens as we see that the demand for services from the most engaged villages increases. As digital skills and the understanding of what it is possible to do with technologies, the number of new service initiatives increases. Moreover, digital services give rise to social interactions and redefine the ways residents engage with one another (Chitrao, 2016). The basic information spreading in DigiBy connects the parts to a whole (Wang, 2021) and creates a feeling of belonging to society (Reisdorf & Rhinesmith, 2020). We can also confirm that technical acceleration leads to social change (Kraus et al., 2021; Rosa, 2013). Halfacree's (2006) triad about the rural—rural locality, everyday life, and formal representation—does not provide new knowledge about rural societies but helps us understand what we already have. It enables us to see how digital solutions reduce the service gap, thereby changing the everyday life of villagers and offering society a new perspective on the opportunities for development in rural societies (Lindberg, 2024). This approach signifies a move towards a more inclusive society, thus promoting a more equitable DT.

7 Conclusions

We set out to explore how low-tech digitalisation solutions in micro-organisations could improve living conditions in rural societies, by pushing technical acceleration through several pilots. Based on our findings, we come to the following conclusions.

As the situation in rural societies stands today, there is a faster system, the DT of municipal centres, and a slower system, the DT to enhance quality of life in villages. Both systems necessitate acceleration, and a more balanced distribution of digitalisation can lead to further democratic societal development. Rural digital ecosystems such as DigiBy rural LLs empower rural residents through collaborative implementation of digital solutions tailored to their specific needs. This ensures that digitalisation contributes to equitable development, preventing stagnation and mitigating the risk of a democratic crisis.

We find significant results in the little things. With minimal input, digital retail services tailored to rural residents' needs can noticeably improve their quality of life. Using low-cost, robust, low-tech, and user-friendly digital solutions, technical acceleration can reduce the service gap between municipal centres and surrounding villages. This development has gained momentum in Norrbotten following the DigiBy project. To rephrase Halfacree (2006), by understanding rural ways and realising that a village has a solid foundation upon which to build, we have developed a new understanding of the importance of micro-changes in a collaborative rural digital ecosystem.

Our study demonstrates that technical acceleration in villages enhances digital skills and increases knowledge about digital technology among villagers. The use of low-tech digital solutions in rural societies significantly improves living conditions. We observe that digitalisation fosters hope and optimism for the future, with many rural residents embracing the opportunities brought to them. However, we also find that the primary motor for social acceleration in villages is the promise of technical acceleration, rooted in the need for change. Furthermore, the promise of technical acceleration drives social change, as evidenced by shifts in the work practices of officials. Thus, the flow within the circle of acceleration is not unidirectional when applied to rural DT.

In conclusion, this study aligns with many others in demonstrating the existence of societal polarisation in this study visualised as a service gap. However, it suggests that the service gap can be reduced when effectively managing digitalisation within a rural digital ecosystem. Furthermore, the findings indicate that rural digitalisation plays a role in mitigating rural crises, particularly by addressing disparities in retail service provision. As such, we address goal 9 of the EU Rural Vision 2040: Lively places equipped with efficient, accessible, and affordable public and private services (European Commission, 2021).

Future research could concentrate on the fundamental mechanisms driving DT in rural societies to enhance our understanding of how these insights can drive societal change. Is participation in social acceleration a prerequisite for full participation in the digital community?

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9 Declaration of AI

During the preparation of this work, the author, Johanna Lindberg, has used [Google Translate, ChatGPT, Grammarly, and Word spelling and grammar check as language support, not in data analysis or composition].

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Johanna Lindberg is a researcher and holds a Fil Dr degree from Luleå University of Technology, boasting over 20 years of experience in regional and local development across various subject areas. Her research primarily focuses on enhancing living and working conditions in rural areas through digital services. Collaborating closely with rural communities and organizations, Johanna and her team have tailored Living Labs methods to meet these areas' specific needs and drive digital engagement. Her work encompasses the development of political goal management from both a researcher's and an official's perspective. Specifically, Johanna has contributed to achieving national political objectives in diverse policy areas, including environmental, gender equality, broadband, digitalization, culture, leisure, commercial services, payment services, and public health.

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