Bridging the Digital Divide in Rural Europe

A Morphological Box to Support the Innovation of Collaborative Business Models for Rural Digital Services

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Extended abstract

To bridge the digital divide and provide high-quality, reliable, and secure internet access and digital services to rural areas in Europe, there is a pressing need for new business models. Currently, many existing models are not viable in rural settings due to insufficient return on investment for network or telecom operators, which hampers the deployment of broadband infrastructure (Cavalcante et al., 2021). As a result, rural areas face inadequate digital infrastructure, impeding the roll-out and functioning of digital services (Stojanova et al., 2022). Moreso, digital services in rural areas often suffer from reliability issues, lack scalability, and struggle with interoperability due to time constraints, limited technological capabilities, and a shortage of skilled personnel for digital service development, leading to high operational and maintenance costs (Lee, 2019; Linde et al., 2023). In addition, concerns surrounding data security and trust, coupled with digital illiteracy in rural communities, as well as an overall low population density in rural areas contribute to a lack of demand for digital services (Yaacoub & Alouini, 2020; Linde et al., 2023; Palattella et al., 2016). All-in-all, these challenges lead to an uncertain and unfavourable investment climate for digital services (Stojanova et al., 2022).

In addressing these challenges, new digital business models for rural areas are essential which (1) cultivate collaboration among diverse stakeholders to overcome investment barriers faced; and (2) foster value co-creation across economic, social, and environmental

dimensions to stimulate adoption of new services. First, the provisioning of digital services requires extensive collaboration among network and telecom operators, infrastructure investors, users and customers, platform developers, and governments (Lee, 2019; Metallo et al., 2018). Also, digital innovation hubs (Stojanova et al., 2022) and rural mobile infrastructure operators (Cavalcante et al., 2021) often play crucial roles in delivering essential digital skills and infrastructure in rural settings. Second, digital services may not only offer substantial economic benefits in rural contexts but can also capitalize on the potential of enhanced internet access to create social and environmental value (Lee, 2019). For example, they facilitate effective communication and collaboration as well as resource management and energy efficiency (Lee, 2019; Parida et al., 2019). Thus, a comprehensive examination of the entire ecosystem is necessary to reveal novel multi-value creation opportunities for the provisioning of digital services in rural settings.

The concept of collaborative business modeling presents a comprehensive view of business models, considering various stakeholders and multiple values (Evans et al., 2017; Rohrbeck et al., 2013). It facilitates the understanding of individual stakeholders' needs, drivers, and perspectives, while also addressing how they collaborate to create and capture value (Evans et al., 2017). Unlike traditional approaches, collaborative business modeling provides a structure in which all stakeholders can derive economic, social, and/or environmental value (Evans et al., 2017), making it particularly relevant in rural settings. It can foster customized solutions catering to areas characterized by low population density and diverse user groups for the commercialization of digital services in rural settings (Yaacoub & Alouini, 2020). This can accelerate the expansion of connectivity in rural areas and support the development of digital services to leverage their deployment (Salemink et al., 2017). Therefore, our research objective is *to explore the options available to organizations for innovating collaborative business models to create and capture value from digital services in rural areas.*

We address this objective by employing action design research (Mullarkey & Hevner, 2019) to develop a morphological box which captures options available for business models supporting rural digital services (see for details Table 1). This tool, comprising a table with rows and columns representing different system components and options, helps to identify and combine elements of collaborative business models. It is particularly useful for rural communities because it aids in tailoring business models to their unique needs and challenges. Our approach began with a literature review on collaborative and digitally-enabled business models, providing foundational insights for identifying the tool's components and options. Next, we conducted interviews with stakeholders from five Living Labs (LL) part of the COMMECT project, funded by the European Union's Horizon Europe Research and Innovation Programme. These interviews, held in June 2023, aimed to refine the morphological box for rural settings. Subsequent workshops with each Living Lab, spanning from August 2023 to January 2024, helped to further substantiate the

morphological box by incorporating specific use cases. The resulting tool can be found in Table 2.

In Table 3, the preliminary outcomes of applying our morphological box to the LL's use cases are presented. LL Turkey concentrates on providing connectivity and digital services for rural olive farmers through a mobile 5G solution and smart farming platform, subsidized by governmental funding. LL Denmark aims to improve animal well-being during livestock transport across Europe via a platform optimizing routes utilizing 5G or satellite connection, facilitating seamless data exchange between transport entities and regulatory bodies. LL Serbia entails a technology provider establishing 5G infrastructure and sensors powered by solar energy for rural farmers, where collective investment from farmers or associations is needed. LL Luxembourg focuses on developing a digital twin for vineyards, aiding vineyard farmers in precision agriculture practices while serving as a valuable data repository for knowledge institutions. Meanwhile, LL Norway is offering local 5G solutions to increase operational efficiency for forest contractors and facilitate faster responses to forest fires, attracting investments from contractors, forest associations, and insurers.

Our morphological box (see Table 2) outlines eight components crucial for innovating collaborative business models tailored to digital services in rural areas:

1. **Stakeholder spectrum:** Uncover the diverse roles played by stakeholders in creating and capturing value within the business model.
2. **Digital services:** Explore the various digital services for connectivity that can be deployed considering the unique characteristics of rural areas.
3. **Purpose of solution:** Understand how connectivity is leveraged in rural settings to create value, whether through data sharing, collection, or analytics.
4. **Data access dynamics:** Examine options related to data ownership from the digital services, influencing value creation and capture mechanisms.
5. **Payment pathways:** Discover different payment methods for end-users and other stakeholders to access digital services.
6. **Investment infrastructure:** Delve into funding options required for the development and commercialization of digital services.
7. **Value creation mechanisms:** Identify key values that stakeholders in rural areas can consider when participating in the business model.
8. **Value capture mechanisms:** Understand how value capture can be structured and its implications for potential stakeholders.

Theoretically, the development of the morphological box contributes to the literature on (rural) connectivity provisioning by supporting the innovation of business models to support the acceleration of connectivity penetration (Cavalcante et al., 2021; Salemink et al., 2017). Moreover, our work illustrates that collaborative business model frameworks, typically situated in urban or densely populated regions (e.g. Lind & Melander, 2023;

Ordonez-Ponce et al., 2021), can also effectively drive business model innovation in rural settings. Additionally, it enhances our understanding of how organizations can capture value 'in partnership' from value-creation opportunities presented by digital technologies in rural areas, aligning with the call by Parida et al. (2019) for a deeper exploration of such dynamics. The study also offers valuable insights for telecom, network and technology providers regarding the possibilities for establishing viable business models in collaboration with key stakeholders in rural areas with limited connectivity.

Keywords

Collaborative business model, morphological box, rural connectivity, digital services

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Table 1. Overview of used review methodology

	Turkey	**Denmark**	**Serbia**	**Luxembourg**	**Norway**
Step 1: Alpha-version through literature review					
Search strings	'ICT AND business models' OR 'connectivity AND business models' OR 'digitally-enabled business models'.				
Databases	ScienceDirect; Scopus				
Date	May 2023				
Step 2: Beta-version through interviews					
Online / offline	Online via Teams				
Interviewees	Living Lab leader	Living Lab leader	Living Lab leader	Living Lab leader	Living Lab leader
Representative(s) of	Telecom operator, Knowledge institute	Value chain stakeholder (transport center), Knowledge institute	Technology provider	Knowledge institute, Agricultural service provider	Knowledge institute, Telecom operator
Date	June 2023				
Themes discussed	Questions centred around the use cases within the Living Lab, value-creation opportunities, and maturity of the business model.				
Step 2: Final version through workshops					
Location	Izmir, Turkey	Padborg, Denmark	Novi Sad, Serbia	Hëttermillen, Luxembourg	Kongsvinger, Norway
Number of participants	16	10	7	10	10
Representative(s) of	Telecom operator, Knowledge institute, Governmental bodies, Farmer association, Farmers	Regulator, Transport company, Trading association, Technology provider, Value chain stakeholder (transport center)	Telecom operator, Rural end-users, Farmer association, Technology provider	Technology provider, Governmental bodies, Research institute, Agricultural service provider, Rural end-users	Telecom operator, Value chain stakeholder (contractor, sawing mills), Forest association

				(vineyard farmers)	
Date	October 2023	August 2023	October 2023	November 2023	January 2024
Format	Participants discussed data requirements, value proposition, collaboration and financing guided by a semi-structured set of questions.				

Table 2. Morphological box supporting the design of business models for rural digital services

Stakeholder spectrum	**Digital services**	**Purpose of solution**	**Data access dynamics**	**Payment pathways**	**Investment infrastructure**	**Value creation mechanisms**	**Value capture mechanisms**
Rural end-users (e.g., households, farmers, rangers, schools, public services)	5G Connectivity Platforms	Data sharing solution	End-users	Onetime payment	Individual investment by end-user	Connectivity / digital inclusion	Value capture through the need for services/compliance
Telecom / network operators	Local 5G Private Networks	Data analytics solution	Shared responsibility	Pay per usage	Collective investment by end-users	Reduced emissions / increased sustainability	Value capture through data collected
Service provider/platform provider	IoT and Edge Computing Solutions	Data collection solution	Rights at the provider	Subscription	Investment by association or cooperative	Reduced inputs needed	Provisioning of new services
Government bodies (local governments, municipalities, ministries)	AI and Network Automation			Outcome-based payment	Investments by a government body	Data-driven insights / improved decision making	Payment for digital services
(Rural) Infrastructure / technology provider					Investments by private organizations	Provisioning of new services	Increased social and environmental well-being
Cooperatives, associations, hubs						Productivity / efficiency	
Investors						Reduced costs	
Value chain stakeholders (operator, retailer, contractor)						Value through compliance	
Regulator, certifier, insurance						Improved safety	
Knowledge institutes						Increased ease-of-use / technology adoption	

Table 3. Overview of application of the morphological box to Living Labs in COMMECT project.

	Turkey	Denmark	Serbia	Luxembourg	Norway
Stakeholder spectrum					
Rural end-users	x	x	x	x	x
Telecom operators	x	x	x	x	x
Service provider/platform provider	x		x	x	x
Government bodies	x			x	
Investors					
Cooperatives, Associations	x		x	x	x
Infrastructure technology provider	x	x	x	x	x
Value chain stakeholders					x
Regulator, certifier, insurance	x	x			x
Knowledge institutes				x	
Digital services					
5G Connectivity Platforms	x	x	x	x	
Local 5G Private Networks					x
IoT and Edge Computing Solutions	x	x	x	x	x
AI and Network Automation		x	x	x	
Purpose of solution					
Data sharing solution	x		x	x	x
Data analytics solution	x	x	x	x	x
Data collection solution	x	x	x	x	x
Data access dynamics					
End-users	x	x			
Shared responsibility			x	x	x
Rights at the provider					
Payment model					
Onetime payment	x		x	x	
Pay per usage				x	
Subscription		x	x		x
Outcome-based payment		x			
Investment infrastructure					
Individual investment by end-user		x			
Collective investment by end-users			x		
Investment by association or cooperative			x	x	x
Investments by a government body	x			x	
Investments by private organizations		x	x	x	
Value creation mechanisms					
Connectivity / digital inclusion	x				
Reduced emissions / increased sustainability	x				
Reduced inputs needed			x		

Data-driven insights / improved decision making		x	x	x	x
Provisioning of new services	x				
Productivity/efficiency	x		x	x	x
Reduced costs			x		x
Value through compliance		x			x
Improved safety					x
Improved competitive position (reputation, brand)		x			
Increased ease-of-use / technology adoption		x			
Value capture mechanisms					
Value capture through the need for services/compliance				x	x
Value capture through data collected	x			x	
Provisioning of new services	x			x	
Payment for digital services	x	x	x		x
Expanding market segment					x
Increased social and environmental well-being					x