Theo Lynn · Pierangelo Rosati · Edel Conway
Declan Curran · Grace Fox · Colm O'Gorman

Digital Towns

Accelerating and Measuring the Digital Transformation of Rural Societies and Economies

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Foreword

In February 2020, the European Commission presented its strategy for a Digital Society based on three pillars:

1. Technology that works for the people
2. A fair and competitive digital economy
3. An open, democratic and sustainable society

The European Union's vision is no less than the digital transformation of Europe by 2030. This will be achieved through secure, performant and sustainable digital infrastructures, the digital transformation of businesses, the digitalisation of public services, and the upskilling of citizens. As such, this book is timely as it explores the digital transformation of one part of society, smaller and rural towns.

In 2020, the OECD estimates 80% of all territory worldwide is rural in which 30% of the world's population resides. These communities face significant societal and economic threats not only from increased urbanisation and climate change, but the very attribute that defines them, their rurality. Low population mass and density combined with geographic remoteness presents rural communities with significantly different challenges than their urban counterparts. Access to markets, tertiary education, and a critical mass of skilled labour, as well as high transportation costs, are just some of the factors that sustain the urban-rural divide. And while digital technologies present rural communities with the opportunity to overcome the challenges presented by remoteness, there remains a danger of being left behind.

In 1997, Ireland was one of the first countries in the world to announce the establishment of an information age town, Ennis. At the same time, similar initiatives were active in Aveiro, Portugal and Parthenay, France, amongst others. And yet, since then while the policy and scholarly discourse on smart cities has accelerated and grown, the digital transformation of towns has faltered and discourse has faded into the background.

The Irish scientist, Lord Kelvin, famously said:

> *When you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind.*

In this regard, while we might speak about the Digital Society or Digital Economy, unless we can express it in measurable units, we can neither fully understand it, diagnose it, monitor progress, nor evaluate decisions and alternatives. The research presented in this book was partly funded by .IE, the national registry for .ie domain names. A key aspect of the .IE mission and corporate purpose is to help everyone in Ireland to thrive online. In much the same way that there is an urban-rural digital divide, there is a measurement divide. The overwhelming majority of international frameworks and composite indices for measuring the evolution and development of digital progress focus on countries and cities. The research presented in this seventh book in the series, "Advances in Digital Business and Enabling Technologies", was motivated by the desire to address this gap.

The book is organised around seven dimensions based on the four sectors of an economy—individuals (citizens), government (public services), business, and civil society (non-profits)—and three enabling infrastructures—connectivity, education, and governance. In each chapter, the relevant dimension is defined and the benefits and challenges to adoption and use of technologies are discussed. Each chapter includes a discussion of how that dimension is measured in existing frameworks for digital society and the digital economy, if at all. The book concludes in Chap. 9 with an overview of a digital town measurement framework, including indicators and their potential sources, for each dimension.

Chapter 1 introduces key concepts and terms in digital society literature. Based on a review of literature and digital town initiatives and projects, ten rationales for adopting digital technologies in towns are identified, and discussed and a working definition of a digital town is proposed. The

chapter concludes with a discussion of commonly cited international frameworks and composite indices for measuring digital society and the digital economy and the need for a discrete measurement framework for digital towns.

Chapter 2 discusses the participation of individual citizens in the digital economy and digital society, and the factors that contribute to digital inequalities and the so-called 'digital divide'. Following an exploration of the ways in which digital technologies and digital literacy can be used to reduce social and digital exclusion, existing international frameworks for measuring the digital literacy of individual citizens are discussed.

Chapter 3 explores how public services can be delivered using digital technologies to deliver greater transparency, efficiency and responsiveness from public sector organisations. This chapter defines digital public services, discusses the existing challenges for the implementation of these services in the rural context, and summarises existing frameworks for assessing the adoption and use of e-Government, e-Health technologies, and open data.

Chapter 4 introduces and defines the concept of the digital economy and digital business. It discusses the main benefits and challenges in the adoption and use of digital technologies by enterprises in general and by those in a rural context. The chapter concludes with a discussion of how international frameworks and composite indices measure the digital adoption and use of digital technologies by businesses.

Chapter 5 outlines the important contribution civil society makes to the economy and society in general. Largely absent from the literature on the digital society and digital economy, digital technologies can transform how civil society organisations operate and interact with their stakeholders, and meet their mission. This chapter defines civil society, discusses the role they play in society, and the opportunities and challenges for digital adoption and use in civil society.

Chapter 6 shifts the discussion from the basic sectors in an economy to enabling conditions. This chapter provides an overview of the growing body of evidence that now documents the positive impact of digital connectivity across a number of different economic indicators. However, it also highlights and discusses the significant challenges that continue to impede the delivery of comprehensive digital connectivity across all social groups and geographical contexts. Digital connectivity is a common feature of most international measurement frameworks for digital progress and key indicators are discussed and presented.

Chapter 7 defines digital education and discusses the rationales, benefits and challenges in integrating digital technologies in education, a major pillar of education policy worldwide. Despite widespread optimism, digital inequalities remain in education—with these inequalities impacting the most vulnerable in society, including those who are socio-economically disadvantaged and/or residing in rural areas. While there is substantial data on the adoption and use in formal education systems, this cannot be said for non-formal education provision.

Chapter 8 assumes that the adoption and use of digital technologies is an essential component of town resilience, growth, and competitiveness in the Digital Society and a Digital Economy. This implies that towns need to integrate a digital layer, comprising technology and non-technology actors, into their existing physical, economic and social ecosystems. This chapter discusses key concepts and terms in relation to building rural community digital resilience and specifically the nature and need for vertical and horizontal integration in digitalisation plans and governance.

Chapter 9 seeks to synthesise the preceding chapters into a Digital Town Readiness Framework with associated indicators that can be used for measuring the evolution and development of a digital town and benchmarking progress against historic and international benchmarks. The chapter discusses issues related to data collection and methodology, as well as communication requirements and challenges. The chapter concludes with recommendations for future research.

This book provides a first attempt at a comprehensive framework and set of indicators for measuring digital town initiatives. We believe it provides useful and practical knowledge for scholars, policymakers and rural communities that can be acted on. In doing so, it can help inform policy making and implementation at national, regional, and local levels so that all parts of society can leverage the opportunities that a Digital Society presents.

Dublin, Ireland — David Curtin

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Abbreviations

3D	Three Dimensional
3G	Third Generation
4IR	Fourth Industrial Revolution
5G	Fifth Generation
AI	Artificial Intelligence
ANBERD	Analytical Business Enterprise Research and Development
BIAC	Broadband Internet Access
BPL	Broadband over Power Lines
CAD	Canadian Dollars
CDSS	Computerised Decision Support Systems
CEN	Comité Européen de Normalisation (European Committee for Standardization)
CMS	Content Management System
CSO	Civil Society Organisation
CWN	Community Wireless Network
DCI	Digital Capital Index
DEcI	Digital Ecosystem Index
DESI	Digital Economy and Society Index
DETF	Digital Economy Task Force
DEvI	Digital Evolution Index
DTRF	Digital Town Readiness Framework
EC	European Commission
e-CF	e-Competence Framework
EFA	European Fundraising Association
EHR	Electronic Health Record
ENRD	European Network for Rural Development
ERP	Enterprise Resource Planning

ESCO	European Skills, Competences, qualifications and Occupations
ETSI	European Telecommunications Standards Institute
EU	European Union
FDI	Foreign Direct Investment
FTTB	Fibre-to-the-Building
FTTC	Fibre-to-the-Cabinet
FTTH	Fibre-to-the-Home
FUA	Functional Urban Area
GDP	Gross Domestic Product
GMIL	Global Media and Information Literacy
GP	General Practitioner
GPS	Global Positioning System
HI	Horizontal Integration
ICIO	Inter-Country Input-Output
ICT	Information and Communications Technologies
IDC	Infrastructure for Digital Connectivity
IDI	ICT Development Index
ILO	International Labour Organization
IMD-SUTD	Institute for Management Development-Singapore University of Technology and Design
IoT	Internet of Things
IP	Internet Protocol
ITU	International Telecommunication Union
JRC-IPTS	Joint Research Centre-Institute for Prospective Technological Studies
KPI	Key Performance Indicator
LAN	Local Area Network
LFS	Labour Force Survey
M2M	Machine-to-Machine
MBPS	Megabit Per Second
m-Health	Mobile Health
MIL	Media and Information Literacy
MSTI	Main Science and Technology Indicators
MWN	Municipal Wireless Network
NGA	Next Generation Access
NGN	Next Generation Network
NGO	Non-Government Organisation
OECD	Organisation for Economic Co-operation and Development
OGD	Open Government Data
ONS	Office for National Statistics
p-Health	Personalised Health
PIAAC	Programme for the International Assessment of Adult Competencies

PISA	Programme for International Student Assessment
PSI	Public Sector Information
PV	Photovoltaic
R&D	Research and Development
RFID	Radio-Frequency Identification
SCI	Smart City Index
SDG	Sustainable Development Goal
SME	Small to Medium sized Enterprise
STAN	Structural Analysis
STEM	Science, Technology, Engineering, Mathematics
TALIS	Teaching and Learning International Survey
TiVA	Trade in Value Added
TSA	Towns and Semi-dense Areas
TV	Television
UAV	Unmanned Aerial Vehicle
UK	United Kingdom
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNESCO	United Nations Educational, Scientific and Cultural Organization
US	United States
USD	US Dollars
VHCN	Very High Capacity Network
VOIP	Voice Over IP
VSCO	Voluntary, Social, and Community Organisation
WAN	Wide Area Networks
WEF	World Economic Forum
Wi-Fi	Wireless Fidelity
WLAN	Wireless Local Area Network
WSIS	World Summit on the Information Society

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CHAPTER 1

Defining, Rationalising and Measuring Digital Towns

1.1 Introduction

The European Union's (EU) 'Digital Society' is the latest in a long line of 'revolutions', 'ages' and societal forms proposed by policymakers, academics and industry for over fifty years (Martin, 2008; Lynn et al., 2018). Critics note that it is at best inaccurate and at worst incorrect to describe society as digital or of technological origin, and is not by and large subject to sudden unexpected phase transitions inherent in revolutions (Martin, 2008). Nonetheless, digital technologies are influencing, and in many cases transforming, how society operates and how social actors interact with each other (Martin, 2008; Reis et al., 2018). Furthermore, there is a well-established literature base regarding the potential benefits of digital technologies for society (Mossberger et al., 2007). The EU's vision of a European digital society is an inclusive one based on "building smarter cities, improving access to eGovernment, eHealth services and digital skills" (European Commission, 2021), and yet for many such a digital society can seem ambiguous, distant, and beyond their technical abilities and imagination.

Over the same time that our conceptualisation of a society permeated and transformed by technologies evolved, there was and continues to be a parallel shift in where and how we live. Since 1975, there has been a rise in the proportion of the global population that live in cities from 37% in 1975 to 48% today (OECD and European Union, 2020). Attracted by the perceived economic opportunities and quality of life in cities, rural

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populations have migrated to cities contributing to their expansion and densification (OECD and European Union, 2020; Lerch, 2017). The socio-cultural, political, and economic benefits of urban agglomeration bring significant challenges in sustainable development, not least pollution, crime, and health issues (OECD and European Union, 2020). So-called 'smart city' technologies are touted as solutions to modern urban problems but what about the rest, the other 52% who don't live in cities?

For those who live in and depend on rural towns to participate fully in a digital society requires an understanding of what digitalisation means in its widest sense, and to imagine alternatives to the current city-centric narrative (Dufva & Dufva, 2019). The remainder of this chapter begins with a brief overview of key terms and concepts followed by a discussion of the urban-rural digital divide. This is followed by a review and discussion of the rationales for increased adoption and use of digital technologies in rural areas and specifically towns. Based on this review, we propose a working definition of a Digital Town. We conclude with a discussion on the need for a discrete measurement framework to measure the digital readiness of a digital society.

1.2 Digital Society—Key Concepts and Terms

Understanding and conceptualising what constitutes a digital society is made more complex by its situation at the intersection of the virtual, physical, and social. To make sense, exist fully, and imagine a future society permeated by digital technologies requires understanding not only the digital and physical world in themselves, but the relationships between the various entities in each of these worlds and between them, a space which is a form of mixed reality. Furthermore, the perspectives taken by different actors can vary substantially, from macro to micro levels.

1.2.1 What Do We Mean by Digital?

When we refer to the digital society or even a digital town, we do not mean that, as Martin (2008) states, it is "[…]made by the digital, and that its essential characteristics have been created because of the development of digital technology." But what do we mean? The answer to this question is not simple.

A significant challenge noted in recent reviews is that terms like Industry 4.0 and Digital Transformation, while widely cited, lack agreement on meaning (Reis et al., 2018; Vial, 2019; Nosalska et al., 2019; Culot et al., 2020). Indeed, whether one is referring to the information society or digital society etc., there would appear to be two major categories. To paraphrase Webster (2006), there are those who endorse or promote the idea of a digital society or information society, and those who see digitalisation or informatisation as the continuation of pre-established relations, a subordinate feature of established social systems. As Webster (2006) puts it, the former emphasise change while the latter emphasise persistence. These need not be binary. Table 1.1 below briefly summarises highly cited and prominent definitions of common terms and concepts with respect to digital society.

Table 1.1 Key terms and concepts in the digital society literature

Term	*Definition*
Digital Citizen	The citizen subject acting through the internet (Isin & Ruppert, 2020). Isin and Ruppert (2020) suggest that the digital citizens only come into being through digital acts and making rights claims.
Digital City	(1) A city that is being transformed or re-oriented through digital technology, or (2) a digital representation or reflection of some aspects of an actual or imagined city (Schuler, 2001).
Digital Economy	All economic activity reliant on, or significantly enhanced by the use of digital inputs, including digital technologies, digital infrastructure, digital services and data. It refers to all producers and consumers, including government, that are utilising these digital inputs in their economic activities (G20 Digital Economy Task Force, 2020).
Digital Society	A society whose social structures and activities, to a greater or lesser extent, are organised around digital information networks that connect people, processes, things, data and networks (Lynn et al., 2018). Also, sometimes referred to as the Internet of Everything.
Digitisation	The process of changing from analogue to digital form, also known as digital enablement (Gartner, 2021).
Digitalisation	The act(s) of transforming various previously physical or analogue actions into digital data systems (Dufva & Dufva, 2019). This includes processes, interactions, and business models.
Digitality	Living in a digital and digitised culture (Negroponte, 2015).
Digital Transformation	A process where digital technologies create disruptions triggering strategic responses from organisations that seek to alter their value creation paths while managing the structural changes and organisational barriers that affect the positive and negative outcomes of this process (Vial, 2019).

(*continued*)

Table 1.1 (continued)

Term	*Definition*
Industry 4.0	A concept of organisational and technological changes along with value chains integration and new business models development that are driven by customer needs and mass customisation requirements and enabled by innovative technologies, connectivity and IT integration (Nosalska et al., 2019). Also referred to as the Fourth Industrial Revolution (4IR).
Information Society	A society in which information is the defining feature. Webster (2006) notes that there are two categories of definitions, those organised around the quantitative measures of information expansion, and those that suggests an information society is one in which a decisive qualitative change has taken place with regard to the ways in which information is used. In the latter, Webster (2006) defines an information society is defined as one in which theoretical knowledge occupies a pre-eminence which it hitherto lacked, but suggests this may be more correctly referred to as a "Knowledge Society."
Networked City	A multitude of social networks comprising systems of interaction, systems of resource allocation, and systems of integration and coordination (Craven & Wellman, 1973).
Smart City	A smart city is a well-defined geographical area, in which high technologies such as ICT, logistic, energy production, and so on, cooperate to create benefits for citizens in terms of well-being, inclusion and participation, environmental quality, intelligent development; it is governed by a well-defined pool of subjects, able to state the rules and policy for the city government and development (Dameri, 2013).

1.2.2 Mainstream vs Frontier Technologies

When one considers digital technologies, we are faced with what Chambers (2010) calls a 'cornucopia of potentials' much more than can be covered within the confines of this chapter. As such, it is important to differentiate between mainstream technologies and frontier or emerging technologies. While the former are widely used in society and are considered relatively normal and conventional, frontier technologies represent technological advancements on previous generations of technologies and offer potential disruption. They are defined by their emergent use, their potential. Mainstream technologies include office productivity software, mobile technologies (incl. smartphones), websites, social media, and basic forms of cloud computing. Frontier technologies are often referred to as emerging technologies as they lack widespread adoption in society. In their most

recent report, UNCTAD references eleven such technologies summarised in Table 1.2 below. The use of these technologies by society as a whole, by definition, is at a nascent stage although they represent significant markets already (UNCTAD, 2021). Similarly, some technologies are further along the adoption cycle than others. In addition to native digital technologies, frontier technologies are often enabled by digital technologies (e.g., gene editing), enter mainstream use through incorporation into general purpose technologies (e.g., artificial intelligence and nanotechnology), or enable (more efficient) access and use to digital technologies (e.g., solar photovoltaic power).

Table 1.2 Selected frontier technologies and definitions (adapted from UNCTAD, 2021)

Technology	*Description*
Artificial Intelligence (AI)	The capability of a machine to engage in cognitive activities typically performed by the human brain.
Internet of Things (IoT)	Internet-enabled physical devices that can collect and share data.
Big Data	Datasets whose size or type is beyond the ability of traditional database structures to capture, manage and process.
Blockchain	An immutable time-stamped series of data records supervised by a cluster of computers not owned by any single entity.
Next Generation Networks (NGN)/Next Generation Access	While UNCTAD (2021) refers to 5G, NGN/NGA is widely used and refers to the next generation of mobile internet access and connectivity.
3D Printing / Additive Manufacturing	The production of three-dimensional objects based on a digital file.
Robotics	Programmable machines that can carry out actions and interact with the environment via sensors and actuators either autonomously or semi-autonomously.
Drones / Unmanned Aerial Vehicle (UAV)	A flying robot that can be remotely controlled or fly autonomously using software with sensors and GPS.
Gene Editing	A genetic engineering tool to insert, delete or modify the genome in organisms.
Nanotechnology	A field of applied science and technology dealing with the manufacturing of objects in scales smaller than 1 micrometre.
Solar Photovoltaic (Solar PV)	Technology that transforms sunlight into direct current electricity using semiconductors within PV cells.

1.3 What Is a Town?

While national and global definitions tend to agree on what cities are, national definitions tend to disagree on the classification of towns, semi-dense areas and rural areas (OECD and European Union, 2020). These definitional challenges reduce comparability and do not recognise governance differences (Lynn et al., 2020). Recently, a consortium of international organisations addressed this issue through the introduction of two new definitions, the degree of urbanisation and the functional urban area (FUA) (OECD and European Union, 2020). The FUA recognises that cities are metropolitan areas comprising the city itself and surrounding areas that are connected to the city in terms of labour market interactions (commuting zones) (Dijkstra et al., 2019). The degree of urbanisation reflects an urban-rural continuum and proposes three classes:

- Cities consist of contiguous grid cells that have a density of at least 1 500 inhabitants per km^2 are at least 50% built up with a population of at least 50,000.
- Towns and semi-dense areas (TSA) consist of contiguous grid cells with a density of at least 300 inhabitants per km^2, are at least 3% built up, and have a total population of at least 5000.
- Rural areas are cells that do not belong to a city or a town and semi-dense area, and for the most part have a density below 300 inhabitants per km^2 (OECD and European Union, 2020).

1.4 The Urban-Rural Digital Divide

While commonly used, the term digital divide, in reality, refers to a variety of interrelated digital divides. Philip et al. (2017) highlights two such divides—(i) divides resulting from inequalities in the technological infrastructure required to support digital connectivity, and (ii) socio-economic digital divides. These aspects have been explored in the urban-rural context for over two decades (Philip et al., 2017; Hindman, 2000; Townsend et al., 2013). Others view the digital divide across three levels—Internet access (first-level digital divide), Internet skills and use (second-level digital divide), and tangible outcomes of Internet use (third-level divide)

(Scheerder et al., 2017; Wei & Hindman, 2011). These two perspectives are clearly not mutually exclusive.

We define the urban-rural divide as an inequality between urban and rural areas with respect to the adoption and use of digital technologies, and the beneficial outcomes resulting from such adoption and use. The hypothesis underpinning this divide is that rural areas present lesser access and use of technologies, and consequently experience less beneficial outcomes, than urban areas. Firstly, inequalities in access and use are not disputed. There is substantial evidence that rural areas experience less availability and less access to infrastructure (Philip et al., 2017; Ashmore et al., 2015; Ali et al., 2020). Furthermore, studies in highly digitised countries such as South Korea and Australia suggest that the digital divide extends to a difference in use by and perceived benefits for rural users (Park & Kim, 2015; Park, 2017). In addition to broadband availability, geographic remoteness and suitability, and social exclusion are some of the factors that have been cited as barriers to digital adoption and use in rural areas (Park & Kim, 2015; Park, 2017; Ali et al., 2019). This is consistent with Philip et al. (2017). Unfortunately, as Scheerder et al. (2017) point out there is a general lack of research on the third-level digital divide i.e., relating to the beneficial outcomes of digital adoption and use. What research exists is fragmented. The limited literature on the urban-rural digital divide does present regional differences but is not comprehensive in scope or particularly current. Regional differences, supporting the urban-rural digital divide hypothesis, are reported for economics and other daily activities (Stern et al., 2009), e-payment and online shopping (Hsieh et al., 2013), parental mediation of adolescent internet use and adolescent exposure to internet risk and harm (Chang et al., 2016), institutional outcomes (Van Deursen & Helsper, 2015), and educational outcomes (Li & Ranieri, 2013). In many cases, these are related to socio-economic factors including age, income, gender, and education.

These interrelated factors may not be capable of being addressed by the market or government intervention alone, particularly where structural and geographic conditions make broadband deployment commercially infeasible or unattractive. Community-led multi-stakeholder initiatives have been suggested as a solution to the urban-rural digital divide however such initiatives need to overcome access to technical expertise, volunteerism, and funding arrangements, as well as geographical conditions to ensure success (Ashmore et al., 2015).

1.5 Rationalising and Defining Digital Towns

Borrowing from Hawkridge (1990) and based on analysis of existing community network and digital town projects, we identify at least ten rationales for digital town initiatives (Table 1.3). Eight of these can be organised along a socio-economic spectrum—Social, Accessibility, Pedagogical, Vocational, Sustainability, Quality of Service, Catalytic, Economic. The proposed Reactive rationale differs in that it represents a short term response to a crisis such as COVID-19; if continued it would likely be rationalised using one of the other rationales. The Opportunistic rationale differs in that it is over-riding.

Table 1.3 Rationales for digital towns

Rationale	*Description*
Social	The Social Rationale recognises that towns are part of a wider digital society and digital technologies help towns and their residents participate and function more fully in such a digital society (da Rocha, 2002; McQuillan, 2001; Hervé-Van Driessche, 2001). In many instances, this revolves around the provision of online platforms where stakeholders can share and consume information, services, and transact through marketplaces (Digitale Doerfer, 2020; Zavratnik et al., 2018).
Accessibility	The Accessibility Rationale posits that the adoption and use of digital technologies can increase accessibility to services and opportunities to those who may be disadvantaged or vulnerable in society (da Rocha, 2002).
Pedagogical	The Pedagogical Rationale posits that digital technologies will enhance teaching and learning (Hawkridge, 1990; Nusche & Minea-Pic, 2020). Distinct from the vocational rationale, here the focus is on the use of digital technologies to support the process of learning and teaching, and the achievement of educational outcomes, inside the classroom, at the educational institution, at home, or elsewhere (Nusche & Minea-Pic, 2020).
Vocational	The Vocational Rationale argues that citizens should be prepared to work in a digital society (European Network for Rural Development, 2018; McQuillan, 2001). This includes embedding digital technologies in educational institutions, the provision of education and training on digital technologies and related topics, and the overall digital competencies for the entire community (McQuillan, 2001; Hervé-Van Driessche, 2001). For example, Aveiro had a specific focus on training and providing employment opportunities for citizens with special needs in their digital town programme (da Rocha, 2002).

(*continued*)

Table 1.3 (continued)

Rationale	*Description*
Sustainability	Unsurprisingly, environmental sustainability is a common rationale for digital town projects. Here, the adoption and use of digital technologies is seen as a means for towns to reduce adverse environmental impacts and build a resilient habitat for existing and future residents (European Network for Rural Development, 2018; Hsieh et al., 2011; Sakurai & Kokuryo, 2018).
Quality of Service	A number of digital town objectives can be categorised under a Quality of Service Rationale. This rationale assumes that digital technologies may increase the range, quality and efficiency of service delivery whether public services (including health services), commercial services, or community services (da Rocha, 2002; Hervé-Van Driessche, 2001; Wichmann et al., 2021).
Catalytic	A common theme in digital town projects is the role of digital technologies as a catalyst of other innovations from all parts of the community (Hosseini et al., 2018; da Rocha, 2002; Hervé-Van Driessche, 2001). Indeed, in the case of Parthenay, a specific objective of the digital town programme was to explore whether citizens were capable of co-inventing services with the public and commercial sponsors (Hervé-Van Driessche, 2001).
Economic	Many digital agenda and digital town initiatives are driven, at some level, by an Economic Rationale. This rationale posits that the availability, quality (including broadband speed), adoption and use of digital technologies may attract greater economic growth and employment to a town (Hervé-Van Driessche, 2001). This includes increased tourism and retail activity in addition to potentially attracting digital industry investment and teleworkers (Wichmann et al., 2021). For example, in the German Digital Doerfer project, the platform includes a service for ordering and delivering local products and services (Digitale Doerfer, 2020).
Reactive	Against the backdrop of COVID-19, it is reasonable to posit that towns and constituent stakeholders might adopt digital technologies in response to a crisis, in this case a global pandemic. There is substantial evidence of all aspects of society adopting digital technologies to deliver services and maintain relationships with stakeholders during the COVID-19 pandemic and lock-down (Lynn et al., 2022; Baig et al., 2020).
Opportunistic	Finally, although somewhat implicitly, digital towns appear to be motivated by an Opportunistic Rationale in that the adoption and use of digital technologies can differentiate a town from other towns and may make it a more attractive place to live, work or visit, or competitive from an economic and investment perspective, when compared to other towns. This rationale has a dual purpose in that towns not only seek to attract new residents, workers and visitors to the town but retain existing residents and mitigate the risk of depopulation (European Network for Rural Development, 2018).

These rationales are reflected in three prevailing perspectives on digital towns in the literature, which we label as infrastructure-centric, service-centric, and community-centric. The Infrastructure perspective of a digital town emphasises the local availability and appropriation of ICT infrastructure as a prerequisite for the connection of a town as a node in a national/global network. The Service perspective emphasises the provision of local information services for citizen's everyday lives and visitors. Finally, the Community perspective emphasises platforms for communities of interest to support work in a geographical and information space where users can interact, sharing knowledge, experience and mutual interests (Hervé-Van Driessche, 2001). In reality, a digital town is all of these things.[1]

Consequently, we define a digital town as:

A geographic and information space that adopts and integrates information and communication technologies in all aspects of town life where a town consists of contiguous grid cells with a density of at least 300 inhabitants per km^2, are at least 3% built up, and have a total population of at least 5,000.

1.6 The Need for a Discrete Digital Town Measurement Framework

Performance management and measurement literature suggests that making strategy more measurable enables decision makers to take corrective actions to keep the organisation on track (de Waal, 2007). Furthermore, by providing critical success factors and indicators necessary for success, organisations and individuals can set goals which, in themselves, may influence performance particularly when specific feedback is provided on progress towards achieving said goals (de Waal & Kourtit, 2013).

Measurement frameworks and composite indices are used widely in policymaking and in particular to measure performance, relative progress or competitiveness through benchmarking, and identify areas of excellence or areas for improvement (Foley et al., 2018). As the G20 Digital Economy Task Force (DETF) (2018, p. 4) stated in the introduction to the G20 Toolkit for measuring the digital economy:

[1] Given the renewed interest in the metaverse, it is important that any definition of digital town is sufficiently broad to accommodate the physical world, virtual reality, and the comingling of both through augmented reality or other forms of hyper-reality.

Sound measurement is crucial for informing and guiding policymaking, as it helps policymakers produce precise diagnostics, assess the potential of alternative policy options, monitor progress, and evaluate the efficiency and efficacy of implemented policy actions.

The measurement of digital progress is not a new idea. Since the turn of the century, a wide range of frameworks and composite indices have been proposed for assessing digital adoption and use by policymakers, scholars, and international organisations (G20 Digital Economy Task Force, 2018).[2] Table 1.4 summarises commonly cited international frameworks and composite indices; links to each framework are provided in the Useful Links section at the end of the book. Initially, these measures were dominated by the desire to quantify the economic impact of digital technology adoption and use. While approaches and indicators to measure the progress towards a digital society as a whole have emerged, for example, the European Union (EU) Digital Economy and Society Index (DESI), the economic imperative has remained the dominant perspective as evidenced in the recent G20 DETF roadmap for measuring the digital economy (G20 Digital Economy Task Force, 2020). As such, existing approaches and indicators mostly focus on national economic indicators. Notwithstanding this, there have been recent efforts to assess the state and evolution of digital progress at more granular levels. For example, both the IMD-SUTD Smart City Index (Bris et al., 2019) and CityKeys framework present a set of city-level indicators (Bosch et al., 2017). These proposals are largely in the smart city domain and as such often conflate both digital and environmental sustainability themes.

In general terms, there are pros and cons to using rankings and composite indicators. As well as informing both policy making and administration, they can also seek to inform and guide the public on the relative success of policy and/or initiatives (Berger & Bristow, 2009). Furthermore, rankings and composite indicators can help summarise complex issues and reduce complexity thereby improving interpretability (Berger & Bristow, 2009). At the same time, such rankings and indicators have been criticised for being too simplistic and condensed and presenting an objective and

[2] Section 4 of the G20 Toolkit for Measuring the Digital Economy includes overviews of frameworks and indicators for measuring various aspects of the digital economy from Argentina, Australia, Brazil, Canada, China, France, Germany, Japan, Korea, Mexico, Russia, Saudi Arabia, Singapore, Turkey, the United Kingdom, and the United States of America.

Table 1.4 Selected international digital society and digital economy measurement frameworks and composite indices

Framework	*Description*	*Source*
Digital Economy & Society Index (DESI)	Measures performance across five dimensions: 1. Connectivity 2. Digital Skills 3. Use of Internet 4. Integration of Digital Technology 5. Digital Public Services	Digital Economy and Skills Unit (2018, 2020, 2021)
Digital Capital Index	Measures digital capital based on two dimensions: 1. Digital competencies • information and data literacy • communication and collaboration • digital content creation, • safety • problem solving. and 2. Digital access • access to digital equipment, • connectivity (quality and place) • historical time spent online • support and training	Ragnedda et al. (2020)
Digital Planet—Digital Evolution Index	The competitiveness of a country's digital economy is a function of two factors: 1. its current state of digitisation based on four drivers(99–170 indicators): • supply conditions • demand conditions • institutional environment • innovation and change and 2. its pace of digitisation (momentum) over time measured by the growth rate of a country's digitisation score over a ten-year period	Chakravorti et al. (2015)

(*continued*)

Table 1.4 (continued)

Framework	*Description*	*Source*
Digital Ecosystem Development Index	64 indicators organised in to 8 pillars: 1. Institutional and regulatory 2. Connectivity 3. Infrastructure 4. Factors of production 5. Household digitisation 6. Competition 7. Digitisation of production 8. Digital industry	Katz et al. (2014), Katz and Callorda (2018)
G20 Toolkit for Measuring the Digital Economy	Over 30 key indicators organised in 4 themes: 1. Infrastructure 2. Empowering society 3. Innovation and technology adoption 4. Jobs and growth	G20 Digital Economy Task Force (DETF) (2018)
ICT Development Index[a]	Comprises three sub-indices and 11 indicators: 1. ICT Access 2. ICT Use 3. ICT Skills	ITU (2018)
I-DESI	International of DESI (see above)	Foley et al. (2018)
Partnership on Measuring ICT for Development	Core list of 50 indicators in 5 themes: 1. ICT infrastructure and access 2. ICT access and use by households and individuals 3. ICT access and use by enterprises 4. ICT sector and trade in ICT goods 5. ICT in education 6. ICT in government A supplemental list of 26 indicators for adequately assessing specific targets of the UN Sustainable Development Goals were proposed in 2020.	ITU (2021)

[a]ITU has proposed a change in the methodology behind the IDI but these have not been implemented at the time of writing. See ITU (2020) for more details

representative view, while sometimes being based on relatively small samples or subjective judgments (Berger & Bristow, 2009). Often data is aggregated or weighted without commonality of approach. Indeed, this largely reflects the motivation for the G20 roadmap for a common framework for measuring the digital economy (DETF, 2020). In these cases,

there is a significant risk of comparing apples to oranges (Berger & Bristow, 2009). Finally, many of these indices are constructed on available data rather than required or ideal data.

These issues also arise in composite indices seeking to measure the digital society or digital economy. Firstly, towns and rural communities typically do not have the same agency as national governments or urban municipal authorities. For example, towns and rural communities may have little or no (a) autonomy with respect to decision making, and/or (b) revenue generation ability. As discussed earlier, successful digital town initiatives require a broad concept of community governance that, as per Leach and Percy-Smith (2001), involves multi-agency working and self-organising networks that cut across organisational and stakeholder boundaries. If this is a critical success factor then measurement frameworks must capture and make such governance measurable in a way that is not done so today.

Secondly, even where data is collected nationally, it may use sampling strategies which are not useful for decision-making at a town level. Indeed, town-level data may not be available at all, or, where available, is not representative due to the sampling strategy employed. For example, small-to-medium sized enterprises (SMEs) in rural communities are largely skewed towards micro-enterprises, those with less than ten employees. There is evidence to suggest that rural SMEs may be under-represented in international composite indices due to reliance on firm-level data from sources, such as Eurostat, that only collect data on enterprises with greater than ten employees. For example, the G20 Toolkit for Measuring the Digital Economy (G20 DETF, 2018), DESI (Digital Economy and Skills Unit, 2018, 2020, 2021), and I-DESI (Foley et al., 2018) all feature indicators that exclude micro-enterprises based on this criteria.

Thirdly, these national and city-level frameworks do not fully recognise the important role that all sectors of society play in rural towns and communities. For example, despite the significant role that civil society plays in modern economies and society as a whole, it does not feature as a discrete sector in digital measurement frameworks. As will be discussed in Chap. 5, civil society organisations are major employers and generators of significant economic value through expenditure. Digital technologies present nonprofit organisations and micro-enterprises in rural areas with a significant opportunity to overcome the limitations of their location yet are excluded or under-represented from critical policy making indicators.

Fourthly, rural towns and communities face specific limitations due to their geographic location. As well as poorer broadband infrastructure, skills and human capital are generally lower in rural areas than in urban areas. Even in more developed economies, rural education attainment can significantly lag urban areas across education levels (OECD, 2017; Campbell, 2019). As higher education institutions are typically located in urban areas, rural communities often experience an out-migration of skilled individuals from rural to urban areas for tertiary education, many of which do not return due the greater employment opportunities and higher wages available in cities. Undoubtedly, digital business and remote working offer rural communities the opportunity to reverse out-migration trends however enabling infrastructure is required. This includes both local access to high-speed broadband and the provision of local education opportunities in and through ICTs. While digital infrastructure is prominent in all measurement frameworks, education is not. In measuring digital town readiness, we suggest these dimensions require specific attention.

To summarise, a comprehensive framework for measuring digital towns must be methodologically appropriate for the specific policy- and decision-making context. Consequently, it needs to be sufficiently flexible and scalable to allow for different local priorities and resources. When considering what factors should be measured with respect to the evolution and development of a digital town, it should not only include comprehensive data on the basic sectors of the local economy—individuals and households, government, business, and nonprofit organisations—but enabling infrastructure i.e., digital infrastructure, education, and community governance. It should be noted that these factors should not be considered fixed in stone. Additional thematic areas may be added or removed, or weighted differently, depending on the local context priorities. For example, more emphasis may be placed on a specific sector or set of economic activities e.g., tourism. Similarly, as technology advances, access, use and outcomes will change. Furthermore, the framework should allow for national and international comparison by including commonly used indicators. The OECD has called for rural areas to drive their own economic development rather than rely on the national government, specifically with respect to identifying and mobilising assets to improve economic performance (OECD, 2014). For both comprehensiveness and local planning, we argue that data needs to be collected at a local level thus the framework needs to be sufficiently easy to use, understand, and be communicated to support a bottom up community approach.

1.7 Conclusion

This chapter introduces key terms and concepts in the digital society literature and emerging definitions of what a town is. From this literature, we define a digital town as "a geographic and information space that adopts and integrates information and communication technologies in all aspects of town life where a town consists of contiguous grid cells with a density of at least 300 inhabitants per km^2, are at least 3% built up, and have a total population of at least 5,000." Our review of existing academic literature and digital town projects suggests a wide range of perspectives and rationales for adopting digital technologies at a town level. Notwithstanding this, it remains a relatively under-researched area particularly with respect to the longitudinal measurement of impact. We present a brief overview of commonly cited frameworks and composite indices for measuring digital society and digital economy, and discuss their applicability for rural towns and communities.

The remainder of this book is organised around seven dimensions based on the four sectors of the economy and three enabling infrastructures outlined in Sect. 1.4 above. Chapter 2 discusses the adoption and use of technologies by citizens and is followed by a similar discussion for public services (Chap. 3), businesses (Chap. 4) and civil society (Chap. 5). Then each of the enabling infrastructures are discussed i.e., infrastructure for digital connectivity (Chap. 6), education (Chap. 7), and governance (Chap. 8). In each chapter, the relevant dimension is defined and the benefits and challenges to adoption and use of technologies are discussed. Each chapter includes a discussion of how that dimension is measured in existing frameworks for the digital society and the digital economy, if at all. The book concludes in Chap. 9 with an overview of a digital town measurement framework including indicators and potential benchmarks.

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CHAPTER 2

The Digital Citizen

2.1 Introduction

New technology is changing the way in which individuals and societies communicate, learn, work and govern (Meyers et al., 2013). Digital citizens are described as 'those who use the internet regularly and effectively—that is, on a daily basis' (Mossberger et al., 2007, p. 1). Digital citizenship is not only the technical ability to participate online but to behave in an appropriate, responsible way with regard to such digital technology use (Mossberger et al., 2007; Ribble & Bailey, 2007). Such regular, appropriate and responsible use implies a level of technical competence and digital literacy skills, as well as access to both technology and to the internet. However, the 'digital divide', representing 'the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard both to their opportunities to access information and communication technologies (ICTs) and to their use of the internet for a wide variety of activities' (OECD, 2001, p. 5), still persists due to the systemic inequalities that have emerged in societies worldwide (Beaunoyer et al., 2020). Evidence suggests that these inequalities are not only evident in developing economies, but also exist within richer economies, where significant disparities remain between urban centres and rural communities. Overcoming these inequalities requires equal emphasis on digital infrastructures and the development of digital skills. However, it is possible that the COVID-19 pandemic has served to widen rather than narrow this divide as more and more services are only available online and because access to workplaces, schools and libraries have been severely restricted, particularly in rural areas (Lai & Widmar, 2021). At the same time, rural towns have become the preferred locations for many to live and

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work, presenting some optimism that previously struggling rural communities and economies can thrive in the future.

As discussed in Chap. 1, there are two important factors in the definition of towns—people and place. To paraphrase Marshall (1950, p. 149), to be a citizen is to be a member of a community. If digital citizenship is the ability to participate online then citizens must have the access, competences, and skills to use digital technologies. This chapter begins with a discussion on how and where digital inequalities, so-called 'digital divides', surface. It then discusses what digital literacy is and how competencies and skills might be categorised. Next, opportunities and challenges associated with remote and other new forms of work are considered. The final section discusses how extant international frameworks and composite indices measure access, competences, and use of digital technologies by individuals and households.

2.2 The Digital Divide

A significant proportion of the population worldwide either do not have access to the internet or the skills to leverage the opportunities presented by digital technologies. This is not limited to the developing world. In 2019, approximately 15% of European households did not have internet access in 2019 citing insufficient skills (44%), equipment costs (26%) and high cost barriers (24%) (Digital Economy and Skills Unit, 2020). This is consistent with findings from the OECD which suggests that 11.7% of adults aged 16 to 65 reported having no prior computer experience and a further 4.7% of adults did not possess basic ICT skills (OECD, 2019b).

As discussed in Chap. 1, the digital divide is a multi-faceted topic. It can be viewed across multiple levels including the availability of and access to technological infrastructure including computing equipment, software, and the internet, digital skills and use, and tangible outcomes of internet use (Scheerder et al., 2017; Philip et al., 2017; Wei et al., 2011). While the main focus of this book concerns bridging the urban-rural divide, rural communities, like their urban counterparts, may experience digital inequalities, typically related to age, income, education, and to a limited extent, gender.

2.2.1 The Grey Digital Divide

Populations are ageing across developed economies worldwide (Rouzet et al., 2019). Economists anticipate that this will impact GDP per capita growth, labour market conditions, earnings, as well as potentially increasing inequality and poverty risk on future generations (Rouzet et al., 2019). Rural areas are not only, on average, older than urban areas but ageing is progressing faster in rural areas (OECD, 2019a). Furthermore, the rural-urban divide with respect to demographic profiles is expected to grow (Daniele et al., 2019).

Social isolation is defined as "a state in which the individual lacks a sense of belonging socially, lacks engagement with others, has a minimal number of social contacts and they are deficient in fulfilling and quality relationships" (Nicholson, 2009, p. 1346). While it may be a personal choice, where it is not so, individuals may experience loneliness (Havens et al., 2004). Social isolation and loneliness represent a substantial difficulty for older populations worldwide. They are associated with a variety of factors associated with poorer well-being and a lower quality of life (Murthy, 2020; Kaye, 2017; Havens et al., 2004). While research on rural and urban differences in social isolation and loneliness in older adults is mixed (Havens et al., 2004), older people in rural areas are impacted significantly from greater physical isolation and associated transportation issues (Kaye, 2017; Davidson & Rossall, 2015).

Digital technologies can mitigate the negative outcomes of physical isolation, social isolation, and loneliness by connecting older adults to meaningful social network support provided they have access and the skills to use these technologies effectively (Francis et al., 2019). This sense of isolation was particularly exacerbated during the COVID-19 pandemic (Garcia et al., 2021), where the lack of ICT access, usage and skills among older populations became more apparent. In one recent study, increasing age was significantly and negatively associated with use of e-services (e.g., e-banking, e-government, e-health and e-learning) and social networking across the EU-28 (more so than education, gender or income) (Elena-Bucea et al., 2020). As Friemel (2016, pp. 12–16) notes, the differences in internet use among those older than 70 years 'seems not to be linear but rather exponential'. Friemel notes that "with every additional year of age, the likelihood of usage decreases by 8% in five-year differences when considering a range of 65–90 years or more" (p. 328).

The key determinants of using new technologies among older adults represent a combination of attitudinal, functional, and physical factors (Neves et al., 2018). Attitudinal factors include interest, anxiety (e.g., technophobia), perceived usefulness and perceptions of being too old to use it. Functional factors include access to devices, levels of education and digital skills, and ease of use depending on technology design and size. Finally, physical factors include limitations due to poor health or other age-related impairments such as visual acuity, reduced dexterity and memory. Access to education is regarded as an effective strategy in reducing social isolation among older people, as well as providing them with new knowledge and helping them to adapt to a changing society (Blažič & Blažič, 2018).

2.2.2 The Income Digital Divide

Extant research suggests that an urban-rural income gap exists (Young, 2013). Level of income is regarded as a further reason for the digital divide (United Nations, 2012; World Bank, 2016) and is regarded as an important driver of the digital development of countries (Cruz-Jesus et al., 2017). Income, which impacts both internet access (Van Deursen et al., 2016) and usage (Robinson & Williams, 2015; Zhang, 2013), was regarded as particularly important during the emergence of new technologies because owning a computer was regarded as an optional luxury (Lindblom & Räsänen, 2017). In a study of 110 countries, Cruz-Jesus et al. (2017) found that 82.7 percent of the variance in the digital divide was explained by GDP alone. Other recent studies, however, show that lower income inequalities are associated with increased internet usage and mobile phone subscriptions, suggesting that the digital divide can be narrowed if income disparities reduce further (Richmond & Triplett, 2018).

2.2.3 The Education Digital Divide

The use of ICT is sometimes complex, which is regarded as a significant obstacle to its adoption (Van Deursen et al., 2016). Pick and Azari (2008) report that government spending on education directly impacts access to ICT, which is positively related to ICT usage in both developed and developing countries. Recent evidence from across the EU-28 reports that education is strongly linked to the adoption of e-services and social networking (Elena-Bucea et al., 2020). Compared to age, gender or income, education

was the strongest driver of the adoption of e-services. Van Deursen et al. (2016) also found that more educated respondents were consistently more confident about all dimensions of internet skills. In addition, competency in the English language represents a further barrier to access and usage (United Nations, 2012), as well as to decent prospects for future employment and life opportunities (Pick & Nishida, 2015). Because digital exclusion has broader implications for accessing education, work and other opportunities, this creates what is termed the 'digital vicious cycle' (Baum et al., 2014). Education will be discussed in greater detail in Chap. 7.

2.2.4 The Gender Digital Divide

Dixon et al. (2014) suggest that 'the phenomenon of technology itself cannot be fully understood without reference to gender' (p. 993). Differences in gender equality across nations reflect complex familial, institutional, religious, societal and stereotypical beliefs, which can also impact ICT access and usage (Cooper, 2006). Despite this complexity, the 'Women in Digital' scoreboard (European Commission, 2020b) suggests relative parity between men and women regarding the 'use of internet' across most EU states. This declines slightly with regard to internet skills among women compared to men. It further declines regarding 'specialist skills and employment'; a finding which reflects the lack of female participation in science, technology, engineering and mathematics (STEM) and ICT occupations. In their analysis across the EU-28, Elena-Bucea et al. (2020) found no evidence to suggest differences in levels of adoption between the genders. Van Deursen et al. (2016), however, found that men rated their skills consistently higher than females, with the exception of 'information navigation skills'. This finding perhaps reflects the so-called 'confidence gap', which has been reported across a range of studies on gender differences (Guillen, 2018).

2.2.5 The Digital Divide and Other Vulnerable Parts of Society

In addition to older adults, the vulnerable in society include a wide range of people including minors, disabled people, persons with serious illnesses or mental disorders, amongst others (European Commission, 2021). Vulnerable people are typically more likely to suffer from social exclusion and social isolation than the general population. The consequences of social exclusion can result in lower social and civic participation and

representation, lower social standing, poverty, low human capital endowments, restricted access to employment and services (Tangcharoensathien et al., 2018). Digital participation may benefit vulnerable people by avoiding or mitigating the effects of social isolation, reducing stigma, and allowing these people to perform activities that are unavailable to them (Dobranski & Hargittai, 2006; Duplaga, 2017). Unfortunately, there is evidence of digital divides for many vulnerable populations. For example, studies have found evidence of a disability digital divide in the UK (Office of National Statistics, 2019), Poland (Duplaga, 2017), Sweden (Johansson et al., 2021), amongst others (Kim et al., 2018; Tuikka et al., 2018). Similarly, digital divides have been found amongst refugees, displaced persons, and specifically asylum-related migrants (Merisalo & Jauhiainen, 2020; Lynn et al., 2021). It is worth noting that inequalities can exist in those parts of society we assume are digitally native. While minors often have physical access to digital technologies, inequalities may exist with respect to mediation and contextualisation of use (Talaee & Noroozi, 2019; Smahel et al., 2020). Talaee and Noroozi (2019) call for a reconceptualization of how we think about the digital divide with respect to children. They argue that access to a supportive 'social envelope', for example active mediation by parents and other family members, is the area in which most digital inequalities exist rather than the physical access to the hardware or even usage time. If a true measure of any society can be found in how it treats its most vulnerable members then digital initiatives and associated measurement frameworks must include those at most risk.

2.3 Digital Literacy

Globally, the lack of progress in the development of digital skills has been associated with difficulties in defining and measuring digital literacy (Van Deursen et al., 2016). While historically, the digital literacy literature has focussed on the prevalence and sophistication of (i) computer skills and (ii) internet skills (Hargittai, 2005), recent conceptualisations are more nuanced seeking to differentiate, between digital knowledge, skills and competencies (Iordache et al., 2017). Unfortunately, these nuances are not widely understood or applied, and as such are often conflated and used synonymously. Based on a review of 13 digital literacy models, Iordache et al. (2017) attempt to unravel these concepts into a practical set of interlinking definitions as per Table 2.1.

While there are a wide range of digital literacy models in the literature, there is significant commonality over the high-level categories of skills and

Table 2.1 Definitions of digital knowledge, skills, competence, and literacy (Iordache et al., 2017)

Term	*Definition*
Digital knowledge	Digital knowledge is the information, awareness, and understanding that users have of the existence and usage of different digital tools.
Digital skills	Digital skills are practical, measurable applications of certain knowledge or aptitudes in digital usage.
Digital competence	Digital competence is the ability to apply digital knowledge and skills to various life contexts, from personal to professional.
Digital literacy	Digital literacy compiles the awareness, practical skills, and competences necessary for users to access, understand, evaluate, communicate with others, and create digital content in a strategic and applied manner, towards the fulfilment of personal and professional goals.

Table 2.2 Categories of digital skills and competences (Iordache et al., 2017)

Category	*Exemplar skills and competences*
Operational, technical and formal	• Using computer hardware and internet software • Handling digital structures • Data privacy and protection
Information and cognition	• Analysing and evaluating online information • Managing data • Digital problem-solving
Digital communication	• Construct and understand digital messages • Exchange messages and share content • Participate in online communities and networks • Netiquette
Digital content creation	• Create and edit new content • Integrate and remix existing content • Awareness of intellectual property rights
Strategic	• Use information towards personal and professional goals • Identify digital competence gaps

competences. Iordache et al. (2017) classify digital skills and competences into five categories, largely based on van Deursen et al. (2014), as per Table 2.2.

Care needs to be taken that digital literacy and digital citizenship are not viewed in isolation. The skills required to participate fully online

depend on the specific tasks to be performed e.g., e-government, e-health, online learning etc. These are discussed in Sect. 2.5 below and subsequent chapters. Furthermore, individuals acquire and develop these competences and skills through informal, formal and nonformal means. The extent to which educational opportunities are provided to all members of a given community varies. While the formal education system has made significant strides to integrate digital technologies, such provision may not be uniform and may struggle to maintain pace with technological change. Similarly, depending on the size of a town, comprehensive nonformal education provision may not be comprehensive or exist at all.

2.4 New Forms of Work and Rural Towns

COVID-19 and associated public health measures resulted in a temporary transition to remote working. Recent studies suggest remote work and virtual meetings are likely to continue, albeit less intensely than at the pandemic's peak (OECD, 2020; McKinsey, 2021). There is some optimism that this increased acceptance of teleworking combined with lower cost of living will help reverse population trends and increase the sustainability of smaller and rural towns. In addition to remote working, the emergence of online platforms to support the sharing economy and gig economy, are providing new markets, income, and economic opportunities to individuals and households in rural communities.

2.4.1 Remote Working

Remote working is the partial or total substitution of technology for the daily commute to and from work. Remote working options include working from home, working from a regional office close to home, or using coworking spaces (Spinuzzi, 2012). The COVID-19 pandemic saw an unprecedented surge in the numbers of people working remotely, with reports of up to half of the entire EU workforce working from home (Eurofound, 2020). The reported benefits of remote working can be organised at three levels: (i) societal (e.g., less traffic congestion and lower air and noise pollution, better opportunities for the disabled); (ii) organisational (e.g., cost savings due to lower infrastructural costs); and (iii) individual (e.g., greater flexibility, job satisfaction, lower transport costs, work-balance etc.) (Bloom et al., 2015; Martin & MacDonnell, 2012; Morganson et al., 2010). Research suggests that remote working can be

community-friendly (Kamerade & Burchell, 2004), that it can increase productivity and improve organisational performance (Martin & MacDonnell, 2012), and is associated with greater work-family balance and less work-family conflict (e.g., He & Hu, 2015). Furthermore, research suggests that those working remotely even half-time can save between $2000 and $6800 a year (Lister, 2010). For organisations, remote work also offers an opportunity to cut costs arising from the reduced need for office space and associated running costs (Popma, 2013; Bloom et al., 2015). It should be noted that remote working need not take place in the home but in remote working hubs. While there is renewed interest and support for remote working hubs and telecenters in rural communities as a result of COVID-19 (Tomaz et al., 2021; Department of Rural and Community Development, 2021), they are not necessarily predicated on digital strategies.

Gallardo and Whitacre (2018) note the lack of research examining the impact that remote work has on local economic indicators such as income. They theorise that if remote working leads to higher levels of worker satisfaction and productivity, these outcomes should in turn lead to higher levels of income. They propose that workers who work remotely in 'outside locations' potentially increase the number of jobs available for local residents, as well as for residents of nearby areas who may commute in. Their study reported a positive relationship between remote working and median household income, suggesting that it can have a positive impact on local area income. They conclude that the traditional economic development approach of industry attraction and geographic clustering fails to consider other strategies and that remote working has the potential to become a community economic development tactic. This suggests a need to modify existing industrial incentive systems to focus more on placing workers in remote jobs (Erard, 2016). This would offer opportunities to rural communities to attract both workers and customers, while continuing to promote existing attractions (e.g., natural amenities, housing costs), which would help to level the playing field between urban and rural economies (Gallardo, 2016b). Despite the many reported benefits of remote working, a number of drawbacks have been noted including the potential for greater social isolation, stress and burnout. (Golden et al., 2008) and increased mental health symptoms (Mann & Holdsworth, 2003; Bloom et al. (2015). One report from the EU suggests that while remote working can afford some flexibility, autonomy and empowerment, there is also a risk of work intensification, increased stress, longer hours, and blurring

of the boundaries between work and private life (Eurofound, 2015; Popma, 2013). Some EU countries including France and Ireland have already developed a code of practice on 'the right to disconnect' and the EU parliament is paving the way for the enactment of legislation on this issue.

Prior to the pandemic, Hynes (2016) noted a lack of interest and/or commitment from employers to more fully embrace opportunities for remote work. From an infrastructural perspective, he noted the poor quality of broadband and a lack of policy or regulation for remote work as further impediments. Gallardo (2016a) suggests that a remote work-friendly policy framework should: (i) make it easier for businesses to offer remote work through subsidies and tax credits, which help retain fast-growth companies that may otherwise leave due to lack of labour supply, (ii) modify existing workforce development programmes to be better aligned with remote work (e.g., self-motivation, self-management, teamwork and other soft skills), and (iii) improve broadband availability and access for remote workers through multiple tax credit mechanisms (e.g., subsidising monthly access costs). Increased rural digitalisation offers a potential win-win for firms seeking labour but also workers seeking improved quality of life.

2.4.2 The Gig Economy

The gig economy relates to the intermediation of labour typically via an online platform. Gig economy platforms are typically two-sided platforms that match workers with customers, those who require work done on a per-service basis (Schwellnus et al., 2019). They include a wide range of services including transportation (e.g., Uber), home delivery (e.g., Deliveroo), home cleaning and maintenance (e.g., Care.com), data processing and other crowd work (e.g., Fiverr.com and Amazon Mechanical Turk), amongst others (Schwellnus et al., 2019). The popularity of such gig economy platforms can be explained by their virtual nature and low barriers to entry (Huang et al., 2018; Lynn et al., 2021). Consequently, work is both location- and time-agnostic enabling flexible, temporary, ad-hoc working arrangements (Huang et al., 2018; Lynn et al., 2021). These attributes may have a positive impact on rural economies by absorbing unemployment shocks, resolving underemployment and unemployment, and as a consequence positively impact rural-to-urban occupational migration (Huang et al., 2018; Burtch et al., 2018). Gig economy work is not

without drawbacks including competition from low-income countries, discomfort associated with working for strangers, and traditional drawbacks associated with freelance work e.g., lack of employment and retirement benefits (Huang et al., 2020; Lynn et al., 2021). While gig work not only provides work that fits the needs and capabilities of workers and overcomes the limitations of rurality, research suggests it does not necessarily value the expertise and experience of, for example, older workers (Cook et al., 2019).

2.4.3 The Sharing Economy

Bartering, renting, swapping and sharing equipment and space are long standing market behaviours in rural communities, typically performed with friends, families and neighbours. In recent years, digital technologies and online platforms have transformed and revitalised these activities by enabling such transactions between strangers in what is widely referred to as the 'sharing economy' (Puschmann & Alt, 2016; Laurenti et al., 2019). Whereas the gig economy focuses on the intermediation of labour, the sharing economy involves "[…] consumers granting each other temporary access to under-utilized physical assets ("idle capacity"), possibly for money" (Frenken & Schor, 2019, pp. 121–122). The sharing economy is disrupting and transforming a number of sectors, not least the short stay and holiday accommodation sector e.g., AirBnB and Couchsurfing. The gig economy shares many of the same benefits of the sharing economy for rural communities in terms of access to income-earning opportunities and employment (Dreyer et al., 2017). However in many cases it is less impacted by competition from low-income countries and has potential additional benefits in terms of environmental sustainability derived from the increased utilisation of resources (Mi & Coffman, 2019). To date, short stay accommodation and associated direct, indirect and induced economic effects has been the primary focus of sharing economy research, and anecdotally activity, in smaller and rural towns. However, recent research suggests that the attitudinal changes the COVID-19 pandemic has wrought with respect to scarcity, community living, and online participation, provides substantial opportunities for rural communities to overcome their local challenges through socio-economic sharing in other sectors including retail sustainability and poverty prevention (Buheji, 2020).

2.5 Measuring Individual and Household Access and Use of Digital Technologies

Unsurprisingly, given the central role citizens play in society, individual and household access and use of digital technologies is a significant feature of the majority of international frameworks and composite indices for measuring the evolution and development of the digital society and the digital economy. There are a number of common themes. These include access to broadband and the internet which we address in Chap. 6, use of digital technologies, and the prevalence and sophistication of digital competences and skills. As can be seen from sources cited in Table 2.3 and later in Chap. 7, there is significant overlap with these themes and those used for measuring the integration of digital technologies into formal and

Table 2.3 Common themes and selected international sources for digital technology access and use by individuals and households

Themes	*Description*	*Selected sources*
Access	Availability and access to digital technologies (incl. the internet) by individuals and households.	Eurostat, ITU, Partnership on Measuring ICT for Development, UNESCO Institute for Statistics
Enrolment	Enrolment in ICT-related courses or fields	Eurostat, Partnership on Measuring ICT for Development, UNESCO Institute for Statistics
Employment	Employment in the ICT sector	Eurostat, ILO Labour Force Survey
Equity	Relative access to and use of digital technologies by female citizens and the relative proportion of female ICT graduates.	UNESCO Institute for Statistics
Digital competence, self-efficacy and skills of individuals	Individual competence, self-efficacy and skills using different technologies and performing related tasks.	Eurostat, EU Survey of Schools: ICT in Education, PIAAC, PISA, TALIS
Use	Incidence, intensity and patterns of digital technology use by individuals.	EU Survey of Schools: ICT in Education, Partnership on Measuring ICT for Development, PIAAC, PISA, TALIS

nonformal education. While equity data is widely collected, it is somewhat myopic focussing on gender balance rather than other potential targets of inequality e.g., older adults, people with disabilities, refugees and other displaced persons, amongst others.

Two significant themes in extant frameworks are digital competences and use of digital technologies in general and by activity. There are a number of different frameworks for assessing digital skills competences sometimes from the same organisation (e.g., the UNESCO Media and Information Literacy (MIL) Curriculum for Teachers (UNESCO, 2021) and the UNESCO Global Media and Information Literacy Assessment (GMIL) Framework (UNESCO, 2013), the European skills/competences, qualifications and occupations (ESCO) transversal ICT skills list (European Commission, 2020b), and the European e-Competence Framework(e-CF) (CEN, 2019). Even where the source may be from the same or related organisations, the definition and gradation of skills and use may vary. In this regard, the European Digital Competence Framework (DigComp 2.0) is useful in that not only does it seek to provide a high level conceptual digital competence framework that synthesises many existing frameworks, it provides a useful mapping with MIL, GMIL, ESCO, and e-CF frameworks (Carretero Gomez et al., 2017). Table 2.4 summarises DigComp 2.1; at the time of writing the consultation for DigComp 2.2 was underway. It is important to note that the extent to which these competences, in any comprehensive way, feature in international frameworks and composite indices for the digital society and the digital economy is limited.

ICT skills are included in a number of international frameworks, typically by type of activity gradated from basic to advanced (Digital Economy and Skills Unit, 2020; G20 Digital Economy Task Force (DETF), 2018; Partnership on Measuring ICT for Development (ITU, 2018). For example, Table 2.5 outlines the main ICT skills indicators for DESI, the data for which is sourced from the Eurostat Community survey on ICT usage in Households and by Individuals (Digital Economy and Skills Unit, 2020).

Regarding ICT use, and more specifically ICT use for digital activities, there is significant variation across frameworks and composite indices. As well as access to digital infrastructure (Chap. 6), and the use of digital technologies for accessing and interacting with government and health services (Chap. 3), working and conducting business (Chap. 4), and for formal and nonformal education (Chap. 7), a wide range of activities are used as indicators. For example, the Partnership on Measuring ICT for Development (ITU, 2016) includes a comprehensive list of activities:

- Getting information about goods or services
- Seeking health information
- Making an appointment with a health practitioner via a website
- Getting information from general government organizations
- Interacting with general government organizations
- Sending or receiving e-mail
- Telephoning over the Internet/VoIP
- Participating in social networks
- Accessing chat sites, blogs, newsgroups or online discussions
- Purchasing or ordering goods or services
- Selling goods or services
- Using services related to travel or travel-related accommodation
- Internet banking (and financial services)
- Doing a formal online course (in any subject)
- Consulting wikis (Wikipedia etc.), online encyclopaedias or other websites for formal learning purposes
- Listening to web radio (either paid or free of charge)
- Watching web television (either paid or free of charge)
- Streaming or downloading images, movies, videos or music; playing or downloading games (either paid or free of charge)
- Downloading software or applications (includes patches and upgrades, either paid or free of charge)
- Reading or downloading online newspapers or magazines, electronic books (includes accessing news websites, either paid or free of charge; includes subscriptions to online news services)
- Looking for a job or sending/submitting a job application (includes searching specific web sites for a job; sending/submitting an application online)
- Participating in professional networks (including social networking sites)
- Managing personal/own homepage
- Uploading self/user-created content to a website to be shared (text, images, photos, videos, music, software, etc.)
- Blogging: maintaining or adding contents to a blog
- Posting opinions on civic or political issues via websites (blogs, social networks, etc.) that may be created by any individual or organization
- Taking part in online consultations or voting to define civic or political issues

- Using storage space on the internet to save documents, pictures, music video or other files (including cloud storage)
- Using software run over the internet for editing text documents, spreadsheets or presentations

Not all international frameworks are as comprehensive. Digital Economy and Skills Unit (2020) employs three sub-dimensions—(i) internet (non-) users, (ii) online activities (news, music, videos and games, video on demand, video calls, social networks, and doing an online course), and (iii) transactions (banking, shopping, and selling). DESI also measures access to infrastructure and e-Government interactions separately in other dimensions (Table 2.6).

Table 2.4 DigComp 2.1 competence areas and competences (adapted from Carretero Gomez et al., 2017)

Competence areas	*Competences*	
1. Information and data literacy	1.1	Browsing, searching and filtering data, information and digital content
	1.2	Evaluating data, information and digital content
	1.3	Managing data, information and digital content
2. Communication and collaboration	2.1	Interacting through digital technologies
	2.2	Sharing through digital technologies
	2.3	Engaging in citizenship through digital technologies
	2.4	Collaborating through digital technologies
	2.5	Netiquette
	2.6	Managing digital identity
3. Digital content creation	3.1	Developing digital content
	3.2	Integrating and re-elaborating digital content
	3.3	Copyright and licences
	3.4	Programming
4. Safety	4.1	Protecting devices
	4.2	Protecting personal data and privacy
	4.3	Protecting health and well-being
	4.4	Protecting the environment
5. Problem solving	5.1	Solving technical problems
	5.2	Identifying needs and technological responses
	5.3	Creatively using digital technologies
	5.4	Identifying digital competence gaps

Table 2.5 Digital skills indicators used in the EU Digital Economy and Society Index (Digital Economy and Skills Unit, 2020)

Indicator	*Description*
At least basic digital skills	Individuals with 'basic' or 'above basic' digital skills in each of the following four dimensions: information, communication, problem solving and software for content creation (as measured by the number of activities carried out during the previous 3 months
Above basic digital skills	Individuals with 'above basic' digital skills in each of the following four dimensions: information, communication, problem solving and software for content creation (as measured by the number of activities carried out during the previous 3 months).
At least basic software skills	Individuals who, in addition to having used basic software features such as word processing, have used advanced spreadsheet functions, created a presentation or document integrating text, pictures and tables or charts, or written code in a programming language.

Extant international frameworks for measuring the evolution and development of digital society and the digital economy, can also be distinguished by the extent to which they focus on individuals and households as opposed to society or an economy as a whole. For example, the Digital Capital Index and the IMD-SUTD Smart City Index exclusively focus on the perceptions of individuals, whereas as others, for example, the EU Digital Economy and Society Index (DESI), the G20 Toolkit for Measuring the Digital Economy, and Partnership on Measuring ICT for Development focus on a variety range of indicators including businesses and government.

While one would not expect the presence of remote working hubs in a set of digital indicators, it may be a proxy for a type of online work. New places of work and ways of working are typically under-represented or absent from commonly cited international frameworks. Similarly, uses of digital technologies associated with online work, the gig economy, and sharing economy have not featured prominently to date. In response to the increased prevalence of such practices during the COVID-19 pandemic, one would anticipate that this is likely to change.

As a final note, it is important to note that collecting data on those parts of society that do not use the internet or digital technologies is a substantial challenge. By definition, more modern methods of data collection such as online survey panels will not capture these cohorts thereby requiring on-site manual data collection from people who may be difficult to identify.

Table 2.6 Selected indicators on digital technology skills and use by individuals and households in selected international digital society and digital economy measurement frameworks and composite indices excluding general access to digital infrastructure

Framework	*Description*	*Source*
Digital Economy & Society Index (DESI)	• Human Capital • Digital skills • Advanced skills and development • Use of Internet Services • Internet use • Activities online • Transactions • Public Services • eGovernment users	Digital Economy and Skills Unit (2020)
Digital Capital Index	• Digital Access • Support and training • Digital Competence	Ragnedda et al. (2020)
Digital Ecosystem Development Index	• Household Digitization • Internet use • Electronic government • Electronic commerce • Telemedicine • OTTs (Video on Demand penetration)	Katz et al. (2014); Katz and Callorda (2018)
G20 Toolkit for Measuring the Digital Economy	• Empowering Society • Digital natives • Internet users • People's use of the internet • E-consumers • Mobile money • Citizen interacting with government via the internet • STEM higher education • Individuals with ICT skills	G20 Digital Economy Task Force (DETF) (2018)
ICT Development Index	• ICT Use • Percentage of individuals using the internet • ICT Skills • Percentage of individuals with ICT skills	ITU (2020, 2021)
Partnership on Measuring ICT for Development	• Proportion of individuals using the internet • By location • By type of activity (see above) • By frequency • Individuals with ICT skills, by type of ICT skills • Household expenditure on ICT • Proportion of individuals not using the internet, by type of reason	ITU (2016)

2.6 Conclusion

This chapter has identified many of the key challenges and opportunities for greater participation by individuals and households in a digital society. It considers a range of factors related to accessibility, affordability, and skills as key challenges. While new forms of work and working present opportunities for many living in rural communities, it is critical that those most vulnerable in society are not left behind in the digital society or digital economy. In measuring the evolution and development of digital progress in any community, whether a rural town, a city, or nation, only by understanding the extent of digital inequality can we take action to eradicate it.

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CHAPTER 3

Digital Public Services

3.1 Introduction

Governments play a key role in our society by providing citizens and businesses with access to a range of essential public services. As such, there is a constant demand for ways to improve transparency, responsiveness and efficiency in the delivery of these services. The adoption and use of digital technologies provides a number of obvious benefits in this regard and the digitalisation of public services has been a constant item on the agenda of policymakers for over a decade.

The potential benefits generated by the adoption of digital public services have become even more visible during the Covid-19 pandemic when the public were forced to move much of their daily activities online due to restrictions put in place to contain the spread of the virus (European Commission, 2020). In this context, any service that was not online was not accessible, so public organisations were forced to accelerate the adoption of digital technologies and to find more innovative uses of existing e-Government solutions to manage the crisis (United Nations, 2020).

The remainder of this chapter defines digital public services and discusses the benefits and the existing challenges for the implementation of these services in the rural context. Three main types of public services, namely e-Government, e-Health and open data, are then discussed together with extant attempts to measure their adoption and use.

T. Lynn et al., *Digital Towns*,
https://doi.org/10.1007/978-3-030-91247-5_3

3.2 What Do We Mean by Digital Public Services?

Digital public services, often termed e-Government, refer to public services provided using digital technologies wherein the interaction with a public sector organisation is mediated by an IT system (Jansen & Ølnes, 2016; Lindgren & Jansson, 2013; Lindgren et al., 2019). While most of the focus around e-Government is on public service delivery, the concept of digital public services is broader than that, as it encompasses all interactions between citizens and public bodies.

Lindgren et al. (2019) discuss the impact of the digitalisation of public services from the perspective of the *public encounter* as conceptualised by Goodsell (1981). The public encounter is defined as "the interaction of citizen and official as they communicate to conduct business" (Goodsell, 1981, p. 4) and is characterised by four general aspects: (1) nature and purpose of the encounter, (2) the actors involved, (3) the communication form and setting in which the encounter occurs, and (4) the encounter's initiation, duration and scope. The shift from traditional to digital public services has an impact on all these characteristics of the encounter, as summarised in Table 3.1.

With regard to the nature of the encounter, digital technologies have mostly been adopted to mimic traditional paper-based processes (Heeks, 2006) and act as mediators of public services. This means that the technology is typically used to provide citizens with access to a public service but the technology does not deliver the service itself (Lindgren & Jansson, 2013). From the perspectives of communication and ease of access, this generates clear efficiencies. However most services still rely on human

Table 3.1 Summary of changes to the public encounter (adapted from Lindgren et al., 2019)

Characteristic	*Impact(s)*
Nature and purpose	Digitalisation facilitates the exchange of information and citizen self-service.
Actors involved	Digitalisation changes the role of actors involved and introduces new actors related to the technology.
Communication form and setting	Digitalisation provides additional communication channels. The setting changes from an official setting to (potentially) anywhere.
Initiation, duration and scope	Digitalisation enables 24/7 access to public services and changes citizens' expectations of government response time.

intervention, so the impact on the average lead time is marginal. Recent advancements associated with machine learning and artificial intelligence offer clear opportunities for seamless automated service provisioning and associated benefits in terms of shorter lead time and higher transparency (Wihlborg et al., 2016; Matheus et al., 2020). Automation may also introduce new risks. These are mostly related to the potential bias in the algorithms that could exclude specific groups of citizens from accessing a service (Wihlborg et al., 2016), and the introduction of new actors, technology providers, who are typically private institutions and multi-tenant in nature. As such, they are responsible for securing and maintaining multiple different service delivery platforms—thus introducing additional risks (Janssen & Klievink, 2009; Lindgren et al., 2019).

The adoption of digital technologies may also change how the provisioning of public services is initiated. In a traditional setting, one of the actors involved would initiate the encounter, but now the use of algorithms and predictive analytics may lead to proactive service provisioning based on a constant incoming data flow (Scholta et al., 2019). In this context, the definition of a start and an end point becomes blurry and potential concerns regarding government surveillance may arise. Furthermore, digital public services introduce a major change compared to the traditional public encounter with regard to *where* the service is actually accessed or provisioned. The fact that citizens can access digital services from a digital device instead of a physical public office provides obvious benefits but it is still unclear whether there may be negative outcomes associated with detaching public services from the traditional places of government (Pollitt, 2012).

Despite some concerns, some of which are briefly mentioned above, the increasing adoption of digital public services promises to deliver enormous benefits for both public organisations and citizens. This promise however is based on two major assumptions. First that citizens will have equal and widespread access to the Internet, and second that they will possess the skills required for interacting with public bodies online (Pors, 2015; Williams et al., 2016; Almeida et al., 2019; Lindgren et al., 2019). Previous studies suggest that e-Government initiatives can be hindered by the digital divide and even contribute to it in some cases (Ebbers et al., 2016). Bélanger and Carter (2009), for example, demonstrate that demographic factors such as income, education and age have a significant impact on the intentions of citizens to use e-Government services. This is mostly related to the so-called “access divide” where specific cohorts of the

population have access to the Internet and digital services while others do not. While enabling widespread access to connectivity has traditionally been one of the main objectives of public and private initiatives (Salemink et al., 2017), research suggests that the physical access divide has evolved into a skills divide where citizens' ability to use the internet and online search experience represents a key determinant of adoption and use of online public services (Bélanger & Carter, 2009; Van Deursen & Van Dijk, 2011). This is particularly important in rural areas as they are typically characterised by lower than average levels of education and skills (Salemink et al., 2017) and may therefore be left behind when governments pursue greater digital provision of public services (Van Deursen & Van Dijk, 2011; Ebbers et al., 2016).

3.3 E-Government

A number of frameworks have been proposed to measure the maturity and sophistication of e-Government solutions. An early framework was that proposed by Layne and Lee (2001) comprising four main stages:

1. Cataloguing: government information is made available on a publicly accessible website.
2. Transaction: as the level of sophistication of both government and users evolves, digital channels become another way for citizens to access public services and seek to utilise them. Citizens begin to demand that government requirements can be fulfilled online.
3. Vertical integration: at this stage, the focus is on transforming government services instead of just digitising existing processes.
4. Horizontal integration: databases across different government departments or functional areas communicate with each other so that information obtained by one department propagates to other functions.

One of the most referenced follow-up frameworks to Layne and Lee (2001) is that adopted by the United Nations Global e-Government Survey (United Nations, 2003). First presented in the early 2000s, like Layne and Lee's (2001), the UN model comprises four stages:

1. Emerging: this stage is somewhat comparable to Cataloguing in Layne and Lee (2001) as the government simply provides information to citizens via digital means.

2. Enhanced: basic one-way or two-way communication between citizens and government is introduced at this stage.
3. Transactional: services can be requested and delivered via digital means through forms.
4. Connected: governments engage in cross-agency integrative services using multiple technologies and platforms.

As Heeks (2015) points out, maturity models are a product of their time and are often context-related. In fact, these initial frameworks are mostly focused on technology adoption reflecting the early stage of development of Internet technologies at the time and are not particularly concerned about the real impact, use, and usefulness of e-Government solutions (Kawashita et al., 2020). Similarly, these initial models are quite rigid and are not able to take into account changing requirements, conditions and developments related to contextual or technological changes (Bertot et al., 2016). A number of frameworks have tried to overcome such limitations by using a variable number of maturity levels which makes a direct comparison quite difficult. Table 3.2 provides a summary and comparison of these models.

The EU eGovernment Framework Benchmark (European Commission, 2020) departs from the concept of *maturity*. Rather, it "is built on the foundation of the EU policy priority areas in the field of e-Government" (van der Linden et al., 2020, p. 8)—user empowerment, preconditions and the digital single market—and translates them into four key dimensions:

1. User centricity: the extent to which information and services are available, supported and compatible with mobile devices.
2. Transparency: the extent to which service processes are transparent and co-designed with users, and users can access and manage their personal data.
3. Key enablers: the extent to which main IT enablers such as, electronic IDs, eDocuments and security are available to users. The presence of these enablers can be used to assess the technical pre-conditions for the efficient and effective use of online services.
4. Cross-border services: the extent to which online information and services are integrated with eIDs and eDocuments for users from other European countries.

Table 3.2 e-Government maturity models (adapted and extended from Kawashita et al., 2020)

	Underlying concepts						
Source/ Stages	*Presenting information*	*Interaction*	*Transaction*	*Integration*	*Transformation*	*e-governance*	*Policy driven e-governance*
Layne and Lee (2001)	Cataloguing	Transaction		Vertical integration	Horizontal integration		
Hiller and Bélanger (2001)	Information	Two-way communication	Transaction	Integration	Participation		
United Nations (2003)	Emerging	Enhanced	Transactional	Connected			
Siau and Long (2005)	Web presence	Interaction	Transaction		Transformation	e-democracy	
Persson and Goldkuhl (2005)	Integration in services				Integration of services		
Shahkooh et al. (2008)	Online presence	Interaction	Transaction	Fully integrated/transformed e-Government		Digital democracy	
Kim and Grant (2010)	Web presence	Interaction	Transaction	Integration	Continuous improvement		
Lee (2010)	Presenting	Assimilating	Reforming		Morphing	e-governance	
Fath-Allah et al. (2014)	Presence	Interaction	Transaction	Integration			

Janowski (2015)	Digitisation				Transformation	Engagement	Contextualisation
Almuftah et al. (2016)	Presence	Communication	Full integration				
Nielsen (2016)	Presenting	Assimilating	Reforming		Morphing	e-governance	
Iannacci et al. (2019)	Rhetorical intention	Strategic planning	Systems development	Integration	Transformation		

Furthermore, most indicators included in the EU eGovernment Framework Benchmark are collected by "mystery shoppers" who are "trained and briefed to observe, experience, and measure a service process by acting as a prospective user" (van der Linden et al., 2020, p. 15). As such, the EU framework represents a shift from supply-side maturity (government) to demand-side experience (citizens).

This user-centricity is also reflected in the UN e-participation index which emphasises citizen participation as the cornerstone of socially inclusive governance. As such, it focuses on the provision of information by governments to citizens ("e-information sharing"), interaction with stakeholders ("e-consultation"), and engagement in decision-making processes ("e-decision making") (UN, 2021). Links to additional information on selected indicators are provided in the Useful Links section at the end of the book.

3.4 E-Health

The e-Government maturity frameworks presented in the previous section consider digital public services in their entirety, as if they represent an homogenous group of services delivered by public organisations. In reality though, public services are not all the same and some are more suitable for digital interaction/delivery than others (Lindgren et al., 2019). Among all public services, healthcare is arguably one of the most important for citizens. Unsurprisingly, e-Health has been on the agenda of policy makers for a long time and has been the focus of a number of digitisation initiatives (Domenichiello, 2015).

e-Health can be defined as "the use of Information and Communication Technologies (ICT) across the whole range of healthcare functions" (European Commission, 2004) and comprises a wide range of applications that can benefit citizens, healthcare professionals and organisations, and public authorities by improving medical practices, simplifying the prescription of diagnostic procedures, producing alerts and reminders, and reducing errors (Bodell et al., 2004; Delpierre et al., 2004; Kaushal et al., 2006; Øvretveit et al., 2007). Cowie et al. (2016) summarise these domains as follows:

- Telemedicine and telecare: disease management services, remote patient monitoring, teleconsultations, and homecare.

- Clinical information systems: electronic health and medical records (EHR) and Computerised Decision Support Systems (CDSSs).
- Integrated regional and national information networks and associated electronic referrals and prescriptions (e-prescribing).
- Disease registries and other non-clinical systems: systems used for education, public health, patient/disease-related behaviour, and healthcare management.
- "Mobile" health (m-health): medical and public health practice supported by mobile technologies delivering health information, screening patients, monitoring physiological signs, providing direct care and patient education.
- 'Personalised' health (p-health): wearable or implantable micro and nano-technologies with sensors and/or therapy delivery devices to help facilitate health and social care decision making and delivery.
- Big Data: large-scale integration and analysis of heterogeneous data sources, usually of high volume, velocity, and variety, ideally linked at the individual person level to provide a more holistic view of a patient/individual and shed light on social and environmental factors that may influence health.

Even before the Covid-19 pandemic, healthcare systems were already facing significant pressure due to increasing demand and costs, inconsistent quality of care, and inefficient, poorly coordinated processes. As the population in developed countries becomes older, questions have been raised regarding the sustainability of traditional healthcare systems. In the European Union, for example, public health expenditure is expected to represent 8.5% of GDP by 2060, a 16% percent increase compared to 2010 (European Commission, 2012b).

More pervasive use of ICT in healthcare has been proposed as a way to overcome these challenges (WHO, 2016). At a macro level, studies suggest that e-Health solutions can result in significant improvements in terms of system productivity, ease of access, and quality of service (Hackett et al., 2019). Successful implementations seem to support this argument. Canada, for example, launched its first eHealth plan in 2001 (Canada Health Infoway, 2021); current estimated savings amount to approximately CAD 119–150 million per annum with a concurrent increase in service quality (Hackett et al., 2019). In an attempt to achieve similar results, the European Commission issued a first eHealth action plan in 2004, followed by a revised version issued in 2012 (European

Commission, 2012a). The main objective of these plans was to increase the adoption of e-Health across different countries but this has proved to be challenging mostly due to lack of awareness of e-Health services, interoperability issues, legal barriers, and high start-up costs (European Commission, 2012a).

General practitioners (GPs) play a central role in facilitating access to and delivery of care as they represent the main point of contact between the healthcare system and citizens, particularly in rural areas (Macinko et al., 2003; Atun, 2004). As such, they are in a position to gather important information which would constitute the basis of an IT-enabled integrated healthcare system (European Commission, 2013). For this reason, the EU mostly focuses on the adoption of e-Health services such as electronic prescriptions (e-prescribing) and data exchanges by GPs when it comes to measuring the digitalisation of healthcare across different countries. However, other actors like pharmacies and specialised health professionals (e.g. physiotherapists, dentists, psychiatrists etc.) may also play a critical role in fostering the adoption of eHealth services within communities (Gregorio et al., 2013; Vorrink et al., 2017; Baines et al., 2018).

Digital Economy and Skills Unit (2018, 2019) represent one of the first attempts to include an explicit measure of e-Health adoption in the context of digital public services. However, the framework only includes three indicators—i.e. e-prescription, online consultations, and use of electronic medical data exchange—and results are only presented at a country level so it does not have the necessary level of granularity to assess adoption across different regions or in rural areas. This may ultimately be due to the difficulty of collecting timely data, as the exclusion of e-Health indicators from Digital Economy and Skills Unit (2020) seems to suggest.

3.5 Open Data

Another aspect of digital public services that is often not considered explicitly is the availability of open government data (OGD). This involves making public sector information (PSI) freely available in open formats and ways that enable public access and facilitate exploitation (Kalampokis et al., 2011). The main benefits of open data are summarised in Table 3.3 It is important to note that open data on its own has little intrinsic value, as value is only created by its use (Janssen et al., 2012).

PSI is a strategic resource that can generate benefits for a number of actors (Ubaldi, 2013) including:

Table 3.3 Overview of benefits of open data (Janssen et al., 2012)

Category	*Benefits*
Political and social	• More transparency; • Democratic accountability; • More participation and self-empowerment of citizens (users); • Creation of trust in government; • Public engagement; • Scrutinisation of data; • Equal access to data; • New governmental services for citizens; • Improvement of citizen services; • Improvement of citizen satisfaction; • Improvement of policy-making processes; • More visibility for the data provider; • Stimulation of knowledge developments; • Creation of new insights in the public sector; • New (innovative) social services.
Economic	• Economic growth and stimulation of competitiveness; • Stimulation of innovation; • Contribution toward the improvement of processes, products, and/or services; • Development of new products and services; • Use of the wisdom of the crowds: Tapping into the intelligence of the collective; • Creation of a new sector adding value to the economy; • Availability of information for investors and companies.
Operational and technical	• The ability to reuse data/not having to collect the same data again and counteracting unnecessary duplication and associated costs (also by other public institutions); • Optimisation of administrative processes; • Improvement of public policies; • Access to external problem-solving capacity; • Fair decision-making by enabling comparison; • Easier access to data and discovery of data; • Creation of new data based on combining data; • External quality checks of data (validation); • Sustainability of data (no data loss); • The ability to merge, integrate, and mesh public and private data.

- Governments: open data provides the scope for faster decision-making, better resource allocation and efficient, and effective delivery of more personalised public services.

- Citizens: open data enables public participation and social engagement which may ultimately lead to service co-development.
- Civil society: civil society initiatives that leverage open data may have a wide range of objectives but they generally tend to focus on the vulnerable segments of the population.
- Economic actors: by making more information available, open data can stimulate a competitive marketplace for both public and private sector services. Competition may result in a higher innovation rate and benefits for the overall economy.

The total direct economic value of PSI is expected to increase from a baseline of €52 billion in 2018 for the EU28 to €194 billion in 2030 (Barbero et al., 2018) and a similar trend can be expected in other economies. There are a number of initiatives that track open government data initiatives worldwide such as the Global Open Data Index[1] and the OECD OURdata Index.[2] However, these frameworks present information at a country level, providing little room for identifying more local initiatives that take place in rural areas. Walker et al. (2020) clearly show that rural open data has a massive economic potential but it is often overlooked by government policies due their focus on smart cities and urban areas.

3.6 Measuring Digital Public Services

As noted earlier in Sect. 3.3, there is a wide range of frameworks for measuring e-Government and the use of digital technologies by the public services. The recent G20 Digital Economy Task Force roadmap for measuring the digital economy specifically includes the government as a producer and consumer of economic activity reliant on or enhanced by the use of digital inputs (G20 DETF, 2020). Notwithstanding this, the inclusion of specific public service indicators in international frameworks and composite indices is limited (see Table 3.4).

[1] https://index.okfn.org
[2] https://www.oecd.org/gov/digital-government/open-government-data.htm

Table 3.4 Selected international e-Government measurement frameworks and composite indices

Framework	*Description*	*Source*
Digital Economy & Society Index (DESI)	Includes a specific eGovernment dimension that measures: 1. e-Government users 2. Pre-filled forms 3. Online service completion for major life events 4. Digital public services for businesses	Digital Economy and Skills Unit (2018, 2020, 2021)
Digital planet—digital evolution index	In the Institutional Environment theme, government uptake and use of ICT is measured.	Chakravorti et al. (2015)
G20 toolkit for measuring the digital economy	Includes one indicator in the empowering society theme regarding individuals using the internet to interact with public authorities.	G20 Digital Economy Task Force (2018)
Partnership on measuring ICT for development	Includes 7 indicators in an ICT in government theme covering: • Employment (2) • Government internet and network access (3) • Web presence (1) • Selected internet-based online services available to citizens by level of sophistication of service (1)	ITU (2016)

Where public services are included in international frameworks and composite indices, they are limited to three main themes—access, employment, and use. It is worth noting that access in this context focuses on the access by the public as opposed to government itself (Table 3.5).

E-health is rarely included as a discrete segment in international frameworks and composite indices on the digital economy or digital society. Where it is included, it is typically included in the context of measuring individual or household access and use of the Internet. For example, the Partnership on Measuring ICT for Development utilizes data on individuals and households using the Internet to seek health information or make an appointment with a medical practitioner (ITU, 2016). In addition to similar indicators on usage, DESI has previously reported on the availability of e-prescriptions and online medical consultation (DESU, 2018). National data on individual and household use of the Internet for health purposes is available through a variety of sources including Eurobarometer, Eurostat and the ITU.

Table 3.5 Themes measured in international digital society and digital economy measurement frameworks and composite indices and indicative benchmark data sources

Themes	*Description*	*Selected international benchmark data sources*
Access	Availability and access to public services online within a country and abroad.	EU eGovernment Benchmarking Report (European Commission, 2020); Eurostat; ITU
Employment	Employment in the government roles using ICT.	Eurostat, ILO labour force surveys; OECD structural analysis (STAN) database; ITU
Use	Availability, intensity and patterns of digital technology use by citizens and businesses to interact with the government.	EU eGovernment Benchmarking Report (European Commission, 2020); Eurostat

Other than DESI, open data is not included in any other major international framework on the digital society or digital economy. DESI measures the maturity of open data in a given country based on:

- Open data readiness: the extent to which countries have an open data policy in place, licensing norms, and the extent of national coordination regarding guidelines and setting common approaches.
- Portal maturity: the portal's usability regarding the availability of functionalities, the overall re-usability of data such as machine readability and accessibility of datasets, as well as the spread of data across domains.

Data on open data maturity is available from the European Data Portal.[3]

3.7 Conclusion

Public services underpin economic activity and are essential for the functioning of society. Despite this, public service delivery has historically been inefficient and, for many, lacks sufficient accessibility—particularly for those in rural and remote areas. The adoption and use of digital

[3] https://data.europa.eu/en/impact-studies/open-data-maturity

technologies can generate substantial benefits in this context by making services more accessible, convenient and efficient. A large number of initiatives have been put in place by national governments to provide public services via digital channels. In line with these initiatives, a similarly large number of maturity frameworks to classify these initiatives have been proposed. Unfortunately, many of these lack commonality or do not address relatively smaller towns and rural communities. As a consequence, very little is known about the adoption and use of digital public services at a rural or municipal government level. It would seem that even for digital public services, an urban-rural digital divide remains.

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CHAPTER 4

The Digital Economy and Digital Business

4.1 Introduction

Small and rural communities face greater challenges than metropolitan areas in generating economic growth. In addition to access to physical and industrial resources and global market competition, rural communities face further obstacles due to their distance from urban centres, low population levels, and associated low population density (OECD, 2014; Liu, 2021). These factors result in significant differences in the attributes of rural economies compared to urban areas; with rural communities characterised by employment in services and manufacturing (often limited to consumer and basic producer services, and either small scale and/or relatively unsophisticated manufacturing), low skilled and ageing workforces, and low levels of innovation and productivity (OECD, 2014; Liu, 2021). In some areas, these factors are exacerbated by geographic impediments such as unfavourable climate and topographies (Freshwater, 2018). While small and medium-sized enterprises (SMEs) represent approximately 90% of businesses and more than 50% of employment worldwide (World Bank, 2021), in rural areas, the vast majority of firms are SMEs or, more precisely, micro-enterprises (i.e., firms with less than ten employees). These companies are traditionally reliant on external markets for their growth but at the same time face greater challenges than their urban counterparts such as more limited access to finance, labour shortages, and higher transport costs to external markets (Freshwater et al., 2019).

T. Lynn et al., *Digital Towns*,
https://doi.org/10.1007/978-3-030-91247-5_4

Digital technologies present rural enterprises with the opportunity to overcome the constraints of their location. The commercial benefits generated by these technologies such as websites, e-commerce, digital marketing and advertising, and social media for enterprises in general, and for SMEs in particular, are clear and have been documented by a large number of studies (see, for example, Walczuch et al., 2000; Mehrtens et al., 2001; Jones et al., 2003; Claffey & Brady, 2014; Tiago & Verissimo, 2014; Jeansson et al., 2017). However, recent research suggests that there exists a digital divide between urban SMEs and rural SMEs in terms of adoption of digital technologies and digital business practices (Richmond et al., 2017). Furthermore, micro-enterprises are often under-represented in official statistics (see, for example, Digital Economy Skills Unit, 2020) therefore making it difficult for policymakers to make informed and effective decisions to close the digital divide in rural communities by both enterprises and individuals. At the same time, the OECD, amongst others, believe that rural areas should drive their own economic development rather than rely on national government, specifically with respect to identifying and mobilising assets to improve economic performance (OECD, 2014). This being in the case, more local and granular data and indicators are needed to guide such local bottom up strategies.

The remainder of this chapter defines the digital economy and digital business and discusses the differences between the two. This is followed by a discussion of the benefits and challenges in adoption and use of digital technologies by enterprises, with an emphasis on SMEs and rural SMEs. The chapter concludes with a discussion of international frameworks and composite indices for measuring the evolution and development of digital technology adoption and use by businesses.

4.2 What Is the Digital Economy?

The digital economy, as a phenomenon, is relatively recent, particularly in developing countries and rural areas (World Economic Forum, 2015) even though the technological underpinnings of the digital economy started to be laid out in the 1990s with the initial adoption of enterprise computing and computerised manufacturing (Sturgeon, 2021). The advent of the Internet in the early 2000s represented a stepping stone toward the digital economy as we know it today. The widespread organisational adoption of the Internet has enabled the development and adoption of a number of technologies and services that are at the core of the digital economy. A number of definitions of digital economy have been proposed over time. However, as Bukht and Heeks (2017, p. 4) put it, “definitions are always a

reflection of the times and trends from which they emerge" and therefore need to adapt as the technological landscape and users' sophistication and knowledge evolve. Table 4.1 provides an overview of how the definition of digital economy has evolved since the early 2000s.

Table 4.1 Selected definitions of digital economy (adapted from Bukht and Heeks, 2017)

Source	*Definition*
Brynjolfsson and Kahin (2000, p. 2)	"[…] the recent and largely unrealised transformation of all sectors of the economy by the computer-enabled digitisation of information".
Kling and Lamb (2000, p. 297)	"[…] includes goods or services whose development, production, sale, or provision is critically dependent upon digital technologies".
OECD (2013, p. 1)	"The digital economy enables and executes the trade of goods and services through electronic commerce on the internet".
Department of Broadband, Communications and the Digital Economy (2013, p. 128)	"The global network of economic and social activities that are enabled by digital technology, such as the internet and mobile networks".
European Commission (2013, p. 2)	"[…] an economy based on digital technologies (sometimes called the internet economy)".
House of Commons (2016, p. 4)	"The digital economy refers to both the digital access of goods and services, and the use of digital technology to help businesses".
G20 Digital Economy Task Force (2016, p. 1)	"[…] a broad range of economic activities that include using digitised information and knowledge as the key factor of production, modern information networks as an important activity space, and the effective use of information and communication technology (ICT) as an important driver of productivity growth and economic structural optimisation".
Knickrehm et al. (2016, p. 2)	"The digital economy is the share of total economic output derived from a number of broad 'digital' inputs. These digital inputs include digital skills, digital equipment […] and the intermediate digital goods and services used in production. Such broad measures reflect the foundations of the digital economy".
Dahlman et al. (2016, p. 11)	The digital economy is the amalgamation of several general purpose technologies […] and the range of economic and social activities carried out by people over the internet and related technologies. It encompasses the physical infrastructure that digital technologies are based on (broadband lines, routers), the devices that are used for access (computers, smartphones), the applications they power (Google, salesforce) and the functionality they provide (IoT, data analytics cloud computing)".

(*continued*)

Table 4.1 (continued)

Source	*Definition*
Pratt (2017)	"The digital economy is the worldwide network of economic activities enabled by information and communication technologies (ICT). It can also be defined more simply as an economy based on digital technologies".
Bukht and Heeks (2017, p. 13)	"[…] that part of the economic output derived solely or primarily from digital technologies with a business model based on digital goods or services".
G20 DETF (2018, p. 25)	"[the] digital economy is characterised by connectivity between users and between devices, as well as the convergence of formerly distinct parts of communication ecosystems such as fixed and wireless networks, voice and data, and Telecommunications and broadcasting".

As can be seen from Table 4.1, extant definitions of the digital economy vary significantly in terms of scope highlighting a clear lack of agreement around what should be included in or excluded from the digital economy. The G20 Digital Economy Task Force has been active in proposing a common definition for the digital economy, reviewing and proposing new measurement frameworks and composite indicators for the digital economy. For the G20 Digital Economy Task Force (2020, p. 114), the digital economy is defined as:

> All economic activity reliant on, or significantly enhanced by the use of digital inputs, including digital technologies, digital infrastructure, digital services and data. It refers to all producers and consumers, including government, that are utilising these digital inputs in their economic activities.

This definition was designed to allow for a flexible approach to measurement including top down and bottom up approaches. Echoing Bukht and Heeks (2017), it allows for a flexible and gradated definition of the digital economy across three tiers (Fig. 4.1):

1. The core measure of the digital economy—economic activity from producers of ICT goods and ICT information services.
2. The narrow measure of the digital economy—the core sector plus economic activity derived from firms that are reliant on digital inputs.

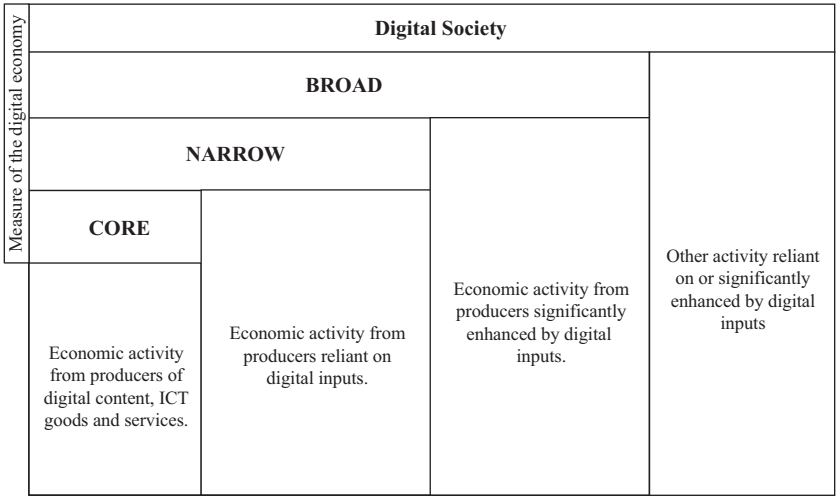

Fig. 4.1 Tiered definition of the digital economy. (Adapted from G20 Digital Economy Task Force, 2020)

3. The broad measure of the digital economy—the first two measures plus economic activity from firms significantly enhanced by the use of inputs.

Furthermore, the G20 Digital Economy Task Force recognise that other parts of the digital society perform digital interactions and activities that add value and impact the economy, which while not strictly part of a digital economy, are important for economic and regional development policies, amongst others (G20 Digital Economy Task Force, 2020).

4.3 What Is Digital Business?

SMEs are arguably the backbone of the economy in many countries and often represent a catalyst for economic growth. This is particularly the case in rural communities where rural enterprises provide a key contribution to local economic and social resilience, and influence the life of rural communities in both direct and indirect ways (Eachus, 2014; Steiner &

Atterton, 2015). Direct effects include more obvious benefits such as the creation of local employment and local product/service availability (Eachus, 2014). Indirect effects are somewhat less visible and yet extremely beneficial for rural communities (Bruce et al., 2006). These include, for example, a reduced risk of migration toward urban areas thanks to local employment opportunities and the development of a more active and higher value local economy that leads to higher quality of life (Hegney et al., 2008).

Unsurprisingly, SME support and rural development are constant items on the agenda of policy makers (Bennett, 2008; Mole et al., 2011; Skerratt & Steiner, 2013; Lyee & Cowling, 2015) however the level of sophistication and effectiveness of such interventions varies depending on their geographical location (European Commission, 2019; Phillipson et al., 2019). In fact, the evidence suggests that despite rural SMEs being comparable to (if not better than) their urban counterparts in terms of longevity, exports and economic growth, they receive significantly less attention and support than urban SMEs (Phillipson et al., 2019).

Some of the challenges affecting rural enterprises may be similar to those faced by urban SMEs but others are typical of rural environments. These challenges can be summarised in the following five categories (Interreg Europe, 2020):

1. Digital infrastructure: rural communities typically lag urban areas in terms of connectivity and this may lead to a digital divide between urban SMEs and rural SMEs in terms of the adoption of digital technologies (Richmond et al., 2017).
2. Access to finance: while access to finance is a known challenge for SMEs due to their limited collateral, this issue is particularly accentuated in rural areas where there is a general shortage of alternatives to bank financing. In fact, investors tend to focus on high-growth SMEs/start-ups which are typically located in urban areas. The vast majority of enterprises in rural areas are small with no, low or average growth rates. These are less attractive for investors but at the same time contribute significantly to regional and national growth (Freshwater et al., 2019).
3. Skills: skilled talent tends to be clustered around universities which are typically located in urban areas. Therefore, it is significantly harder for rural SMEs to attract skilled individuals and this ultimately may nega-

tively impact the ability of rural enterprises to innovate and grow (Phillipson et al., 2019).
4. Seasonal challenges: rural SMEs are typically less diversified in their economic activities therefore seasonal changes such as an inconsistent influx of seasonal customers/workers throughout the year may make it more difficult for local businesses to grow.
5. Access to new markets: rural enterprises rely on external markets to grow due to the limited size of their local markets. Entering new markets though can be particularly challenging for rural enterprises due to geographical and/or infrastructural barriers.

The roll out of connectivity infrastructure in rural areas is mostly being driven by national governments (Salemink et al., 2017). However, merely providing the infrastructure is not sufficient to make an impact. Adoption and actual usage are the next steps that need to be taken for digital connectivity to have an impact on rural communities in general and businesses in particular (Hage et al., 2013). The adoption of digital technologies could mitigate all the other challenges presented above by facilitating entry into new markets, providing access to training and skills, and ultimately by enabling growth (Price et al., 2018).

The adoption of infrastructure for digital connectivity is also a necessary prerequisite for enabling digital business practices in rural enterprises. Digital business is a relatively new concept and in the academic literature it is often referred to as e-business or electronic commerce. A number of different definitions of e-business have been proposed over time and are presented in Table 4.2.

Most definitions link digital business to the use of Internet technologies or mobile technologies, while others (e.g., Rayport & Jaworski, 2001) provide a technology-agnostic definition of e-business. A common trait across these definitions is the transactional nature of e-business. However, digital business is much broader than transaction-based commerce conducted via digital means (Chaffey et al., 2019). Chaffey et al. (2019, p. 15) define digital business as "how businesses apply digital technology and media to improve the competitiveness of their organisation through optimising internal processes with online and traditional channels to market and supply". As such, digital business is not only limited to buying and selling online but it encompasses a range of processes and activities enabled by digital technologies that aim to integrate the digital and physical worlds (Gartner, 2021).

Table 4.2 Selected definitions of e-business (adapted from Wirtz, 2019)

Definition	*Source*
Technology-mediated exchanges between parties (individuals, organisations, or both) as well as the electronical based intra- or inter-organisational activities that facilitate such exchange.	Rayport and Jaworski (2001)
The use of electronic means to conduct an organisation's business internally and/or externally.	Jelassi and Enders (2005)
Business that is conducted using electronic networks or electronic media. Sometimes used synonymously with e-commerce and sometimes used more widely to include other business activities in addition to buying and selling.	Chen (2005)
The conduct of automated business transactions by means of electronic communications networks (e.g., via the internet and/or possibly private networks) end-to-end.	Papazoglou and Ribbers (2006)
All electronically mediated information exchanges, both within an organisation and with external stakeholders supporting the range of business processes.	Chaffey (2007)
The use of internet, the world wide web (web) and mobile Apps to transact business.	Laudon and Traver (2013)
All business activities that use internet technologies. Internet technologies include the internet, the world wide web and other technologies such as wireless transmissions on mobile telephone networks.	Schneider (2017)

Digital business definitions rarely distinguish between mainstream and frontier technologies, however by and large they focus on the former. Frontier technologies represent a significant opportunity for businesses with some market estimates as high as US$3.2 trillion by 2025 (UNCTAD, 2021). The adoption of such technologies is not uniform. For example, the finance and manufacturing sectors were early adopters of AI, IoT, big data and blockchain, and the US and China dominate frontier technology supply (UNCTAD, 2021). While the opportunity for frontier technologies for economies is significant in terms of jobs and expenditure, capacity to exploit these technologies depends heavily on human capital, access to finance, and other structural factors to support scale (UNCTAD, 2021). Unfortunately, these are less likely to be found in rural communities (UNCTAD, 2021).

Finally, it must be noted that some commentators suggest that it is important to differentiate between (1) businesses that make *extensive* use

of digital technologies (their existence depends on digital technologies), and (2) businesses that make *intensive* use of digital technologies (applying digital technology to enhance their productivity) (Bukht & Heeks, 2017). Consequently, one can conceptualise the adoption and use of digital technologies across a spectrum of competencies, from core and distinctive to common and subordinate as per Fig. 4.1.

4.4 Benefits and Challenges of Digital Technologies for Businesses

Digital business leverages a wide range of digital technologies including website technologies, digital advertising, social media and social commerce, email marketing, mobile and e-commerce, and analytics, amongst others. The emergence of cloud computing in particular provides SMEs with the opportunity to outsource their technology infrastructure to support their web operations therefore providing greater reliability and scalability (Trigueros-Preciado et al., 2013; Leimbach et al., 2014). Similarly, the availability of user-friendly digital advertising platforms and content management systems (CMS) with support for mobile responsive themes has resulted in websites that are easy to navigate on both desktop and mobile devices therefore providing users with a more seamless experience. These technologies can support a range of commercial objectives including information dissemination and exchange (Daniel et al., 2002; Jeansson et al., 2017), demand generation (Jones et al., 2015; Richmond et al., 2017), sales (Drew, 2003; Jones et al., 2015; Jeansson et al., 2017; Tiwasing, 2021), and customer relationship management (McCann & Barlow, 2015; Richmond et al., 2017).

The potential benefits of digital technologies to SMEs are well-established. These include, reductions in distance-related barriers (Walczuch et al., 2000; Sinkovics & Sinkovics, 2013), cost savings and operational efficiency (Walczuch et al., 2000; Trigueros-Preciado et al., 2013), IT resilience and scalability (Trigueros-Preciado et al., 2013; Leimbach et al., 2014), easier access to new markets (Walczuch et al., 2000; Jones et al., 2003; Pergelova et al., 2019), marketing effectiveness (Jones et al., 2015), customer service and engagement (Claffey & Brady, 2014), and market and customer intelligence (Tiago & Verissimo, 2014). From a strategic perspective, digital technologies can represent the basis for a competitive advantage for SMEs and enable them to compete with

larger firms (Mehrtens et al., 2001; Richmond et al., 2017). Despite the wide range of benefits provided by digital technologies, SMEs continue to lag in terms of adoption and usage when compared to their larger counterparts, particularly with regard to the adoption of more sophisticated technologies (OECD, 2021). This is due to a number of reasons including difficulty accessing skills and skilled resources, perceived risk associated with greater investment to adopt and support more advanced technologies (McDowell et al., 2016), or security (Trigueros-Preciado et al., 2013; Leimbach et al., 2014).

The digital divide between urban and rural communities has been a focus of research for a number of years (Hindman, 2000; Townsend et al., 2013; Philip et al., 2017; OECD, 2021). However, the divide between urban and rural SMEs in general and micro-enterprises in particular has not attracted the same level of interest from researchers. Previous studies reported relatively low broadband access, website and social media use by rural SMEs in developed countries (Michaelidou et al., 2011; Daun & Muessig, 2012; Townsend et al., 2013). More recently, Richmond et al. (2017) found that, while broadband access has become more widespread in rural communities, rural SMEs still lagged urban SMEs in online marketing practices, website sophistication, and e-commerce and social media usage.

The need for more widespread adoption of digital technologies by rural SMEs has become even more evident since the breakout of the COVID-19 pandemic and the associated disruption of the normal operations of businesses worldwide. In fact, SMEs have been disproportionately impacted by the restrictions put in place by national governments in order to contain the spread of the virus (OECD, 2021). This is because SMEs (1) are over-represented in sectors that have been impacted by lockdowns, (2) have lower productivity and weaker supply chain capabilities, (3) are more fragile than large firms from a financial perspective due to limited cash reserves, and (4) typically lack the managerial capabilities to navigate through the evolving challenges presented by the pandemic (Bartik et al., 2020; Cowling et al., 2020; Humphries et al., 2020; OECD, 2021). Despite the large number of initiatives launched by different governments to promote and support digitalisation, innovation and technology development, upskilling and reskilling, and finding new alternative markets for SMEs (OECD, 2021), a large number of SMEs reported making significant layoffs during the COVID-19 pandemic, and expect that it could take up to two years for them to recover (Bartik et al., 2020; Humphries

et al., 2020). Rural SMEs are likely to be more adversely affected due to their less diversified economic activity, disproportionate reliance on local markets, disruption to national and international supply chains and, as mentioned above, their lower adoption and use of digital technologies (Richmond et al., 2017; OECD, 2020).

Against the backdrop of COVID-19, the pandemic has contributed to a significant acceleration of digital initiatives and may lead to a radical change in consumer behaviour (Guo et al., 2020; McKinsey, 2020; Riom & Valero, 2020). Such a change may represent an opportunity for businesses (Klein & Todesco, 2021) so it is crucial for rural SMEs to be fully equipped to fully seize this opportunity.

4.5 Measuring Digital Business

As is evident from Chap. 1, there is a large number of measurement frameworks and composite indices for measuring digital business, typically labelled under the 'Digital Economy'. Not only do these include frameworks specific to the digital economy but those seeking to measure the evolution and development of the Digital Society e.g., DESI (Digital Economy and Skills Unit, 2020). The proliferation of these frameworks is largely due to the priority given to economic research and the availability of data at a national level.

There are a wide range of digital economy indicators included in extant frameworks and composite indices. These can be categorised into a number of major themes as per Table 4.2; links to sources and indicators can be found in the Useful Resources section at the end of the book. The majority of the indicators that compose digital economy indices are sourced from national sources and statistics and are aggregated by a variety of sources for international comparison as indicated in Table 4.3. Data for a specific rural town and environs may not be available at a national level depending on the methodology employed for data collection. Furthermore and as discussed in Chap. 1, such statistics may only include enterprises with more than ten employees. As a result, micro-enterprises, that make up the bulk of rural SMEs, may not be included. Furthermore, extant measures typically do not include new paradigms and business models enabled by digital technologies such as the so-called 'sharing economy' and 'gig economy'. Measuring these activities is more difficult as traditional sources of national statistics may not probe sufficiently to uncover such work arrangements, workers may not consider these

Table 4.3 Common themes and selected international sources for digital business

Themes	*Description*	*Selected international benchmark data sources*
Access	Availability and access to digital technologies (incl. The internet) by workers where work occurs including home working.	EU Broadband Coverage in Europe Studies; EU Broadband Internet Access (BIAC) surveys; EU Communications Committee surveys; Eurostat, ITU World Telecommunication/ICT Indicators database; OECD Broadband portal; UNESCO Institute for Statistics
Digital competence, self-efficacy and skills of workforce	Workforce competence, self-efficacy and skills using different technologies and performing related tasks. Enrolment and graduates from ICT-related courses or fields.	Eurostat, EU Survey of Schools: ICT in Education, PISA, UNESCO Institute for Statistics, ILO Labour Force Surveys
Employment	Employment in the ICT sector and ICT occupations.	Eurostat, ILO Labour Force Surveys; OECD Structural Analysis (STAN) Database
Equity	Relative proportion of female employees in the ICT sector and in ICT occupations, and female ICT graduates in ICT-related fields.	Eurostat; ILO Labour Force Surveys, OECD Education database, UNESCO Institute for Statistics
Growth	Value added by information industries and digitally-intensive industries; ICT investment; ICT productivity growth; ICT and global value chains, ICT and digital deliverable services as a proportion of trade.	Eurostat; OECD Inter-Country Input-Output (ICIO) tables; OECD Trade in Value Added (TiVA) database; OECD Productivity Statistics database; UNCTAD Digital Economy database

(*continued*)

Table 4.3 (continued)

Themes	*Description*	*Selected international benchmark data sources*
Innovation & Technology	R&D in digital technologies; Government funding of business R&D and tax incentives for ICT-related R&D; Patents and trademarks granted for ICT-related products and services.	JRC-IPTS Reports on Public ICT R&D Expenditures; OECD Intellectual Property Database, OECD Main Science and Technology Indicators (MSTI) Database, OECD Analytical Business Enterprise Research and Development (ANBERD) database; OECD R&D Tax Incentives database; OECD Structural Analysis (STAN) Database
Use	Incidence, intensity and patterns of digital technology use by businesses and employees for selected technologies, to conduct business across borders, and to interact with public authorities.	Eurostat; ITU World Telecommunication/ ICT Indicators database; OECD Broadband portal

activities as their primary employment or even a job, or workers may not wish to report such activities for tax avoidance reasons (Riggs et al., 2019). Similarly, statistics based on the digital platforms that enable these activities may not be comprehensive, representative, or consistent over time (Riggs et al., 2019). Most international frameworks do not include evaluations of laws and regulations related to digital business, one would assume due to the difficulty in reducing these variables to a numeric indicator. That is not to say that such indicators do not exist. The World Bank Digital Business Indicators (Chen, 2019) includes indicators for data privacy and security (individual rights, cross-border data flows, and data security and enforcement) and digital market regulations (consumer protection, intermediary liability, and e-signatures). Similarly, Chakravorti et al. (2019) include a measurement of institutional barriers (wholesale foreign direct investment (FDI) regulatory restrictiveness indicator, anti-monopoly policy, and FDI regulations). In the context of rural towns, these are less important measurements in that local decision-makers do not typically have the requisite agency to effect change in laws and regulations.

Despite the wide range of indicators included in these frameworks, the extent to which they assess the penetration and the use of a comprehensive

and relevant range of technologies by businesses is limited. There are exceptions. DESI, the G20 Digital Economy Task Force, and the Partnership on Measuring ICT for Development all propose indicators using ICTs other than internet infrastructure and computer equipment (see Table 4.4), some of which can be inferred by activities reported. Furthermore, data on other relevant indicators may be collected but not used in these frameworks. For example, Eurostat's Digital Economy and Society Statistics includes data on computer-based tasks performed by individuals at work including e-mail, data entry, electronic document creation or editing, received tasks via apps, occupation-specific software, social media use for work purposes, and developed or maintained IT systems or software (Eurostat, 2021). This data can be used to infer digital technologies used by businesses.

4.6 Conclusion

The potential benefits of digital business technologies adoption for enterprises including SMEs are well established, and yet adoption and use by rural enterprises still lag their urban counterparts, particularly for more advanced technologies and sophisticated uses. This is an important differentiation as it is through leveraging emerging technologies that the

Table 4.4 Selected indicators for digital business in digital society and digital economy measurement frameworks and composite indices

Framework	*Description*	*Source*
Digital Economy & Society Index (DESI)	• Electronic Information Sharing • RFID • Social Media • eInvoices • Cloud computing • SMEs Selling Online • E-commerce Turnover • Selling Online Cross-border	Digital Economy and Skills Unit (2020)
G20 Toolkit for Measuring the Digital Economy	• Infrastructure for the Internet of Things using GSMA data • Secure server infrastructure • Sales via e-commerce • ICT goods as percentage of merchandise trade • ICT services as percentage of services trade	G20 Digital Economy Task Force (2018)

(*continued*)

Table 4.4 (continued)

Framework	*Description*	*Source*
Partnership on Measuring ICT for Development	• Computers • Internet • Web presence • Broadband • Intranet, extranet or local area network • Giving or receiving orders over the Internet • Sending or receiving email • Telephoning over the Internet/VoIP (voice over Internet Protocol), or using video-conferencing • Use of instant messaging, bulletin boards • Getting information about goods or services • Getting information from general government organizations • Interacting with general government organisations • Internet banking • Accessing other financial services • Delivering products online • Internal or external recruitment • Staff training	ITU (2018)

greatest benefits and opportunities may be realised. While policymakers have been mostly focused on connectivity, there are also a number of other reasons behind this digital divide that have partly been overlooked. These include, for example, limited access to finance and skilled resources that put rural enterprises in a disadvantaged position compared to urban enterprises, largely due to their size and location. There are a number of initiatives that aim to measure the level of adoption and sophistication of digital business technologies by SMEs but they tend to leverage secondary data that are only available at a national or regional level. These assessments are typically based on samples where rural SMEs and micro-enterprises are under-represented compared to urban SMEs due to information availability and ease of access. As such, any decision taken on the basis of aggregated statistics may ultimately widen the urban-rural divide even further.

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CHAPTER 5

Digital Technologies and Civil Society

5.1 Introduction

'Civil society' is a term increasingly used to refer to social institutions outside of the confines of households, the market and the state. Such social institutions are typically characterised by varying degrees of self-governance, voluntarism, and not-for-profit operation (Salamon et al., 1999). Civil society includes a wide range of voluntary, social and community organisations including charities, social and sports clubs, political parties, religious bodies amongst others (see Table 5.2). These civil society organisations (CSOs) often play an integral role in rural society providing an important underlying social fabric in a community and addressing issues that have not been satisfactorily addressed by the market or state. Like commercial and indeed government institutions, digital technologies have the potential to transform organisational capacity and stakeholder engagement in and with civil society institutions yet CSOs are rarely included in indices seeking to measure digital progress in society.

The remainder of this chapter defines civil society and discusses the role of CSOs in the context of rural communities. The opportunities and challenges for the digital transformation of CSOs are then discussed followed by a discussion of extant attempts to measure digital adoption and use by civil society.

5.2 Defining Civil Society

'The Third Sector', 'the independent sector', 'the nonprofit sector', and CSOs are just a few of the terms used loosely to refer to civil society (United Nations, 2003). In many respects there are broad and narrow

T. Lynn et al., *Digital Towns*,
https://doi.org/10.1007/978-3-030-91247-5_5

perspectives to defining civil society. Anheier et al. (2001, p. 21) define civil society as:

> the sphere of ideas, values, institutions, organizations, networks, and individuals located between the family, the state, and the market and operating beyond the confines of national societies, polities, and economies.

In this respect, they conceive civil society as a broad, global and somewhat abstract concept, which has been critiqued as lacking in rigor and precision (Taylor, 2002). In contrast, Salamon and Anheier (1998, p. 216) define civil society as a collection of entities that share five characteristics:

- organisations, i.e., institutionalised to some meaningful extent;
- private, i.e., institutionally separate from government;
- non-profit-distributing, i.e., not returning profits generated to their owners or directors;
- self-governing, i.e., equipped to control their own activities; and,
- voluntary, i.e., involving some meaningful degree of voluntary participation.

While providing specific criteria for inclusion in a civic society or non-profit 'sector', this definition is also sufficiently broad. As such, it encapsulates a wide range of organisations including those involved in culture and recreation, education and research, health, social services, education, environmental protection and conservation, human rights advocacy, religion, and politics, amongst others. Furthermore, as an operational definition, it clearly distinguishes between households, the market, and the private sector, the other three economic units defined in the System of National Accounts by the United Nations (United Nations, 2003). Internationally, civil society both varies in presence, composition, financing and scale with specific CSO categories more or less prominent depending on context (Salamon et al., 1999). Notwithstanding this, education and research, health, social service, and culture and recreation are historically dominant in most countries (Salamon et al., 1999; Indecon, 2018). Given that many of these activity categories are influenced by government, Salamon et al.'s (1999) five defining organisational characteristics serve to distinguish CSOs from facilities and services provided from entities other than households, the market or the state.

5.3 The Role of Civil Society

A number of theories have been posited to explain the pattern of civil society growth in a given region (Salamon, 1999). These are summarised in Table 5.1. Although the most common and prevalent theory is the market failure/government failure theory, it does not fully explain the patterns for growth although the remaining anomalies can be explained by a combination of other theories, namely supply-side and social origins theory (Salamon, 1999).

At a practical level, civil society institutions play a number of important roles. Firstly, CSOs play an important role in the context of society. They play a key role in not only encouraging community involvement but promoting citizenship values, skills and attitudes and motivating citizens to use in the public interest (Salamon, 1997; Edwards & Foley, 2001). Secondly, they play a representative and contestory role for presenting and advocating distinct interests and diverse points of view (Ben-Ner & Van Hoomissen, 1992; Salamon, 1997; Edwards & Foley, 2001). Thirdly, they perform a variety of public and quasi-public functions through

Table 5.1 Major theories explaining the presence of civil society institutions (Salamon et al., 1999)

Theory	*Description*
Market Failure / Government Failure	The market and government fail to supply sufficient quantities of public goods to meet unsatisfied public demand.
Supply-Side	Actors, sometimes referred to as social entrepreneurs, exist with a sufficient incentive to meet unsatisfied public demand.
Trust	CSOs are more trustworthy suppliers of a service than the market or government.
Welfare State	State provision of welfare services expands in line with economic growth resulting in a contraction of the nonprofit sector.
Interdependence	There are inherent limitations in the nonprofit sector to meet unsatisfied public demand. Similarly, the market and government may not or cannot meet the unsatisfied demand. Therefore, the nonprofit sector co-exists and must cooperate with government.
Social Origins	CSOs are not only providers of facilities and services but are embedded in social and economic structures. The prominence of a nonprofit sector is therefore related to the social conditions and nonprofit regime in which they are situated e.g., socio-democratic, corporatist, liberal, and statist.

service delivery (Salamon, 1997; Edwards & Foley, 2001). These roles are reflected in the wide range of activities they perform and are summarised in Table 5.2. As discussed, education and research, health, social service, and culture and recreation are historically dominant CSO activities in most countries (Salamon et al., 1999; Indecon, 2018).

Secondly, the nonprofit sector is a significant employer. For example, recent data suggests that the sector is the third largest employer in the US with 12.5 million paid workers (Salamon & Newhouse, 2020). Similarly, in Europe the sector employs 28.3 million full-time equivalent (FTE) workers (paid and volunteer) in the EU28+ countries, accounting for c. 13% of the European workforce (Salamon & Sokowlowski, 2018). Thirdly, in addition to social impacts and employment, these institutions create significant economic value through expenditure. Even in relatively small countries the impact can be significant. For example, a recent report on the social and economic impact of the nonprofit sector in Ireland estimated that charities in Ireland resulted in direct, indirect and induced expenditure of €24.98 billion in 2017 (Indecon, 2020). Significantly, the economic value of volunteering alone was estimated at €649 million per year driven by more than 300,000 volunteers working over 67 million hours in 2017 (Indecon, 2020).

Unfortunately, the COVID-19 pandemic has significantly impacted the nonprofit sector. As well as rising demand for services pre-pandemic, CSOs have experienced an increase and intensification of demand resulting from the pandemic (Pro Bono Economics, 2020, 2021; EFA and Salesforce.org, 2020). Service delivery and fundraising were adversely impacted by increased demands from other service closures and exacerbated by social distancing requirements (EFA and Salesforce.org, 2020; Pro Bono Economics, 2020, 2021). Unsurprisingly, many CSOs have had to reduce their workforce due to COVID-19 restrictions (Salamon & Newhouse, 2020; EFA and Salesforce.org, 2020; Pro Bono Economics, 2020, 2021). At the same time, CSOs have reported lower income levels due to COVID-19 restrictions while also encountering difficulties in reaching and engaging volunteers and supporters (EFA and Salesforce.org, 2020; Pro Bono Economics, 2020, 2021).

Table 5.2 Civil society organisations and activities (adapted from Salamon et al. (1999) and ISIC (United Nations, 2008))

Organisation type	*Provision of facilities and services to*
Culture and Recreation	• Pursue cultural or artistic activities including media and communications, visual arts, architecture, and ceramic art, performing arts, historical, literary and humanistic societies, museums, zoos and aquariums. • Engage in sporting activities including fitness and wellness activities. • Support other recreational facilities and services including associations for the purpose of social acquaintanceship and service (e.g., rotary clubs, lodges etc.), youth and student associations, clubs and fraternities etc.
Education and Research	• Provide elementary, primary, and secondary education, higher education, vocational, technical, adult, and continuing education. • Conduct research in medical, science and technology fields and the research and analysis in the social sciences and policy area.
Health	• Provide social services including hospitals, rehabilitation, nursing homes, mental health and crisis interventions, and other health services including public health and wellness education, health treatment, and emergency medical services etc.
Social Services	• Provide child welfare, services and day care, youth services and youth welfare, family support, services for the elderly and handicapped, and other self-help and personal social services including support groups. • Prevent and control disasters and emergencies, and provide temporary shelter and refugee assistance. • Provide income support and maintenance or other material assistance including food, clothing, transport etc.
Environment	• Abate and control pollution, conserve and protect natural resources, support environmental beautification and open spaces, and support animal protection and welfare.
Development and Housing	• Support economic, social and community development including community and neighbourhood organisations, programmes and services to improve local infrastructure and capacity, financial services, and support social development. • Provide housing facilities and services including housing associations and housing assistance. • Support employment and training including vocational counselling, guidance, and rehabilitation.

(*continued*)

Table 5.2 (continued)

Organisation type	*Provision of facilities and services to*
Law, Advocacy and Politics	• Promote and protect civil liberties, human rights, civic mindedness, and the rights and interests of specific groups of people. • Provide legal services, and services to protect consumers, prevent crime, support victims, and rehabilitate offenders. • Support specific political parties and candidates for political office including information dissemination, public relations and fundraising.
Philanthropic Intermediaries and Voluntarism Promotion	• Promote, support and fund voluntarism including grant-giving and fundraising organisations.
International	• Support international exchange, friendship and cultural programmes, international development assistance, disaster and relief, and the international promotion and monitoring of human rights and peace.
Religion	• Promote religious beliefs and administer religious services and rituals.
Business and professional	• Promote, regulate and safeguard the interests of specific businesses, professions, or employees (e.g., labour unions).
Other	• Other membership organisations not covered elsewhere.

5.4 Digital Technologies and Civil Society

Information and communication technologies (ICT) are used widely in civil society reflecting, albeit lagging, commercial organisations as a whole. There is a long established body of literature on the topic, often referred to as ICT4D (Walsham, 2017).

5.4.1 Mainstream Technologies

Like commercial organisations, CSOs can generate value and exploit the same opportunities from mainstream digital technologies improved organisation capacity and stakeholder engagements, cost savings, process efficiencies, new revenue generation, and improved quality of service (Dufft & Kreutter, 2018; O'Grady & Roberts, 2019; Ehnold et al., 2020; Walker et al., 2020). Indeed, there is pressure on nonprofit organisations to adopt the methods and values of the market (Eikenberry & Kluver, 2004). Increasingly, this includes the adoption of digital technologies and

Table 5.3 Selected scholarly research on civil society usage of digital technologies

Activity	*Example*	*Selected Research*
Information sharing and promotion	Information sharing, event promotion, advertising	Kang and Norton (2004), Tuckman et al. (2004), Briones et al. (2011), Bingley et al. (2011), Dumont (2013), Lovejoy and Saxton (2012), Muñoz (2019), Dommett (2019)
Community Building	Recognition and gratitude, acknowledgement of events, dialogue and engagement	Kang and Norton (2004), Bortree and Seltzer (2009), Waters et al. (2009), Lovejoy and Saxton (2012), Waters (2008), Lovejoy et al. (2012), Paek et al. (2013), Bellucci and Manetti (2017), Lucas (2017)
Fundraising	Donation appeals, product sales, crowdfunding	Lovejoy and Saxton (2012), Waddingham (2013), Panic et al. (2016), Charbit and Desmoulins (2017), Di Lauro et al. (2019), Salido-Andres et al. (2021)
Recruitment and Management	Employees, volunteer and member recruitment and management	Lovejoy and Saxton (2012), Schönböck et al. (2016), Nichols and James (2017), Silva et al. (2018), Morgan and Costas Battle (2019)
Advocacy	Lobbying and advocacy	Lovejoy and Saxton (2012), Paek et al. (2013), Kingston and Stam (2013), Guo and Saxton (2014), Johansson and Scaramuzzino (2019), Johansson et al. (2019), Schmitz et al. (2020)

platforms. Furthermore, ICT, and internet-based technologies more specifically, are changing how civil society organisations organise themselves locally, regionally and globally (Williams, 2018). As can be seen from Table 5.3, there is a well-established literature on the use of digital technologies by nonprofit organizations for information sharing and promotion, community building, fundraising, recruitment, and advocacy. This literature cites a wide range of potential advantages including increasing organisation capacity (Sun & Asencio, 2019), improved transparency (Dumont, 2013), access to market and targeting (Shier & Handy, 2012; Saxton & Wang, 2014), message amplification and reach (Saxton & Wang, 2014; Briones et al., 2011), faster service delivery (Briones et al., 2011), and payment (donation) efficiency (Shier & Handy, 2012). Notwithstanding these benefits, academic literature suggests goals and overall organisational capacity are significant barriers to adoption, and specifically

leadership, skills and training, privacy concerns, and budgetary constraints (see, for example, Campbell et al., 2014; Sun & Asencio, 2019; Mogus & Levihn-Coon, 2018; Ehnold et al., 2020).

More recently there have been a number of surveys by private organisations seeking to benchmark use of digital technologies. Notwithstanding the promise of digital technologies, extant literature published prior to COVID-19 suggested that digital adoption by CSOs is limited (Dufft & Kreutter, 2018), with a substantial focus on the use of digital technologies for communication (Ehnold et al., 2020; Dufft & Kreutter, 2018; Skills Platform, 2019). In their 2019 survey of 5721 NGOs, Nonprofit Tech for Good (2019) found that NGOs used a wide range of digital technologies including websites, emails, online payment systems, social media, paid advertising, customer relationship management (CRM) systems, internal communications and project management tools. However, usage varied across regions and by level of intensity and sophistication. For example, only 40% use a CRM and while 68% utilise recurring/monthly giving, only 31% use some form of crowdfunding. Similarly, while 90% use social media, respondents overwhelmingly use Facebook with less than 30% using LinkedIn, WhatsApp or YouTube.

Like most organisations and society as a whole, CSOs shifted their approach to service delivery and fundraising online during the COVID-19 pandemic (EFA and Salesforce.org, 2020; CharityComms, 2021). In response to social distancing and increased service demand, CSOs significantly expanded their use of digital technologies for communication and collaboration, marketing and fundraising including virtual events (Techsoup Global Network, 2021; EFA and Salesforce.org, 2020). The widespread adoption of web conferencing and collaboration technologies during the COVID-19 pandemic unsurprisingly led to an increase in cloud computing adoption. However, extant surveys do not provide insights in wider and more sophisticated use of the cloud. Notwithstanding this, a survey of 11,758 nonprofit decision makers from 135 countries suggests a significant proportion of CSOs are unlikely to adopt more sophisticated digital technologies in the near future including customer relationship management (CRM), donor management, marketing automation, project management, and data analytics tools (Techsoup Global Network, 2021). A number of reasons are cited for this adoption hesitance. Few CSOs have a digital strategy in place (Techsoup Global Network, 2021). Most have limited funding and small IT teams, often relying on volunteers for the most part (Techsoup Global Network, 2021). In particular, while there are many benefits to remote working, there would seem to be some evidence that it contributes

to employee dissatisfaction and burnout, particularly in the charity sector (Skills Platform, 2021). Furthermore, even where digital technologies were available, skill levels are a significant barrier to successful adoption and use (Techsoup Global Network, 2021; EFA and Salesforce.org, 2020; Skills Platform, 2021). It is important to note that while this chapter is looking at adoption and use of digital technologies from the supply side, digital inclusion is also an important consideration for civil society actors. For example, the Skills Report notes that 22% of UK charities cancelled services during the COVID-19 pandemic because their users didn't have the skills or technology to avail of them (Skills Platform, 2021).

5.4.2 Frontier Technologies

Different parts of civil society are using and/or funding frontier technologies to a greater or lesser degree (see Table 5.4). As well as being innovation catalysts within civil society organisations, they may be catalysts for social entrepreneurship or indeed become substitutes for service delivery. In some cases, as we will discuss in the next section, these technologies may become the focus of civil society organisations e.g., in the context of advocacy.

5.4.3 Digital Inclusion and Exclusion

It is well established that digital technologies can change both how organisations operate and who can participate in civil society. In particular, there are numerous studies that suggest they can play an important role in mitigating social exclusion for those most vulnerable in society including those with disabilities (Manzoor & Vimarlund, 2018), the elderly (Biniok et al., 2016), immigrants and ethnic minorities (Maya-Jariego et al., 2009), the displaced (Benton & Glennie, 2016; Lynn et al., 2021), and other disadvantaged groups (Phipps, 2000). Despite these benefits, it is important to note that, as per Chap. 2, digital divides do exist. Many segments of society, especially the poorest in society, do not have the skills or access to avail of these technologies. In seeking to exploit digital technologies, civil society organisations must be cognizant of inclusion and exclusion, from both a social and digital perspective. While both mainstream and frontier technologies offer substantial benefits, they come with significant challenges, not least upskilling and governance. As well as leveraging these technologies, civil society will play a significant role in the governance of many of these technologies including advocating for the equality of access and protection of human rights (UNCTAD, 2021).

5.5 Measuring Digital Civil Society

As can be seen in Sect. 5.4, organisations such as Techsoup Global Network and Nonprofit Tech for Good have attempted to provide insights into the adoption and use of digital technologies by civil society. These surveys, however, suffer from a number of methodological constraints. They are typically cross-sectional, self-reported and are sometimes

Table 5.4 Selected frontier technologies and illustrative civil society applications

Technology	*Illustrative civil society applications*
Artificial Intelligence (AI)	• AI-assisted medicine in rural areas (Guo & Li, 2018) • Community well-being (Phillips et al., 2020) • Injury risk assessment and performance prediction in sports (Claudino et al., 2019) • Personalised and remote education (Zawacki-Richter et al., 2019; Guan et al., 2020) • Regulatory compliance by charities (Singh et al., 2021) • Refugee resettlement (Ahani et al., 2021)
Internet of Things (IoT)	• Citizen engagement (Nansen et al., 2014; Celino et al., 2016) • Remote monitoring of vulnerable citizens (Lee et al., 2020) • Smart streets (Lynn et al., 2020) • Wildlife monitoring and conservation (Guo et al., 2015; Liu et al., 2015)
Big Data	• Citizen Science (Poisson et al., 2020) • Data activism (Milan & Almazor, 2015) • Environmental governance (Duberry, 2019) • Open data (Bertot et al., 2014; Janssen et al., 2012)
Blockchain	• Fundraising (Howson, 2021) • Organisational governance (Howson, 2021) • Humanitarian assistance (Howson, 2021)
5G	• Enabling infrastructure (Kaur et al., 2020)
3D Printing / Additive Manufacturing	• Community and skills development (Taylor et al., 2016) • Disaster relief and rural electrification (Basset et al., 2015) • Humanitarian supply chain improvements (Corsini et al., 2020)
Robotics	• Demining and ordnance disposal (Dorn, 2019) • Emergency and disaster response (Scanlan et al., 2017) • Socially-assistive robots for the vulnerable (Vandemeulebroucke et al., 2018; Martinez-Martin et al., 2020; Papadopoulos et al., 2020)
Drones / Unmanned Aerial Vehicle (UAV)	• Humanitarian drones (Rejeb et al., 2021)
Solar Photovoltaic (Solar PV)	• Off-grid power generation (Franceschi et al., 2014)

compiled across multiple time periods. They use inconsistent definitions of what constitutes a civil society entity, what technologies should be measured, and what scales should be used for measurement. More pertinently in the context of this book, the lens is typically at a country or regional level and not city- or town levels of granularity. As such, it does not allow comparison with other entities in society or academic studies.

Despite the significant role CSOs play in society and their contribution to the economy in terms of employment, expenditure and value added, neither civil society nor CSOs are typically measured as discrete entities in existing frameworks and composite indices for measuring digital society or the digital economy. While there are indices to measure digital social innovation, for example the DSI Index (Bone et al., 2018), these indices typically focus specifically on innovation or social entrepreneurship ecosystems rather than the use of digital technology more generally by civil society, and specifically CSOs, in their day to day activities. Again, such indices are often at a country- or city-level, and rarely include town or more general rural-level measurement. Indeed, the G20 Digital Economy Task Force (DETF) note that not only is the number of indicators produced jointly with other actors of civil society limited, where it is produced, it is nearly exclusively related to infrastructure (DETF, 2018). The DETF goes on to call for "interactions among government, business and other actors of civil society to strengthen the evidence base and complement official statistics, improving the design of frameworks that facilitate and allow a better use of data" (DETF, 2018, p. 10). While this call was reiterated in the recent DETF roadmap toward a common framework for measuring the digital economy, specific indicators for civil society organisations were not proposed (DETF, 2020). The nonprofit sector overlaps both the private sector and public sector in terms of activities; however CSOs have distinctive characteristics which should be reflected in measurement frameworks. Supporting indicators can then be used by policymakers and the nonprofit sector to inform strategy and actions for improvement.

5.6 Conclusion

Civil society plays a significant role in communities and performs a number of valuable functions that address unmet public needs. Digital technologies can support voluntary, community and social organisations in achieving and maintaining sustainability and fulfilling their missions more efficiently and effectively. Given the role and impact of civil society on society and economies as a whole, there is a clear need to measure the digital progress of this important part of society on a consistent and ongoing basis to enable comparison with other parts of society.

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CHAPTER 6

Infrastructure for Digital Connectivity

6.1 Introduction

Our economic and social interactions have become increasingly organised around digital information networks that connect people, processes, things, data and networks. Digital connectivity is, of course, a prerequisite for participating in a networked "knowledge economy". In economic terms, digital connectivity brings together businesses and consumers via a web of sophisticated information and communication technology (ICT) applications, such as cloud computing, supply-chain and business-to-business networks (Canzian et al., 2019). However, the impact of digital connectivity extends far beyond the economic sphere. The potential societal benefits of digital connectivity are well illustrated in an EU context, where the European Commission has emphasised digital connectivity as a component of the European Pillar of Social Rights, a set of principles outlined by the European Commission in November 2017 which aims to ensure that EU citizens enjoy equal opportunities and access to the labour market, fair working conditions, and social protection and inclusion.[1] Furthermore, the availability of a secure and performant sustainable digital infrastructure is one of four pillars of the EU's plans for Europe's digital transformation by 2030. Indeed, the European Commission (2021a, p. 5) states.

> *It is our proposed level of ambition that by 2030, all European households will be covered by a Gigabit network, with all populated areas covered by 5G.*

[1] For further details, see: https://ec.europa.eu/commission/priorities/deeper-and-fairer-economic-and-monetary-union/european-pillar-social-rights_en.

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Of course, digital infrastructure aspirations are not confined to the EU. Policymakers across the globe have sought to harness the potential of digital connectivity to drive economic development and improve standards of living. However, while a growing body of evidence now documents the positive impact of digital connectivity across a number of different economic indicators, significant challenges continue to impede the delivery of comprehensive digital connectivity across all social groups and geographical contexts.

6.2 What Is Infrastructure for Digital Connectivity?

The definition of digital connectivity is widely debated. These definitions range across a socio-technological spectrum. For example, it can be defined as the relations enabled via digital media technologies (Ponzanesi, 2019) or as the deployment of broadband infrastructure and its quality (Digital Economy and Skills Unit, 2018). In many respects, both definitions are too narrow. The former does not allow for technologies other than digital media while the latter emphasises only one type of connectivity, broadband. Digital connectivity, as the term suggests, cannot be characterised in isolation but rather needs to be viewed as part of a wider digital ecosystem. It needs to accommodate a constantly evolving technology base and a wide range of use cases and contexts. As such, we use the term 'Infrastructure for Digital Connectivity' (IDC) in this chapter to mean the availability and access to infrastructure for using digital technologies.

While policy overwhelmingly focuses on the deployment and quality of telecommunications infrastructure, and specifically broadband, when referring to digital connectivity, this reflects a first world and macro bias. Firstly, it assumes uninterrupted power supply. Over 770 million people worldwide do not have access to electricity, and the overwhelming majority are located in rural areas, primarily in Asia and sub-Saharan Africa (IEA, 2020). As one observer noted: "without energy, the Internet is a black hole" (Rubin, 2017). Secondly, it assumes once telecommunications infrastructure is deployed, citizens and other social institutions will have access to the computing equipment and the skills to use this telecommunications infrastructure. As discussed in Chap. 2, this cannot be assumed. Finally, it assumes freedom to connect to the Internet. As well as

inequalities resulting from the digital divide, access to the Internet may be subject to state control generally or in specific in specific contexts (Freedom House, 2020).

Against this background, and in the context of this book, towns play an important role in rural communities as (i) they are not only likely to have the prerequisite electricity supply but are more likely to have higher quality telecommunications infrastructure than sparsely populated areas, and (ii) public access to computer equipment and the Internet through civic buildings, libraries, Internet cafes etc. Table 6.1 below briefly summarises key terms and concepts with respect to IDC. For the most part, IDC comprises increasingly mainstream technologies e.g., fixed broadband, 2G–4G wireless networks, and Wi-Fi. However, frontier technologies such as solar photovoltaic energy are providing greater access to power in remote areas (UNCTAD, 2021), while next generation access (NGA) technologies such as 5G and artificial intelligence are dramatically increasing the availability and quality of broadband access. Furthermore, blockchain technologies are being deployed to enable distributed and shared broadband (Messié et al., 2019; Haleem et al., 2018).

6.3 Economic Impact of Infrastructure for Digital Connectivity

In recent years, a growing body of research has sought to estimate the impact of enhanced IDC on economic activity. While headline Gross Domestic Product (GDP) data yields an aggregate estimate of IDC's contribution to economic activity, research has increasingly sought to ascertain the channels through which this contribution emerges—be it at a household level or a firm level; also, at a variety of spatial scales, from local and regional upwards, as well as in distinct geographical and economic contexts. The picture that emerges when one goes beyond the aggregate economic level is one of marked social, spatial, and occupational unevenness in the impact of IDC on economic activity.

6.3.1 Macro-Level Economic Impact

A substantial body of evidence now indicates that increased broadband penetration is positively associated with growth in GDP (ITU, 2012;

Table 6.1 Key terms and concepts in Infrastructure for Digital Connectivity

Term	*Definition*
2G	The second generation of wireless networks designed to improve on analogue with digital circuit-switched solutions (Gartner, 2021). 2G services typically support data rates of 9.6 kilobytes per second (Kbps), 14.4 Kbps and up to 64 Kbps.
3G	The third generation of wireless networks. 3G wireless networks support peak data rates of 144 Kbps at mobile user speeds, 384 Kbps at pedestrian user speeds and 2 megabytes per second (Mbps) in fixed locations (peak speeds).
4G	4G is the fourth generation of broadband cellular network technology that supports high peak data rates; handover between wireless bearer technologies; Internet Protocol (IP) core and radio transport networks for voice, video and data services; and support for call control and signalling (Gartner, 2021). 4G can support peak data rates of 100 Mbps in wide area networks (WANs) and 1 gigabyte per second (Gbps) in fixed or low-mobility situations (Gartner, 2021).
5G	5G is the fifth generation technology standard for broadband cellular network technology, and is characterised by a step change in data rates, latency, massive connectivity, network reliability, and energy efficiency (Shafi et al., 2017). It targets maximum downlink and uplink throughputs of 20 Gbps and 10 Gbps (Gartner, 2021).
Broadband	A term applied to high speed telecommunications systems, i.e., those capable of simultaneously supporting multiple information formats such as voice, high-speed data services and video services on demand (European Commission, 2021b).
Fixed Broadband	Fixed broadband connectivity is provided to end users via a number of wired broadband technologies, such as copper telephone lines, coaxial cables bundled with an existing television cable network, broadband over power lines (BPL), and optical fibre cables ((European Commission, 2021c). It is optical fibre cables—cables of glass fibre connected to end-users' homes (FTTH), buildings (FTTB) or street cabinets (FTTC)—that offer the capacity to meet anticipated future bandwidth demands (European Commission, 2021c). Optical fibre lines allow for very high transmission rates (over 100 Gbps) within a wide (10–60 kilometres) efficiency range (European Commission, 2021c).
Hotspot	A hotspot is a physical location where people can access the Internet, typically using Wi-Fi, via a wireless local area network (WLAN) with a router connected to an Internet service provider (Intel, 2021).
Mobile Broadband	Mobile broadband is the name used to describe various types of wireless high-speed internet access through a portable modem, telephone or other device (European Commission, 2021b).

(*continued*)

Table 6.1 (continued)

Term	*Definition*
Municipal WiFi	Local networks of wireless Internet access that adhere to 802.11 technological standards and are built by or for local governments for the use of the government and the people and business in that area (Jassem, 2010).
Next Generation Access (NGA)	Access networks which consist wholly or in part of optical elements and which are capable of delivering broadband access services with enhanced characteristics (such as higher throughput) as compared to those provided over already existing copper networks (European Commission, 2021b).
Wi-Fi	Wireless Fidelity. Certification mark issued by the Wi-Fi Alliance to certify that a product conforms to the 802.11b, g and standards for WLANs (Gartner, 2021).

Minges, 2016; Bertschek et al., 2016). A number of cross-country studies focusing on the early 2000s pointed to a 10 percentage point increase in fixed broadband penetration yielding an increase in per capita gross domestic product (GDP) growth of 0.25 to 1.5 percentage points (Czernich et al., 2011; Qiang et al., 2009). However, studies that avail of more up-to-date datasets and longer time spans have produced a wider range of estimates. These studies have also coincided with rapid advances in broadband speeds and greater public investment in digital infrastructure. Koutroumpis (2019), for example, in a study of 35 OECD countries over a 15-year period (2002–2016), found that increased broadband adoption over that period led to an average increase in GDP of 0.3% per annum. Enhanced broadband speed has also been found by Koutroumpis (2019) to exert a positive economic impact, albeit at a diminishing rate until a market saturation point is reached.

This incremental contribution of high-speed broadband to economic growth has been the focus of a number of recent empirical studies. Briglauer and Gugler (2018), for example, in a study of the EU27 member states over the period 2003 to 2015 find a small but significant effect of ultra-fast fibre-based broadband adoption (0.002–0.005% of GDP) over and above the effects of basic broadband on GDP. The positive impact of increased broadband speed is also found by Kongaut and Bohlin (2017) in their study of OECD countries, with the authors concluding that a 10% increase in average broadband download speed positively impacts GDP per capita by 0.8%.

Empirical studies have also sought to distinguish between fixed broadband and mobile broadband penetration. Katz and Callorda (2018a), have estimated, based on a set of 139 countries over the period 2010–2017, a 1 % increase in mobile broadband penetration yields almost twice as large an increase in GDP than a 1 % increase in fixed broadband penetration. According to the authors, the impact of mobile broadband penetration is likely to be higher in lower income countries where market saturation has not been reached and the impact of incremental increases in mobile broadband penetration on economic growth has yet to encounter diminishing returns.

The positive economic impact associated with broadband availability and increased broadband speed has also been evident at a regional level. Briglauer et al. (2021), in a study of 401 German counties over the period 2010 to 2015, find that an increase in average broadband speed had a significantly positive effect on county-level GDP, with an increase in average bandwidth speed by one unit (1 Mpbs) bringing about a rise in county-level GDP of 0.18%. What is more, when positive regional externalities across counties are taken into account, the effect is almost doubled (0.31%).

6.3.2 Households and Digital Connectivity

At a micro-level, research suggests that high-speed broadband contributes positively to household income levels. Rohman and Bohlin (2013), in a study of eight OECD countries and three BRIC countries (Brazil, India and China), found that those households who did not have high-speed broadband (2–4 Mbps at that time) resulted in a difference of c. US$2100 per household per year (c. US$182 per month). For Brazil, India and China, additional annual household income of US$800 is expected to be gained by introducing 0.5 Mbps broadband connection (US$70 per month per household).

As noted by Dutz et al. (2009, 2012), high-speed home broadband connectivity has transformed the daily routines, consumption patterns, and information exchange of households across the globe. Economic efficiencies—such as remote working, at-home entrepreneurship, and online job searching—are merely the tip of the iceberg. A vast range of knowledge-based activities and commercial interactions—relating to e-commerce, education, entertainment, health care, news and information, personal finances, social networking, and interactions with

government—can now be undertaken online. Given recent COVID-related restrictions on public gatherings, households have become even more reliant on digital connectivity. In particular, broadband has facilitated more flexible patterns of work in the form of teleworking, as well as a rapid shift of education provision to virtual and blended formats.

A 2015 report from the UK-based Centre for Economics and Business Research (CEBR) has sought to categorise and quantify the array of economic impacts accruing from enhanced digital connectivity and digital skills. These include *employability benefits* and an estimated earnings premium of 3%–10% for people who acquire digital skills; *retail transaction benefits*, with evidence showing that shopping online saves individuals on average 13% compared to if they were to shop in-store; *time-saving benefits* via rapid access to government services and swift completion of online banking transactions; and *communications benefits*, as individuals connect and communicate with their community, friends and families more frequently.

6.3.3 Firm-Level Productivity and Entrepreneurship

Existing research also explores the impact of enhanced IDC on the labour market, employee and firm-level productivity, and new firm formation. The impact of connectivity appears to manifest itself in an uneven manner: enhanced IDC appears to complement high skilled workers and highly productive firms—both of which tend to be geographically concentrated in particular regions.

Microeconomic studies have not yielded unanimous evidence of positive productivity effects of IDC on the firm level. Colombo et al. (2013), based on a sample of 799 Italian SMEs from 1998–2004, found that adoption of basic broadband applications did not increase firm-level productivity. However, SMEs that adopted advanced broadband applications did experience productivity gains, though this was contigent on these applications being industry-specific (e.g., supply chain and client management applications in manufacturing) and the SMEs augmenting them with firm-level strategic or organisational changes. Advanced broadband is also found to positively contribute to firm-level productivity in Canzian et al. (2019). This study of the impact of upgraded broadband (up to 20 Mbps download; up to 1 Mbps upload) in Trento (Italy) from 2011–2014 found that upgraded broadband was associated with increases in both firm revenue and total factor productivity.

However, the productivity impact of ultra-fast broadband networks has been shown to exhibit marked spatial, sectoral, and occupational disparities. Hasbi (2020), in a study of almost 5000 municipalities in metropolitan France from 2010 to 2015, finds that municipalities with ultra-fast broadband networks enjoy higher firm formation in services activities, rather than across industry more generally. Similarly, Mack and Faggian (2013) and McCoy et al. (2016) find that broadband brings greater productivity benefits to regions that possess high skilled firms and high levels of human capital. These spatial disparities are indicative of what has been referred to in previous chapters as the "digital divide". Indeed, as noted by Philip et al. (2017) and Ali et al. (2020), this digital divide is most usefully understood as referring not only to inequalities in the provision of technological infrastructure required to support digital connectivity, but also as a wider socio-economic digital divide in which factors such as geographic remoteness and social exclusion create barriers to digital adoption and use in rural areas.

Specific to sectoral disparities, Haller and Lyons (2019), in a study of Irish services firms from 2002 to 2009, assess whether or not the introduction of digital subscriber line (DSL) broadband services increased firms' productivity in the services sector in Ireland from 2006 to 2012. While they did not find significant productivity effects across the services sector as a whole, they did find positive significant effects on firm's total factor productivity in Information and Communication and Administrative and Support Services. In contrast, a previous study by the same authors (Haller & Lyons, 2015), found no evidence that broadband adoption led to higher firm productivity across a sample of 2290 Irish manufacturing firms over the same time period. The extent to which broadband adoption manifests itself as a *skill-biased* technological change that favours high skilled occupational groups is considered by Akerman et al. (2015) in a study of Norwegian firms over the period 2001–2007. Akerman and co-authors find that broadband adoption complements the skillsets of skilled workers and thereby increases their productivity, whereas it substitutes for routine tasks formerly undertaken by unskilled workers and ultimately lowers their productivity.

6.3.4 Employment Impact of Digital Connectivity

While the empirical evidence outlined above provides indications of digital connectivity enhancing productivity of existing skilled workers

and skill-intensive regions or municipalities, evidence of new employment being created as a direct result of broadband adoption has been less clear cut. For example, Fabling and Grimes (2021)—utilising Statistics New Zealand's *Longitudinal Business Database*, which surveys approximately 7500 firms annually—find that over the period 2008 to 2018 ultrafast broadband adoption had a positive impact on firm-level productivity within a four-year time horizon, but a negative impact on employment. While positive productivity effects were evident among firms that had also made complementary investments, negative employment effects were observed among firms with initial low computer intensity. Briglauer et al. (2019), evaluating the impact of a European state aid programme for speed upgrades in broadband internet availability to rural areas in the German state of Bavaria throughout 2010 and 2011, find that those municipalities with greater broadband coverage at relatively higher speed did not, on average, experience an increase in local jobs per resident.

A number of early US studies found that greater broadband availability positively impacts upon employment growth across zip-code areas (Lehr et al., 2006; Kolko, 2012). However, recent US studies focusing on the employment impact of increased broadband speeds provide conflicting results. Ford (2018), in a study of broadband speed differentials (10 Mbps versus 25 Mbps) across US counties for the years 2013 to 2015, finds no evidence of counties that predominantly use 25 Mbps broadband connections enjoying higher employment growth than those with 10 Mbps connections. In contrast, Lobo et al. (2020)—exploring the effects of broadband speed on county unemployment rates within the U.S. state of Tennessee over the period 2011 to 2016—find that unemployment rates were 0.26 percentage points lower in counties with high speeds compared to counties with low speeds, with better quality broadband appearing to have a disproportionately greater effect in rural areas.

However, recent studies from beyond EU and US contexts have identified both productivity and employment gains associated with digital connectivity. Chen et al. (2020) in a study of Chinese firms over the period 1998–2007 find that high-speed internet significantly increases firm's productivity and worker's wage, albeit with the impact being larger for firms in industries with high skill intensity and for more educated workers. Hjort and Poulsen (2019), using firm-level data for 12 African countries

over the period 2006 to 2014, find that fast internet availability in the observed African countries leads to employment increases in higher-skill occupations, but also employment gains (albeit of a relatively smaller magnitude) for less educated worker. The employment benefits manifest themselves through a variety of channels, such as greater firm entry in South Africa; higher firm level productivity among existing Ethiopian manufacturing firms; and by an increase in exports, on-the-job training, and use of online communication among firms in a further six African countries.

6.4 Free and Municipal Wi-Fi

Public Wi-Fi network access is the provision of broadband Internet services to the public in spaces other than the home or office, under non-discriminatory terms and conditions (Fuentes-Bautista & Inagaki, 2005). In this context, "public" refers to availability of the networks that provide public benefits, and therefore serve the public interest, in the form of wireless connectivity as a service to passing users (Clement & Potter, 2008; Bar & Galperin, 2004). The network may be owned or provided by government, communities or local businesses who typically provide use of the network at low cost or free of charge (Lehr & McKnight, 2003) in small localised spaces (e.g., libraries, shopping centres, coffee shops or hotels), or on a larger scale (e.g., municipal, city-wide or town-wide networks). Picco-Schwendener et al. (2018) identifies three main types of public Wi-Fi networks:

1. Municipal Wireless Networks (MWNs)—the local public administration provides Wi-Fi Internet access across a whole city or town, or a section of it, in order to serve the public interest.
2. Community Wireless Networks (CWNs)—residents in a community share part of their wired home Internet connectivity with other people of the community using Wi-Fi technology. The providers of CWNs typically have a social motivation.
3. Commercial providers—businesses provide public wireless internet access to further a business purpose.

Table 6.2 Six developed countries: value of free Wi-Fi 2018 and 2023 (Katz & Callorda, 2018b)

Country	*Economic surplus (in US$ billions) 2018*	*Economic surplus (in US$ billions) 2023*
United States	7.36	8.52
United Kingdom	0.26	0.25
France	0.11	0.12
Germany	0.30	0.36
Japan	1.44	2.03
South Korea	1.53	1.63

The primary economic benefit of free public Wi-Fi is derived from the savings that consumers benefit from by accessing the Internet through sites offering free public Wi-Fi rather than relying on their mobile data plan. A study on future access to public Wi-Fi suggested that 60% of UK total mobile traffic will be offloaded to Wi-Fi in 2019 and of that approx. 4.32% will be free (Katz & Callorda, 2018b). This projection signals further potential savings to the consumer generated by greater access to public Wi-Fi. While the total value of this consumer surplus is significant (see Table 6.2), it is not without controversy, not least because it may represent unfair competition to existing telecommunications providers (Potts, 2014).

As well as the direct consumer surplus described above, the benefits of free municipal public Wi-Fi access include economic development, community branding, collaboration between other public service providers in a municipality, provision of internet connectivity (and associated services) to low-income and underserved citizens, and revenue generating activities (see Table 6.3).

It is noteworthy that free public Wi-Fi forms part of the European Tourism Manifesto for Growth and Jobs (European Tourism Manifesto Alliance, 2017). Item 7 of the manifesto emphasises, amongst other things, that the EU should encourage free Wi-Fi for visitors in tourist attractions, events and destinations (European Tourism Manifesto Alliance, 2017).

Table 6.3 Motivations and anticipated benefits for MWNs (adapted and extended from Picco-Schwendener et al., 2018)

Motivation	*Benefits*	*Sources*
Economic development	Fosters growth, efficiency, productivity, innovation and competitiveness.	Yovanof and Hazapis (2009), Lambert et al. (2014), Ojala et al. (2008).
	Creates and increases destination and/or market attractiveness.	Bar and Galperin (2004, 2005), Middleton (2007).
	Stimulates competition.	Infante et al. (2007).
	Encourages local innovation including improved municipal services and applications.	Ballon et al. (2009), Fuentes-Bautista and Inagaki (2005), Heer et al. (2010), Infante et al. (2007), Middleton et al. (2006, 2008).
Promoting tourism	Provides internet connectivity to international visitors and thus avoids roaming costs; transforms public spaces in to productive spaces.	Heer et al. (2010), Ballon et al. (2009), Lambert et al. (2014), Ojala et al. (2008), Tapia and Ortiz (2008), Van Audenhove et al. (2007).
	Provides information and/or brings people to attractions or special places of interest incl. conferences.	Forlano (2008), Hampton and Gupta (2008), Picco-Schwendener et al. (2018), Mandviwalla et al. (2008).
Social inclusion	Serves a public good/utility	Clark (2002), Middleton et al. (2006, 2007).
	Fosters civic participation and social engagement.	Chesley (2009), Bar and Park (2005), Hampton et al. (2010).
Public safety	Facilitates the two-way sharing of information on issues of public safety.	Chesley (2009), Tapia and Ortiz (2008), Tapia et al. (2011).
Improved public service	Provides internet connectivity to employees working in public spaces.	Ballon et al. (2009), Bar and Park (2005).
	Simplifies exchange of information.	Heer et al. (2010).
	Yields telecommunications cost savings.	Ballon et al. (2009), Bar and Park (2005), Infante et al. (2007).

6.5 Rural Digital Hubs

Rural digital hubs have been proposed as a potential solution to improve broadband connectivity, improve digital literacy for individuals, workers and businesses, attract new residents and visitors, and stimulate economic activity (European Network for Rural Development, 2017). Refining the European Network for Rural Development (ENRD) working definition of

rural digital hubs (ENRD, 2017), Rundel et al. (2018, p. 1) define a rural digital hub as "a physical space, which can be fixed or mobile, focused on digital connectivity, digital skill development and/or emergent technologies." They are not a new idea. Indeed, they merely represent the latest wave of optimism for what was referred to as telecottages in the 1990s and telecentres in the 2000s (Moriset, 2011). They have become an increasing part of policy responses during the COVID-19 pandemic to support remote working and indeed rural digital hubs and co-working spaces report renewed optimism for the sector backed by state and corporate support for remote working (Tomaz et al., 2021). For example, the Irish government launched a National Hub Network and support funding for up to 380 remote working hubs (Department of Rural and Community Development, 2021).

Consistent with the telecentre literature (Moriset, 2011), in their recent analysis of rural digital hubs, Rundel et al. (2020) note that such hubs can be organised into hubs for businesses, hubs for communities, and hubs for both sets of stakeholders. Similarly, they may be standalone or co-located in libraries or community centres (Rundel et al., 2020). They also note that while the ENRD (2017) aspired for rural digital hubs to play an active role in improving digital literacy, in reality few offered such services or indeed recognise themselves as a digital hub, and where offered these services required payment (Rundel et al., 2020). As a result, accessibility issues may not be addressed satisfactorily. The ENRD (2017) notes that committed leaders and community engagement are critical success factors for rural digital hubs initiative, and that rural digital hubs should form part of a wider strategic vision for a town. It is also important to note that the establishment and sustainability of such hubs requires a mix of funding from local and national authorities but also the private sector through sponsorship (ENRD, 2017). This suggests high levels of both vertical and horizontal integration are needed, a subject that will be discussed later in Chap. 8.

6.6 Measuring Infrastructure for Digital Connectivity

The manner in which digital connectivity impacts upon economic outcomes also gives rise to numerous measurement problems. As Canzian et al. (2019) note, digital connectivity is best characterised as a "general purpose technology" and, as such, its positive impact on economic outcomes most likely takes the form of growth-enhancing externalities that enhance all economic activities and social interactions. But as Abrardi and Cambini (2019) point out, empirical measurement of such externalities has proven to be problematic, as it seeks to quantify the effects of

high-speed broadband diffusion in terms of economic metrics rather than as network effects. What is more, available data points to a low take up of ultra-fast broadband—something which may underestimate the full extent of potential network effects which can accrue from digital connectivity. Briglauer and Gugler (2018) note that, across the EU member states in 2015, basic broadband take-up rates (72.50%) were much larger than for hybrid (20.59%) and end-to-end fibre-based (25.91%) broadband. While recent data suggests that high-speed fibre Internet connections surpassed copper-wire DSL connections in the OECD for the first time in 2020 (OECD, 2021), there would seem to be persistent gaps between urban and rural areas in terms of ultrafast broadband availability (OECD, 2020). This low take-up may be due to consumers opting for satisfactory basic broadband rather than switching to more expensive high-speed alternatives. Should measurement difficulties—compounded by low take-up of high-speed broadband—lead to the positive overall welfare contribution of digital connectivity being underestimated, cost-benefit analyses might not be supportive of additional public investment in digital infrastructure provision.

As per Table 6.4, IDC features in most major international measurement frameworks and composite indices to varying degrees. Reflecting the literature, the availability and adoption of broadband is a significant focus. Some frameworks include additional relevant indicators including:

- 5G readiness—Digital Economy and Skills Unit (2018, 2020, 2021);
- Access settings, time spent online and support and training—Digital Capital Index (Ragnedda et al., 2020);
- Secure Internet Infrastructure—Digital Capital Index (Ragnedda et al., 2020); G20 Toolkit for Measuring the Digital Economy (G20 Digital Economy Task Force, 2018);
- Institutional and regulatory—G20 Toolkit for Measuring the Digital Economy (G20 Digital Economy Task Force, 2018);
- Infrastructure for the Internet of Things—G20 Toolkit for Measuring the Digital Economy (G20 Digital Economy Task Force, 2018).

Interestingly only two frameworks include access to electricity (the Digital Evolution Index and the Partnership on Measuring ICT for Development), and only one includes public access to Wi-Fi (CityKeys).

Unlike data for other topics discussed in this book, it is worth noting that data on IDC is typically collected and reported regularly by national

Table 6.4 Selected Infrastructure for Digital Connectivity indicators by international digital society and digital economy measurement frameworks and composite indices

Indicator category	*Selected international frameworks and composite indices*
Access to electricity fixed and mobile broadband penetration (incl. by service quality)	Digital Planet—Digital Evolution Index (Chakravorti et al., 2015); Partnership on Measuring ICT for Development (ITU, 2021) CityKeys (Bosch et al., 2017); DESI (Digital Economy and Skills Unit, 2018, 2020, 2021); Digital Planet—Digital Evolution Index (Chakravorti et al., 2015); Digital Ecosystem Development Index (Katz et al., 2014; Katz & Callorda, 2018a); G20 Toolkit for Measuring the Digital Economy (G20 Digital Economy Task Force, 2018); ICT Development Index (ITU, 2016), I-DESI (Foley et al., 2018); Partnership on Measuring ICT for Development (ITU, 2021).
Device penetration	DESI (Digital Economy and Skills Unit (2018, 2020, 2021); Digital Capital Index (Ragnedda et al., 2020); Digital Planet—Digital Evolution Index (Chakravorti et al., 2015); Digital Ecosystem Development Index (Katz et al., 2014; Katz & Callorda, 2018a); G20 Toolkit for Measuring the Digital Economy (G20 Digital Economy Task Force, 2018); ICT Development Index (ITU, 2016), I-DESI (Foley et al., 2018); Partnership on Measuring ICT for Development (ITU, 2021).
Fixed and mobile broadband coverage (incl. by service quality)	DESI (Digital Economy and Skills Unit (2018, 2020, 2021); Digital Planet—Digital Evolution Index (Chakravorti et al., 2015); Digital Ecosystem Development Index (Katz et al., 2014; Katz & Callorda, 2018a); G20 Toolkit for Measuring the Digital Economy (G20 Digital Economy Task Force, 2018); ICT Development Index (ITU, 2016), I-DESI (Foley et al., 2018); Partnership on Measuring ICT for Development (ITU, 2021).
Pricing and affordability	Digital Planet—Digital Evolution Index (Chakravorti et al., 2015); G20 Toolkit for Measuring the Digital Economy (G20 Digital Economy Task Force, 2018); ICT Development Index (ITU, 2016); Partnership on Measuring ICT for Development (ITU, 2021).

sources, often at high levels of granularity including towns and their environs. International benchmark data is also widely available. Commonly cited international sources include:

- EU Broadband Coverage in Europe Studies
- EU Broadband Internet Access (BIAC) survey
- European Broadband Mapping Portal
- EU Communications Committee survey
- Eurostat
- ITU World Telecommunication/ICT Indicators database

- OECD Broadband portal
- UNESCO Institute for Statistics

IDC cannot be examined in isolation. As noted above and in previous chapters, the skills-bias inherent in digitalisation, as a whole, brings with it the risk of creating economic winners and losers. Abrardi and Cambini (2019, p. 184) neatly summarise the risks posed to employees and firms who find themselves on the losing side:

> *While higher productivity could translate into higher wages, firms might as well shed staff in response to the increased automation. Differences in income between skilled and non-skilled workers could increase, as broadband is complementary to human capital. Moreover, if broadband increases competition, some firms will lose staff or go out of business altogether.*

The spatial manifestation of disparities associated with digital connectivity is, of course, one aspect of the "digital divide" referred to in previous chapters. As Ford (2018, p. 775) points out, "broadband is not randomly distributed across geography, but rather is deployed in areas where the ratio of demand to costs is favorable, complicating the task of discovering broadband's influence on economic outcomes." Lower population densities and greater distances in rural areas discourage private sector actors from investing in new technologies, re-enforcing this digital divide between urban and rural communities. Salemink et al. (2017), in a review of 157 papers on digital developments and regional growth, find a persistent and widening gap in data infrastructure quality between urban and rural areas, with public policies aimed at promoting the availability or improvement of data infrastructure becoming rapidly outdated by market developments. As such, more granular analysis at the level of towns and sparsely populated areas is required.

6.7 Conclusion

In studies of the economic benefits accruing from technological advances, references to eminent economist Robert Solow's quip that "you can see the computer age everywhere but in the productivity statistics" have become ubiquitous.[2] While it may be tempting to declare that Solow's

[2] Solow, Robert M. 1987. "We'd Better Watch Out" review of Manufacturing Matters: The Myth of the Post-Industrial Economy, by Stephen S. Cohen and John Zysman, New York Times, July 12, 1987.

productivity paradox has now been resolved, such a conclusion appears to be premature.[3] As discussed above, it would appear that instead the paradox noted by Solow is more akin to—to borrow another oft-cited phrase, albeit from an entirely different context—"a riddle, wrapped in a mystery, inside an enigma".[4] While the majority of empirical studies examined in this chapter document positive impacts of digital connectivity on GDP, firm-level productivity, and—to a lesser extent—employment, the effects of digital connectivity are characterised by a marked social, spatial, and occupational disparities. So, rather than resolving Solow's productivity paradox, a host of further puzzles have emerged. These issues relate primarily to the digital divide. For example, should the digital divide be understood merely in terms of uneven roll-out of digital infrastructure or as a wider societal inequality? Will greater digital connectivity benefit both rural and urban regions, or indeed low-income and high-income countries, or will existing regional and national disparities persist? Do the benefits of digital connectivity only accrue to high-skilled workers and those firms which possess the requisite organisational structures? While empirical studies have in recent years begun to engage with these questions, conclusive answers have yet to materialise.

There is an onus on policymakers to respond to the inequalities that arise due to the emergence of new digital technologies and, indeed, to use new technologies to bridge existing economic and societal "digital divides". The crafting of such digitally-informed economic, social, and regional policies has become all the more pertinent in the post-pandemic context. 5G mobile access networks are expected to have a greater impact than previous network shifts, enabling new classes of advanced applications, fostering business innovation and spurring economic growth (IHS, 2019). However, as this chapter illustrates, such far-reaching digital advances can bring great economic and societal benefits but can also see certain social groups and regions left behind. The challenge facing policy makers in the coming years will be to ensure that no-one is left disconnected.

[3] For a recent debate regarding the productivity paradox, see Brynjolfsson and McAfee (2011) who argue that US workplaces have been transformed by advances in ICT and Acemoglu et al. (2014) who call for further direct evidence regarding the IT-induced transformation of the US economy.

[4] Winston Churchill (1 October, 1939) The Russian Enigma. (BBC Broadcast), London.

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CHAPTER 7

Digital Education

7.1 Introduction

The formative impact of education in both society and economic development is widely accepted and is well supported by empirical evidence (Baker, 2020). Studies have found that education levels contribute positively to economic growth, productivity, income, innovation, health, among other socio-economic indicators (Jorgenson & Fraumeni, 1993; Feinstein et al., 2006; Hanushek & Woessmann, 2010). Depending on your sociological perspective, education follows society or vice versa (Baker, 2011). The reality is that probably both are true. As well as conveying and reinforcing societal norms, education provides citizens with the skills and knowledge to participate in society. In so doing, the human capital attributes of the labour force are enhanced. Furthermore, consistent with new growth theories, there is increasing evidence that expanding the cognitive capacity of individuals can usher in societal change, such as transforming both the nature of jobs and the nature of work (Baker, 2011). That said, there has been a longstanding tension between technology and education. New technologies change societal norms and increase demand for new skills and knowledge, thus driving demands on the education system. This is particularly the case with information and communication technologies (ICTs).

The transformative potential of ICTs on education has long been heralded. Each successive generation of ICTs has resulted in renewed enthusiasm for how digital technologies and related affordances will change the

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nature of teaching and learning, not least the emergence of the Internet and Web 2.0 (Wagner, 2018). This is particularly poignant against the backdrop of the COVID-19 pandemic. Digital education is a complex multidimensional topic that includes not only elementary, secondary, and tertiary education, but also the delivery of education both through and on digital technologies to all ages and competences within communities, from early learners to older adults. This chapter outlines the rationales, benefits and challenges associated with digital technologies in education, and discusses how digital education might be measured in the context of rural towns.

7.2 What Is Digital Education?

Humans are continuously learning throughout their lives via three learning systems—formal, non-formal and informal education. Formal education is hierarchically structured and typically chronologically graded from early childhood education and care, primary and secondary education, post-secondary non-tertiary education, through to tertiary education (Coombs & Ahmed, 1974). Non-formal education is any organised educational activity outside the established formal system designed to serve identifiable learner audiences and objectives (Coombs & Ahmed, 1974). Finally, informal education includes all the other sources of learning that individuals experience in their daily lives and from their environment including family and friends (Coombs & Ahmed, 1974). As such, informal education is typically individually motivated, idiosyncratic, unorganised and often unsystematic.

In the context of this book, digital education refers to the use and sophistication of digital technologies for teaching and learning in formal and non-formal education within a community, and the infrastructure required to support such provision. As such, we are primarily concerned with social institutions rather than individuals. As per Chap. 1, digital technologies in education can be characterised as mainstream or frontier technologies, and can be general purpose or education-specific in form. They can enter the formal and non-formal education system at different levels, as per Table 7.1 (Nusche & Minea-Pic., 2020).

By and large, access to digital technologies in education focuses on mainstream technologies. With the exception of higher education research,

Table 7.1 Digital technology entry points in to education systems (adapted from Nusche and Minea-Pic. 2020)

Technology entry level	*Description*
Objectives of learning for students and educators	Hard and soft digital skills, competences, and specific ICTs are increasingly part of the curriculum, education standards, and competency frameworks for primary, secondary and tertiary education, and are widely available through non-formal education providers.
Tools to support student learning	Digital technologies are key tools to support learning in the classroom, school, home or other locations e.g., libraries. These technologies include general ICT, multimedia materials, multi-tasking and interactive environments, gaming and simulations, and collaborative and Web 2.0 environments, amongst others.
Tools to support educators	Digital technologies can be integrated into teaching practices to enhance learning both inside and outside the classroom. In addition to those being used with students, educators are using technologies to communicate with parents and other stakeholders, prepare lessons, and for personal development, knowledge sharing, networking and collaboration, amongst others.
Tools to support the management of educational institutions or systems	Beyond the specific learning experience, whether in the classroom or online, digital technologies are being used to manage educational institutions and systems. The use of digital technologies is widespread for operational planning and management, data management and decision making, marketing and stakeholder communication.

other education and training markets typically lag behind commercial adoption of frontier technologies. This can be explained by a number of factors, such as risk averseness, lack of resources, and competence requirements. This is not to say that such emerging technologies are not being developed for—or being used in—education and training. In addition to learning about these technologies, with the exception of nano technologies and gene editing, education applications for frontier technologies abound. Table 7.2 below provides examples of such digital applications in education, disaggregated by frontier technology. Furthermore, in addition to purpose-built educational technology products, many of these technologies are incorporated into general purpose technologies (Southgate et al., 2019; Southgate, 2020).

Table 7.2 Selected frontier technologies and illustrative applications in education (adapted and extended from UNCTAD, 2021)

Technology	*Description*	*Illustrative education applications*
Artificial intelligence (AI)	The capability of a machine to engage in cognitive activities typically performed by the human brain.	• Intelligent tutoring systems (Southgate et al., 2019; Southgate, 2020) • Pedagogical agents (Southgate et al., 2019, Southgate, 2020) • Adaptive learning and learning analytics (Southgate et al., 2019; Southgate, 2020)
Internet of Things (IoT)	Internet-enabled physical devices that can collect and share data.	• Smart classroom (Southgate et al., 2019; Southgate, 2020) • School safety and security (Kamalraj et al., 2020) • Campus management (Bagheri & Movahed, 2016)
Big Data	Datasets whose size or type is beyond the ability of traditional database structures to capture, manage and process information.	• Personalised adaptive learning (Peng et al., 2019) • Performance prediction (Muthukrishnan et al., 2018) • Predicting at risk students (Aulck et al., 2017; Li et al., 2020)
Blockchain	An immutable time-stamped series of data records supervised by a cluster of computers not owned by any single entity	• Credentialing and fraud reduction (Chen et al., 2018) • Digital guardianship consent (Gilda & Mehrotra, 2018) • Learning rewards systems (Zhong et al., 2018) • IPR protection (Hori et al., 2018)
5G	Next generation of mobile internet connectivity.	• Enabling infrastructure (Baratè et al., 2019; Xue & Mao, 2021)

(*continued*)

Table 7.2 (continued)

Technology	*Description*	*Illustrative education applications*
3D Printing/ Additive Manufacturing	The production of three-dimensional objects based on a digital file.	• Secondary skill development (Ford & Minshall, 2019) • Special education and assistive technologies (Buehler et al., 2016) • Inclusive innovation (Woodson et al., 2019)
Robotics	Programmable machines that can carry out actions and interact with the environment via sensors and actuators either autonomously or semi-autonomously.	• Educational companionship and tutoring (Causo et al., 2016) • Assistive technologies and inclusion (Encarnação et al., 2017) • Delivery systems (Kim et al., 2020)
Drones/ Unmanned Aerial Vehicle (UAV)	A flying robot that can be remotely controlled or fly autonomously using software with sensors and GPS.	• Virtual field trips (Palaigeorgiou et al., 2017) • Low cost precision mapping (Muthukrishnan & Winiski, 2016) • Building inspection (Rakha & Gorodetsky, 2018) • Security monitoring and emergency response (Rahn, 2021; Ravoory et al., 2021)
Solar Photovoltaic (Solar PV)	Technology that transforms sunlight into direct current electricity using semiconductors within PV cells.	• Off-grid power generation (Hanus et al., 2019) • Renewable energy education (Kacan, 2015)

7.3 Digital Technologies in Education: Rationales, Benefits, and Challenges

Increased use of digital technologies is a cornerstone of national and international education policy (Office of Educational Technology, 2017; Spires, 2018; European Union, 2020). The COVID-19 pandemic has resulted in greater investment in and commitment to these strategies (European Union, 2020). A wide range of rationales and potential benefits emanating from digital technologies are cited in policy and scholarly works, largely reflecting those presented in Chap. 1 and summarised in Table 7.3.

Despite the general enthusiasm regarding the potential benefits of digital technologies in education, there are significant challenges to digital adoption and usage in education. One can categorise these challenges in terms of (1) access, (2) motivation, skills and competences, and (3) evidence of outcomes.

Access is a multi-layered challenge which includes both access to digital education providers and access to digital technologies. Firstly, due to lower population densities, rural and remote geographic areas are less likely to have access to the same number or range of digital education providers as those in urban areas. It is reasonable to say that few small towns and rural areas have a tertiary education presence or can sustain a significant digital skills training business. Due to COVID-19, a significant proportion of the student population has been unable to attend school or university. On the one hand, this levelled the playing field between rural and urban students. On the other hand, it highlighted the challenges of rolling out online education at scale when digital inequalities exist in many home settings. Secondly, while there has certainly been an increase in access to digital technologies in formal education, neither access nor adequacy is uniform internationally (OECD, 2020). Even if learners or educators can access digital technologies at their institution, they may not have such access or an internet connection at home, particularly if socio-economically disadvantaged or from rural areas (OECD, 2020). It is also worth noting that broadband quality, and technology intensity and sophistication typically decrease as one moves downward from tertiary education to early childhood education and care.

Undoubtedly, there is evidence of greater integration of basic and advanced digital skills in curricula across all parts of formal and non-formal education. With creativity and critical thinking, digital literacy forms a

Table 7.3 Rationales for adopting digital technologies in education

Technology	*Description*
Social	Digital technologies in education help to prepare citizens to participate and function more fully in a society permeated by digital technologies (Hawkridge, 1990; Kozma, 2008; Office of Educational Technology, 2017; Spires, 2018; European Union, 2020).
Accessibility	Digital technologies can increase accessibility to education for those who may be disadvantaged and vulnerable in society thereby reducing inequalities in society (Hawkridge, 1990; Burgstahler, 2003; Bocconi & Ott, 2011; Seale, 2013; Khetarpal, 2014; Wagner, 2018).
Pedagogical	Digital technologies can support educational reform and enhance teaching and learning (Hawkridge, 1990; Kozma, 2008; Office of Educational Technology, 2017; Peterson et al., 2018; OECD, 2020; European Union, 2020).
Vocational	Digital technologies in education can prepare citizens to work in a society permeated by digital technologies (Hawkridge, 1990; Kozma, 2008).
Sustainability	Digital technologies in education can help promote environmental sustainability and the use of advanced technologies to address climate change (EU, 2020).
Quality of service	Digital technologies in education can reduce the costs of educational delivery and increase the range, quality and efficiency of educational institutions and the quality of educational management (Kozma, 2008; Wagner, 2018; Foutsiki & Caridakis, 2019; OECD, 2020).
Catalytic	Digital technologies in education can act as a catalyst for other innovations (Hawkridge, 1990; Kozma, 2005).
Economic	Digital technologies in education can contribute to greater economic growth and employment, including meeting demand for labour (Kozma, 2008; Anderson, 2008; World Economic Forum, 2015).
Reactive	Digital technologies in education can ensure continuity in response to a crisis (Bergdahl & Nouri, 2020; Daniel, 2020; World Bank, 2020).
Opportunistic	Digital technologies in education can differentiate an educational institution from its peers and make it more attractive to stakeholders (Foutsitzi & Caridakis, 2019).

significant part of the wider twenty-first century skills movement (World Economic Forum, 2015; Global Partnership for Education, 2020). Recent research suggests that digital literacy is also an increasing part of the wider curriculum in primary, secondary and tertiary levels (OECD, 2020). However, research also suggests that even in the most developed economies, digital inequalities remain. For example, in addition to literacy and numeracy, the OECD Survey of Adult Skills (PIAAC) evaluates the ICT

skills of adults aged 16–65 and specifically their problem solving skills in technology-rich environments. Every participating country and economy in the most recent PIAAC survey (year) reported a substantial proportion of adults who were unable to display any proficiency in problem solving in technology-rich environments (Kankaraš et al., 2016). Furthermore, around one in ten adults (11.7%) reported having no prior computer experience and a further 4.7% of adults did not possess the basic ICT skills that are assessed by the ICT core test, such as the capacity to use a mouse or scroll through a web page (OECD, 2019a). Similarly, Eurostat's Digital Economy and Society statistics suggest that 10% of the EU-27's population in 2019 had never used the internet (Eurostat, 2020). Skill levels are a significant factor in the use of digital technologies for learning, not only for adults but also for younger students. Van Deursen and van Dijk (2014) note that low-skilled students, even where the internet is available, are more likely to use the internet for recreational rather than instructional activities. While digital technologies present numerous benefits, not least the flexibility of time- and location-agnostic learning, it potentially excludes parts of the population, young and old, with limited or no access to technologies or with low or non-existent ICT skills. These cohorts often rank among the most vulnerable in society and the most susceptible to social exclusion as well as digital exclusion.

The digital skills, competences and practices of educators are equally, if not more, important than those of learners. Prior to COVID-19, the OECD's Teaching and Learning International Survey (TALIS) of lower secondary education indicated that only 53% of teachers had students use ICT for projects or class work and only 56% of teachers across the OECD participated in training in the use of ICT for teaching as part of their initial education or training (Schleicher, 2020). Indeed, after special needs, the use of ICT for teaching was the second highest priority for professional development among teachers (Schleicher, 2020). For vocational teachers, ICT skills were identified as the greatest need for professional development in TALIS 2018 (OECD, 2019b). Again, digital divides persist. For example, findings from the OECD's Programme for International Student Assessment (PISA) study suggests that school capacity to enhance teaching and learning using digital devices is greater in socio-economically advantaged schools than disadvantaged schools (OECD, 2020). While EU data suggests that educators have improved their skills over the period of COVID-19 (European Union, 2020), the time commitment required to keep pace with both technological and pedagogical innovations is significant.

As well as learners and educators, the institutional environment in which learning takes place can pose significant challenges to the successful adoption and use of digital technologies. A number of studies have found that successful adoption of digital technologies in education requires strong leadership, an emphasis on the connection between pedagogical aims and digital technologies, school-wide adoption of the digital technologies, a focus on the process, and collaboration with external partners (Voogt et al., 2011). This presents a significant financial, cultural, and logistical challenge. Research suggests that educator attitudes, perceptions, and confidence in ICT capabilities are critical factors influencing the adoption and use of digital technologies (Fu, 2013). As such, institutions must provide the guidelines, time, space and resources for educators to learn basic and advanced digital technological skills as well as how best to use these technologies in pedagogical settings and embed them in the curriculum (Voogt et al., 2011). These resources may include the recruitment of specialist staff to provide technical and pedagogical support both within the educational institution and externally, if remote learning is anticipated (Somekh, 2008; Strudler & Hearrington, 2008). Furthermore, requisite resources may also include the provision of institution-wide learning and administrative software platforms, including data management.

Finally, and most importantly from an education perspective, evidence of a positive relationship between access to and use of digital technologies in education and learning outcomes remains inconclusive or weak at best (World Bank, 2008; Hinostroza, 2018; OECD, 2020). For example, in a recent study in a rural context, Hampton et al. (2021) found that broadband access fills the "homework gap" but has little relationship to academic achievement. Regarding digital literacy, the results are similarly mixed. Again in a rural context, Hampton et al. (2021) found that social media skills are related to higher performance on standardised exams but that internet access, use, and skills have limited influence on educational aspirations. In an Italian study, Argentin et al. (2014) found that at a descriptive level, there would seem to be a strong positive relationship between digital skills and academic achievement, however a deeper analysis suggests that other factors drive this achievement. Indeed they suggest that an individual's digital skills do little to drive educational performance, possibly due to the nature of the current school system. Similarly, while investment in so-called STEM subjects (science, technology, engineering and mathematics) has increased significantly, especially to encourage more female participation, outcomes are mixed. For example, while a greater

proportion of those employed in the EU ICT sector have tertiary qualifications, the percentage of women employed in the EU with an ICT education has declined from 20.2% in 2009 to 17.3% in 2019. This enthusiasm for digital technologies in education has been referred to by some as the "educational productivity paradox" or the "student productivity paradox" (Pedró, 2018). As a term, it highlights the fact that mere access to and use of digital technologies in the absence of adequate enabling resources and appropriate underlying educational methodologies, are unlikely to result in significant improvements to learning outcomes (Strudler & Hearrington, 2008; Pedró, 2018). An alternative view is that the right things are not being measured (Wagner, 2018; Voogt et al., 2011; Pelgrum, 2009).

7.4 Measuring Digital Education

International data on digital education is not collected consistently for each of the levels identified—access, digital skills, competence and use, and outcomes. Indeed, common challenges in measuring digital education include (1) "fuzzy boundaries" between (a) technologies, education levels, and domains, and (b) gradations in access, usage, competences and skills, (2) self-reporting of data, (3) frequency of data collection and reporting, and (4) maintaining pace with technological change. As is evident in this chapter, research focuses significantly on secondary level education without addressing the dearth of data on early childhood education, primary education, as well as other non-formal and informal education and training provision. Even when such data is collected, in common with other aspects of digital research in society, this data is collected at a national level from which information on rural and sparsely populated areas cannot be easily extracted.

International education-specific studies typically focus on a number of common themes reflecting the previous discourse, as per Table 7.4. It should be noted that coverage varies by source. Links to sources are provided in the Useful Links section at the end of the book. Where education is included in general digital economy and society frameworks, it typically focuses on internet access and computer availability in schools (ITU, 2018; Katz & Callorda, 2018). Despite the important role that education plays in both society and economies, many of these general frameworks do not include education at all—as is the case, for example, with the EU Digital Economy & Society Index (Digital Economy and Skills Unit, 2018).

Table 7.4 Common themes and selected data sources for digital technologies in education

Themes	*Description*	*Selected sources*
Access	Availability and access to digital technologies (incl. the internet) by learners and educators where educational activity occurs including at educational institutions and at home.	Eurostat, EU Survey of Schools: ICT in Education, ITU, Partnership on Measuring ICT for Development, PISA, TALIS, UNESCO Institute for Statistics (2009).
Enrolment	Enrolment in ICT-related courses or fields.	Eurostat, Partnership on Measuring ICT for Development, UNESCO Institute for Statistics.
Employment	Employment in the ICT sector.	EU Survey of Schools: ICT in Education, Eurostat, ILO Labour Force Survey.
Educator professional development	Provision and need for training on digital technologies in general and for teaching.	PIAAC, TALIS, UNESCO Institute for Statistics.
Equity	Access to and use of ICT for education purposes and relative proportion of female graduates in ICT-related fields.	UNESCO Institute for Statistics.
Digital competence, self-efficacy and skills of learners	Learner competence, self-efficacy and skills using different technologies and performing related tasks.	Eurostat, EU Survey of Schools: ICT in Education, PIAAC, PISA, TALIS.
Digital competence, self-efficacy and skills of educators	Educator competence, self-efficacy and skills using different digital technologies and performing related tasks for and in teaching.	EU Survey of Schools: ICT in Education, PISA, UNESCO Institute for Statistics.
Institutional guidelines and practices for the use of digital technologies	Documented guidelines and policies, and organised programmes on appropriate behaviour and use of digital technologies in general, for pedagogical purposes or in specific subjects.	EU Survey of Schools: ICT in Education, PISA, UNESCO Institute for Statistics.

(*continued*)

Table 7.4 (continued)

Themes	*Description*	*Selected sources*
Institutional capacity to enhance teaching and learning using digital devices	Adequate digital infrastructure, technical and pedagogical skills, support staff, time, and incentives to enhance teaching and learning.	PISA, TALIS, UNESCO Institute for Statistics.
Parents	Parental attitudes and support for digital technologies in education.	EU Survey of Schools: ICT in Education.
Use	Incidence, intensity and patterns of digital technology use by learners and educators for educational activities.	EU Survey of Schools: ICT in Education, Partnership on Measuring ICT for Development, PIAAC, PISA, TALIS.

7.5 Conclusion

Education plays a fundamental role in the onward march of societies and economies. Through formal, non-formal and informal means, citizens are imbued with the norms, skills and knowledge that they need to prosper in society. This equally applies to the Digital Society. As such, it is unsurprising that digital technologies have become central pillars of government education and training strategies worldwide. While there is widespread enthusiasm about the potential for digital technologies in education, there is both a digital deficit and a digital divide. The former relates to the lack of conclusive evidence on the positive impact of digital investments in education, while the latter relates to the divides between the *haves* and *have-nots*. Unfortunately this includes the most vulnerable in society—the socio-economically disadvantaged, older adults, younger children, those with special needs—as well as those living in rural areas.

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CHAPTER 8

The Governance of Digital Town Initiatives

8.1 Introduction

Urbanisation, globalisation, ageing populations, climate change, and technological breakthroughs pose inter-connected challenges to rural areas (OECD, 2019). Yet, as was evident during the COVID-19 pandemic, technological innovation offers new potentials for where people will live, and how, where and when they will work (OECD, 2019; McKinsey, 2020). With the right digital infrastructure, smaller towns and rural communities may offer workers and families a quality of life unavailable in metropolitan areas. At the same time, as the OECD (2019, p. 16) notes "[…] without the right incentives and policy interventions, rural areas could miss out the benefits of the ongoing technological revolution further widening inequalities."

This chapter continues the discussion of enabling conditions for digital towns with a specific focus on the governance of digital town initiatives. This book assumes that the adoption and use of digital technologies is an essential component of town resilience, growth, and competitiveness in the Digital Society. This implies that towns need to integrate a digital layer, comprising technology and non-technology actors, into their existing physical, economic and social ecosystems. Realising the potentials related to digital initiatives within towns partly depends on the effectiveness of networks of informal and formal relationships and formal

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coordination structures that underpin efforts towards increasing and embedding digital initiatives. The remainder of this chapter discusses key concepts and terms in relation to building community resilience and specifically the nature and need for vertical and horizontal integration.

8.2 Agenda Setting and Governance of Digital Town Initiatives

The role of political and administrative leaders in regional and local planning includes agenda setting, co-ordinating, and influencing the actions of others (Clark, 2015). However, a simple focus on setting policy objectives and goals is insufficient in tackling complex and multifaceted objectives. Complex policy issues such as the environment, require horizontal and vertical policy coordination or integration because in such contexts governance and policy making is frequently characterised by "landscapes of functionally and/or spatially interdependent but fragmented arenas" (Hogl & Nordbeck, 2012, p. 111). In some instances, as suggested by Torfing and colleagues (2012), some policy issues can now only be addressed by multiple stakeholders and where government organisations and conventional policy actors are no longer the dominant stakeholder.

The promise of digital town initiatives are multifaceted, including improved economic growth, population growth, better quality of life and, in the context of local governance, potential increased engagement in digital town initiatives and more open town governance (Meijer & Rodríguez Bolívar, 2016). However, notwithstanding the multiplicity of initiatives that might be characterised as elements of "digital town plans", and the spectrum of activity from local community initiatives, to town-driven, to "stakeholder/town", to more state and national government initiatives, these is relative scarcity of work which evaluates programme outcomes in systematic ways (Hauge & Prieger, 2010). This failure to systematically evaluate programmes and policies characterises many aspects of local and national policy.

The experience of existing digital town initiatives (Ashmore et al., 2015) suggest that digital towns require a broad concept of community governance that involves multi-agency working and self-organising networks that cut across organisational and stakeholder boundaries (Leach & Percy-Smith, 2001). While digital technologies can lead to better town governance, as described in Chap. 3, the focus here is on achieving better digital outcomes for the town rather than increased digital governance.

This is a distinction between the content of governance, for example, in this context outcomes such as increased digitalisation, and the process of governance, for example, in this context increased civic engagement of citizens and stakeholder in the development of digital town plans and initiatives (Meijer & Rodríguez Bolívar, 2016). Digital technologies can aid in increasing stakeholder involvement in digital initiatives, and improved digital public services is just one outcome that is an indicator of the Digital Town.

Policy objectives such as digitalisation and digital town initiatives require town and city officials to influence and shape policies, programmes, and processes which they do not directly control. In its broadest sense, this challenge of policy integration "concerns the management of cross-cutting issues in policy-making that transcend the boundaries of established policy fields, which often do not correspond to the institutional responsibilities of individual departments" (Meijers & Stead, 2004, p. 1).

Delivery on complex and multifaceted policy objectives such as town digitalisation can be considered from the perspective of town governance as an organisational or managerial challenge of how to organise and coordinate across a diverse range of stakeholders, including town governance structures (Torfing et al., 2012). Local governance structures may have advantages over more centralised state initiatives aimed at increasing digitalisation. For example, initiatives led by local governance structures with local stakeholder engagement may have better local contextual knowledge and better capacity to increase participation in initiatives (Hauge & Prieger, 2010). However, local initiatives may suffer from insufficient resources, multiple, nested and conflicting goals, and less capacity to review outcomes of initiatives.

Policy governance involves effective institutional arrangements and coordination arrangements that are efficient and enable interaction and synchronisation. Interactive governance is "the complex process through which a plurality of actors with diverging interests interact in order to formulate, promote and achieve common objectives by means of mobilising, exchanging and deploying a range of ideas, rules and resources" (Torfing et al., 2012, p. 14). While new forms of governance can take different forms, a key feature of these newer forms of governance are that they pursue a common agreed objective, even though this may differ from the preferences of individual stakeholders. Furthermore, in these more complex and process orientated forms of governance, the focus is on inducing actors to engage in multi-actor actions, without one person or organisations in control (Torfing et al., 2012).

The changes involved in moving towards a digital town may reflect a process of incremental changes in town governance or in some instances it could involve more fundamental and transformative changes to governance structure (Meijer & Rodríguez Bolívar, 2016). Notwithstanding the case for new forms of governance, there are strong arguments that in many multi-level systems of governance the reality is that at least the key decisions remain within centralised structures (Marshall, 2008) or alternatively the multi-levels separate, losing the elements of integration across actors (Young, 2006).

8.3 Community Resilience, Vertical Integration, and Horizontal Integration

Resilience, borrowing from the sciences, refers to the capacity to bounce back to an equilibrium after a disturbance or adversity (Norris et al., 2008). It has been applied in a variety of regional contexts including individuals, sectoral, local knowledge production, local entrepreneurship, and community resilience after a sudden shock, crisis or disaster (Gong & Hassink, 2017). Historically, the study of community resilience focussed on the ability of communities to withstand disturbances and (re-)organise to maintain their social infrastructures (Adger, 2000). More recently, a wider view of community resilience, couched in socio-ecological systems, recognises that community resilience does not only include sustenance, recovery, and renewal, but varying degrees of transformation (Magis, 2010; Gong & Hassink, 2017). In this way, community resilience includes adaptation to or in anticipation of future or slowly developing changes, so-called slow burns (Gong & Hassink, 2017).

Norris et al. (2008) suggest that community resilience emerges from four primary sets of adaptive capacities:

- Economic development—the degree of resource volume and diversity, and resource equity and social inclusion within a community;
- Social capital—the strength of network structures and linkages, social support, and community bonds, roots, and commitments within a community;
- Information and communication—the systems and infrastructure for informing the Public, and the presence of communal narratives that give the experience shared meaning and purpose; and

- Community competence—the ability of the community to participate in collective action and decision making with collective efficacy and empowerment.

Research suggests that local communities and community capital play an important role in building community resilience (Berkes & Ross, 2013; McDonnell et al., 2019). In this sense, it is the very substance of a community that builds resilience. As Berkes and Ross (2013, p. 14) put it, community resilience is "[…] a function of the strengths or characteristics that have been identified as important, leading to agency and self-organisation." These characteristics include people-place relationships, a diverse and innovative economy, community infrastructure, positive outlook, values and beliefs, social networks, knowledge skills and learning, leadership, and not least, engaged governance (Berkes & Ross, 2013). Indeed, agency and self-organisation are, in many respects, the essence of community resilience. This is consistent with the view of the OECD discussed in Chap. 4 who believe that rural areas should drive their own economic development rather than rely on national government, specifically with respect to identifying and mobilising assets to improve economic performance (OECD, 2014).

Building community resilience does not take place in isolation. Indeed, the act of empowerment infers coordination with a higher administrative authority and community implies coordination across multiple actors. As such, in the context of the participatory policy making and policy implementation discussed above, both vertical and horizontal integration are key. Horizontal and vertical integration, terms borrowed from Warren (1963), were used by Berke et al. (1993) to classify communities based on the strength of their interactions between local and national players and in terms of the degree of coherence. Vertical integration of policy making refers to the integration across different levels within the governance or policy sphere. Vertical integration is important as it may provide access to resources and it may facilitate the influencing of policy and programmes. For example, McDonnell et al. (2019) suggests that by adapting policies to local needs, communities can access resources, gain effective power and influence, and communicate better with external actors. Even though in a disaster planning context, McDonnell et al. (2016) offers some guidance on defining and characterising horizontal and vertical integration (Table 8.1).

Horizontal integration refers to integration across different elements of policy making, and across policy and other stakeholders, typically those

Table 8.1 Definitions and selected characteristics of horizontal and vertical integration (adapted from McDonnell et al., 2016)

Dimension	*Definition*	*Characteristics*
Horizontal integration	• Inter-relations among members of local communities in terms of social ties, collective action, and responsibility; neighbourhood ownership and sense of place; resource mobilisation; and awareness of disaster vulnerabilities and community assets • Relations between local citizens and organisations, including emergency services, schools, churches, non-governmental and nonprofit organisations, associations, boards of business, Chambers of Commerce, and community groups.	• Institutional mandates incl. Positions accessible to citizens, formal outreach plan, publicised meetings, and regular progress reports. • Representation and scope incl. Local participation in committee formation and membership criteria. • Role of technical expertise in encouraging participation incl. Facilitation of public engagement and reflection of public opinion. • Contribution of the final output (plan) to participation incl. commitment to public engagement and local capacity building. • Alignment of professional expertise and local needs.
Vertical integration	• Connection and access to political, social, and economic institutions and agencies, which may facilitate the flow of resources and adjusting policies in response to disasters and in anticipation of possible future risks.	• State (Regional) leadership. • Encouraging stronger vertical ties by Program Design. • Facilitating upward flow of information incl. Independent organization and mandated/required upward flow. • Engendering active citizen influence incl. local participation in risk identification, public input prior to final projects, and project evaluation.

considered at the same level of governance but with different responsibilities and objectives. It is concerned with organising and coordinating the policy fields in a specific area and normally refers to all the actors operating at that level, even if some of them may be the delivery function of a national (or regional) ministry. It involves both "(a) inter-relations among members of local communities in terms of social ties, collective action and responsibility, neighbourhood ownership and sense of place, resource

mobilization, and awareness of disaster vulnerabilities and community assets; and (b) relations between local citizens and organizations […]" (McDonnell et al., 2019, p. 313). By its nature, horizontal integration is difficult to 'organise' as it requires much greater flexibility in developing and changing objectives, ways of organising and engagement with stakeholders. The EU URBACT project suggests that this coordination will involve looking for solutions at a level above or below the level where the problem manifests—so seeking support from state or national government, or seeking solutions by engaging with local stakeholders, or perhaps combining multiple levels simultaneously (Clark, 2015).

In the context of digital town initiatives, while vertical integration is important, we suggest greater emphasis should be placed on horizontal integration. Firstly, focusing solely on supply-side interventions (e.g., the roll out of broadband services) does not address the demand-side barriers to use of digital services. Horizontal integration allows for both supply-side and demand-side issues to be addressed. Similarly, emphasising broader bottom-up participation may overcome the disadvantages associated with a predominately top-down model of planning (Putnam et al., 2004) which may fail to capture local knowledge, local needs, and local social capital. Notwithstanding this, digital initiatives that build on the problems/challenges/needs of local citizens, businesses and organisations are more likely to become embedded where there is integration across policy makers. Involving users early in the design processes increases the likelihood of success for initiatives. Stakeholders may need to develop physical infrastructure, as well as supporting digital solutions, and therefore will need to engage across a number of stakeholders including government agencies and state-owned companies. In this respect, online town portals and platforms have been cited as key components in digital town projects (da Rocha, 2002; Hervé-Van Driessche, 2001).

Research on the capacity for communities to engage in collective action suggests that communities face difficulties in organising for collective action if the capacity for horizontal integration is missing or low (McDonnell et al., 2019). To deliver on broad goals such as a digital town agenda requires governance structures that recognise the role of local agency in strengthening the capacity across stakeholders to tackle and deliver on digital initiatives, rather than the centralisation of capacity and resources into an existing central governance system (Landry, 2006). In particular, smaller towns may lack the decision-making power and revenue generating capacity to support a digital town initiative, thus requiring strong levels of vertical integration for success. McDonnell et al. (2019)

further suggest that communities characterised by a low capacity for vertical integration will be slower to engage with central authorities. Even where such capacity exists, towns may face resistance to change in governance structures. The governance of digital town initiatives is dependent on not just incremental changes within existing governance structures, but also requires engagements with a broader range of stakeholders, from external policy and government bodies as well as local stakeholders, that result in new forms of governance of projects and initiatives. Successful engagement with a wide range of stakeholder groups can suffer from miscommunication, exclusion of salient voices, and paralytic stalemates (Torfing et al., 2012). Likewise, participation by local stakeholders may not result in representative participation of stakeholders as, frequently, groups and individuals with specific interests will dominate the participation process. For example, it has been shown that higher levels of income and education is associated with participation (Weber, 2000) and participation is driven by those with personal or business interests and those who have the resources and time to commit to regular participation (Irvin & Stansbury, 2004). Finally, a significant critique of local digital town plans and bottom-up initiatives is that the capacity to evaluate the effectiveness of actions and interventions may be missing at a local town level (Hauge & Prieger, 2010). LaRose et al. (2011) found that local community efforts to publicise and demonstrate broadband applications increased adoption, though they did not find strong evidence that local broadband availability produced greater community satisfaction or local individual economic development activities.

8.4 Measuring the Governance of Digital Town Initiatives

Given that the overwhelming majority of frameworks and composite indices for the digital society and digital economy are national frameworks, few assess the specific governance of ICT initiatives. Even where governance is measured, it is in a context largely irrelevant to smaller and rural towns. In contrast, both the IMD-SUTD Smart City Index and the CityKeys project, include governance specific indicators. IMD-SUTD (Bris et al., 2019) include four specific governance indicators:

- Information on local government decisions are easily accessible;
- Corruption of city officials is not an issue of concern;

- Residents contribute to decision making of local government; and
- Residents provide feedback on local government projects.

Firstly, the IMD-SUTD framework is demand-side only and other than individual residents provides very little information that can be used to measure vertical or horizontal integration.

The CityKeys framework goes further with three sub-dimensions to measure governance—organisation, community involvement (Bosch et al., 2017). Unlike the IMD-SUTD framework, CityKeys includes indicators that might act as proxies for vertical and horizontal integration (Table 8.2), however not to the extent presented by McDonnell et al. (2016) in Table 8.1.

It is worth noting that the availability on an online town portal or platform is not included in extant frameworks. Furthermore, the concept of community resilience is not reflected in these measurement frameworks. In the context of digital towns, one might reasonably ask "resilience to what?" The answer to which might be the changes being brought to society and economies due to ongoing digital technology evolution. While frameworks do exist for measuring resilience to disasters (Jordan & Javernick-Will, 2012; Clark-Ginsberg et al., 2020), economic resilience (Dinh & Pearson, 2015), and both social and economic community resilience (Sherrieb et al., 2010), there would seem to be a dearth of validated

Table 8.2 CityKeys governance dimensions and indicators (Bosch et al., 2017)

Dimension	*Indicator title*
Organisation	Cross-departmental integration.
	Establishment of leadership and resources within the administration.
	Monitoring and evaluation of compliance with smart city requirements.
	Availability of government data.
Community involvement	Citizen participation in projects.
	Open public participation.
	Voter participation in municipal elections.
Multi-level governance	Strategies and Policies: Smart city policy.
	Budget: Expenditures by the municipality for a transition towards a smart city.
	The extent to which the city cooperates with other authorities from different levels.

measurement frameworks for community digital resilience (Nguyen & Akerkar, 2020). This lack of measurement frameworks may be explained by a combination of the nascency of both the digital town literature and the non-disaster community resilience literature, but also the relative complexity in translating digital town governance, including vertical and horizontal integration and the adaptive capacities proposed by Norris et al. (2008), into measurable indicators.

8.5 Conclusions

Putting in place the community governance structures to adapt for technological change in society and the economy is a complex task, even for a smaller or rural town. It requires a multi-stakeholder approach to coordinating and reconfiguring resources at local, regional and national levels. To build resilience to digital technology evolution requires mechanisms that can enable a town, its structures, institutions and stakeholders to keep pace with this change. This may require or catalyse new forms of community governance, agency and self-governance and increased coordination both within towns and with external actors, each of which may have different, potentially conflicting, objectives for pursuing increased digitalisation within the town.

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CHAPTER 9

Bringing It All Together: The Digital Town Readiness Framework

9.1 Introduction

In the previous chapters, we have explored the digital society and digital economy from seven different perspectives and discussed how international frameworks and composite indices have sought to measure key aspects of these dimensions, or not. In many respects, important aspects of society, and indeed the economy, are not considered adequately in these frameworks. Civil society, nonformal and informal education, new places of work and ways of working, and various cohorts of the population are just some of the aspects under-represented in these sets of indicators. While there is a burgeoning ecosystem of international indicators for digital progress (G20 Digital Economy Task force, 2020), smaller and rural towns are largely absent or under-represented.

This chapter seeks to advance the way in which digital initiatives are measured and managed for and by smaller and rural towns. The proposed integrated framework combines both societal and economic perspectives through the seven dimensions discussed in previous chapters, established indicators used by intergovernmental and international organisations, and proposed indicators relevant to rural towns, to arrive at a measurement framework for digital towns. Our hope is that this Digital Town Readiness Framework (DTRF) can be used by town leaders, local authorities and associations, policymakers, and indeed scholars, to:

T. Lynn et al., *Digital Towns*,
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- obtain an initial characterisation and understanding of the digital readiness of a town;
- enable a dialogue between stakeholders on the potential for digitalisation and digital transformation within towns;
- inform and assess progress of digital town initiatives, strategies and plans; and,
- benchmark progress against other towns, and regional, national and international benchmarks.

9.2 Design Principles

This section outlines some of the major design principles informing the DTRF design, namely inclusiveness, commonality, context-sensitivity, modularity, multidirectionality, and once-only.

1. *Inclusiveness (P1)*: the framework should be inclusive with respect to "the where", "the who", "the what", and "the how". Consideration should be given to all parts and actors in smaller and rural towns and their environs ("the where"), and particularly those in risk of social and digital exclusion ("the who"). The boundaries of rural communities are often blurry and may include citizens outside of the immediate townlands as defined by administrative authorities. Attention should be given to what infrastructure and activities those actors are excluded from ("the what") and policies or actions that can reduce the risk of exclusion ("the how").
2. *Commonality (P2)*: the framework should share features and attributes with other national and international measurement frameworks to ensure comparability. As such, where possible agreed definitions, standards and guidelines for data collection and analysis should be used. Where such statistical definitions and standards are not available from intergovernmental or international organisations, validated scales from academic literature should be used, if appropriate.
3. *Context-sensitivity (P3)*: the framework should allow for local contexts and priorities. Towns are complex human and physical systems, made more complex by the inclusion of a digital layer. While general indicators remain important, relative importance may vary from town to town and similarly may change over time at different rates (Miller et al., 2013). By allowing for context-sensitivity, frictions

between regional and national stakeholders and local stakeholders can be avoided. As well as geographic, social, and economic contexts, the administrative and financial resources available to collect and analyse data, and the ability to take action resulting from such an activity should be taken into account.

4. *Modularity (P4)*: the framework should be designed in such a way that at least some dimensions and indicators are optional and there exists the ability to add or remove dimensions and indicators according to the needs and priorities of a given town or set of stakeholders. This provides stakeholders with greater choice and flexibility. Each dimension should provide value in its own right without the need to implement the whole framework. Modularity introduces greater reflexibility and can reduce both implementation complexity and cost.
5. *Multidirectionality (P5)*: the framework should be designed in such a way that it can be implemented in top-down, bottom-up, or ideally a combination of both. As discussed throughout the book, notwithstanding this general principle, we believe digital town initiatives should, where possible, be primarily community-driven (i.e., bottom-up) with support from regional or national government.
6. *Once-only (P6)*: where possible, data should be collected from actors in a community only where such data is not available through other sources e.g., public websites and databases, or existing government sources. This can reduce the administrative burden of implementing the framework and accelerate the speed of implementation.

9.3 The Digital Town Readiness Framework (DTRF)

The Digital Town Readiness Framework seeks to assess the state of preparedness for a town for full participation in a Digital Society, one whose social structures and activities, to a greater or lesser extent, are organised around digital information networks that connect people, processes, things, data and networks (Lynn et al., 2018). To support commonality and comparison (*P2*), we adapt a similar approach to the G20 framework design for measuring the digital economy (G20 DETF, 2020). Figure 9.1 provides a high level visual representation of the Digital Town Readiness Framework.

The starting point of the Digital Town Readiness Framework is a clear definition of a digital town. As per Chap. 1, we define a digital town as:

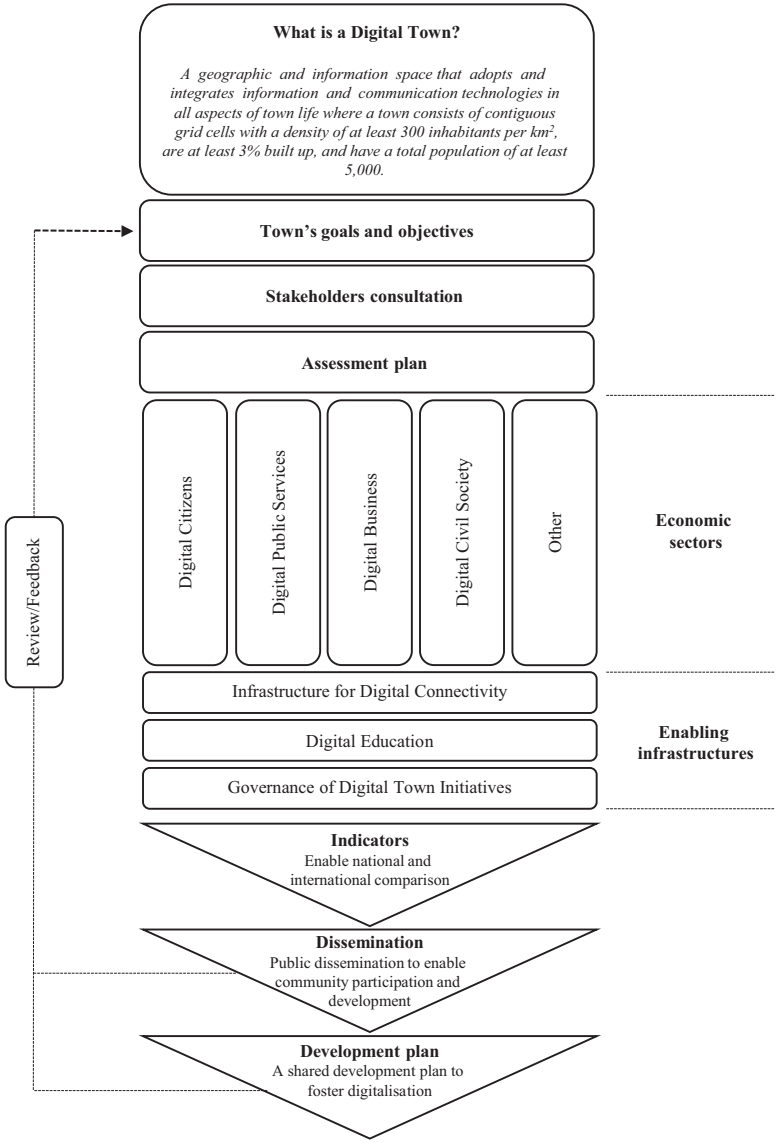

Fig. 9.1 Digital Town Readiness Framework

A geographic and information space that adopts and integrates information and communication technologies in all aspects of town life where a town consists of contiguous grid cells with a density of at least 300 inhabitants per km², are at least 3% built up, and have a total population of at least 5,000.

This definition clarifies the context for which our framework has been designed and leads to the next step of the design i.e., determining what are the key elements that determine and affect the digital readiness of a town and how they relate to each other. The discussion regarding key elements of a digital town is ongoing and could not be otherwise given the continuous changes in the technological landscape and their impact on people's life. However, based on the literature presented in previous chapters, we propose that at least three enabling infrastructures—Digital Connectivity, Digital Education, and Digital Town Governance—and four sectors of the economy—Digital Citizens, Digital Public Services, Digital Business and Digital Civil Society—should be considered. In line with *P3*, additional sectors could also be added to reflect local priorities (e.g., digital tourism, smart agriculture etc.) or future technological developments.

For each enabling infrastructure and sector, a set of indicators needs to be agreed and weighted (*P3*) with consultation from stakeholders with regard to both horizontal and vertical integration. While it is important that indicators enable national and/or international comparison, it is particularly important that the selected indicators are logistically feasible to collect while (1) providing a comprehensive, meaningful and nuanced picture of the digital readiness of a town (*P1*), (2) sufficiently complete from a benchmarking perspective (*P2*), and (3) in line with local priorities and goals (*P3*).

Once indicators are agreed and data collected, the results of the assessment must be analysed and communicated appropriately to stakeholders. This dissemination stage enables evidence-based policy-making and community and stakeholders participation (*P1; P6*). The feedback gathered through dissemination will then feed into a development plan which outlines the town's journey to increase its digital readiness and will ultimately influence the town's future goals and priorities. In fact, a town's goals and corresponding drivers may change over time to reflect changing priorities and ambitions.

9.4 Digital Town Dimensions, Sub-dimensions, and Indicators

The Digital Town Readiness Framework comprises seven dimensions in its generic form:

1. Digital Citizens;
2. Digital Public Services;
3. Digital Economy and Digital Business;
4. Digital Civil Society;
5. Infrastructure for Digital Connectivity;
6. Digital Education; and,
7. Governance of Digital Town Initiatives.

Each of these comprise a number of sub-dimensions and indicators. The following subsections present potential indicators and benchmarks, where available.

9.4.1 Digital Citizens

Access to digital connectivity is a pre-requisite for the widespread adoption and usage of digital technologies by citizens but it must be combined with the appropriate competences and skills to realise the full benefits of a digital society. The Digital Citizen dimension focuses on the competence and usage of digital technologies by citizens in a town. Table 9.1 presents a list of potential indicators for measuring the digital readiness of citizens.

9.4.2 Digital Public Services

As outlined in Chap. 3, we define Digital Public Services as the use and sophistication of digital technology by local government and health service providers, and the availability of local open data.

E-Government is commonly defined as "the use of IT to enable and improve the efficiency with which government services are provided to citizens, employees, businesses and agencies" (Carter & Bélanger, 2005, p. 5). As Singh et al. (2020) point out, it is important to place the citizen at the centre of e-Government performance assessment. Our proposed framework follows this recommendation and applies a citizen-centric to Hiller and Bélanger's (2001) five-level maturity framework i.e., (1) information, (2) two-way communication, (3) transaction, (4) integration, and

Table 9.1 Potential Digital Citizen indicators and example benchmarks

Dimension	*Sub-dimension*	*Indicator*	*Description*	*Example benchmarks*
Digital Citizen	Household expenditure on ICT	Yearly household expenditure on ICT	Household expenditure on ICT products/services per year	Partnership on Measuring ICT for Development[a]
		Household ICT device ownership by type	Household ICT device ownership by type (e.g., TV, radio, smartphone, laptop etc.)	Partnership on Measuring ICT for Development[a]
	Internet users	% of individuals who never used the internet	Individuals who never used the internet	DESI[b]; DEcI[c]; IDI[d]
		% of individuals who used the internet at least once a week	Individuals who have used the internet in the last three months	DESI[b]; DEcI[c]; IDI[d]
		% of individuals NOT using the internet by reason	Individuals NOT using the internet by reason	
	Use of the internet	% of individuals who use the internet by type of activity[e]	Proportion of individuals who use the internet by type of activity (e.g., news, games, video, financial services, social media, sell/buy goods etc.)	DESI[b]; Partnership on Measuring ICT for Development[a]
		% of individuals who use the internet by type of activity[e] and demographic[f]	Proportion of individuals who use the internet by type of activity (e.g., news, games, video, financial services, social media, sell/buy goods etc.) and demographic	DESI[b]; Partnership on Measuring ICT for Development[a]
	Digital competence	Digital competence index[g]	Citizen's interiorised digital abilities	DCI[i]
		Digital competence index by demographic[f]	Citizen's interiorised digital abilities by demographic	DCI[i]
	Basic digital skills	% of individuals with basic level of digital skills by domain[h]	Individuals with 'basic' or 'above basic' digital skills by domain measured on the basis of activities carried out during the previous three months	DESI[b]; DigComp 2.1[g]
		% of individuals with above basic level of digital skills by domain[h] and demographic[f]	Individuals with basic or above basic digital skills by domain and demographic measured on the basis of activities carried out during the previous three months	DESI[b]; DigComp 2.1[g]

(*continued*)

Table 9.1 (continued)

Dimension	*Sub-dimension*	*Indicator*	*Description*	*Example benchmarks*
	Above basic digital skills	% of individuals with above basic level of digital skills by domain[h]	Individuals with above basic digital skills by domain measured on the basis of activities carried out during the previous three months	DESI[b]; Partnership on Measuring ICT for Development[a]; IDI[d]; DigComp 2.1[g]
		% of individuals with above basic level of digital skills by domain[h] and demographic[f]	Individuals with above basic digital skills by domain and demographic measured on the basis of activities carried out during the previous three months	DESI[b]; Partnership on Measuring ICT for Development[a]; IDI[d]; DigComp 2.1[g]
	Software skills	% of individuals with at least basic digital skills in Software domain	Individuals who have basic software skills to create and edit new content (from word processing to images and video). The indicator is based on activities users have been able to do during the previous three months	DESI[b]; DigComp 2.1[g]
		% of individuals with at least basic digital skills in Software domain by demographic[f]	Individuals who have basic software skills to create and edit new content (from word processing to images and video) by demographic. The indicator is based on activities users have been able to do during the previous three months	DESI[b]
		% of individuals with above basic level of digital skills in Software domain	Individuals who have above basic software skills to create and edit new content (from word processing to images and video). The indicator is based on activities users have been able to do during the previous three months	DigComp 2.1[g]
		% of individuals with above basic level of digital skills in Software domain by demographic[f]	Individuals who have above basic software skills to create and edit new content (from word processing to images and video) by demographic. The indicator is based on activities users have been able to do during the previous three months	

Support and training	% of individuals that have had formal training in using the internet	Individuals that have had formal training in using the internet	DCI[i]
	% of individuals who feel have support with accessing the internet	Individuals who feel have support with accessing the internet	DCI[i]
	% of individuals who have you looked or asked for help to use the Internet in the past 3 months	Individuals who have you looked or asked for help to use the Internet in the past 3 months	DCI[i]
ICT sector employment	% of individuals employed in the ICT sector	Individuals who are employed in the ICT sector	Partnership on Measuring ICT for Development[a]
	% of individuals employed in the ICT sector by demographic[f]	Individuals who are employed in the ICT sector by demographic[f]	Partnership on Measuring ICT for Development[a]
ICT specialists	% of individuals employed as ICT specialists	Individuals who are employed in roles like ICT service managers, ICT professionals, ICT technicians, ICT installers and servicers (ISCO-08 classification)	DESI[b]
	% of individuals employed as ICT specialists by demographic[f]	Individuals who are employed in roles like ICT service managers, ICT professionals, ICT technicians, ICT installers and servicers (ISCO-08 classification). Breakdown by demographic	DESI[b]
	% of individuals with a degree in ICT	Individuals who have a university degree in ICT	DESI[b]
	% of individuals with a degree in ICT by demographic[f]	Individuals who have a university degree in ICT by demographic	DESI[b]
Remote working	% of individuals engaging in full-time remote working[j] by location type	Proportion of individuals working remotely full-time by location type (e.g., home, satellite office, co-working space, digital hub etc.)	
	% of individuals engaging in part-time remote working[j] by location type	Proportion of individuals working remotely part-time by location type (e.g., home, satellite office, co-working space, digital hub etc.)	

(*continued*)

Table 9.1 (continued)

Dimension	*Sub-dimension*	*Indicator*	*Description*	*Example benchmarks*
	Gig economy	% of individuals engaging in full-time gig economy[j] work by type	Proportion of individuals engaging in full-time gig economy work by type (e.g., food delivery, home cleaning, data processing, crowdsourcing platforms etc.)	
		% of individuals engaging in part-time gig economy work[j] by type	Proportion of individuals engaging in part-time gig economy work by type (e.g., food delivery, home cleaning, data processing, crowdsourcing platforms etc.)	
	Sharing economy	% of individuals engaging in full-time sharing economy[j] work by type	Proportion of individuals engaging in full-time sharing economy work by type (e.g., hospitality, ridesharing etc.)	
		% of individuals engaging in part-time sharing economy[j] work by type	Proportion of individuals engaging in part-time sharing economy work by type (e.g., hospitality, ridesharing etc.)	

[a]For a detailed list of indicators used by the Partnership on Measuring ICT for Development refer to ITU (2016)

[b]Digital Economy and Society Index. For a detailed list of indicators included in DESI refer to Digital Economy and Skills Unit (2020)

[c]For a detailed list of the indicators included in the Digital Ecosystem Index refer to OECD (2020b)

[d]ICT Development Index. For a detailed list of indicators included in the IDI refer to ITU (2021). ITU proposed some methodological changes in 2020 (see ITU, 2020) but these were not implemented at the time of writing

[e]For a list of exemplar activities refer to ITU (2016) and Digital Economy and Skills Unit (2020)

[f]For example, age, education level, gender (including LGBTQ), disabilities etc.

[g]For a detailed list of digital competencies refer to The European Digital Competence Framework for Citizens (Carretero et al., 2017)

[h]For a detailed list of domains refer to the Eurostat—Community survey on ICT usage in Households and by Individuals

[i]For a detailed list of indicators included in the Digital Capital Index refer to Ragnedda et al. (2020)

jRefer to Chap. 2 for a more extensive discussion and definition

(5) participation. In addition, we include mobile and desktop usability as an indicator of digital readiness. For comparability, we use similar indicators to Digital Economy and Skills Unit (2020). Table 9.2 presents a list of potential indicators for measuring e-Government digital readiness.

e-Health can be defined as "the use of Information and Communication Technologies (ICT) across the whole range of healthcare functions" (European Commission, 2004). As such, e-Health comprises a wide range of applications that can generate significant benefits for citizens, healthcare professionals and organisations, and public authorities (Bodell et al., 2004; Delpierre et al., 2004; Kaushal et al., 2006; Øvretveit et al., 2007) (see Chap. 3 for a more extensive discussion). Existing frameworks that aim to assess the maturity of e-Health practices in different countries tend to focus on the adoption of these technologies by general practitioners (GPs) as they represent the main point of contact between the healthcare system and citizens and therefore play a central role in facilitating access to, and delivery of, care (Macinko et al., 2003; Atun, 2004). However, other healthcare service providers like pharmacies and specialised doctors (e.g., physiotherapists, orthodontists, etc.) may also play a critical role in promoting the adoption of e-Health services (Gregorio et al., 2013; Vorrink et al., 2017; Baines et al., 2018). For this reason, our proposed framework is based on a wider definition of health service provider that includes GPs, pharmacies and specialised doctors. Table 9.3 presents a list of potential indicators for measuring e-Health adoption in rural towns by health service providers. The use of e-Health by individuals is measured in Digital Citizen.

The last component of the Digital Public Services dimension is Open Data. This is commonly defined as "data that can be freely used, shared and built-on by anyone, anywhere, for any purpose" (James, 2013). More specifically, the focus of our framework is on Public Sector Information (PSI) which is specifically concerned with "making public sector information freely available in open formats and ways that enable public access and facilitate exploitation" (Kalampokis et al., 2011, p. 17). Open data in general and PSI in particular has the potential to deliver a wide range of political and social, economic, and operational and technical benefits (Janssen et al., 2012), and to bridge the gap between government and citizens therefore enhancing inclusion and social participation (European Commission, 2018).

Given the positive effects that open data can generate for the economy and the society as a whole, we include it as a component in our proposed framework to uncover evidence of local government availability of an open

Table 9.2 Potential e-Government indicators and example benchmarks

Dimension	*Sub-dimension*	*Indicator*	*Description*	*Example benchmarks*
Digital public services	ICT in government	% of government staff routinely using the Internet	Proportion of persons employed in government organisations routinely using the Internet	Partnership on Measuring ICT for Development[a]
		% of government organisations with Internet access	Proportion of central government organizations with Internet access	
	ICT expenditure and use	Yearly expenditure on ICT from government organisations	Government organisations expenditure on ICT products/services per year	
		Number of full-time employees in ICT roles	Number of full-time employees in ICT roles	
		Number of part-time employees in ICT roles	Number of part-time employees in ICT roles	
	Web intensity	% government organisations with a web presence	Proportion of central government organisations with a web presence	
		% of government organisations with a website with sophisticated functions	Government organisations that have a website with sophisticated functions (e.g., Google Analytics, online chat etc.)	
		% of government organisations with a mobile responsive website or mobile app	Government organisations with a mobile friendly website	
		% of government organisations paying to advertise on Internet	Government organisations that use online advertisements (e.g., Google Ads, Facebook Ads etc.)	
		% of government organisations making sophisticated use of online advertising	Government organisations that use sophisticated online advertising (e.g., retargeting, tracking etc.)	
		% of government organisations with social media presence	Government organisations with at least one social media page/profile (e.g., Facebook, Twitter etc.)	
		% of government organisations using cloud computing services	Government organisations that use cloud hosting or other cloud services	
		% of government organisations that have a website with e-Commerce functionalities and/or accept payments online	Healthcare providers that have a website with e-Commerce functionalities and/or accept payments online	

e-Government users	% of individuals who sent filled forms to public authorities over the internet in the previous 12 months	Individuals who, during the previous year, needed to send filled forms to the public administration	DESI[b]
e-Government usability	Mobile-friendliness of local authority's website	Mobile-friendliness of local authority's website	eGovernment Benchmark Framework[c]
	Support availability	Support options available within the services	eGovernment Benchmark Framework[c]
	Pre-filled forms	Amount of data that is pre-filled in public service online forms	DESI[b]; eGovernment Benchmark Framework[c]
e-Government information	Information availability on the local authority's website	Information availability on the local authority's website	eGovernment Benchmark Framework[c]; UN E-Participation Index[d]
e-Government two-way communication	Online form submission availability	Online form submission availability	DESI[b]; eGovernment Benchmark Framework[c]
	Request and receive services through online channels	The share of administrative steps that can be done online for major life events (birth of a child, new residence, etc.)	DESI[b]; eGovernment Benchmark Framework[c]
e-Government transaction	Online payments availability	Online payments availability on the local authority's website	

(*continued*)

Table 9.2 (continued)

Dimension	*Sub-dimension*	*Indicator*	*Description*	*Example benchmarks*
	e-Government integration	Information and services integration	The extent to which information and services are integrated in to the local authority's website	
	e-Consultation	Citizens contributions to and deliberation on public policies and services	Engaging citizens in contributions to and deliberation on public policies and services	UN E-Participation Index[d]
	e-Decision making	Citizens participation in policy co-design and service co-production	Citizens participation in policy co-design and service co-production	UN E-Participation Index[d]
	Training	Frequency of staff training on data management	Frequency of staff training on data management	
		Frequency of staff training on digital tools	Frequency of staff training on digital tools	
		Frequency of staff training on cybersecurity	Frequency of staff training on cybersecurity	
	Use of mainstream digital technologies	% of government organisations that make intensive use mainstream digital technologies	Government organisations that use digital technologies to enhance their productivity	
	Use of frontier technologies	% of government organisations that make intensive use of frontier technologies[e]	Government organisations that use digital technologies to enhance their productivity	

[a]For a detailed list of indicators used by the Partnership on Measuring ICT for Development refer to ITU (2016)

[b]Digital Economy and Society Index. For a detailed list of indicators included in DESI refer to Digital Economy and Skills Unit (2020)

[c]For more details refer to European Commission (2020)

[d]For more details refer to United Nations (2021)

[e]For a detailed list of frontiers technologies refer to UNCTAD (2021)

Table 9.3 Potential e-Health indicators and example benchmarks

Dimension	*Sub-dimension*	*Indicator*	*Description*	*Example benchmarks*
Digital Public Services	e-Health—Web intensity	% of healthcare providers with a website or homepage	Healthcare providers that have their own website or homepage	
		% of healthcare providers with a website with sophisticated functions	Healthcare providers that have a website with sophisticated functions (e.g., Google Analytics, online chat etc.)	
		% of healthcare providers with a mobile responsive website or mobile app	Healthcare providers with a mobile friendly website	
		% of healthcare providers paying to advertise on the internet	Healthcare providers that use online advertisements (e.g., Google Ads, Facebook Ads etc.)	
		% of healthcare providers making sophisticated use of online advertising	Healthcare providers that use sophisticated online advertising (e.g., retargeting, tracking etc.)	
		% of healthcare providers using cloud computing services	Healthcare providers that use cloud hosting or other cloud services	
		% of healthcare providers selling on the internet from their website	Healthcare providers that have a website with e-Commerce functionalities and/or accept payments online	
		% of healthcare providers with social media presence	Healthcare providers with at least one social media page/profile (e.g., Facebook, Twitter etc.)	
	e-Health—e-Prescription	% of healthcare providers who provide/accept e-prescriptions	Healthcare providers that provide or accept electronic prescriptions	DESI[a]
	e-Health—Online consultation	% of healthcare providers providing online consultations	Healthcare providers that provide online consultations	DESI[a]

(*continued*)

Table 9.3 (continued)

Dimension	*Sub-dimension*	*Indicator*	*Description*	*Example benchmarks*
	e-Health—Information exchange	% of healthcare providers using an electronic network to exchange medical data with other healthcare providers	Healthcare providers using an electronic network to exchange medical data with other healthcare providers	DESI[a]
	e-Health technology adoption	% of healthcare providers using e-Health technologies by type[b]	% of healthcare providers using e-Health technologies by type (e.g., telemedicine, m-health, p-health, clinical information systems etc.)	
	Use of mainstream digital technologies	% of healthcare providers that make intensive use mainstream digital technologies	Healthcare providers that use digital technologies to enhance their productivity	
	Use of frontier technologies	% of healthcare providers that make intensive use of frontier technologies[c]	Healthcare providers that use digital technologies to enhance their productivity	

[a]Digital Economy and Society Index. For a detailed list of indicators included in DESI refer to Digital Economy and Skills Unit (2020)

[b]For more details refer to Cowie et al. (2016)

[c]For a detailed list of frontiers technologies refer to UNCTAD (2021)

data plan, a systematic approach to collecting and publishing town level open data on local and/or national open data portals. Table 9.4 presents a list of potential indicators for open government data at a town level.

9.4.3 Digital Business

As discussed in Chap. 4, the adoption and use of digital technologies provides clear benefits to businesses in rural towns. These benefits mostly relate to the exploitation of new revenue streams, new business models and faster time to market that are enabled by digital technologies. The assessment framework proposed in this book includes two sub-dimensions related to the availability of a documented plan to increase use of digital technologies by businesses in the town and the prevalence of firm-level plans for digital business. As per Digital Economy and Skills Unit (2020), the assessment should also include sub-dimensions on business digitisation and ecommerce but also the availability of digital equipment and next generation technologies. Table 9.5 presents a list of potential indicators for measuring digital business penetration in rural towns.

The Digital Town Readiness Framework is a firm-level assessment. Town stakeholders may decide to focus on a local digital economy index by adapting existing digital economy frameworks/indexes.

9.4.4 Digital Civil Society

Civil society, often referred to as "the third sector", "the independent sector" or "the nonprofit sector", can be defined as the group of social institutions outside the confines of households, the market and the state (see Chap. 5 for a more in-depth discussion on the definition of civil society). These include charities, sports and social clubs, political parties etc. While there are indices to measure digital social innovation (e.g., Bone et al., 2018), they tend to focus on innovation or social entrepreneurship ecosystems rather than the use of digital technology more generally by civil society. Similarly to businesses, civil society organisations (CSOs) can generate value and exploit new opportunities enabled by digital technologies leading to lower costs, new revenue streams and higher quality of service (O'Grady & Roberts, 2019; Ehnold et al., 2020; Walker et al., 2020). The assessment framework proposed in this book includes similar sub-dimensions as those for businesses although adapted to the CSO context. Table 9.6 presents a list of potential indicators for measuring the adoption and use of digital technologies by civil society groups in rural towns.

Table 9.4 Potential open data indicators and example benchmarks

Dimension	*Sub-dimension*	*Indicator*	*Description*	*Example benchmarks*
Digital Public Services	Open data	Sophistication of open data plan	Level of sophistication of local open data plan(s)	DESI[a]; Open Data Maturity[b]
		Number of open datasets available	Number of open datasets available on local and/or national open data portals	Open Data Maturity[b]
		Number of open datasets downloads	Number of downloads of local open datasets	Open Data Maturity[b]
		Number of unique users who downloaded the datasets	Number of unique users who downloaded local open datasets	
		Variety of open datasets available	Variety of areas covered by available open datasets	
		Availability of local open data portal	Availability of local open data portal	Open Data Maturity[b]
		Number of unique visitors to the platform	Number of unique visitors to the platform	Open Data Maturity[b]
		Number of unique users in the platform	Number of unique users in the platform	Open Data Maturity[b]

[a]Digital Economy and Society Index. For a detailed list of indicators included in DESI refer to Digital Economy and Skills Unit (2020)

[b]For more details refer to European Data Portal (2020)

Table 9.5 Potential digital business indicators and example benchmarks

Dimension	*Sub-dimension*	*Indicator*	*Description*	*Example benchmarks*
Digital business	ICT access and use by enterprises	Yearly business expenditure on ICT	Enterprise expenditure on ICT products/services per year	
		% of businesses using computers	Proportion of businesses using computers	Partnership on Measuring ICT for Development[a]
		% of employees routinely using computers	Proportion of persons employed routinely using computers	Partnership on Measuring ICT for Development[a]
		% of businesses using the internet	Proportion of businesses using the internet	Partnership on Measuring ICT for Development[a]
	Web intensity	% of businesses with a website or homepage	Businesses that have their own website or homepage	Partnership on Measuring ICT for Development[a]
		% of businesses with a website with sophisticated functions	Businesses that have a website with sophisticated functions (e.g., Google Analytics, online chat etc.)	
		% of businesses with a mobile responsive website or mobile app	Businesses with a mobile friendly website	
		% of businesses paying to advertise on the internet	Businesses that use online advertisements (e.g., Google Ads, Facebook Ads etc.)	
		% of businesses making sophisticated use of online advertising	Businesses that use sophisticated online advertising (e.g., retargeting, tracking etc.)	
		% of businesses using cloud computing services	Businesses that use cloud hosting or other cloud services	DESI[b]
		% of businesses selling online	Businesses that have a website with e-Commerce functionalities and/or accept payments online	Partnership on Measuring ICT for Development[a]; DESI[b]
		% of businesses with social media presence	Businesses with at least one social media page/profile (e.g., Facebook, Twitter etc.)	DESI[b]
	e-Commerce turnover	% of total turnover from e-commerce	Total electronic sales by enterprises, as a % of their total turnover	DESI[b]
	Cross-border sales	% of businesses carrying out electronic sales to other EU countries	Enterprises having done electronic sales to other EU countries in the last calendar year	DESI[b]

(*continued*)

Table 9.5 (continued)

Dimension	*Sub-dimension*	*Indicator*	*Description*	*Example benchmarks*
	Electronic payments	% of businesses that accept digital payments by type[b]	Enterprises that accept digital payments by type (e.g., PayPal, direct debit, card payment, cryptocurrencies, etc.)	
	Electronic information sharing	% of businesses who have in use an ERP (or similar) software package to share information between different functional areas	Enterprises that share internally electronic information with an ERP system (or similar)	DESI[b]
	Training	Frequency of staff training on data management	Frequency of staff training on data management	
		Frequency of staff training on digital tools	Frequency of staff training on digital tools	
		Frequency of staff training on cybersecurity	Frequency of staff training on cybersecurity	
	Use of digital technologies	% of businesses making extensive use of mainstream digital technologies	Enterprises whose business depends on mainstream digital technologies	
		% of businesses making intensive use of mainstream digital technologies	Enterprises that use mainstream digital technologies to enhance their productivity	
	Use of frontier technologies	% of businesses making extensive use of frontier technologies[c]	Enterprises whose business depends on frontier technologies	
		% of businesses making intensive use of frontier technologies[c]	Enterprises that use frontier technologies to enhance their productivity	DESI[b]
	Digital strategy	% of businesses with a formalised digital strategy	Enterprises with a formalised digital strategy	

Digital tools adoption	% of businesses that use an internal digital communications tool	Enterprises that use an internal digital communications tool	
	% of businesses that use an online project management tool	Enterprises that use an online project management tool	
	% of businesses with an intranet	Enterprises with their own intranet	Partnership on Measuring ICT for Development[a]
	% of businesses with an extranet	Enterprises with their own extranet	Partnership on Measuring ICT for Development[a]
	% of businesses with a Local Area Network	Enterprises with a Local Area Network	Partnership on Measuring ICT for Development[a]
R&D and innovation	Business expenditure on R&D	Business expenditure on R&D in the last fiscal year	
	Direct government funding to businesses for R&D	Direct government funding to businesses for R&D (e.g., grants, tax incentives etc.)	
	Number of ICT-related patents	Number of ICT-related patents over the previous two years	

[a]For a detailed list of indicators used by the Partnership on Measuring ICT for Development refer to ITU (2016)

[b]Digital Economy and Society Index. For a detailed list of indicators included in DESI refer to DDESU (2020)

cFor a detailed list of frontiers technologies refer to UNCTAD (2021)

Table 9.6 Potential digital civil society indicators and example benchmarks

Dimension	*Sub-dimension*	*Indicator*	*Description*	*Example benchmarks*
Digital civil society	ICT expenditure and use	Yearly expenditure on ICT from voluntary and social groups	Voluntary and social groups expenditure on ICT products/ services per year	
		Number of full-time employees in ICT roles	Number of full-time employees in ICT roles	
		Number of part-time employees in ICT roles	Number of part-time employees in ICT roles	
	Web intensity	% of voluntary and social groups with a website or homepage	Voluntary and social groups that have their own website or homepage	
		% of voluntary and social groups with a website with sophisticated functions	Voluntary and social groups that have a website with sophisticated functions (e.g., Google Analytics, online chat etc.)	
		% of voluntary and social groups with a mobile responsive website or mobile app	Voluntary and social groups with a mobile friendly website	
		% of voluntary and social groups paying to advertise on the internet	Voluntary and social groups that use online advertisements (e.g., Google Ads, Facebook Ads etc.)	
		% of voluntary and social groups making sophisticated use of online advertising	Voluntary and social groups that use sophisticated online advertising (e.g., retargeting, tracking etc.)	
		% of voluntary and social groups using cloud computing services	Voluntary and social groups that use cloud hosting or other cloud services	

	% of voluntary and social groups selling online	Voluntary and social groups that have a website with e-Commerce functionalities and/or accept payments online
	% of voluntary and social groups with social media presence	Voluntary and social groups with at least one social media page/profile (e.g., Facebook, Twitter etc.)
Digital strategy	% of voluntary and social groups with a formalised digital strategy	Voluntary and social groups with a formalised digital strategy
Training	Frequency of staff training on data management	Frequency of staff training on data management
	Frequency of staff training on digital tools	Frequency of staff training on digital tools
	Frequency of staff training on cybersecurity	Frequency of staff training on cybersecurity
Digital tools adoption	% of voluntary and social groups that use an internal digital communications tool	Voluntary and social groups that use an internal digital communications tool
	% of voluntary and social groups that use an online project management tool	Voluntary and social groups that use an online project management tool
Fundraising	% of voluntary and social groups that use digital fundraising solutions	Voluntary and social groups that use digital fundraising solutions
	% of voluntary and social groups that accept digital payments by type	Voluntary and social groups that accept digital payments by type (e.g., PayPal, direct debit, card payment, cryptocurrencies, etc.)

9.4.5 *Infrastructure for Digital Connectivity*

Infrastructure for Digital Connectivity is the foundation for the digital society and digital economy. Based on extant literature, our framework includes a connectivity dimension with a number of sub-dimensions relating to the availability, quality, adoption and use of connectivity. Table 9.7 presents a list of potential indicators for assessing digital connectivity in rural towns.

9.4.6 *Digital Education*

It is well-established that digital technologies can radically change the nature of teaching and learning. This has become particularly evident in the backdrop of the COVID-19 pandemic. Digital Education, as interpreted in this book, relates to the support for use and sophistication of digital technology in education and the provision of digital skills training for all levels. While a number of measurement frameworks for digital education have been proposed over the years, they tend to either focus on Internet access and computer availability in formal education (e.g., Katz & Callorda, 2018) and therefore ignore all other education service providers (e.g., pre-primary or older citizens training initiatives) or do not consider digital adoption and usage in education at all (e.g., Digital Economy and Skills Unit, 2020). Our proposed framework includes the availability of documented plans at both a town-level and institution-level for digital skills provision and integration for all levels of education and age levels and a range of indicators to assess the actual adoption of digital technologies by education providers. Table 9.8 presents a list of potential indicators for assessing digital connectivity in rural towns.

9.4.7 *Governance of Digital Town Initiatives*

The experience of previous digital town projects clearly highlights that the delivery of complex and multifaceted policy objectives such as digitalisation requires significant coordination among a wide range of stakeholders. As such, it requires appropriate governance mechanisms that enable widespread participation while also guiding the implementation of the policy objectives. In Chap. 8 we identify two main types of governance mechanisms that are particularly relevant in the context of digital town initiatives i.e., horizontal and vertical integration. While horizontal integration refers

Table 9.7 Potential indicators for Infrastructure for Digital Connectivity and example benchmarks

Dimension	*Sub-dimension*	*Indicator*	*Description*	*Example benchmarks*
Infrastructure for Digital Connectivity	Take-up Coverage	% of households subscribing to fixed broadband	Households with fixed broadband connection	DESI[a]; DEcI[b]
		% of households subscribing to fixed broadband of at least 100 Mbps	Households with ultrafast fixed broadband connection	DESI[a]; DEcI[b]
		Number of mobile data subscriptions per 100 people	Take-up of mobile broadband (subscriptions/100 people)	Partnership on Measuring ICT for Development[c]; DESI[a]; IDI[d]
		Mobile broadband Internet traffic per mobile broadband subscription	Average volume of data uploaded or downloaded per mobile broadband subscription	IDI[d]
		Fixed broadband Internet traffic per fixed broadband subscription	Average volume of data uploaded or downloaded per fixed broadband subscription	IDI[d]
		% of households covered by fixed broadband of at least 30 Mbps download	NGA broadband coverage/availability (as a % of households)	DESI[a]; DEcI[b]
		% of households covered by any fixed very high capacity networks	Very High Capacity Network (VHCN) coverage	DESI[a]; DEcI[b]

(*continued*)

Table 9.7 (continued)

Dimension	*Sub-dimension*	*Indicator*	*Description*	*Example benchmarks*
		% of populated areas with coverage by 4G—measured as the average coverage of telecom operators in the area	4G coverage	DESI[a]; DEcI[b]
		% of populated areas with coverage by 5G—measured as the average coverage of telecom operators in the area	5G coverage	
		The amount of spectrum assigned and ready for 5G use within the so-called 5G pioneer bands. These bands are 700 MHz, 3.6 GHz and 26 GHz	5G readiness. All three spectrum bands have an equal weight	DESI[a]
	IoT infrastructure	Number of Machine-to-Machine SIM card per 100 inhabitants	Machine-to-Machine SIM card penetration per 100 inhabitants	
	Competition	5G coverage quality	Overall 5G service quality in the area	
		4G coverage quality	Overall 4G service quality in the area	DESI[a]; DEcI[b]
		3G coverage quality	Overall 3G service quality in the area	DEcI[b]
		2G coverage quality	Overall 2G service quality in the area	DEcI[b]
		Number of mobile service providers	Number of providers offering a mobile connectivity service in the area	
		Number of fixed broadband providers	Number of providers offering a fixed broadband connectivity service in the area	
		Prices for connectivity	Price for connectivity baskets	

Planning	Plan/initiatives for fixed broadband development	Local authority or national government's plans for fixed broadband improvements in the area
	Plan/initiatives for mobile broadband development	Local authority or national government's plans for mobile broadband improvements in the area (e.g., 5G)
Public connectivity	% of businesses offering Wi-Fi connectivity to customers (free or fee)	Businesses offering Wi-Fi connectivity to their customers (free or fee)
	Community Wireless Networks (CWN) availability	Community Wireless Networks (CWN) availability
	Municipal Wireless Networks (MWNs) availability	Municipal Wireless Networks (MWNs) availability in municipal locations (e.g., parks, high street etc.)
Digital hubs	Availability of digital hubs for businesses by type[f]	Availability of digital hubs for businesses by type
	Availability of digital hubs for citizens/community by type[f]	Availability of digital hubs for citizens by type

[a]Digital Economy and Society Index. For a detailed list of indicators included in DESI refer to Digital Economy and Skills Unit (2020)

[b]For a detailed list of the indicators included in the Digital Ecosystem Index refer to OECD (2020b)

[c]For a detailed list of indicators used by the Partnership on Measuring ICT for Development refer to ITU (2016)

[d]ICT Development Index. For a detailed list of indicators included in the IDI refer to ITU (2021). ITU proposed some methodological changes in 2020 (see ITU, 2020) but these were not implemented at the time of writing

[e]For more details on price baskets refer to OECD (2017)

fFor a classification of digital hubs refer to Rundel et al. (2020)

Table 9.8 Potential Digital Education indicators and example benchmarks

Dimension	*Sub-dimension*	*Indicator*	*Description*	*Example benchmarks*
Digital Education	Web intensity	% of education providers with a website or homepage	Education providers that have their own website or homepage	
		% of education providers with a website with sophisticated functions	Education providers that have a website with sophisticated functions (e.g., Google Analytics, online chat etc.)	
		% of education providers with a mobile responsive website or mobile app	Education providers with a mobile friendly website	
		% of education providers paying to advertise on the internet	Education providers that use online advertisements (e.g., Google Ads, Facebook Ads etc.)	
		% of education providers making sophisticated use of online advertising	Education providers that use sophisticated online advertising (e.g., retargeting, tracking etc.)	
		% of education providers using cloud computing services	Education providers that use cloud hosting or other cloud services	
		% of education providers selling or accepting payments online	Education providers that have a website with e-Commerce functionalities and/or accept payments online	
		% of education providers with social media presence	Education providers with at least one social media page/profile (e.g., Facebook, Twitter etc.)	
	Access	% of education providers with a Virtual Learning Environment (VLE)	Education providers with a Virtual Learning Environment (VLE)	2nd Survey of Schools: ICT in Education[a]; PISA[b]
		% of education providers with broadband	Education providers with broadband	Partnership on Measuring ICT for Development[c]; 2nd Survey of Schools: ICT in Education[a]
		% of education providers with interactive whiteboards	Education providers with interactive whiteboards	2nd Survey of Schools: ICT in Education[a]; PISA[b]
		% of education providers using computers for educational purposes	Education providers using computers for educational purposes	2nd Survey of Schools: ICT in Education[a]; PISA[b]
		% of education providers using laptops or tablets	Education providers using laptops or tablets	2nd Survey of Schools: ICT in Education[a]; PISA[b]

	Students to computers ratio	Current ratio between the number of the number of students and the number of computers/laptops available	Partnership on Measuring ICT for Development[c]; 2nd Survey of Schools: ICT in Education[a]
Enrolment	% of learners enrolled in ICT-related fields	Proportion of learners enrolled in ICT-related fields	Partnership on Measuring ICT for Development[c]
	% of learners enrolled in ICT-related fields by demographic[c]	Proportion of learners enrolled in ICT-related fields by demographic	Partnership on Measuring ICT for Development[c]
Employment	% of graduates employed in the ICT sector	Proportion of graduates employed in the ICT sector	Eurostat, ILO Labour Force Survey
	% of graduates employed in the ICT sector by demographic[c]	Proportion of graduates employed in the ICT sector by demographic[c]	Eurostat, ILO Labour Force Survey
Institutional guidelines and practices for the use of digital technologies	% of education providers with institutional guidelines for the use of digital technologies in place	Education providers with institutional guidelines for the use of digital technologies in place	PISA[b]
	% of education providers with an ICT coordinator	Education providers with an ICT coordinator	
	% of education providers offering incentives to encourage participation in training	Education providers offering incentives to encourage participation in training	

(*continued*)

Table 9.8 (continued)

Dimension	*Sub-dimension*	*Indicator*	*Description*	*Example benchmarks*
	Competencies/ skills (educators)	% of ICT-qualified educators in schools	Proportion of ICT-qualified educators in schools	Partnership on Measuring ICT for Development[c]
		Problem solving in technology-rich environments	educators' level of problem solving skills and confidence	PISA[b]; PIAAC
		ICT support to students' learning	The extent to which educators can support students learning through the use of digital technology	TALIS[d]
	Educators professional development	Time spent by educators on ICT training	Time spent by educators on ICT training	PISA[b]; TALIS[d]
		% of education providers with a professional development plan for educators	Education providers with a professional development plan for educators	PISA[b]
	Use of ICT in classroom	Frequency of educators' use of ICT in the classroom	Frequency of educators' use of ICT in the classroom	PISA[b]; TALIS[d]
	Digital skills training	Digital skills education availability	Digital skills education offered by institutions other than schools	

[a]For a detailed list of items included in the survey refer to European Commission (2019)

[b]Programme for International Student Assessment. For a detailed list of indicators included in PISA refer to OECD (2020a)

[c]For a detailed list of indicators used by the Partnership on Measuring ICT for Development refer to ITU (2016)

[d]For a detailed list of indicators refer to OECD (2021)

[e]For example, age, education level, gender (including LGBTQ), disabili**ties etc.**

to integration across different elements of policy making, and across policy and other stakeholders, vertical integration is mostly concerned with integration between political, social, and economic institutions which may facilitate access to resources and coordination with higher level policy objectives. Table 9.9 presents a list of potential indicators for assessing digital town governance.

9.5 Methodological Considerations

As has been mentioned in previous chapters, data collected for national and international statistics are very rarely available at a town level. While secondary data may be available from other sources (detailed fixed and mobile broadband coverage, for example, tends to be available through national communication regulators—see, for example, ComReg, 2021), primary data collection is required for most (if not all) indicators included in a town's assessment. This poses significant challenges in the terms of resources required, accuracy, and national and international comparability. In this section, we outline some basic principles and guidelines that should be considered when planning and rolling out data collection using the Digital Town Readiness Framework.

9.5.1 Selection of Indicators

Most of the intergovernmental and international frameworks discussed in previous chapters rely on data that is collected frequently by national or international agencies. In this respect, international benchmarking is easier due to the availability of data and widespread compliance with internationally accepted standards and practices set by relevant bodies. As discussed, data is unlikely to be available for most indicators for a specific town, therefore those seeking to assess a specific town (an assessor) needs to take into account the relevance, feasibility, and frequency of data collection. Where possible, indicators should be based on international standards and assessors should use extant standards and guidelines for designing data collection instruments and analysis to aid validity, interpretability, and comparability (*P2*, *P6*). To aid periodic comparison, typically yearly, indicators should be reviewed and updated regularly while optimising historic and external benchmark comparability (*P2*).

Table 9.9 Potential indicators for the governance of digital town initiatives and example benchmarks

Dimension	*Sub-dimension*	*Indicator*	*Description*	*Example benchmarks*
Governance of digital town initiatives	Horizontal integration	Coordination of digitalisation	The extent to which different digitalisation initiatives within a town are coordinated	
		Citizen participation plan	The extent to which there is a defined plan for involving citizens into digital town initiatives	
		Representation and scope	The extent to which different stakeholder types are represented and involved in the planning phase.	
		Technical expertise	The extent to which technical expertise is used to assist with the design and development of a community engagement strategy	
		Commitment to public engagement	The extent to which digital town initiatives are accessible and communicated to the public	
		Commitment to local capacity building	The extent to which digital town initiatives are committed to local capacity building by collaborating with other organisations and communities	
		Town-level platform availability	Availability of an integrated town-level platform availability to promote digital initiatives	
	Vertical integration	Town-level platform maturity	Maturity of the integrated town-level platform availability to promote digital initiatives	
		Cross departmental integration	The extent to which different administrative departments contribute to digital town initiatives and management	
		Establishment within the local authority	The extent to which digital town initiatives are assigned to one department and resources allocated	
		Monitoring and evaluation	The extent to which progress toward a digital town and compliance with requirements is being monitored and reported	
		Multilevel government	The extent to which the local authority cooperates with other authorities from different levels	
		Alignment	The extent to which digital town initiatives are aligned with government policy	

Context-sensitivity (*P3*) and modularity (*P4*) are important design principles in the Digital Town Readiness Framework. For example, tourism is a national and local priority in many countries and rural communities. In an earlier work, a rapid Digital Town Readiness Framework was developed and implemented in five rural Irish towns with digital tourism as one of the dimensions reflecting Irish regional and national priorities (Lynn et al., 2020; .IE, 2021). Similarly, agriculture is a significant sector in many rural communities and the e-agriculture readiness may warrant additional emphasis (Trendov et al., 2019).

9.5.2 Data Collection

There are a number of challenges in collecting representative data in smaller and rural towns. Firstly, while the once-only principle (*P7*) is a central design principle of the Digital Town Readiness Framework, the full range of data is unlikely to be available from national sources due to the sampling strategies such sources employ. A multi-directional (*P5*) approach is needed because top-down methodologies often fail to capture local complexity (G20 Digital Economy Task Force, 2018). Secondly and relatedly, some local actors, for example those in schools and businesses, may be time-poor and suffer from survey fatigue. In these cases, one tactic may be to reduce the time and effort required by requesting their data submission for other studies or statistical exercises and then focusing only on missing data. Thirdly, some segments of society are difficult to survey e.g., the most vulnerable in society and those who are not currently digitally active. Consequently, online surveys may not be suitable and either face-to-face or telephone surveys may be more appropriate. These factors can result in relatively high data collection costs and lengthy data collection times particularly for the Digital Citizen dimension. A bottom-up community-driven initiative, combined with top-down secondary data, may be more cost efficient and effective due to local relationships and knowledge (*P5*). Online crawlers can be used in some cases for website-based data collection and may prove fruitful for rapid assessment of web-based activity, however these cannot be considered complete or authoritative. For example, a website may still be live while a company has closed.

9.5.3 Data Preparation and Cleaning

It is likely that raw data will be sourced from primary and secondary sources. Qualitative data will be subject to interpretation by coders. To avoid bias and optimise objectivity, clear data coding guidelines and ideally multiple coders should be used. Even where quantitative data is sourced, it may be presented in different units, time periods, or spatial coordinates. Similarly, data quality and the level of granularity may vary over time. This data will need to be cleansed and normalised before aggregation. In addition, for multi-period comparison, a policy should be set for handling missing values. Where possible, follow data preparation methodologies similar to the framework you wish to benchmark against, see for example Digital Economy and Skills Unit (2020).

9.5.4 Weighting and Aggregation

Context sensitivity (*P3*) is an important consideration when assessing a town. As well as selecting relevant dimensions, sub-dimensions and indicators, the relative weighting of indicators, sub-dimensions, and dimensions can be weighted to reflect the priorities of the town or given equal weighting. For example, Digital Economy and Skills Unit (2020) uses differential weights at the dimension and sub-dimension level reflecting EU policy priorities whereas the IDI (ITU, 2016) uses a differential weighting at the sub-indices level and equal weights for indicators (see Tables 9.10 and 9.11). There are a variety of weighting techniques including simple additive weighting, weighted product, weighted displaced ideal and ordered weighted averaging methods. Similarly, there are a number of methods for determining weights. This will depend on the purpose and complexity of analysis one wishes to undertake. Once weighted, care needs to be taken that aggregation calculations are computed correctly and consistently.

Table 9.10 DESI weighting system (adapted from Digital Economy and Skills Unit, 2020)

DESI	*Weights*	*Weights*
	Sub-dimensions	*Dimensions*
Connectivity		**25%**
Fixed broadband take-up	25%	
Fixed broadband coverage	25%	
Mobile broadband	35%	
Broadband price index	15%	
	100%	
Human capital		**25%**
Internet user skills	50%	
Advanced skills and development	50%	
	100%	
Use of internet		**15%**
Internet use	25%	
Activities online	50%	
Transactions	25%	
	100%	
Integration of digital technology		**20%**
Business digitisation	60%	
e-Commerce	40%	
	100%	
Digital public services		**15%**
e-Government	100%	
	100%	

Table 9.11 IDI weighting system (ITU, 2016)

IDI	*Weights*	*Weights*
	Sub-indices	*Indicators*
ICT access		**40%**
Fixed-telephone subscriptions per 100 inhabitants	20%	
Mobile-cellular telephone subscriptions per 100 inhabitants	20%	
International Internet bandwidth per Internet user	20%	
Percentage of households with a computer	20%	
Percentage of households with Internet access	20%	
	100%	
ICT usage		**40%**
Percentage of individuals using the Internet	33%	
Fixed-broadband Internet subscriptions per 100 inhabitants	33%	
Active mobile-broadband subscriptions per 100 inhabitants	33%	
	100%	
ICT skills		**20%**
Mean years of schooling	33%	
Secondary gross enrolment ratio	33%	
Tertiary gross enrolment ratio	33%	
	100%	

9.5.5 *Sensitivity Analysis*

A sensitivity analysis may be carried out to assess the robustness of the assessment results to different aggregation methods or weighting. Potential differences in the final results may be due to, for example, selection of indicators, data normalisation procedures or weighting. The sensitivity analysis would reveal how changes in any of these processes would affect the final results of the assessment. In the absence of errors in the assessment design, data collection or aggregation, the conclusions reached following the assessment should not vary dramatically.

9.5.6 *Stakeholder Support and Communication*

Communicating with a wide range of stakeholders is a significant challenge characterised by varying degrees of interest and influence/power. Understanding the nature of these different stakeholders, how and what to communicate to them, is a critical success factor in driving participation and support for a digital town initiative but also gaining consensus. The Digital Town Readiness Framework can generate a lot of data on a town which can be complex to communicate in a positive way. Care needs to be taken in how results of digital town readiness assessments are communicated to avoid negative backlash, demotivation, and disengagement. Data interpretation is a key consideration. For example, the .IE Digital Town Blueprint (.IE, 2021) aggregates scores across each dimension and sub-dimension and presents them as a cobweb diagram across a spectrum readiness from *non-existent* to *leading* as outlined in Table 9.12.

Identifying appropriate local digital champions for different stakeholders, dimensions and sub-dimensions may make data collection easier and less costly but will also ensure greater buy-in and support for subsequent actions. As well as local digital champions, there are a wide range of engagement methods including collaborative teams/task forces, town/community meetings, and of course online methods including websites, email newsletters, and social media.

Table 9.12 .IE Digital Town Blueprint Readiness Levels (.IE, 2021)

Dimension score	*Readiness*	*Explanation*
1	Non-existent	Digital Readiness is non-existent or at a very low level—The use and sophistication of digital technologies and capabilities likely do not exist. If they do exist, they are at very low levels of use and sophistication, largely informal and not documented, managed or measured at a town level. Key performance indicators (KPIs) are significantly below regional, national or EU averages
2	Ad Hoc	Digital Readiness is ad hoc and mostly not Documented—Some evidence of digital readiness in the use and sophistication of digital technologies and capabilities. Most are not documented and not managed. Performance may be measured and reviewed periodically but mostly informally. KPIs are below regional, national or EU averages
3	Defined/competitive	Digital Readiness is clearly defined and documented—There is clear evidence of digital readiness. Use and sophistication of digital technologies and capabilities are documented and planned. KPIs are competitive relative to peer towns and regional, national and EU averages
4	Significant/differentiating	Digital Readiness is clearly differentiating and Significant—The use and sophistication of digital technologies and capabilities and levels of digitalisation are significant and clearly differentiating compared to peers. KPIs are higher relative to peer towns and regional, national and EU averages
5	Leading	Digital Readiness is leading—The use and sophistication of digital technologies and sophistication and levels of digitalisation are best-in-class and approaching optimum states/full digitalisation with clear plans for further optimisation. KPIs are at the highest levels when compared to peers and regional, national and EU averages

9.6 Conclusion

All towns are different - however they, by and large, face many of the same problems. Digital technologies offer a solution for some of these problems. Unfortunately, very little is known about the state of digitalisation in smaller and rural towns. While the COVID-19 pandemic accelerated use of digital technologies by many, it also highlighted not just one digital divide but many. To reap the social and economic benefits of digitalisation in rural communities requires improved access to digital infrastructure and more sophisticated use of digital technologies, underpinned by more advanced digital competences and skills. The Digital Town Readiness Framework offers local communities, policy makers, and scholars an initial set of indicators upon which to develop digital town initiatives, and measure progress. For those ready to embrace the opportunity, it is a pathfinder on the road to a more equitable and impactful digital society.

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Useful Links

- IE Digital Town Blueprint: https://www.weare.ie/ie-digital-town-blueprint/
- CityKeys: http://www.citykeys-project.eu/
- Digicomp: https://ec.europa.eu/jrc/en/digcomp
- Digital Economy & Society Index (DESI): https://digital-strategy.ec.europa.eu/en/policies/desi
- Digital Planet: https://sites.tufts.edu/digitalplanet/
- ESCO: https://ec.europa.eu/esco/portal
- EU Broadband Connectivity Data: https://digital-strategy.ec.europa.eu/en/policies/desi-connectivity
- EU Broadband Internet Cost Study: https://digital-strategy.ec.europa.eu/en/library/broadband-internet-access-cost-biac-study
- EU eGovernment Framework Benchmark Report: https://digital-strategy.ec.europa.eu/en/library/egovernment-benchmark-2020-egovernment-works-people
- EU Survey of Schools: ICT in Education: https://data.europa.eu/data/datasets/2nd-survey-of-schools-ict-in-education?locale=en
- European Broadband Mapping Portal: https://www.broadband-mapping.eu/
- European e-Competence Framework: https://www.ecompetences.eu/
- Eurostat: https://ec.europa.eu/eurostat/web/main

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- G20 Roadmap Toward a Common Framework for Measuring the Digital Economy: https://www.oecd.org/sti/roadmap-toward-a-common-framework-for-measuring-the-digital-economy.pdf
- G20 Toolkit for Measuring the Digital Economy: https://www.oecd.org/g20/summits/buenos-aires/G20-Toolkit-for-measuring-digital-economy.pdf
- Global Open Data Index: https://index.okfn.org/
- I-DESI: https://digital-strategy.ec.europa.eu/en/library/i-desi-2020-how-digital-europe-compared-other-major-world-economies
- ILO Labour Force Survey: https://www.ilo.org/dyn/lfsurvey/lfsurvey.list?p_lang=en
- IMD-SUTD Smart City Index: https://www.imd.org/smart-city-observatory/smart-city-index/F
- ITU Development Statistics: https://www.itu.int/itu-d/sites/statistics/
- JRC Publications Repository: https://publications.jrc.ec.europa.eu/repository/
- OECD ANBERD database: https://www.oecd.org/sti/inno/anberdanalyticalbusinessenterpriseresearchanddevelopment-database.htm
- OECD Broadband Portal: https://www.oecd.org/sti/broadband/broadband-statistics/
- OECD Education Database: https://data.oecd.org/education.htm
- OECD Inter-Country Input-Output (ICIO) tables: https://www.oecd.org/sti/ind/inter-country-input-output-tables.htm
- OECD IP Database: https://www.oecd.org/sti/intellectual-property-statistics-and-analysis.htm
- OECD Main Science and Technology Indicators (MSTI) Database
- OECD OURdata Index: https://www.oecd.org/gov/digital-government/open-government-data.htm
- OECD Productivity Statistics database: https://www.oecd.org/sdd/productivity-stats/
- OECD R&D Tax Incentives database: https://stats.oecd.org/Index.aspx?DataSetCode=RDTAX
- OECD STAN Database: https://www.oecd.org/sti/ind/stanstructuralanalysisdatabase.htm
- OECD TiVA Database: https://www.oecd.org/sti/ind/measuring-trade-in-value-added.htm

- Partnership on Measuring ICT for Development: https://www.itu.int/en/ITU-D/Statistics/Pages/intlcoop/partnership/default.aspx
- PIAAC: https://www.oecd.org/skills/piaac/
- PISA: https://www.oecd.org/pisa/
- TALIS: https://www.oecd.org/education/talis/
- UNCTAD Digital Economy database: https://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx
- UN e-Government Survey: https://publicadministration.un.org/egovkb/en-us/
- UN e-Participation Index: https://publicadministration.un.org/egovkb/en-us/About/Overview/E-Participation-Index
- UNESCO Institute for Statistics: http://uis.unesco.org/
- UNESCO Media and Literacy Portal: https://en.unesco.org/themes/media-and-information-literacy

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