Nordregio

Smart communities in the Nordic-Baltic Region: A literature review

Indicators and policies for bridging the urban-rural digital divide

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Contents

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English and Swedish summary

English

Past studies have identified a weak business case for 5G in the Nordic-Baltic region, often attributing this to the persistent challenges of the urban-rural digital divide and the region's relatively low population density. Gaining a deeper understanding of the on-the-ground effects of enhanced digital connectivity, particularly 5G, on local businesses and overall quality of life can yield valuable insights and incentives. These insights in turn can facilitate a more inclusive rollout of emerging digital solutions, aligned with local needs.

The present literature review has identified both the most prevalent and the currently understudied indicators in this context. This underscores the need for novel empirical insights into the interplay between digitally enabled local economic growth and broader societal implications, including technology acceptance, trust and privacy concerns. While numerous policies at the international and national level aim to address and support progress on these issues, bottom-up perspectives from underserved regions remain crucial as these policies continue to evolve.

The present working paper presents a systematic literature review. That review identified a set of indicators aimed at addressing remaining gaps in the scholarly and policy debate on the best practices and lessons learned from smart rural communities in the Nordic-Baltic region. Key insights from the report, which the proposed set of indicators aims to address, include:

- **Rural-urban digital divide:** Highlighting the experiences of otherwise underrepresented groups is essential for fostering a more inclusive digital transformation in the Nordic-Baltic region. In this context, addressing the urban-rural digital divide is crucial to ensure that the specific needs and experiences of rural communities are brought to the forefront, fostering a more equitable and comprehensive approach to digital inclusion.
- **Business case for 5G:** A deeper understanding of the process by which novel digital technologies are integrated into rural communities will strengthen the business case for 5G and related applications. This approach promises scalability to other regions facing similar rural-urban divides. In light of the European Union's Gigabit Infrastructure Act (GIA), the scalability of best practices from smart rural communities is of even greater relevance.
- **Nordic-Baltic societal implications of improved digital connectivity:** There remains a gap in the literature regarding Nordic-Baltic case studies of (rural) smart communities, as well as the absence of a methodological framework balancing economic development insights with societal implications. Such a

framework could provide novel insights into the intended and unintended societal consequences of improving digital connectivity.

- **Evolving policy landscape:** The national and international policy landscape for inclusive, ethical and socially responsible technology development and deployment has evolved considerably over the past years. However, more tailored policies, coordinated across regional, national and European levels, are needed to address the specific needs of individual groups and mitigate infrastructural, economic and skill-related disparities.

Swedish

Tidigare studier har identifierat en svag affärsmässig grund för 5G i den nordisk-baltiska regionen, ofta tillskrivet de kvarstående utmaningarna med den digitala klyftan mellan stad och landsbygd och regionens relativt låga befolkningstäthet. En djupare förståelse av de praktiska effekterna av förbättrad digital anslutning, särskilt 5G, på lokala företag och den övergripande livskvaliteten kan ge värdefulla insikter och incitament. Dessa insikter kan underlätta en mer inkluderande utrullning av nya digitala lösningar som är anpassade till lokala behov.

Denna litteraturöversikt har identifierat både de mest förekommande och de för närvarande understuderade indikatorerna i detta sammanhang. Detta understryker behovet av nya empiriska insikter om samspelet mellan digitalt möjliggjord lokal ekonomisk tillväxt och bredare samhälleliga konsekvenser, inklusive teknikacceptans, förtroende och integritetsfrågor. Även om många policyer på internationell och nationell nivå syftar till att adressera och stödja framsteg i dessa frågor, förblir perspektiv från underbetjänade områden avgörande när dessa policyer fortsätter att utvecklas.

Det aktuella arbetsdokumentet presenterar en systematisk litteraturöversikt som identifierade en uppsättning indikatorer som syftar till att adressera kvarstående luckor i den akademiska och politiska debatten om bästa praxis och lärdomar från smarta landsbygdssamhällen i Norden och Baltikum. Viktiga insikter från rapporten som den föreslagna uppsättningen indikatorer syftar till att adressera inkluderar:

- **Digital klyfta mellan stad och landsbygd**: Insatser för att lyfta fram erfarenheterna från marginaliserade grupper är avgörande för en mer inkluderande digital transformation i Norden och Baltikum. Att hantera den digitala klyftan mellan stad och landsbygd är avgörande, särskilt med tanke på begränsade ekonomiska incitament för att adressera landsbygdssamhällens behov.
- **Business Case för 5G**: En djupare förståelse av integrationsprocessen för nya digitala teknologier i landsbygdssamhällen kommer att stärka business case för 5G och relaterade applikationer. Denna metod lovar skalbarhet till andra regioner som står inför liknande klyftor mellan stad och landsbygd. Mot

bakgrund av Europeiska unionens Gigabit Infrastructure Act (GIA) får skalbarheten av bästa praxis från smarta landsbygdssamhällen ytterligare relevans.

- **Nordiska och baltiska samhälleliga konsekvenser av förbättrad digital anslutning**: Det finns fortfarande en lucka i litteraturen när det gäller nordiska och baltiska fallstudier av (landsbygd) smarta samhällen och en metodologisk ram som balanserar insikter om ekonomisk utveckling med samhälleliga konsekvenser, vilket kan ge nya insikter om de avsedda och oavsiktliga samhälleliga konsekvenserna av förbättrad digital anslutning.
- **Utvecklande policylandskap**: Det nationella och internationella policylandskapet för inkluderande, etisk och socialt ansvarig teknikutveckling och implementering har utvecklats avsevärt under de senaste åren. Mer skräddarsydda policyer, samordnade över regionala, nationella och europeiska nivåer, behövs dock för att adressera de specifika behoven hos enskilda grupper och minska infrastrukturella, ekonomiska och kompetensrelaterade skillnader.

CHAPTER

1

Left: In Kärkölä, Finland, local food is produced with digital logistics
Right: Smøla is a Norwegian wind turbine island with smart-grid solutions

1. Introduction

In the highly digitalised societies of the Nordic and Baltic region, access to fast and reliable internet has become essential for fostering innovation, business growth, well-being and robust democratic engagement. However, leveraging recent technological advancements presents challenges in some parts of the Nordic and Baltic countries. In particular, rural areas with low population density have been shown to struggle with limited digital connectivity, as the incentives for infrastructure investments are lower (de Jesus & Melander, 2024).

Geographical disparities are particularly evident in the case of 5G accessibility. A recent study highlighted that the rollout of 5G has favoured the urban centres of the Nordics and Baltics (ibid). Beyond merely offering faster browsing speeds, 5G and other low latency digital connectivity solutions are essential for advancing automation in the transportation and industry sectors, supporting telemedicine, enabling sensor data collection critical for sustainability and agriculture, enhancing energy efficiency and more. A lack of modern infrastructure and associated solutions has also been linked to some of the specific challenges faced by rural areas in the Nordic and Baltic countries, such as outmigration, unemployment, decreasing competitiveness of local businesses, loneliness and lack of prospects (Adams & Komu, 2022; Slätmo et al., 2022).

Nevertheless, several "smart communities" in the more rural parts of the Nordic and Baltic countries have successfully integrated smart, often 5G-enabled solutions into everyday practices to enhance local economies and improve the quality of life. These cases provide a framework for examining how technology, particularly connectivity-driven modernisation, can bolster the competitiveness of local businesses, promote sustainable living models and elevate overall well-being in the

less populated areas of the Nordic-Baltic region. However, moving beyond the cognitive trap of technological determinism, a notable lack of comprehensive data on the societal implications of new technological implementations has been identified. For better understanding of both the intended and unintended consequences of the digital transformation and to ensure that its short- and long-term effects on local populations are not treated as an after-thought, this working paper aims to bring the human experience to the forefront by exploring the following two questions:

1. *What are the key characteristics of smart communities (in a rural context)?*
2. *What indicators should be considered when conducting a social impact assessment of 5G and other connectivity-enabled technological transformation in (rural) smart communities in the Nordic and Baltic countries?*

The first question will provide a conceptual framework for this working paper by defining and discussing the appropriate terminology. The second question will dive deeper into the current knowledge base on the societal implications of improving connectivity in the Nordic and Baltic countries. The goal is to identify a set of indicators which can be used for both quantitative and qualitative studies of the societal implications of improved digital connectivity, such as through 5G. Such an indicator-based approach is designed to enhance understanding of the societal effects of solutions such as 5G deployment in these specific contexts and to identify best practices and areas for improvement on that basis. The aim is to provide a roadmap towards a stronger (business) case for 5G and beyond in the Nordic-Baltic countries and their rural areas in particular.

The structure of the paper is as follows: it begins with the executive summary and introduction, followed by an outline of the methodology in Chapter 2, detailing the chosen approach of a systematic literature review. Chapter 3 provides background information on terminology related to smart communities and highlights key characteristics of smart communities, linking them to the Nordic-Baltic (rural) context. Chapter 4 introduces the concept of social impact assessment and presents the findings of the systematic literature review. The following subsections provide a deeper analysis and discussion of those findings while consolidating the identified and selected indicators. Finally, Chapter 5 offers a comprehensive review of policies promoting and supporting the development of technologies aligned with societal needs and ethical standards in the Nordic and Baltic countries. This additional regulatory perspective helps to position the identified indicators within the current policy landscape, providing a better understanding of the policy incentives currently in place to drive technological development in line with societal needs and interests. Chapter 6 sets out some concluding remarks.

CHAPTER

2

Left: In Österåker, Sweden, water quality in lakes and rivers is remotely monitored
Right: On the Swedish island of Gotland, drones are used to increase sustainability in agriculture

2. Methodology

To address the first question, "What are the key characteristics of smart communities in a rural context?", the approach of a narrative literature following the guidelines proposed by Baumeister and Leary was employed (Baumeister & Leary, 1997). This method allows for a comprehensive overview of key terms and their definitions, drawing on both peer-reviewed publications and grey literature (Chapter 4).

In response to the second question, "What indicators should be considered when conducting a social impact assessment of 5G and other connectivity-enabled technological transformations in rural smart communities in the Nordic and Baltic countries?", the approach of a systematic literature review was selected. This method facilitates an exhaustive and systematic search of pertinent publications and ensures reproducibility of results, which is paramount for identifying relevant indicators for a social impact assessment and contributing to the scholarly debate on the societal implications of digitalisation. The adopted approach is based on the work of Higgins et al. as well as Tranfield, Denyer and Smart (Higgins et al., 2019; Tranfield et al., 2003).

Investigating the societal implications of enhanced connectivity involves a heightened risk of bias and the potential omission of critical aspects due to the complex and context-dependent nature of technology-induced societal changes. Synthesising existing literature based on predefined search terms and eligibility criteria facilitates the identification of consensus and gaps in the current literature. This process therefore supports selection of the most relevant and previously underrepresented indicators that offer substantial value for policymakers and communities.

However, it is important to note that the intricate societal dynamics shaping the framework and resulting from the integration of emerging technologies into everyday life are unlikely to be fully captured by a list of indicators confined to the scope of the present research project. Chapter 4 elaborates on the selection process used to narrow down the list of indicators identified through the literature review and elaborates on the reasoning behind the final selection of indicators while also exploring potential shortcomings and limitations.

2.1. Study selection and eligibility criteria

For the selection of relevant publications through the systematic literature review, several eligibility criteria were defined (see Table 1). To be included in the review, articles had to be published between 2020 and 2025. This is due to the fast-changing nature of smart technologies and the relatively recent rollout of 5G. The selected time frame further excludes the majority of literature published before the COVID-19 pandemic. Given that the pandemic altered many everyday practices, particularly in relation to technology use, it was essential to exclude literature published before 2020.

It was initially considered that the respective studies should focus on at least one Nordic or Baltic country to be included in the review. However, this eligibility criterion was expanded to include a global focus, as findings from beyond the Nordic-Baltic region were deemed relevant for informing the selection and discussion of societal analysis indicators. Studies also had to be published in English to ensure accessibility and comprehension for further analysis in the more advanced stages of the review process. Additionally, studies had to be peer-reviewed, leading to the exclusion of dissertations, books and similar sources. Lastly, overall relevance for the project was critically evaluated based on whether the study explored the societal consequences of improved digital connectivity.

Number	Theme	Inclusion criteria	Exclusion criteria
1	**Time frame**	Published between 2020 and 2025	Published before and including 2019
2	**Language**	Published in English	Non-English publications
3	**Quality assessment**	Peer-reviewed publications (with exceptions for conference proceedings* and reports from reputable organisations)	Non-peer-reviewed literature (dissertations etc.)
4	**Relevance**	Focus on societal implications of (technology linked to) improved digital connectivity	Societal implications not focal point of study

Table 1: Inclusion and exclusion criteria for the selection of relevant publications for the systematic literature review. *While most conference proceedings undergo a comprehensive peer-review process, it was not within the scope of the present literature review to verify if this applies to all the conference papers included in the present review.

Based on these eligibility criteria and the overall objective of the project, a search query was developed to identify the most relevant publications exploring systematic approaches towards social impact assessment in the context of digital transformation. The resulting search query outlined in Table 2 was used in two bibliographic databases: *Scopus* and *Web of Science*. The search settings were configured to limit queries to titles, keywords and abstracts. Certain search operators had to be adapted to the specific requirements of each bibliographic database.

Overall, the search yielded 298 results.[1] Publications which had previously been retracted were immediately removed from the list of results by the researcher. In the next step, duplicates between the two databases were identified and removed from the corpus of studies. After elimination of 62 duplicates, 232 articles remained for further analysis (see Figure 1). A preliminary individual screening process conducted by one of the authors examined the title of each publication to make a general assessment of the paper's relevance to the topic of the present study and whether it met the selection criteria regarding language used (criterion 2) and being peer-reviewed (criterion 3). After this initial screening process, 165 publications remained in the body of literature considered for further analysis.

1. The search was conducted multiple times per database to ensure accuracy and reproducibility. The search was re-entered in Scopus several weeks after the systematic literature review had commenced, yielding a more extensive list of results. As the search had been tested several times and the study was already underway, this anomaly was disregarded and might have been due to changes in the databases' search algorithm.

Technology	Boolean operator	Impact	Boolean operator	Indicator	Boolean operator	Year range
("digital connectivity" OR "digitalisation" OR "digital infrastructure" OR 5G OR "smart cit*" OR "smart village*" OR "IoT")	AND	(("socie*" OR "socio*") W/5 ("impact*" OR "effect*" OR "implication*"))	AND	(indicator* OR measure* OR metric*)	AND	PUBYEAR > 2019 AND PUBYEAR < 2026

Table 2: Search query used to identify relevant publications on Scopus. The Boolean operators were slightly adapted for the search of the Web of Science databases due to differences in the search engines. Titles, keywords and abstracts were searched.

In the second screening stage, the remaining 165 articles were reviewed more thoroughly by one of the report's authors in consultation with a second author. For that purpose, abstracts of the articles were reviewed with regard to criterion 4, i.e. the overall relevance of the respective study. Studies excluded at this stage included publications with an overly technical focus or those that merely referred to the importance of studying the societal implications of the technological intervention proposed. After this second screening phase, at total of 48 publications remained. However, 15 publications were not accessible in a full text format to the researchers and another eight publications were removed from the list after a more thorough review of the full text revealed an insufficient focus on the social scientific dimension of technology assessment studies. After removing both the inaccessible and the non-relevant publications, a final set of 25 peer-reviewed papers remained. These papers form the basis of the presented literature review as well as the selection of relevant indicators for the social impact assessment of improved digital connectivity in the more rural parts of the Nordic-Baltic region.

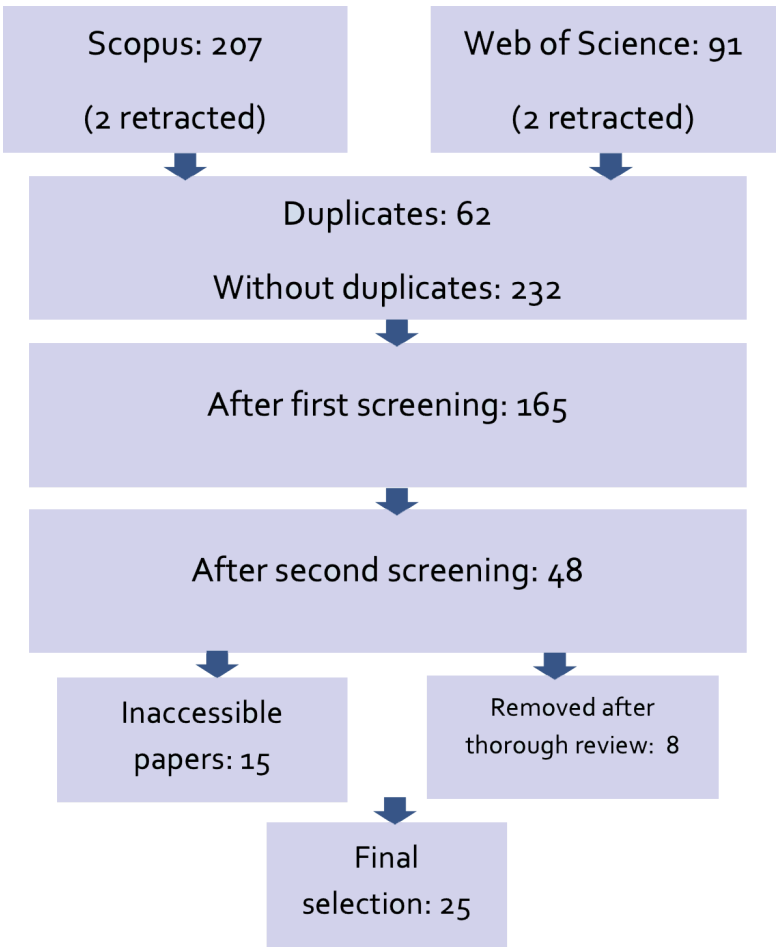


Figure 1: Overview of included and excluded studies based on findings from the two databases and application of eligibility criteria.

2.2. Indicator identification and scoring

The identification and selection of relevant indicators for further study of the societal implications of digital connectivity in a Nordic-Baltic context built on analysis of the selected 25 publications. Due to the inductive nature of the indicator identification and selection process, a content analysis based on an open coding approach inspired by the work of Clarke and Braun (Clarke & Braun, 2017), was chosen. Using a manual coding process, 20 categories of indicators could be identified (see Appendix A for the full table). These were further grouped together into seven overarching categories comprising (1) social, (2) economic, (3) political and (4) legal aspects, as well as (5) safety and security, (6) sustainability and (7) technology. Each category covered one to five associated broader indicator descriptions. As shown in the appendix, the individual indicators found in the literature were in most cases more precise, describing for instance the acquisition

of advanced technical competencies. These were grouped under the subcategory of "human capital", which was further associated with the overarching "social indicator" category.

To select a final and more refined set of indicators to be used in the next stage of analysis within the "N-B Connect" project, a scoring system was developed to assess the identified indicator subcategories. This scoring system assigned scores from 0 to 10 in the segments (1) frequency of appearance in the selected publications, (2) relevance for the analysis of societal implications of improved digital connectivity, particularly in a Nordic-Baltic context, (3) expected impact of related findings for future policy discussions, (4) expected data availability both in quantitative and qualitative terms and (5) expected ease of acquisition considering potential participants' willingness and interest to discuss the topics in question and the likelihood of finding the relevant quantitative data for all countries covered by this study (see Table 3).

To avoid bias, the scoring was conducted independently by four researchers from the research team for all segments except for the first, i.e. frequency. The frequency of appearance was calculated based on the findings resulting from the thematic coding conducted in the previous step; as such, the score for this category was pre-determined and was not evaluated individually by the researchers. Subsequently, the average score was determined for each of the 20 categories (see Table 3), forming the foundation for the final selection of indicators.

Based on this scoring exercise, six indicator subcategories obtained a score of higher than seven, which was set as the threshold. These were employment (9), digital inclusion (8.35), local economic impact (7.70), quality of life (7.20), human capital (7.10) and connectivity (7.05). Further analysis and contextualisation of these findings can be found in Chapter 4.

Theme	Subcategory	Frequency score	Relevance	Impact	Data availability	Ease of acquisition	Total
Social	Digital inclusion	10	10	10	7	6	8
	Quality of life	7	9	9	6	6	7
	Culture	3	6	6	4	5	5
	Health and wellbeing	6	8	9	6	6	7
	Human capital	7	8	8	7	6	7
Economic	Employment	10	8	9	9	9	9
	Local economic impact	8	8	9	7	7	8
	Innovation for growth	4	8	7	5	6	6
Political	Community engagement	6	8	8	6	6	7
	Local governance	6	7	7	6	6	6
Sustain-ability	Environmental sustainability	7	7	7	6	6	6
Safety and security	Public safety	6	7	7	6	6	6
	Privacy and trust	4	8	7	5	5	6
	Information security	7	8	7	5	5	6
Legal	Regulatory compliance	1	7	6	5	5	5
Technology	Connectivity	1	9	10	8	8	7
	Transport	4	6	7	7	7	6
	Innovation	2	6	7	6	5	5
	Technology acceptance	2	7	8	5	5	5
	Energy	3	6	8	6	6	6

Table 3: Scoring of identified indicators based on the systematic literature review. This table displays the average scores resulting from four independent reviews.

CHAPTER

3

Left: In Hyllie, Sweden, sensors manage energy, heating, waste, and water consumption
Right: A mobile tower with birds sitting on top of it

3. Background and terminology

In this chapter, we examine the terminologies that influence the public and scientific discourse on enhancing digital connectivity as it becomes embedded in numerous everyday practices in urban centres and rural areas of the Nordic-Baltic region. This definition mapping and associated discussions are grounded in a comprehensive narrative literature review aimed at identifying the specific characteristics that define and distinguish the various formats of "smart" societal structures – smart cities, smart villages, smart communities and smart territories. The chapter goes on to explore how these concepts have been employed in a Nordic-Baltic context before critically examining identified gaps and shortcomings, particularly in view of designing inclusive digital transformation practices. This mapping will establish the terminological and conceptual framework for further engagement with and exploration of smart entities in the Nordic-Baltic region within the context of the present research project.

3.1. Smart development strategies and concepts

The term "smart" has become a widely used label in planning and policy, signifying the integration of digital technologies and sustainable practices into development strategies for collaborative living environments. Concepts such as smart cities, smart villages, smart communities and smart territories aim to address societal challenges by leveraging technological innovations, such as 5G technologies, and fostering sustainable solutions. In a smart setting, these two elements often rely on each other, as technological progress is frequently used to promote, facilitate and implement sustainable practices. The employment of smart technologies has accelerated over the last decade, driven by increasingly widespread adoption of the

fifth generation (5G) of wireless mobile communication (Gohar & Nencioni, 2021) and advancement of the Internet of Things (IoT).[2] Although interconnected, the frameworks of smart communities, cities and villages differ in scale, approach and objectives, with the principles of each tailored to urban and rural contexts.

The concept of the "smart city" that emerged in the 1990s initially focused on incorporating digital technologies into urban infrastructure to enhance efficiency and functionality. By the early 2000s, its scope had expanded to encompass sustainability, economic growth and improved quality of life. This evolution inspired related ideas, such as smart villages and smart communities, with these principles adapted to meet the needs of rural and diverse settings (Dameri & Cocchia, 2013). Recent approaches emphasise the holistic integration of technological, social, environmental and economic dimensions to build inclusive, resilient and sustainable communities capable of addressing complex challenges in both urban and rural environments.

Despite widespread use of the term "smart", its definition remains fluid, varying across territorial contexts. This section introduces the four most commonly used concepts of "smart" development, focusing on how they are linked to 5G technologies and the overall rollout of faster digital connectivity in the Nordic and Baltic countries.

Smart cities

A smart city is an urban system that leverages digital technologies, data-driven solutions and efficient resource management to enhance services, improve quality of life and address urbanisation and sustainability challenges (Kitchin et al., 2019; Silva et al., 2018; Zhu et al., 2022). Unlike related concepts such as "digital cities", which primarily revolve around information and communication technologies (ICT), smart cities involve a more holistic approach, with policies and technologies integrated to foster sustainability, inclusivity and well-being (Dameri & Cocchia, 2013). This comprehensive approach takes social, economic and environmental dimensions into account to create connected and resilient communities.

Modern smart cities operate across multiple domains, including urban mobility, energy efficiency, infrastructure management, sustainability, citizen engagement, safety, economic development and resilience (Makkonen & Inkinen, 2024a; Silva et al., 2018). To assess these initiatives, Sharifi (2019) developed indicators across seven overarching themes: data, economy, people, governance, environment, living quality and mobility, each of which is associated with a set of indicators. This model

2. The Internet of Things (IoT) refers to a network of devices and sensors which interact through the internet to share information and develop more efficient and intelligent services and Human-Computer interactions (Alahi et al., 2023).

is designed to provide a measurable framework for evaluation and comparison of the success of individual smart city initiatives (Sharifi, 2019). This approach is based on the original model of the "smart city wheel" as developed by Cohen (Cohen, 2012).

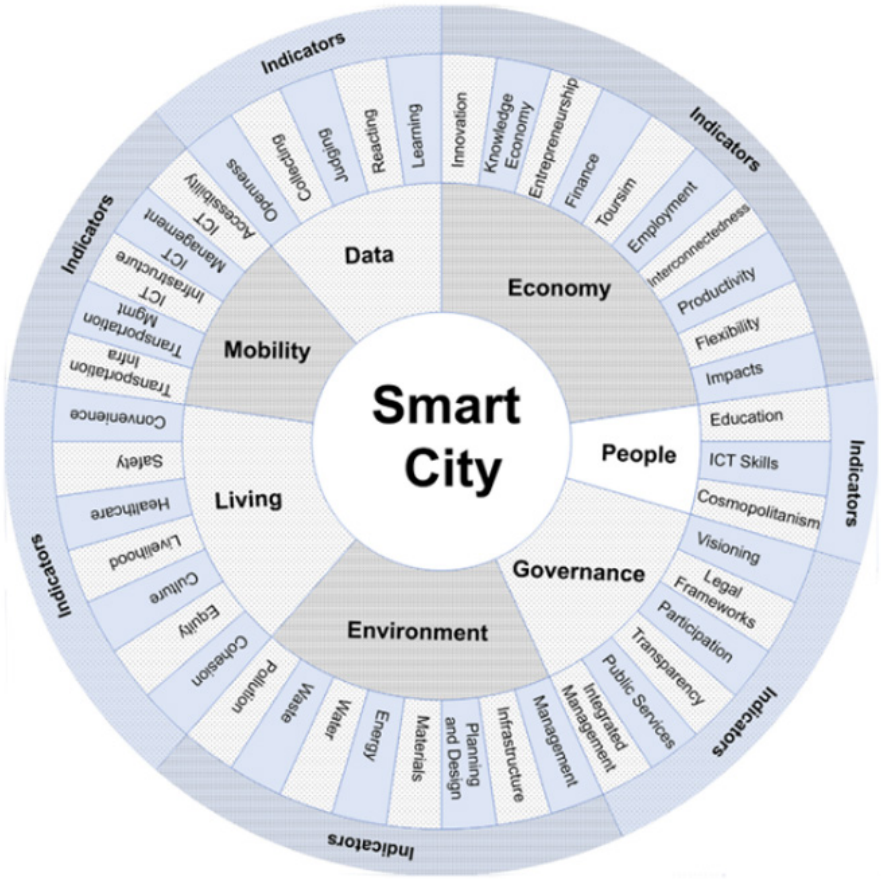


Figure 2: Smart City indicator themes developed by Sharifi (2019) based on the work of Cohen (2012).

The concept of the smart city gained momentum in the late 2000s with the rise of the Internet of Things (IoT), under which interconnected devices exchange data to enhance urban functions. In parallel, user platforms like Airbnb and Uber emerged during this period, aligning services with user needs through digital connectivity (Ramdani & Kawalek, 2024). The European Union further promoted the concept with its European Innovation Partnership for Smart Cities and Communities in 2011, which now forms part of the Smart Cities Marketplace (European Commission, 2025d). This initiative integrates communication technologies, energy management and transportation to tackle environmental, societal and health challenges in European cities (European Commission, 2016).

Globally, many cities now have dedicated administrative units for coordinating smart city projects, with public funding playing a central role in their implementation (Gerli et al., 2024). The Nordic Region is considered a leader in digitalisation, particularly in terms of 5G network development, access to public digital services and ICT skills (Nesse & Erdal, 2022). The growing availability of 5G can be considered a crucial factor in the development of smart city structures. Thanks to its low latency, 5G enables the collection of real-time data, which are essential for smart functionalities like traffic management. In 5G-enabled traffic systems, IoT sensors installed on traffic lights, streets and vehicles help analyse traffic patterns, prevent congestion and accidents and prioritise vehicles such as emergency vehicles, ensuring more efficient emergency responses (Liu et al., 2017).

While enabling these new kinds of communication networks, for example in vertical industries such as transportation, energy, healthcare, manufacturing and entertainment, most of the 5G projects in smart city contexts are still in their early stages (Gohar & Nencioni, 2021). Many challenges remain, including financial barriers, technical limitations and the acceptability of widespread 5G adoption (de Jesus & Melander, 2024).

The concept of smart cities, although recognised for leveraging technology to address urban challenges, has faced criticism for its vagueness and techno-centric foundation (Gerli et al., 2022; Makkonen & Inkinen, 2024b). Critics argue that smart cities often prioritise technological innovation and corporate interests over citizen welfare, neglecting democratic and social rights (Cardullo & Kitchin, 2019; Rosol & Blue, 2022).

Concerns have been also raised about technological determinism, where technology drives societal change, potentially leading to social fragmentation and weakening community bonds. Some argue that this shift from physical to digital interactions risks eroding the cultural and historical identities of cities (Makkonen & Inkinen, 2024b). Moreover, smart city technologies carry risks such as surveillance overreach, algorithmic bias and inequitable AI-driven decision-making processes (Samsurijan et al., 2022). These critiques highlight the importance of balancing innovation with inclusivity, governance and ethical considerations.

Smart villages

The concept of the smart village extends and adapts the principles of smart cities to rural areas, focusing on digital transformation and sustainable development to enhance quality of life. Smart villages aim to address common rural challenges, including limited access to services, economic opportunities and digital connectivity. By leveraging technology, such communities promote social inclusion, economic growth and environmental sustainability.

A key motivation for the development of smart villages is the disparity in data infrastructure between urban and rural areas. Rural communities often face significant connectivity gaps as well as challenges related to adoption and use of technology. Improving digital connectivity through broadband infrastructure and mobile cellular networks like 5G can enhance access to healthcare, education and public services, bridging the rural-urban divide (Salemink et al., 2017).

The European Commission adopted the EU Action for Smart Villages programme in 2017, aimed at supporting innovative solutions to enhance resilience and quality of life and foster dialogue among stakeholders in rural areas (European Commission, 2019; Ocsko, 2019). The resulting definition of a smart village defines it as a rural community that leverages local strengths and uses innovative solutions to enhance resilience and quality of life. The definition emphasises inclusivity, with participatory approaches used to improve economic, social and environmental conditions (Directorate-General for Agriculture and Rural Development et al., 2020). Digital technologies are not the primary focus under this approach. The EU emphasises the leveraging of local resources, innovation and community-led solutions alongside technology. Funding strategies often combine public and private resources and adapt national frameworks to suit local contexts (Ocsko, 2019).

The introduction of 5G offers a promising shift from the city-centric deployment observed in 3G and 4G to a more uniform, distributed approach. This is linked to the longer range of 5G cell towers, which can support a larger number of devices over a wider area. Furthermore, the low latency of 5G is crucial for many of the precision applications that are of particular interest to rural communities, such as remote healthcare solutions or digital systems for agricultural use (Cvar et al., 2020). For example, "Smart Agriculture" can improve efficiency and reduce environmental impacts through precision farming, smart irrigation and supply chain management. However, challenges such as connectivity issues, cost management and data security as well as potential misalignments between technology design and local needs must be addressed to ensure inclusivity and acceptance (Kumar et al., 2024).

Salemink et al. (2017) found that there are growing differences in data infrastructure quality between urban and rural areas. The deployment of technologies is generally lower in rural areas. Paired with lower average levels of education and skills, that has a negative impact on the adoption and use of technologies. The authors note that while rural communities are in greater need of improved digital connectivity due to their remoteness, they are the least connected and included (Salemink et al., 2017).

The employment of smart villages has the potential to empower rural communities through knowledge sharing, skills development and participatory decision-making, fostering resilience and self-reliance. However, further research is needed to inform policies tailored to less connected rural communities (Salemink et al., 2017) .

Smart communities

The concept of "smart communities" recognises that ICT technologies need to integrate social and economic aspects into digital development through the involvement of communities, both in urban and rural settings (Ma et al., 2024). Building on concepts such as “e-communities” and “digital communities”, which emerged in the 1980s (Malina et al., 1998), the “smart community” attempted to integrate information technology into social and economic governance (Zaidan et al., 2022).

The smart community reflects a community-centred philosophy, highlighting the critical need for social inclusion in decision-making processes to achieve social and environmental objectives in smart development, including aspects such as affordability, acceptability, privacy and coherence (Zaidan et al., 2022). Smart communities should also generate social innovation through inclusive governance and infrastructural and technological drivers, which can engage local actors to respond to challenges related to quality of life and inclusion (Zaidan et al., 2022).

While there are multiple definitions of smart communities, there is a common understanding of a smart community as a place where information technology, through innovation and interconnectivity, transforms living and working environments. It can also be seen as a framework which integrates society, government, businesses and individuals to improve societal systems through ICT technologies (Ma et al., 2024).

Recent research on smart communities often focuses on how to integrate smart technologies, such as 5G applications and IoT technologies, into community governance effectively. However, while much research focuses on constructions which facilitate smart communities, such as smart energy management, smart homes and smart transportation, there is lack of research on how various actors in a community interact within the technological sphere, including humanistic aspects of smart communities (Ma et al., 2024). Expanding fields of research include civic engagement, social innovation, smart economics and digital health (Ma et al., 2024).

Overall, the concept recognises that "smartness" is not confined to large cities but can be adapted and applied in various contexts, including smaller, localised areas. It emphasises collaborative, citizen-driven technological solutions. Accordingly, the concept of “smart communities” focuses more on the social governance structure underlying smart initiatives than on the geographical context in which the concept is applied.

Smart territories

"Smart territories" is a further term which can be found in the pertinent scientific literature. It refers to geographical areas that address public challenges through technology-driven solutions facilitated by cross-sector collaboration. This concept extends the model of the smart city to a wider geographical context and scale, encompassing interconnected urban, suburban and rural regions. It employs ICT tools to tackle challenges such as food security and waste management (Navío-Marco et al., 2020).

By integrating technology and governance, smart territories aim to enhance sustainability, connectivity and territorial management on a broader scale. A central aspect of this framework is the holistic approach to territorial management, which takes the unique objectives and conditions of each area into account and pushes for digital transformation that benefits both urban and rural communities equally (Navío-Marco et al., 2020).

The idea has gained traction within regional development strategies, with initiatives supported by organisations such as the EU and UN. These efforts often involve cross-border and interregional projects, thereby fostering collaboration and innovation across diverse geographical contexts (Navío-Marco et al., 2020).

Smart communities in the Nordic-Baltic region

The Nordic-Baltic region has emerged as a leader in research and development of smart solutions, driven by a commitment to sustainability, citizen engagement and technological innovation. There are multiple innovation beds for smart cities, villages and communities as well as initiatives focusing on knowledge sharing and enhanced technological accessibility.

The Nordic Smart City Network is an initiative aimed at fostering liveable and sustainable cities in the Nordic Region. It is a collaboration between five Nordic countries and provides insights from 20 Nordic cities, with emphasis on the need for collaboration, co-learning and the active role of citizens. One example of this approach is the Nordic Urban Living Labs project, which ran between 2018 and 2020, focusing on development of best practices and co-learning. The project emphasised sustainability through technical solutions, such as improved energy efficient buildings, waste management systems and green mobility. Countries like Finland and Denmark are leading the way in integrating digital platforms into public services, transportation and urban planning. The Baltic countries are also involved. For example, Estonia's digital government serves as a model for smart communities and villages, particularly in creating e-governance frameworks (Nordic Smart City Network, n.d.).

Recently, smaller and more rural communities have gained more attention in the field of digitalisation. While the Nordic countries are considered one of the leading regions in smart urban planning, there are considerable discrepancies in the development of smart cities and communities, with both local conditions and country-level policies influencing smart city development. Examining Sweden, Norway, Denmark and Finland, Lindtvedt et al. (2021) found significant variations in smart city development in medium-sized municipalities. Here, organisational structures, clearly defined goals and strategies were found to foster more successful implementation of smart city projects (Lindtvedt et al., 2021).

Multiple projects in the EU apply the EU concept of Smart Villages, developed in the pilot project on Smart Eco-Social villages, to local contexts. For example, the Smart Rural 27 Geomapping Tool, presents smart rural communities in the EU, showcasing several examples in the Nordic and Baltic regions. The map highlights villages with "smart" village strategies and other smart projects or initiatives (Smartrural27, n.d.-a). Furthermore, the LEADER platform aims to bring stakeholders together to discuss the development of Smart Villages for the purpose of exchanging good practices (Smartrural27, n.d.-b).

3.2. Inclusive smart development

Since individuals have varying capacities and access to digital technologies, there is a risk that the benefits of smart development may be unevenly distributed within society. This concern underscores the need for smart initiatives to address disparities and ensure equitable access. While the importance of inclusivity applies equally to smart cities, villages, territories and communities, more research on the topic is needed.

Scholars are increasingly stressing the need to address the social dimensions of "smart" developments, highlighting issues like the digital divide and the importance of inclusive development strategies (Alizadeh & Sharifi, 2023b; Kitchin et al., 2019; Salemink et al., 2017; Toli & Murtagh, 2020). This criticism has led to the rise of a justice-oriented perspective, including "the right to the Smart City" (Cardullo & Kitchin, 2019; Kitchin et al., 2019).

For example, Makkonen and Inkinen (2024) highlight a significant gap in the literature regarding the impact of technology-driven urban development on people with disabilities. They call for more critical discussions and advocate for adapting and contextualising smart city initiatives to ensure more inclusive development of living conditions. The authors argue that without such considerations, smart city development threatens to exclude vulnerable populations and perpetuate inequalities.

The literature also stresses that simply offering digital services to everyone does not automatically create an inclusive smart city. True inclusivity requires addressing

the preconditions and capacities necessary for individuals to engage with and benefit from smart solutions, ensuring that no group is left behind in the transition to digitalised, technology-driven environments (Makkonen & Inkinen, 2024a).

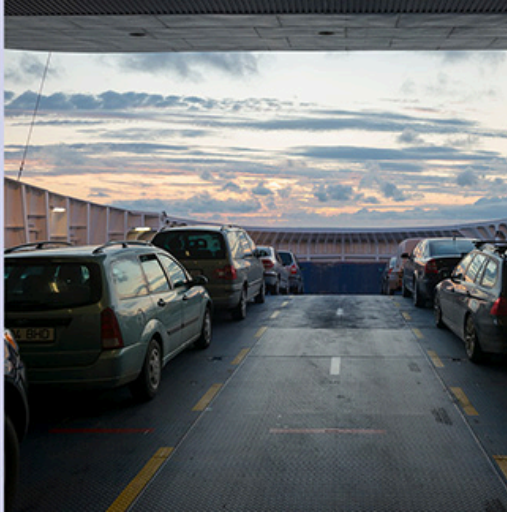
In rural contexts, inclusivity challenges arise regarding who can afford to implement digitalised technologies, such as precision farming tools and the potential loss of human control as automation and digitalisation increase (Rolandi et al., 2021). These issues highlight the need for inclusive strategies that enable equitable access to technology and ensure its benefits are widely shared.

3.3. Concluding remarks

The present work will mainly focus on rural contexts, bringing the concept of the "smart village" to the fore. However, as the concept might not always be employed to discuss a specific village and could also refer to a wider rural community, such as a municipality, the term "smart community" will be used in such cases. Due to the extensive body of literature on smart cities, this work will draw on some of the prominent conceptual frameworks and publications from that field and apply them to the specific context of Nordic and Baltic rural communities.

CHAPTER

4



Left: In Riga, Latvia, data collection is used to optimize public transportation
Right: The ferry to Hiiumaa, Estonia, where a digital strategy ensures e-services in transportation

4. Social impact assessment: Literature review and indicator selection

As described in Chapter 2, a systematic literature review was conducted as part of this study to identify and review relevant publications that have previously explored and assessed the societal implications of improving digital connectivity. This review of the pertinent literature will help to answer the question outlined in the introduction to this working paper: "What indicators should be considered when conducting a social impact assessment of 5G and other connectivity-enabled technological transformation in (rural) smart communities in the Nordic and Baltic countries?"

This chapter provides an overview of the current state of research in this field and helps to pinpoint remaining knowledge gaps. It begins with a bibliometric analysis of the reviewed articles, followed by identification and elaboration on the main arguments presented in the given literature. These will be synthesised in a narrative manner. The chapter will further elaborate on the final selection of indicators based on the systematic literature review with the aim of further contextualising and refining them for use in the later stages of the present research project. The final selection of indicators will be used in a social impact assessment of improved digital connectivity in general and 5G in particular in smart rural communities in the Nordic and Baltic region. Social impact assessments are designed to analyse and eventually monitor the intended and unintended consequences of an intervention, in this case the integration of "smart" and digitally enabled technologies into everyday practices (Freudenburg, 1986).

4.1. Systematic literature review – bibliometric analysis

Overall, the publications identified through the systematic review represent a diverse body of research on the societal dimension of digital technology development and application. With publications spanning various disciplines, from engineering to the social sciences, it became apparent that the topic can be addressed from a variety of angles. However, during the screening process, it also became clear that while many papers refer to and highlight the importance of evaluating the societal implications of emerging technologies, only a limited number present a systematic, empirical approach along with the corresponding results. This was the primary reason for excluding papers under the relevance criterion. The following brief bibliometric analysis will provide an overview of the geographical, temporal and topical range covered by the remaining selected 25 papers.

As the decision was made to broaden the geographical frame within the search query, the final sample of publications represented a wide range of geographical frameworks. This is also reflected in the affiliation of the authors of the 25 selected papers. Most authors are affiliated with a research institution within Europe, with the USA being one notable exception (see Figure 3). This pattern reflects overall trends influenced by factors such as the global distribution of research funding, international reputation and established networks of renowned researchers (Rodríguez-Navarro, 2024). However, these findings also underline the pioneering role of Nordic countries in the field of digital transformation, with Finland being among the top eight countries of affiliation.

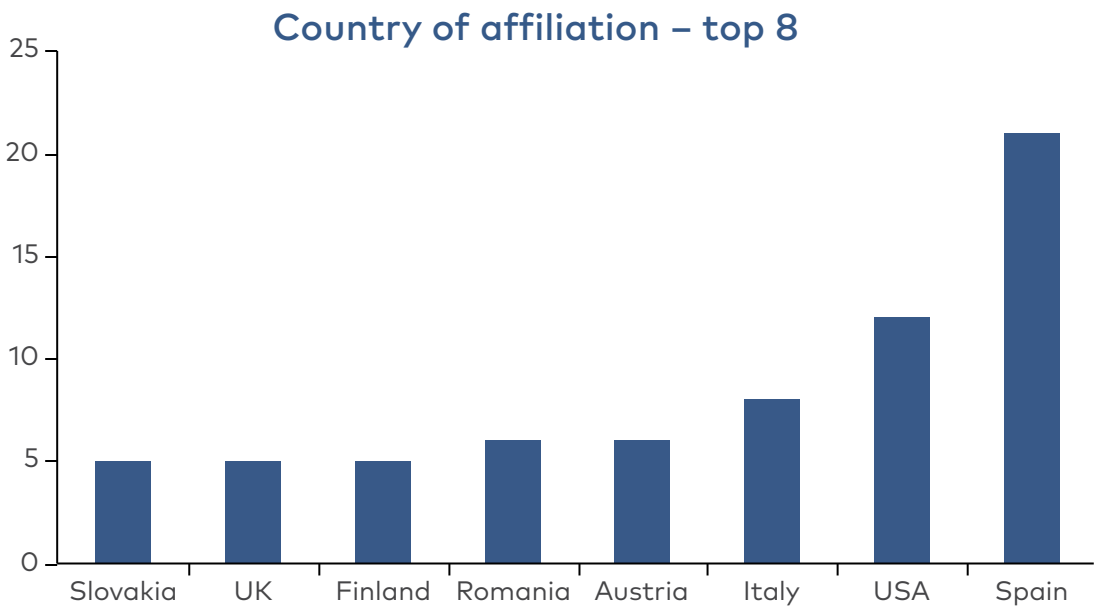


Figure 3: Overview of the top eight countries in terms of affiliation of the authors that contributed to the 25 papers finally selected.

The bibliometric analysis further revealed that most publications stem from the broader field of economics. This could be explained by the indicator-based and hence quantitatively dominated review of technology-induced societal implications. Altering the search query described in the methodology chapter and excluding the "indicator" dimension might therefore yield a different set of results. The publications that fall outside the wider field of economics (including management) are split almost evenly among other social sciences or computer sciences and related disciplines. This can be explained by the close interconnection between the technical and social dimension when exploring such topics (see Figure 4).

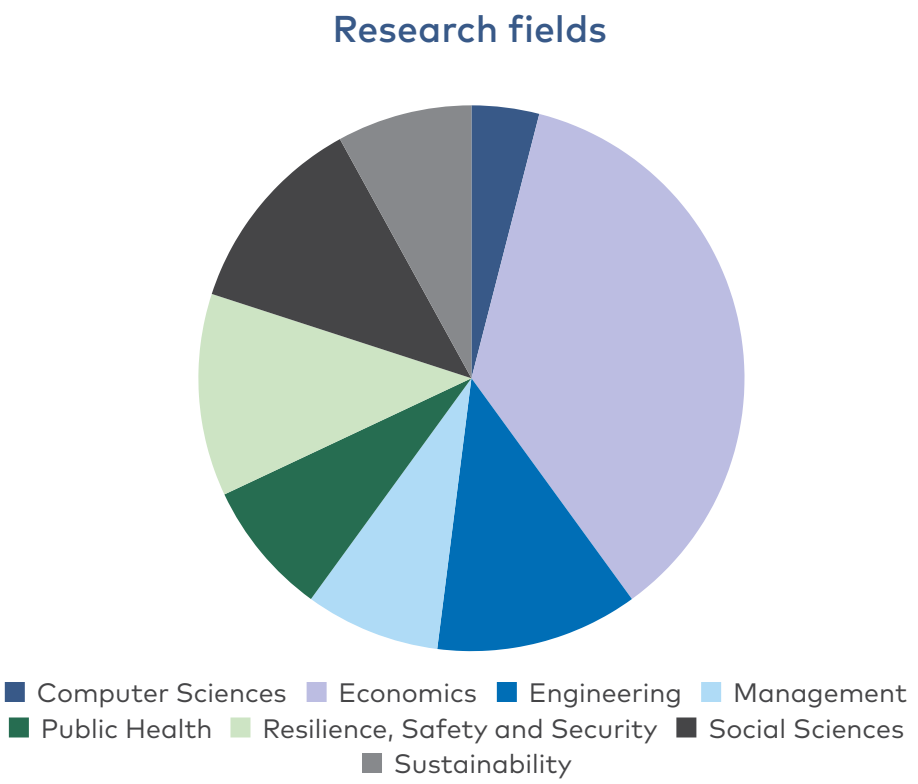


Figure 4: Research fields associated with the 25 selected publications.

While all the publications address digital transformation processes, only ten explore the topic in the context of a "smart community" and only three relate their research directly to 5G. While two Nordic/Baltic countries were among the top eight countries of affiliation, only two publications focused on a Nordic/Baltic case study, highlighting the need for more research on the societal implications of improved digital connectivity in a Nordic and Baltic context. An analysis of the years of publication reveals growing interest in the topic, with a peak in 2022 (see Figure 5).

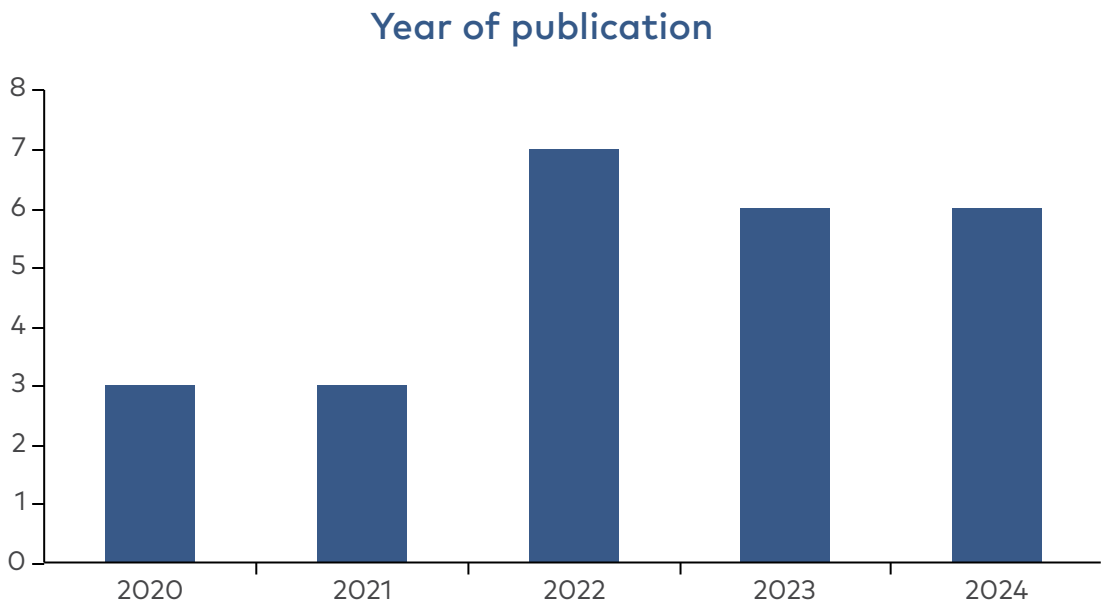


Figure 5: Year of publication of the 25 publications included in the final review.

4.2. Systematic literature review – findings and analysis

As outlined in the methodology chapter, the selected 25 papers were thoroughly reviewed with the aim of identifying the indicators employed in the current research landscape to evaluate the wider societal impacts of digitalisation. This section aims to contextualise this evaluation by providing a narrative overview and analysis of the reviewed literature, exploring and elaborating on the most common themes. The structure of this section follows the format of the indicator mapping (see Table 3).

Economic Factors

As mentioned in the bibliometric analysis, economic aspects and methodologies dominated the framing and investigation of the topic in most of the selected papers, with employment being a key aspect of inquiry on the microeconomic level. Beyond employment, several authors also explored the effect of smart communities on the wider national economies at the macroeconomic level (see e.g. Popova & Popovs, 2022). Although the broader economic impact of smart communities on national economies is crucial for understanding the societal benefits and challenges of enhanced digital connectivity, this discussion will focus on more specific, contextualised findings and frameworks as a wider, macroeconomic analytical frame lies beyond the scope of this study.

Employment was investigated from various angles, predominantly by means of quantitative methods. A common theme that emerged across the literature in this respect was accessibility of skilled labour and the need to expand relevant training opportunities to address and pre-empt labour shortages in sectors that are increasingly reliant on digital services and technologies (Kiseľáková et al., 2024). Malkowska et al. (2021) highlighted the benefits of a stronger focus on digital skills and lifelong learning for the workforce, stressing positive impacts on employment stability, general quality of life and wage prospects for the individuals in question. These benefits, in turn, contribute to economic growth and innovation and efficiency for society as a whole when digital technologies are successfully integrated into local business models, according to the paper's authors. The authors urge policymakers to prioritise relevant training opportunities to ensure these benefits can be realised (Malkowska et al., 2021).

In their study on the effects of digitalisation on youth employment in the EU, Bașol et al. (2023) found that DESI indicators, such as connectivity, digital skills and digital technology integration, correlated with reduced youth unemployment across the Union, underscoring the importance of addressing these cornerstones of the digital transformation to ensure financial stability and professional success for younger generations (Bașol et al., 2023). Kiseľáková et al. (2024) further emphasised that successful education in digital skills is among a list of factors crucial for a thriving national digital economy. This is particularly important for all working-age adults in the context of increased automation and associated employment risks (Bălțățeanu, 2020; Kiseľáková et al., 2024).

However, several publications also emphasised that a range of socioeconomic factors play a pivotal role in the acquisition of both advanced and basic digital skills (Gómez-Carmona et al., 2023; Malkowska et al., 2021).While these skills were mainly addressed more broadly as enablers of employment and economic success in the selected publications, both advanced and basic digital skills are also central elements in the digital inclusion literature. Social inequalities that lead to and result from uneven availability of digital skills training opportunities and necessary hardware and software continue to hinder the creation of equitable digitalised societies, exacerbating socioeconomic differences beyond issues of labour market access (see e.g. (Lythreatis et al., 2022)).

The study by Gómez-Carmona et al. (2023) delved into the challenges arising from a lack of relevant digital skills. The paper examined digital transformation in a rural context, where insufficient digital infrastructure and skills often hinder the integration of technologies and services into local businesses and other everyday structures – opportunities that could benefit the local population not only in terms of employment but also more broadly (Gómez-Carmona et al., 2023). In this context, the authors stressed the importance of aligning digital transformation

measures with the needs and goals of rural populations, as these might differ from urban priorities and viewpoints, which may tend to dominate technology development, design and implementation processes through an urban bias.

Looking beyond skilled labour, a study by Ha (2022) used ergonometric methods to explore how the introduction of digital public services has positively impacted employment levels, exports, resource efficiency and the turnover of eco-industries. The author connects the findings to the contribution of digital public services to a more dynamic and responsive labour market, where resources are used in a more efficient and transparent manner (Ha, 2022).

Social and political factors

Several studies included in the final selection of papers focus more closely on the social and related political dimension of the digital transformation process. Panfilova and Popova (2021) found that cloud solutions have a positive impact on quality of life by increasing social and human capital in general and in particular by facilitating community engagement, providing citizens with novel pathways to make their voices and experiences heard (Panfilova & Popova, 2021). Exploring public cloud services primarily, the authors also underlined more efficient access to key public services as a factor contributing to overall improved life satisfaction. Life satisfaction was also explored by Hannola et al. (2020) in their study on the impact of the introduction of smart solutions on factory workers. Besides increased efficiency, the authors found an increase in job satisfaction due to the introduction of smart solutions alleviating the burden of monotonous tasks and encouraging more innovative thinking and approaches (Hannola et al., 2020). Studying smart transport solutions in low and middle income countries, Ashraf and Idrisi (2024) argue that smart transportation is not only more sustainable but also leads to improved quality of life by reducing travel times and facilitating social encounters (Ashraf & Idrisi, 2024).

Other authors also discussed the reinforcement of participatory practices in the wake of increased digitalisation, highlighting both their potential benefits and shortcomings. The need to strengthen the consultation and integration of local actors in the design and implementation of technology and employment processes was emphasised in several of the publications. This was deemed particularly important to ensure that local needs and objectives are taken into account and met, especially for populations that do not represent a majority group, such as rural communities (Gómez-Carmona et al., 2023; Hu et al., 2022; Ilie, Oprea, Turcea, & Parnus, 2022). Hu et al. (2022) particularly stress the significance of public trust in establishing digital services that benefit communal life. The authors correlate trust in digital public services with a higher likelihood of using these services, leading to closer and more interactive ties between the government and the public and

reinforcing social cohesion based on equal access to information and services. In their case study on social cash transfers, Kemal and Shah (2024) explored the mechanisms that drive digital transformation and innovation processes within a society, examining the dimensions of coercive (techno-economic, regulatory), normative (socio-organisational), mimetic (international) and covert power (political) (Kemal & Shah, 2024). While international learnings, economic competitiveness and regulatory pressures can drive the adoption of new technological solutions, such as the social cash transfer systems discussed in the study by Kemal and Shah, the authors stress the critical role of social and organisational norms in shaping how digital innovation is perceived, implemented and accepted.

Closely related to the dimension of community well-being and quality of life in terms of improved access to digital public services and information is the study of potential impacts in the health and care sectors. Two of the selected articles addressed these questions in more detail. While focusing on two different sub-topics, both publications highlight the role of data privacy and security. As increasingly sensitive data migrates to the digital sphere, including medical records, Benevento et al. (2023) debate the need for fostering willingness among the population to share their data. Related to the exploration of public trust by Hu et al. (2022), the authors of this paper stress the role of an individual's awareness of the risks associated with identity theft and other data breaches (Benevento et al., 2023). The researchers found that comprehensive anonymisation methods and the perceived benefit of the digital services in question had the greatest effect on people's willingness to share personal data for health and care purposes. This not only informs possible privacy loss mitigation methods but also draws attention to the risks of misuse. The second study in the selected corpus of literature focusing on the effects of improving digital connectivity in health and care, by Rantanen et al. (2021), further stressed that online solutions do not replace in-person efforts, particularly in a mental health context (Rantanen et al., 2021). Similar to the arguments on employment and digital skills presented above, the authors underline the role of the inclusion gap and socio-economic factors in this context. Lower levels of digital literacy, access issues, weaker social support systems and limited trust in digital services due to past experiences or lack of familiarity can lead to the exclusion of certain population groups considered to be at risk of digital exclusion more generally due to their socioeconomic status and other factors including physical and mental health. This is particularly significant in the context of the study by Rantanen et al., which investigates access to and use of digital mental health services.

Sustainability

Another aspect that became evident from the collected data was a reoccurring focus on sustainability, which reflects its crucial role within the smart community concept. Several studies investigated ways to identify the sustainability efforts that make a "smart city" smart (e.g. Gorantla & Bansal, 2023). Santa (2022) addressed the role of the citizen in this context, examining the use and promotion of sustainable energy in smart communities and the need for policies to support such proactive behaviour among consumers (Santa, 2022). Regarding the previously discussed dimensions of social and economic factors, improved resource efficiency played a central role in the publications, with a stronger focus on environmental sustainability factors, particularly in terms of natural rather than human resources. Several of the selected publications noted an overall improvement in use of resources resulting from better digital connectivity (e.g. Berman et al., 2022; Ha, 2022; Santa, 2022) with Mahmoudi et al. (2024) applying this indicator in a more specific agricultural context. In their study on agriculture robots, the authors of this study found that the use of IoT and other digital technologies in the agricultural sector can lead not only to improved use of resources, such as water, nutrients, energy and labour, but also to overall better efficiency and crop yield (Mahmoudi et al., 2024). However, the authors also discussed the potential challenges that result from automation and digitalisation in the agricultural sector. As in other sectors, these may include labour displacement and unemployment, compromised data privacy and discrimination due to algorithmic biases (ibid). The authors further explored the overall challenges faced by the relevant governance frameworks, which need to adapt, follow and anticipate technological progress and the described risks to help integrate novel digitally enabled solutions into the societal fabric in a "safe and equitable" way (ibid, p.17).

Legal factors

Overall, relatively little attention was given to the legal and regulatory dimension of improved digital connectivity and the digital transformation more generally. A study by Edelmann et al. (2023) focused on the digital transformation in the Austrian public sector. In this context, the authors underlined the necessity of adapting governance and regulatory frameworks to accommodate and guide the new digital operational processes (Edelmann et al., 2023). The limited engagement with the topic in the selected set of articles can be attributed to the predominantly empirical and quantitative focus on the implications of digitalisation, where legal aspects are often marginalised. However, legal considerations are crucial in shaping the digital transformation to align with societal needs and prevent the misuse of power in the complex landscape of emerging digital technologies given that these technologies are particularly vulnerable to surveillance overreach and data

exploitation by tech companies and other actors (see e.g. Wylde et al., 2023). The balance between innovation and regulation is a widely discussed issue that has garnered further attention in recent public debates. Such discussions often revolve around the balance between accelerated innovation and associated economic and political advantages and the safe and sustainable development and usage of technology. The risks associated with limited policymaker involvement have been repeatedly highlighted in this context, with ethical considerations, particularly regarding privacy infringements, at the forefront of these discussions (see e.g. (Dhirani et al., 2023; Nasim et al., 2022)).

Despite the significance of this ethical debate, it was only marginally reflected in the selected publications reviewed in this systematic literature review. Given the importance of understanding the policy landscape that shapes the legal framework for technology development and use, the policy review chapter (Chapter 6) has been included in this working paper to provide further context in this regard.

Safety and security

Safety and security aspects linked to the introduction of digital technologies were discussed in several of the publications. Data privacy, one aspect already explored in a previous section in the context of personal medical data and digital health care services, was addressed by several papers. Those studies integrate the data protection dimension into the analysis of potential risks of new digital technologies (Szalkowski & Johansen, 2024). Beyond the purely digital sphere, two of the reviewed articles explore the intersection between digital technology and physical safety.

Hu et al. discuss how improved digital communication between citizens and public authorities through novel digital services helps to protect livelihoods in times of emergencies and crises, including natural hazards (Hu et al., 2022). Two further studies (Lin et al., 2022; Samarakkody et al., 2023) explored the link between digitally enabled public communication and awareness services, employing the example of disaster and emergency communication and relief.

The study by Makhalany et al. (2024) investigated the use of drones to improve public safety in South Africa, finding that the use of this technology can support law enforcement, including through the identification of hidden weapons, tracking of suspects by night and other otherwise challenging tasks. However, the authors also touch upon ethical challenges in this context, including privacy issues and the balance between individual rights and enhanced public safety (Makhalany et al., 2024).

Technical factors

As most publications captured by the systematic literature review focus on a case study regarding the use of a specific (type of) digital or digitally enabled technology, technical factors are central to all the publications. In line with the literature on smart cities (and other smart community formats), transport, energy, public engagement and digital connectivity more generally are the most recurring themes, exploring how automation and sensor data can make these more sustainable, democratic and safe (see e.g. (Ortega-Fernández et al., 2020)).

Where connectivity itself is mentioned, it is often linked to questions of digital inclusion and the accessibility of stable and affordable internet (see e.g. Gómez-Carmona et al., 2023; Ilie, Oprea, Turcea, & Părnuș, 2022). Particularly in the context of the rural-urban divide, access to reliable digital connectivity might seem like a given, yet it continues to pose a significant challenge for individuals living in more remote areas. As certain services are designed to require increasingly lower latency, these disparities can further marginalise rural communities.

Key insights

It has become apparent that the social impact of digital transformation can be assessed from various perspectives. Employment, overall improvement in the quality of life, and the development of digital skills, along with heir implications, are mong the most studied factors in the current literature. While there is growing interest in the sustainability dimension, other aspects such as digital inclusion and trust remain relatively understudied.

Systems like Cohen's wheel for smart cities (Cohen, 2014), as well as the various adaptations built on that model or the impact universe framework of Berman et al. (Berman et al., 2022) are some attempts at providing a structural framework to assess the strengths and weaknesses of smart cities and associated socio-technical systems and to advocate for greater social responsibility in an increasingly techno-centric society. Yet, these frameworks generally offer a very comprehensive outlook, which can be beneficial to provide a holistic picture of the societal dimension of the digital transformation.

However, a significant risk, as highlighted in several of the reviewed publications, is the omission of key indicators and the empirical exploration of specific bottom-up experiences of individuals using these technologies in their everyday lives. This omission can lead to a limited understanding of the unintended consequences of digitalisation, particularly for communities that are not at the centre of innovation and technology design, such as rural areas.

The absence of these more in-depth and contextualised perspectives can result in frameworks that do not fully capture the unique challenges and needs of these

communities. For instance, rural areas might face specific issues related to limited digital accessibility and poor infrastructure due to the specific natural topography of their location. The adoption of digital solutions might further affect and be affected by historically established local cultures and practices. Without incorporating lived experiences and feedback from these communities, frameworks may fail to capture and address critical aspects of digital inclusion and equity.

The next section aims to address this identified gap in the literature by proposing a set of indicators for a mixed-methods study. This study design aims to better capture the individual citizen perspective on the societal implications of improving digital accessibility in a rural context, while also considering the broader economic implications. By integrating qualitative and quantitative data, the study seeks to provide a more detailed understanding of how digital technologies impact rural communities and to develop strategies that ensure these technologies benefit all members of society.

4.3. Final selection of indicators

The review of the selected publications revealed a set of categories which have been previously explored in the context of studying the societal implications of improved digital connectivity. To better adapt the identified indicators to the specific context of rural smart communities in the Nordic-Baltic region and to keep the selection within the scope of the current study, the following section will outline the selected elements that will be explored in more detail in the next stage of the project.

Based on the previously described scoring of the identified indicators (in the table and hereafter named *subcategories)*, the following six indicators received the highest scores, i.e. scored at least seven out of ten points: 1) employment, 2) digital inclusion, 3) local economic impact, 4) quality of life, 5) human capital and 6) connectivity. To associate more detailed and precise indicators with the selected subcategories, the findings from the systematic literature review were consulted alongside key publications such as Cohen's wheel and adaptations of this concept (including Sharifi, 2019) as well as the work by Alamoudi et al., 2023 (see Table 4).

No	Category	Subcategory	Indicators	Research questions	Data type
1	Economic factors	Employment **9.00**	• Employment rates	• How have employment rates evolved over the past 10 years?	Quantitative
2	Social factors	Digital inclusion **8.35**	• Digital literacy/skills • Digital public services and e-governance • Digital divide among groups • Inclusive approaches in new smart initiatives in the community	• Do the inhabitants feel that they have the skills to participate in and benefit from the new opportunities brought about by improved digital connectivity (IDC)? • Is there any support offered in terms of digital skills training? • What measures are being taken to make the digital transformation as inclusive as possible?	Qualitative
3	Economic factors	Local economic impact **7.70**	• Number and type of new and dissolved companies/startups (business demographics) • Income levels	• How has IDC affected local businesses? (overall business demographics, ways in which they integrated 5G, identification of the key technologies, associated risks and challenges) • Which sectors have made the most advancements in the adoption of smart solutions? • How have income levels evolved over the past 10 years?	Mixed
4	Social factors	Quality of life **7.20**	• Improved working conditions • Work-related stress and monotony • Improved living conditions • Enhanced social interactions • Access to health and other public and social services (see above) • Perceived online safety	• How are the changes to local businesses linked to IDC improved job satisfaction? • Beyond work: to what extent has IDC affected general "place attractiveness" and quality of lie based on the listed indicators? • Are there any concerns regarding data privacy because of these changes? • How widely accepted are smart digital solutions in everyday life among the general population?	Qualitative
5	Social factors	Human capital **7.10**	• Educational attainment • Digital skills	• How have educational attainment levels evolved over the past 10 years? • Linked to digital inclusion: how is the training in digital skills being supported?	Mixed
6	Technical factors	Connectivity **7.05**	• Access to stable and affordable internet	• Do people have access to stable and affordable internet?	Quantitative

Table 4: Overview of final selection of indicators based on the systematic literature review and additional sources. These indicators will be used to explore the societal implications of improved digital connectivity in general and 5G in particular in the next stage of the project.

The selected list of indicators facilitates a mixed methods-based approach to exploring the transformative impact of improved digital connectivity in rural or less populated areas. The overall study design derived from this set of indicators can be described as threefold, encompassing the following focal points:

1. **Business demographics**: This aspect examines how the integration of new technologies has influenced the emergence of new local businesses and the development of existing local businesses. It provides insights into novel, digitally enabled business models and can help to identify key areas requiring further adaptation to allow for purposeful, socially and ethically aligned and successful integration of digital solutions.
2. **Socioeconomic and societal effects**: By including indicators related to overall quality of life, this study design places economic changes within a broader societal context. It evaluates the impacts on everyday life practices, thereby highlighting the societal dimensions of digital connectivity and its economic implications as well as the effects on the inclusive rollout of smart solutions in rural societies.
3. **Broader insights on technology acceptance**: This component integrates fundamental concepts into the qualitative dimension of the study design. It investigates underlying notions of technology acceptance and trust as prerequisites for the successful implementation and adaptation of new technological solutions.

By combining these three focal points based on the selected six indicators, the study offers a comprehensive understanding of the multifaceted impacts of digital connectivity, emphasising the need for a holistic yet contextualised approach to fostering sustainable smart developments in rural areas. These insights will contribute to broader scholarly and policy debates on bridging the urban-rural digital divide, providing situated perspectives that can inform inclusion, business and infrastructure policies alike. By identifying key sectors and technologies to be evaluated on a case-by-case basis, the proposed model will also provide scalable insights, supporting enhanced digital connectivity and more targeted integration and inclusion strategies for rural communities.

4.4. Limitations

There are three main methodological limitations regarding the systematic literature review and the selection of indicators:

1. **Design of the systematic literature review**: The integration of the "indicator" search term likely led to an overrepresentation of quantitative studies, potentially narrowing the scope of the results. Consequently, some relevant studies that approach the topic from a more qualitative methodological and

empirical angle may have been omitted. However, this focus on quantitative studies provides a robust foundation for understanding key metrics.

2. **Review and manual coding of papers**: The coding process included not only indicators studied in depth by the respective publications but, in some instances, also those discussed more generally. Each publication presented a unique research design, which introduced certain challenges in streamlining the process. Accordingly, the indicator table in the appendix should be viewed as a qualitative review of the selected data set rather than an exhaustive list. This approach ensures a comprehensive overview of the indicators considered.
3. **Scoring of indicators**: The scoring of the final selection of indicators, conducted independently by four individuals, carries a risk of bias. Despite the same explanation of indicators and scoring categories being provided to each researcher, variations in interpretation may occur due to the broad nature of the selected indicators. This scoring exercise should be understood in the context of possible human error and varying interpretations rather than being regarded a definitive representation of reality. Nonetheless, this method offers valuable insights into the indicators' relevance and applicability.

CHAPTER

5

Left In Røros, Norway, there are guided tours and monitoring of visitor flows via an app
Right: In Lolland, Denmark, green energy are combined with smart grid technology

5. Policy review: Incentives for inclusive and responsible digital transformations

Emphasising the societal dimension of enhanced digital connectivity is essential when designing future socio-technical solutions that prioritise ethical considerations and align technological progress with societal needs. While building a robust, evidence-based information base is crucial for advancing the scholarly debate and policy development in the field, it is equally important to understand the factors currently driving – and regulating – socially sustainable, transparent and ethically sound technology design. Operating at the frontiers of human knowledge, often led by private companies, the challenges of monitoring, guiding and regulating the ever more complex emerging digital technologies have been a central concern for various groups including policy makers, researchers, civil rights activists over the past years (see e.g. Sharon & Gellert, 2024; Strauss et al., 2024).

In the Nordic-Baltic region, the Nordic-Baltic Cooperation Programme for Digitalisation 2025 to 2030 outlines the political goals of the Nordic Council of Ministers. These goals include subgoals such as "robust and secure digital services, safeguarding users' privacy and ensuring that personal data are stored and processed in a secure and trustworthy way, giving everyone the ability to better control their own data" and "the goal to empower people to actively participate in a digital and democratic society and coming workforce transitions" (Nordic Council of Ministers, 2024). The policy document notes that "with a strong common set of values and highly educated, digitally skilled populations, the Nordic-Baltic region has the potential to lead by example in the use of technology" (ibid). This highlights

the normative dimension – and ambitions – of technology development and the pivotal role of cross-border policies in serving as guiding beacons and watchdogs.

To understand what this looks like in practice, this chapter aims to provide an overview of the policies that, beyond the Nordic-Baltic Cooperation Programme, offer guidance to industry, research and policymakers on how the societal implications of technology development and implementation can be anticipated and better integrated into the digital transformation.

As most Nordic and Baltic countries are members of the European Union, this chapter will focus particularly on EU policies while also providing an overview of relevant Nordic and Baltic policies that currently form the regulatory framework for technology development. Five key EU policies and their transposition to the national level have been explored in more detail: (1) the Digital Services Act, (2) the Digital Markets Act, (3) the General Data Protection Regulation (GDPR), (4) the Artificial Intelligence Act (5) and the Web Accessibility Directive. This overview is followed by a review of Nordic and Baltic national policies relevant to this area.

The central question in this policy review is: **to what extent does the current policy landscape encourage consideration of the societal impact of digitally enabled technologies?** The methodology for this review is based on a narrative literature review approach as described by Baumeister and Leary (1997).

5.1. The origins of responsible innovation

Preliminary efforts to address the social, legal and ethical dimensions of emerging technologies and innovation focused primarily on the research sector and were made in the mid-1990s using the ELSA (ethical, legal, social aspects) approach of the 4th European Research Framework Programme (Ryan & Blok, 2023). The approach initially emerged in the life sciences and health-related research fields with the aim of ensuring that potential ethical and societal challenges arising from genome and related studies were addressed in an anticipatory manner by the scientific community (Zwart et al., 2014).

The main criticism of the ELSA initiative was its comparatively limited funding, leading some to view it as a smokescreen for the life sciences, serving more as a PR exercise than genuinely fostering critical engagement with the societal implications of research and development in that field (Forsberg, 2015). However, the concept evolved and reemerged under the name "Responsible Research and Innovation" (RRI), often interchangeably used with "Responsible Innovation" (RI), in 2010 as part of the European Commission's research agenda, forming a cornerstone of the funding programme Horizon 2020 and later Horizon Europe (Ryan & Blok, 2023). Within Horizon 2020, the RRI framework focused on several dimensions: (1) public

engagement, (2) gender equality, (3) science education, (4) open access, (5) ethics and (6) governance (European Commission. Directorate General for Research and Innovation., 2020). Expanding beyond the life sciences, RRI was to be employed particularly in the fields of engineering and the natural sciences more generally, aiming to strengthen researcher reflexivity while also bridging the gap between the "ivory tower" and the wider public through transparency and more direct citizen involvement (Zwart et al., 2014).

However, RRI did not fully replace the ELSA model. The continued use of both concepts beyond 2010 points towards the fine differences between them. Ryan and Blok (2023) found that one central distinction lies within the use and conceptualisation of "ethics", describing the ethical approach within ELSA as building on a "position of moral intuitionism" stemming from "specific morally self-evident rights and wrongs in the world" and the critical application of this approach through a case-by-case basis (Ryan & Blok, 2023, p. 9). By contrast, RRI emphasises the use of "research ethics" and remains vague on other ethical questions. The authors of the 2023 paper hypothesise that this is linked to the stronger engagement of social scientists in the framing and application of RRI, who underscore the social construction of the concept (ibid). In this context, they further highlight that RRI gives greater emphasis to the term "responsibility", shifting from the prohibitive character of ELSA ethics to a more constructive notion of designing progress responsibly for the common good (von Schomberg, 2013).

Looking beyond European funding schemes, associated discussions can be found on a "normative turn" within innovation research and technology development. Recent publications in innovation research, notably within the fields of economics and geography, have called on the research community to open up innovation research and associated discourses and policy initiatives to new, more normatively driven perspectives. This development can be traced back to what Uyarra et al. (2019) identified as the prior inability of innovation policy to consider and incorporate societal challenges, including poverty, climate change and regional economic restructuring (Uyarra et al., 2019). This argument is also reflected in the study by Castellaci (2023), who emphasised the need for a broadened research agenda when studying innovation in the context of economic outcomes and material prosperity, suggesting a shift away from prioritising efficiency over equity and material well-being over social justice (Castellacci, 2023). Building on the debate around the "normative turn" in innovation research, Binz and Castaldi (2024) suggest three pathways towards a more holistic and equitable approach. These pathways cover a broader conceptualisation of the innovation concept, a critical assessment of the institutional dynamics and a stronger focus on identifying and addressing spatial disparities in innovation and ensuring that these findings are fed into the relevant policy debates (Binz & Castaldi, 2024).

While the scholarly debate regarding the "normative turn" and the overlaps and complementary aspects of ELSA and RRI approaches persists, it continues to raise awareness within the research community of its social responsibilities and to foster a more interdisciplinary approach to technology development. Such multidisciplinarity is essential for comprehending the complexity of the societal implications that arise from disruptive innovation.

However, the debate originates and resonates primarily within scientific circles, with ELSA and RRI mainly applying to research practices within a European research context. Although these frameworks play a critical role in countering the prevalence of techno-centrism and determinism, it is worth noting that, rather than being developed as part of publicly funded research projects, many digital technologies originate from privately funded companies. These are generally not obliged to adhere to the same guidelines and regulations, nor are they necessarily attuned to the most recent scholarly debates on the topic. This is where national and international legal frameworks assume an increasingly important role. The following section will therefore explore four key European policies in this respect in more detail.

5.2. Overview of relevant EU policies

This section will focus on six initiatives and regulations that have been developed and implemented at the EU level in recent years: (1) the Web Accessibility Directive, (2) the General Data Protection Regulation (GDPR), (3) the Digital Markets Act, (4) the Digital Services Act, (5) the Artificial Intelligence Act and (6) the Gigabit Infrastructure Act (see Figure 6).

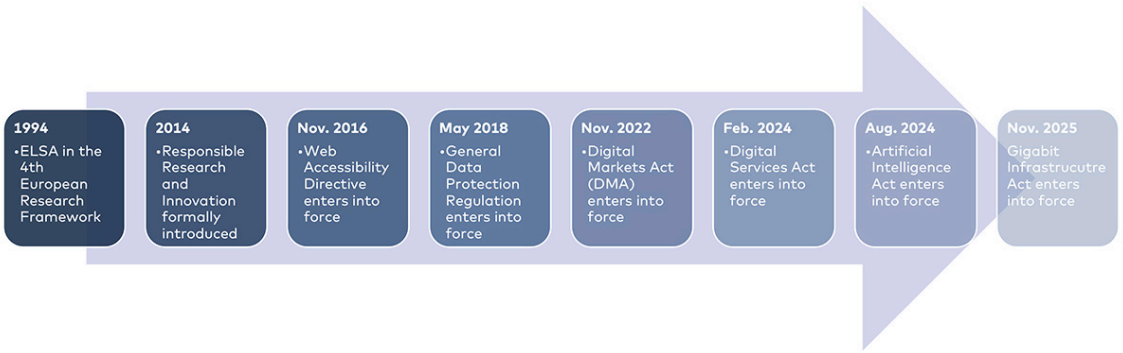


Figure 6: Timeline of the EU policies and initiatives outlined in this chapter.

The Web Accessibility Directive (WAD)

Public services and information that were previously available in physical versions are being digitalised to an ever greater extent and are increasingly only accessible online today. With approximately 100 million Europeans living with a disability, it is a key objective for the EU to ensure digital accessibility for all in its pursuit of becoming an inclusive Union (European Commission, 2025c). The WAD was adopted in 2016 and entered into full effect in June 2021. The WAD requires the websites and mobile apps of all public sector entities in the EU to be digitally accessible for all, regardless of their abilities. WAD defines three main requirements: i) an accessibility statement for all websites and mobile apps for the public sector, clarifying non-accessible content and relevant contact information. ii) the opportunity for users to provide feedback and indicate accessibility problems. iii) monitoring of accessibility of public sector websites and apps, with the monitoring results published every third year (ibid).

The term "accessible" is, in this context, relatively arbitrary. To ensure a shared understanding across the EU, a harmonised technical standard supports implementation of the WAD (European Commission, 2023). This standard is closely aligned with the Web Content Accessibility Guideline (WCAG) version 2.1 developed by the W3C (W3C, 2024). The WCAG version 2.1 provides guidelines for everything from perceivability (e.g., colourblind-friendly colour-schemes or text-to-audio options) and operationality (e.g., functionality is available from a keyboard) through to understandability (e.g., the language being used). As of today, all Member States have transposed the WAD into national law, with the deadline having been September 2018.

The General Data Protection Regulation (GDPR)

The GDPR is a strict set of data privacy and security laws introduced in 2016 by the European Commission. The GDPR entered into full effect two years later, in May 2018 (European Commission, n.d.b). While the GDPR is legally binding upon the EU Member States, it also impacts firms and organisations outside the EU that collect data on European individuals. The GDPR was prompted by the increased use of personal data in the digital economy, followed by increasing concerns over misuse, breaches and a lack of transparency in data processing. At the same time, there was a need for new harmonised data protection laws to replace the 1995 Data Protection Directive (European Data Protection Supervisor, 2018). The GDPR consists of seven data protection and accountability principles relating to i) lawfulness, fairness and transparency, ii) purpose limitation, iii) data minimisation, iv) storage limitation, v) accuracy, vi) integrity and confidentiality and vii) accountability (European Commission, n.d.a). The GDPR safeguards individuals' rights over their personal data, including the right to erasure and the right to be informed (ibid). The GDPR was transposed into national laws of the Member States concurrently with the GDPR entering into full effect in May 2018.

The Digital Markets Act and the Digital Services Act

The Digital Markets Act (DMA) and the Digital Services Act (DSA) together form a legal package that aims to ensure fair and open digital markets in the EU (European Commission, 2025e). The DMA focuses on fostering market competition, while the DSA primarily addresses user protection and transparency (ibid).

The DMA, which was introduced in 2022, defines large digital platforms, such as Alphabet, Amazon, Apple, ByteDance, Meta and Microsoft, as "gatekeepers". These gatekeepers are required to ensure fair market conditions by facilitating third party interoperability. Failure to comply may result in substantial fees for the gatekeepers (European Commission, 2022a).

The DSA entered into full effect in February 2024. It aims to ensure that online platforms are held accountable for preventing illegal content, disinformation and algorithmic transparency on their platforms. Responsibility for enforcing the DSA lies with the European Commission, alongside the national authorities, which oversee the compliance of national-specific platforms (European Commission, 2022b).

The Artificial Intelligence Act

The EU acknowledged that while AI systems could potentially help to solve various societal challenges, certain AI systems pose threats and vulnerabilities, which need to be mitigated (European Commission, 2025f). The AI Act is the first legal framework that addresses the risks of AI. It is intended to guarantee safety, fundamental rights and human-centric AI while also fostering the implementation, investment and innovation of AI in the EU (ibid).

The AI Act adopts a risk-based approach, defining four distinct levels of risk for AI systems: unacceptable risk, high risk, limited risk and minimal risk. AI systems that pose an unacceptable risk to people's well-being are banned. High-risk AI systems are those that present serious risks to people's health, safety or fundamental rights. For high-risk AI systems to be placed on the market, they must adhere to strict requirements as specified by the AI Act. The AI Act also addresses transparency risks and states that AI-generated material should be clearly identifiable. No guidelines are provided in the AI Act for AI systems with minimal or no risk (European Commission, 2025f).

The implementation and oversight of the AI Act is the responsibility of the European AI Office and the Member States (European Commission, 2025f). The AI Act was introduced in August 2024 and will enter into full effect in August 2026 for

all Member States.[3] The European Commission has introduced an AI Pact, which is a voluntary pact where entities can commit to the guidelines ahead of 2006 before they become legally obliged to do so (ibid).

The Gigabit Infrastructure Act

While not directly related to responsible innovation, the European Union's Gigabit Infrastructure Act (GIA) is of central importance to this project. Having identified disparities in terms of affordable and reliable digital accessibility across the Union, the EU's GIA was developed over the course of 2024 and entered into force in May 2024, becoming fully applicable in November 2025 in all Member States (European Commission, 2025b). The aim of the GIA is to enable faster, cheaper and simpler rollout of "very high-capacity networks" (VHCNs) such as gigabit networks and 5G, which are crucial for smart city development across the EU The GIA thus constitutes a fundamental element on the path towards achieving the EU's 2030 Digital Decade goal, which aims to ensure cross-EU access to gigabit connectivity and fast mobile data (ibid).

Some of the key measures under the GIA encourage increased collaboration through the shared use of digital infrastructure and the co-deployment and coordination of civil works (ibid). These strategies are supplemented by a reduction in bureaucratic hurdles to streamline and facilitate network rollout. The GIA further includes the goal of equipping new buildings with "high-speed ready infrastructure" and incorporating sustainable practices throughout the rollout and implementation process by reusing existing infrastructures and prioritising the use of environmentally efficient technologies, including fibre and 5G (ibid).

5.3. National policies in the Nordic and Baltic countries

Responsible digitalisation

Beyond the presented EU regulations, the Nordic and Baltic countries have placed strong emphasis on responsible digitalisation. According to the reviewed digitalisation policies, responsible digitalisation focuses on ensuring that digital transformation benefits all members of society. The key themes across these policies include digital inclusion, cyber security and data protection, ethical use of technology and accessibility and usability.

3. There are, however, a few exceptions: prohibitions and AI literacy obligations entered into force from 2 February 2025; the governance rules and the obligations for general-purpose AI models become applicable on 2 August 2025; and the rules for high-risk AI systems – embedded into regulated products – have an extended transition period until 2 August 2027 (European Commission, 2025a).

The majority of the policies highlight the need for digital inclusion, ensuring that all citizens, regardless of their socio-economic status or geographical location, have access to digital tools and services (Government of Åland, 2023; Lithuanian Ministry of the Economy and Innovation, 2024; Naalakkersuisut, 2023). This includes efforts to bridge the digital divide and prevent digital exclusion (Ministry of Finance, Local Government Denmark, Danish Regions, 2022; Ministry of Local Government and Regional Development, 2023) and increase the overall level of digital skills and literacy (Danish Ministry of Digital Government and Gender Equality, 2023a; Government of Åland, 2017; Talgildu Føroyar, 2023).

One notable policy dedicated to digital inclusion is Denmark's "Principles for Digital Inclusion". This policy outlines six key principles aimed at promoting inclusive digitalisation, ensuring that digital solutions are accessible and beneficial to all citizens. It is argued that these principles only add value when they are integrated into decisions, projects and interactions between citizens and public authorities (The Danish Agency for Digital Government, Local Government Denmark and Danish Regions, 2024).

Ensuring the safe and secure use of digital solutions is a common priority. Policies emphasise the importance of robust cyber security measures to protect personal and confidential data, prevent cyber-attacks and maintain trust in digital services (Icelandic Ministry of Higher Education, Science and Innovation, 2022; Ministry of Defence of the Republic of Latvia, 2023; Naalakkersuisut, 2023). The ethical and responsible use of digital technologies is another recurring theme. Policies stress the importance of transparency, accountability and inclusivity in digital transformation processes (Digital Iceland, 2021). This includes the responsible handling of public and personal information (Ministry of Finance, Local Government Denmark, Danish Regions, 2022; Talgildu Føroyar, 2023) and the ethical use of emerging technologies such as artificial intelligence (Danish Ministry of Digital Government and Gender Equality, 2023a).

Enhancing the accessibility and usability of digital services is also a key focus of the policies (Digital Iceland, 2020). Strategies aim to make digital services user-centric, ensuring that they are easy for all citizens to access and use, including those who are digitally challenged or vulnerable (Danish Ministry of Digital Government and Gender Equality, 2023b; Finnish Government, 2022; Government of Åland, 2024; Talgildu Føroyar, 2023).

Connectivity and 5G developments

The development of high-speed internet infrastructure and connectivity, including 5G networks, is a critical component of the digital policies in the Nordic and Baltic countries. Key points include expansion of broadband and 5G networks, infrastructure sharing and investment and challenges and opportunities of 5G and future technologies.

Various Nordic and Baltic policies emphasise the need for continuous improvement and expansion of broadband and 5G networks to ensure widespread and reliable connectivity (Estonian Ministry of Economic Affairs and Communications, 2021; Swedish Agency for Digital Government, 2023). This includes efforts to provide high-speed internet access to both densely populated urban areas and sparsely populated rural regions (Norwegian Ministry of Digitilisation and Public Governance, 2024).

However, the rollout of 5G technology presents both challenges and opportunities, which are also specified in the existing policy documents. Challenges include the need for substantial capital investments, legal constraints and ensuring security and resilience of the networks (Lithuanian Ministry of the Economy and Innovation, 2024; The Danish Government, 2021). For example, in Sweden, it is expected that expanding the 5G network to cover 99% of the Swedish population by 2025 is feasible by upgrading existing infrastructure. However, rural areas may not experience the highest 5G speeds due to reliance on low-frequency bands. New masts are needed in underserved areas, but economic incentives for operators are low due to underutilisation and limited revenue from existing masts in these regions (Swedish Agency for Digital Government, 2023; The Government of Sweden, 2023).

Opportunities for expanding 5G networks described by the countries' policies include the potential for new business models and advancement of novel technologies (Latvian Ministry of Environmental Protection and Regional Development, 2021), enhanced emergency preparedness (Norwegian Ministry of Digitalisation and Public Governance, 2024), the development of smart cities (Swedish Agency for Digital Government, 2024) and autonomous transport systems (Lithuanian Ministry of the Economy and Innovation, 2021).

The importance of infrastructure sharing and significant investments in digital infrastructure is highlighted in several policies. This includes the deployment of 5G technology and the development of next-generation networks to support new services (Finnish Government, 2022). However, several policies emphasise that realising the potential of 5G and 6G requires a coherent approach to infrastructure investment that takes account of common standards and interoperability solutions (Danish Ministry of Finance, 2022). The fragmented nature of the EU market, comprising 27 national markets with different conditions and regulations, is identified as problematic in a statement on Europe's connectivity infrastructure needs (Swedish Agency for Digital Government, 2024).

Looking beyond 5G, some policies also mention preparations for the adoption of future technologies, such as 6G technology. This forward-looking approach aims to ensure that the region remains at the forefront of technological advancements and can leverage new opportunities as they arise (Lithuanian Ministry of the Economy and Innovation, 2024). For instance, Estonia's "Digital Agenda 2030" underscores

the importance of further deployment of 5G networks to ensure connectivity for all. The agenda also places emphasis on preparations for the adoption of 6G technology, highlighting the importance of constant technological advancements (Estonian Ministry of Economic Affairs and Communications, 2021). Similarly, Finland's "Digital Compass" states that the country aims to achieve comprehensive 5G coverage by 2030 as well as to maintain its leadership in 6G research (Finnish Government, 2022).

In the Baltic countries, a collaborative 5G initiative called the "5G TEN-T Transport Corridor" is underway. This project, a partnership between Lithuania, Latvia and Estonia, aims to transform the Via Baltica highway into an international 5G transport corridor. The goal is to ensure seamless 5G coverage and high-quality connectivity to support the development of autonomous and smart transport systems along the route (Lithuanian Ministry of the Economy and Innovation, 2021).

In summary, the Nordic and Baltic digitalisation policies show a strong commitment to responsible digitalisation, with a particular focus on digital inclusion, cyber security, ethical use of technology and accessibility. The development of high-speed internet infrastructure, including 5G networks, is viewed as essential for supporting digital transformation, economic growth and innovation.

5.4. Concluding remarks on the policy review

Various efforts at the European and national levels aim to define principles that guide the increasing digitalisation of our everyday lives, ensuring the development and use of trustworthy and ethical technologies. While the presented EU regulations offer clear rules and guidelines on matters including the protection of personal data, market access and AI, Nordic and Baltic national policies describe broader policy visions. These visions relate to inclusive practices to be implemented in the specific cultural, linguistic and socio-technical contexts of the Nordic-Baltic region.

However, to ensure that the challenges and needs of underrepresented and digitally underserved communities, such as those in rural areas, are sufficiently taken into account and represented as these policies further evolve and new technologies emerge, it is important to continue to bring local perspectives and voices to the fore. Specific measures and economic incentives are needed to drive digital infrastructure development in remote and less densely populated areas and to foster the development of the relevant digital skills in those areas.

CHAPTER

6

Left: Smart waste sorting in Mazsalaca, Latvia. The town is part of an EU initiative on the digitalization of rural areas
Right: Estonia has an advanced digital infrastructure, where citizens can vote, pay taxes, etc.

6. Conclusion

Catering to the needs of rural communities during the digital transformation remains a political, societal and technological challenge. With relatively large parts of the population in the Nordic and Baltic countries living in less populated and, in some cases, hard-to-reach remote areas, it is crucial to integrate and consider these local perspectives when studying the impact of improved digital connectivity. This includes addressing infrastructural deficits in terms of stable, fast and affordable digital connectivity, such as 5G accessibility and beyond. Furthermore, it involves the design of digitally enabled applications aimed at making everyday practices more efficient, sustainable and inclusive in both professional and domestic contexts, but which may not yet be adapted to the needs and demands of rural populations.

As technological progress and regulation evolve at both international and national levels, ongoing efforts to place the experiences of geographically, economically and infrastructurally marginalised groups in the foreground will ensure a more inclusive digital transformation in the Nordic-Baltic region. Tackling the urban-rural digital divide is essential, especially as economic incentives to address rural communities' needs remain limited. Moreover, a deeper understanding of the integration process of novel digital technologies in rural communities will strengthen the business case for 5G and other related digital connectivity-based applications for economic development, tailored to the unique setting of the Nordic-Baltic region. This approach promises scalability to other parts of the region and similar regions worldwide facing a rural-urban divide.

The societal impacts of digitalisation and the rollout of 5G on rural communities so far can be studied by examining examples of "smart communities" to explore best

practices and lessons learned. Although an extensive body of literature already exists on the topic, this working paper identified a gap in the literature both in terms of Nordic-Baltic case studies and regarding a methodological framework that balances insights on economic development with a deeper understanding of the associated societal implications. A systematic literature review was conducted to identify relevant indicators to address this gap. The developed set of indicators aims to facilitate a holistic yet targeted approach to better understand the integration of 5G (and beyond) digital applications in rural communities and the unintended and intended socioeconomic consequences. This working paper identified a focus on business demographics combined with societal factors – encompassing both everyday life practices and more fundamental concerns among the local population in terms of technology acceptance, trust and privacy concerns – as the most relevant approach.

The structural problems underlying the urban-rural digital divide and the general neglect of marginalised communities in technology design and infrastructural rollout will, however, require more than additional in-depth knowledge of local conditions, needs and best practices. A review of the current policy landscape provided insights into the regulations that shape responsible and inclusive technology design and usage, as well as the provision of fast and reliable internet connectivity in all regions of the European Union. This short review has shown increasing efforts at both international and national levels to prioritise ethical and socially responsible practices over a technology deterministic agenda. Furthermore, the Gigabit Infrastructure Act (GIA) promises fundamental changes in terms of digital accessibility, underscoring the need for insights on best practices of rural 5G employment. However, since much technological innovation is still driven by the private sector, more tailored policies – coordinated across regional, national and European levels – may be needed to ensure that the specific needs of individual groups are not overlooked as infrastructural, economic and skills-related disparities continue to create a divide between urban and rural experiences in the digital transformation.

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Appendix A

						Social					Economic			Political		Sustainability	Safety and Security			Legal	Technology				
Paper	Technology	Smart community	5G Focus	Rural Focus	Geographical Focus	Digital Inclusion	Quality of Life	Culture	Health and Wellbeing	Human Capital	Employment	Economic Impact	Innovation	Community Engagement	Governance	Environmental Sustainability	Public Safety	Privacy and Trust	Information Security	Regulatory Compliance	Connectivity	Transport	Innovation	Technology Acceptance	Energy
Başol, O., Sevgi, H. & Yalçın, E. C. (2023). The Effect of Digitalisation on Youth Unemployment for EU Countries: Treat or Threat? In *Sustainability (Switzerland)* (Vol. 15, Issue 14).	Digitalisation	NO	NO	NO	Pakistan					improved (IT) education	decrease in youth unemployment	creation of new businesses; increase in individual earnings													
Benevento, M., Mandarelli, G., Carravetta, F., Ferorelli, D., Caterino, C., Nicoli, S., Massari, A. & Solarino, B. (2023). Measuring the willingness to share personal health information: A systematic review. In Frontiers in Public Health (Vol. 11).	Digital Health Care	NO	NO	(YES)	International (Italy)				improved health care quality									willingness to disclose personal health information	data security					perceived benefits affect willingness to share data	
Gorantla, R. & Bansal, S. (2023, April). Towards a sustainability index calculator for smart cities. In Companion Proceedings of the ACM Web Conference 2023, pp. 715-722.	Sustainability monitoring app	YES	NO	NO	General	social inclusion	quality of life				employment rates	economic growth				carbon footprint; waste management			cybersecurity measures		accessibility				
Makhalany, T. M., Mamushiane, L., Kobo, H. & Lysko, A. (2024). Towards a 5G Equipped Video Surveillance UAV for Public Safety. 2024 IST-Africa Conference (IST-Africa), pp. 1-11.	UAVs	NO	YES	NO	South Africa												air surveillance to combat crimes			balance of increased safety and civil rights					
Samarakkody, A., Amaratunga, D. & Haigh, R. (2023). Technological Innovations for Enhancing Disaster Resilience in Smart Cities: A Comprehensive Urban Scholar's Analysis. In Sustainability (Switzerland) (Vol. 15, Issue 15).	Disaster Resilience – 24 technologies	YES	NO	NO	General									enhanced gov-citizen communication (during disasters); public participation in technology development			coordination of emergency responders							perceived usefulness and perceived ease of use	
Popova, Y. & Popovs, S. (2022). Impact of Smart Economy on Smart Areas and Mediation Effect of National Economy. In Sustainability (Switzerland) (Vol. 14, Issue 5).	General	YES	NO	NO	Latvia	employment of women in tech	working hours			adult learning; educational attainment; spending on education; employment in knowledge-intense areas	unemployment rates	turnover of SMEs due to e-commerce; contribution of ICT industry to GDP				emissions from transport						passenger transport			energy consumption per capita; share of energy from renewable resources
Kemal, A. A. & Shah, M. H. (2024). Digital innovation in social cash organisations – the effects of the institutional interactions for transforming organisational practices. In Information Technology and People (Vol. 37, Issue 5), pp. 2092-2126.	Social Cash Payments	NO	NO	NO	Pakistan	access to digital payments for women									corruption				safer money transfers						
Kiseľáková, D., Košíková, M., Miškufová, M. & Loumová, V. (2024). Driving factors of the digital economy – how countries can manage their digital development; [CZYNNIKI NAPĘDOWE GOSPODARKI CYFROWEJ – JAK KRAJE MOGĄ ZARZĄDZAĆ SWOIM ROZWOJEM CYFROWYM]. In Polish Journal of Management Studies (Vol. 29, Issue 2), pp. 311-327.	Digitalisation	NO	NO	NO	EU	digital skills and literacy	satisfaction with quality of life		improved health care	public expenditure on education; public expenditure on R&D	unemployment (decreasing DESI)						public safety								
Gómez-Carmona, O., Buján-Carballal, D., Casado-Mansilla, D., López-de-Ipiña, D., Cano-Benito, J., Cimmino, A., Poveda-Villalón, M., García-Castro, R., Almela-Miralles, J., Apostolidis, D., Drosou, A., Tzovaras, D., Wagner, M., Guadalupe-Rodriguez, M., Salinas, D., Esteller, D., Riera-Rovira, M., González, A., Clavijo-Ágreda, J., ... Bujalkova, N. (2023). Mind the gap: The AURORAL ecosystem for the digital transformation of smart communities and rural areas. In Technology in Society (Vol.	Digital service platform for rural areas	YES	NO	YES	General	inclusive services for all groups; digital skills and literacy training programmes					employment in digital and tech sectors	growth in businesses using digital tech; development of innovative business models specific to the unique challenges		engagement in forums and digital platforms	availability, transparency and efficiency of e-government tools				privacy concerns and lack of trust		stable and reliable digital connectivity			

74). Elsevier Ltd. https://doi.org/10.1016/j.techsoc.2023.102304												and benefits of rural life														
Ha, L. T. (2022). Socioeconomic and resource efficiency impacts of digital public services. In Environmental Science and Pollution Research (Vol. 29, Issue 55), pp. 83839-83859.	Digital Public Services	NO	NO	NO	Europe						employment rates	exports turnover from eco-industries; business mobility				resource efficiency score; intensity of greenhouse gas emissions		user centricity								
Malkowska, A., Urbaniec, M. & Kosala, M. (2021). The impact of digital transformation on European countries: Insights from a comparative analysis. Equilibrium. Quarterly Journal of Economics and Economic Policy, 16(2), pp. 325-355.	Digitalisation	NO	NO	NO	EU	digital skills				graduates in STEM fields		export of tech; online orders	use of new technologies; patent applications; R&D personnel	use of cloud services and online shopping	interaction with public authorities online				enterprises using ICT security measures							
Lin, Y., Chang, T., Su, W. & Shang, R. (2022). IoT for Environmental Management and Security Governance: An Integrated Project in Taiwan. Sustainability, 14(1).	Disaster Risk Management	NO	NO	NO	Taiwan					social return on investment							risk awareness						platforms for emergency operation and communication		
Hannola, L., Lacueva-Pérez, F., Pretto, P., Richter, A., Schafler, M. & Steinhüser, M. (2020). Assessing the impact of socio-technical interventions on shop floor work practices. In International Journal of Computer Integrated Manufacturing (Vol. 33, Issue 6), pp. 550-571.	Digital Shop Floor interventions	NO	NO	NO	Germany, Slovenia and Spain	increase in competences through use of new tech	reduction in work-related stress and monotony; job satisfaction																	
Rantanen, T., Gluschkoff, K., Silvennoinen, P. & Heponiemi, T. (2021). The associations between mental health problems and attitudes toward web-based health and social care services: Evidence from a Finnish population-based study. In Journal of Medical Internet Research (Vol. 23, Issue 9).	Digital Health and Social Care	NO	NO	NO	Finland	equal accessibility of new digital services			mental health (depression, anxiety rates)									vulnerable groups suspicious of confidentiality, safety and privacy of digital health and care services						acceptance of digital health solutions; usage rates; satisfaction levels	
Ortega-Fernández, A., Martín-Rojas, R., & García-Morales, V. J. (2020). Artificial intelligence in the urban environment: Smart cities as models for developing innovation and sustainability. In Sustainability (Switzerland) (Vol. 12, Issue 19). MDPI.	What makes a smart city smart, what technologies are used to promote sustainability	YES	YES	(YES)	Spain						unemployment	GDP per capita			open databases; procedures carried out online; citizen-government channels	percentage of clean energy usage; average daily NO2 concentration; total volume of waste generated					number of charging stations; density of public transportation			
Panfilova, O. & Popova, E. (2021). Financial result of the digitalisation process in corporations. In ACM International Conference Proceeding Series. Association for Computing Machinery.	Cloud Technology	(YES)	NO	NO	Russia	access to stable connectivity; digital divide among socioeconomic groups	enhanced social interactions			increased access to information	job creation in tech and cloud services	growth in tech sector and contribution to GDP			Citizens' perception that smart gov services increase their sense of belonging and improve influence; contingency powers	carbon footprint		public trust in cloud technologies	measures for data protection and cybersecurity awareness						energy efficiency
Hu, G., Chohan, S. R., & Liu, J. (2022). Does IoT service orchestration in public services enrich the citizens' perceived value of digital society? In Asian Journal of Technology Innovation (Vol. 30, Issue 1), Routledge, pp. 217-243.	IoT in the public sector	YES	NO	NO	Pakistan									increased public participation				public trust in IoT					perceived value		
Santa, A. (2022). Prosumers - A New Mindset for Citizens in Smart Cities. SMART CITIES, 5(4), pp. 1409-1420.	Smart cities, energy production and consumption	YES	NO	NO	European Union		energy poverty									greenhouse gas emissions; energy from renewable sources; material footprint and recycling rates								energy efficiency, energy productivity and import dependency
Szalkowski, G. A. & Johansen, C. (2024). Defining and measuring the effects of digital technologies on social sustainability: A systematic literature review. Sustainable Development, 32(3), pp. 1678-1699.	Digital technologies and social sustainability	NO	NO	NO	General	socioeconomic inequalities (minorities, gender)	working conditions	access to cultural content	positive impact on physical and mental health; health risks linked to digital technologies	facilitating education	creation and loss of jobs			political participation and representation; knowledge exchange within communities			crime prevention		cyberattacks					
Berman, F., Cabrera, E., Jebari, A. & Marrakchi, W. (2022). The impact universe – a framework for prioritising the public interest in the Internet of Things. Patterns, 3(1).	IoT	YES	NO	NO	General	socioeconomic inequalities					creation of new jobs	economic growth; market leadership	rise of new services	political participation and representation		emission reduction; sustainable material usage;		protection of personal data; ensuring transparency in data usage	ensuring cybersecurity						

																reducing e-waste									
Ilie, N., Oprea, I., Turcea, V. & Parnus, A. (2022). New Dimensions of Rural Communities Development in Romania - Smart Village Concept. Scientific Papers Series: Management, Economic Engineering in Agriculture and Rural Development, 22(2), pp. 425-436.	smart villages	YES	NO	YES	Romania	inclusion of marginalised groups and reduction of social inequalities; digital literacy	improvement of living conditions	strengthening of local identity and cultural heritage	access to public health services	higher education levels	unemployment rates		increase in local entrepreneurship and business opportunities; development of local infrastructure	participation in local governance and decision-making								availability of ICT		implementation of IoT in agriculture and other sectors		
Mahmoudi, S., Davar, A., Sohrabipour, P., Bist, R., Tao, Y. & Wang, D. (2024). Leveraging imitation learning in agricultural robotics: A comprehensive survey and comparative analysis. Frontiers in Robotics and AI, 11.	agricultural robots	NO	NO	(YES)	General		improved working conditions for farmers				labour displacement; creation of new technological roles				need for robust governance and ethical frameworks	reduction in resource usage and improved crop yield and efficiency		concerns over data privacy					revolutionise agricultural practices		
Edelmann, N., Mergel, I. & Lampoltshammer, T. (2023). Competences That Foster Digital Transformation of Public Administrations: An Austrian Case Study. Administrative Sciences, 13(2), Article 2.	Digital Public Services	NO	NO	NO	Austria	IT skills													cybersecurity awareness	compliance with data governance and legal regulations					
Ashraf, A. & Idrisi, M. J. (2024). Smart and sustainable public transportation-a need of developing countries. International Journal of Networked and Distributed Computing, 12(1), pp. 144-152.	Smart Public Transportation	YES	YES	(YES)	Developing Countries (India)		improved quality of life due to more efficient transport and facilitated social contacts									less emissions from transport	safer transport					safer, more reliable and more comfortable transport			
Bălțățeanu, A. M. (2020). Digitalisation. Global Challenges and Economic Prosperity. Example: Romania. Strategica 2020.	Digitalisation and economic prosperity	(NO)	(NO)	(NO)	Romania	social exclusion			better healthcare	better education		economic growth through increased productivity													

About this working paper

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