Addressing the Urban-Town-Rural Divide: The Digital Town Readiness Assessment Framework

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***Abstract*—Economic growth, job creation, better public services, and improved quality of life are just some of the benefits from the digital transformation of society. Policymakers worldwide are not only investing in the infrastructure to deliver this digital future but measurement and benchmarking to assess digital progress. These benchmarks are, for the most part, national benchmarks heavily influenced by broadband connectivity and an increasing focus on cities and metropolises. Against the backdrop of global urbanisation, towns outside the functional urban area of cities are in danger of both being depopulated and disconnected. This paper proposes a definition for a digital town and outlines eight rationales for digital towns. Based on these rationales and a review of existing benchmarking frameworks for digitisation, we present a framework for measuring digital readiness at a town level. The framework can be used by local stakeholders and regional and national policymakers to understand digital town readiness and digital competitiveness; compare a town against selected national and international benchmarks; and stimulate stakeholder engagement on digital strategies for town development.**

Keywords–Rural Development; Digital Town; Smart Cities; Smart Towns; Government Policy; Framework.

I. INTRODUCTION

"The Digital Society" is the latest sobriquet in a long list for 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 [1]. There is near-universal agreement that, at a national level, progress towards such digitisation and the societal and economic consequences are beneficial. As such, policymakers have invested heavily in Information and Communication Technologies (ICTs) to support digital agendas. To assess and benchmark performance and progress, a wide range of country-level and city-level indices have been developed and introduced by international organisations, industry bodies, firms, and academics.

Concurrent with the introduction and evolution of the digital society, there has been a significant rise in the proportion of the population that live in cities, from 37% in 1975 to 48% today [2]. This urbanisation has been driven by city expansion, city densification, and rural migration driven by economic opportunities and higher quality of life [2][3]. While the larger population results in an agglomeration of resources that attract economic activity, government investment, and opportunities for socio-cultural and political participation, greater population density has an adverse impact on sustainable development [2]. In an effort to reduce pollution and crime, limit exposure to natural hazards, transition to a low-carbon economy, and more recently curb the spread of infectious diseases such as COVID19, there has been an increased focus on the use of ICTs at a city level, so-called "smart city" technologies. Given the level of investment in smart cities, it is unsurprising that smart city indices have emerged including the Horizon 2020-funded CITYkeys indicators for smart city projects and smart cities, and the more recent IMD Smart City Index.

The term "digital divide", in reality, refers to two inter-related digital divides - (i) divides resulting from inequalities in the technological infrastructure required to support digital connectivity, and (ii) socio-economic digital divides [4]. These aspects have been explored in the urban-rural context for over two decades [4]–[6]. A substantial number of studies from around the world suggest this divide exists due to inadequate infrastructure [4][7][8], however more recent 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 [9][10]. In addition to broadband availability and geographic remoteness, suitability and social exclusion are also factors that have been cited as barriers to digital adoption and use in rural areas [8]–[10]. These inter-related factors may not be capable of being addressed

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by the market or government intervention alone, particularly where 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 [7].

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 [2]. This definitional ambiguity reduces comparability at all levels - international, national, regional, city, town, and other levels - and does not recognise fundamental differences in governance. While countries and cities have both policy making and investment capabilities, towns and rural areas may not, or if they do so, such capabilities are limited. This has been recently addressed by the European Union, the Food and Agriculture Organization of the United Nations (FAO), the International Labour Office (ILO), the OECD, UN-Habitat and the World Bank by the introduction of two new definitions, the degree of urbanisation and the Functional Urban Area (FUA) which proposes three classes instead of the traditional two - (i) cities; (ii) Towns and Semi-dense Areas (TSA); and iii) rural areas [2]. With the adoption of these definitions, new research is required to explore whether these categorisations provide new insights and identify a need for renovation of existing theories, measurement frameworks, and interventions that delineate between cities, towns and semi-dense areas, and rural areas so that the efficacy of digital policy and investment can be assessed and compared for these important and discrete parts of society. This paper presents preliminary work on a digital readiness framework to support towns (outside FUAs) and semi-dense areas in the assessment of digital readiness, benchmarking against national and international indicators, and the development of multi-stakeholder digitisation strategies.

The remainder of this paper is structured as follows. Next, we discuss the rationales for digital towns and propose a definition of a digital town based on extant literature. In Section 3, we review existing national and smart city frameworks for assessing digital performance and progress. We then briefly present the Digital Town Readiness Assessment Framework in Section 4. The paper concludes with a discussion of the current status of the project.

II. Defining and Rationalising Digital Towns

While there is extensive literature on smart cities, there is a paucity of research on the digital transformation of towns [11]. This can be partly explained by the attractiveness of cities to researchers and policymakers as a focal topic due to their size, impact and profile. This is not the only reason. A number of researchers and projects have focussed on *smart towns* [11]. While the term *smart city* focuses attention on cities, it does not necessarily preclude other urban areas, including towns, that use smart city technology and data to optimise the operation and services in that area [12]. Notwithstanding this, while towns face similar issues to cities albeit at a smaller scale, they have a number of local contextual challenges including availability of infrastructure services, geographic remoteness, smaller population sizes, amongst others [13][14]. In this paper, we do not focus on the quality of *smartness* as this derives from the use of (i) near-real-time data obtained from physical and virtual sensors; (ii) the interconnection between different services and technologies within the urban area; (iii) the intelligence from the analysis of the data, and the process of visualising it; and (iv) the optimisation of operations resulting from this analysis [12]. Instead, we focus on *digital* as a quality as we are interested in the transformations triggered by widespread adoption of digital technologies that generate, process, share and transfer information, in all aspects of life.

In addition, and as previously discussed, towns, until recently, were inconsistently classified as urban or rural thus preventing international comparisons. These factors are evident even in the limited literature on digital towns. For example, Aveiro in Portugal pioneered a "digital town programme" in the late nineties [15]. At the time, it had a population of over 75,000 people and today is an urban agglomeration with a population of over 120,000. Similarly, Fujisawa, a prominent Japanese *smart town* project is an urban area with a population of over 420,000 people [16]. At the other end of the scale, researchers and projects have focussed on smart and digital villages [17]–[19]. Again, definitional consistencies abound. The Digitale Doerfer project in Germany includes Billerbeck with a population of 450 people and Bodenheim with a population of over 20,000 [20]. In arriving at a usable definition of a Digital Town, we must recognise and account for the increasing expansion of cities and accommodate the new higher resolution OECD definitions, while also recognising existing perspectives on digital towns, and both general and local contextual rationales for digital adoption and use at a town level. As mentioned earlier, the OECD has adopted two definitions - the degree of urbanisation and the FUA. The degree of urbanisation reflects an urban-rural continuum and proposes three classes (i) cities; (ii) TSAs; and iii) rural areas [2]. 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) [21]. These definitions provide new insights in to population change. As discussed, population share in cities has increased to 48% with a corresponding drop in towns and semi-dense areas, and rural areas. However, overall population growth has meant that the population has increased in all area classifications. More importantly, research by the OECD on 111 countries suggest that social and economic opportunities follow an urban gradient including life satisfaction, income premia, employment opportunities, economic mobility, educational attainment, internet and mobile access and use, and the provision of public services [2]. Consequently, we focus on towns and semi-dense areas outside of the FUA of cities, and exclude low density rural areas. As such and to enable future comparability, we adopt the definition of town as per the revised OECD [2] definition:

1) Cities consist of contiguous grid cells that have a density of at least 1,500 inhabitants per km^2 and are at least 50% built up with a a population of at least 50,000.
2) Towns and semi-dense areas 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 5,000.
3) Rural areas are cells that do not belong to a city or a town and semi-dense area, and for the most part have

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a density below 300 inhabitants per km^2.

Based on analysis of existing community network and digital town projects, we identify at least eight rationales for digital towns that can be organised along a socio-economic spectrum - Social, Accessibility, Vocational, Sustainability, Quality of Service, Catalytic, Economic - and an over-riding Opportunistic rationale. 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 [15][22][23]. In many instances, this revolves around the provision of online platforms where stakeholders can share and consume information, services, and transact through marketplaces [20][24]. The Accessibility and Vocational Rationales also relate to participation in society. The former 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 [15], while the latter assumes that digital technologies help town residents prepare to work in a Digital Society [19][22]. 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 [22][23]. For example, Aveiro had a specific focus on training and providing employment opportunities for citizens with special needs in their digital town programme [15]. 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 [16][19][25][26].

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 [15][23][27]. A common theme in digital town projects is that role of digital technologies as a catalyst of other innovations from all parts of the community [11][15][23] (Catalytic Rationale). 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 [23]. 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 [23]. This includes increased tourism and retail activity in addition to potentially attracting digital industry investment and teleworkers [27]. For example, in the German Digital Doerfer project, the platform includes a service for ordering and delivering local products and services [20]. 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 [24].

These rationales are reflected in three prevailing perspectives found 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 [23]. In reality, a digital town is all of these things. 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.

III. Measuring Digital Readiness

The emergence of frameworks for assessing digital adoption and use emerged in the mid-nineties with the emergence of the World Wide Web and wider use of the Internet by the general public [28]. Unsurprisingly, given that telecommunications connectivity is a key enabling technology in the digital value chain, research and measurement frameworks initially emphasised the availability, quality, adoption and use of broadband as a key digital indicator [28]. For example, the International Telecommunications Union (ITU) ICT Development Index (IDI) seeks to assess country-level progress towards becoming an information society by measuring the level, evolution, and differences over time of ICT developments in countries and the experience of those countries relative to other countries [29]. First developed in 2008 and revised in 2018, IDI comprises three sub-indices - ICT Access (infrastructure availability and access), ICT Use (level of ICT usage and intensity), and ICT Skills (capabilities of the citizens) comprising 14 indicators in total [29]. ICT Access and ICT Use each have a weighting of 40%, the ICT skills sub-index has a weighting of 20%; discrete indicators within each sub-indices have equal weightings [29]. While commonly referenced, this index places a significant emphasis on Internet, and specific broadband and mobile connectivity, and is relatively simplistic. For example, ICT skills indicators primarily relate to enrollment in schools with only one indicator on specific ICT skills. Other than education, it does not delineate between different actors in a given country.

In the last decade, frameworks have expanded to reflect the wider transformative impact of digital technologies on society at different levels - country, city, and to a lesser extent towns and other rural areas. These include the European Union (EU) Digital Economy and Society (DESI) Index, the Digital Capital Index, the Digital Evolution Index, and the Digital Ecosystem Development Index, to name but a few. DESI [30] is a composite index designed for monitoring and benchmarking the digital competitiveness of EU Member States in digital competitiveness. DESI [31][32] measures performance across five dimensions:

1) Connectivity: the deployment of broadband infrastructure and its quality i.e., broadband take-up, fixed broadband coverage, mobile broadband and broadband prices;
2) Human Capital: the Internet user and advanced skills needed to take advantage of the possibilities offered by a digital society;

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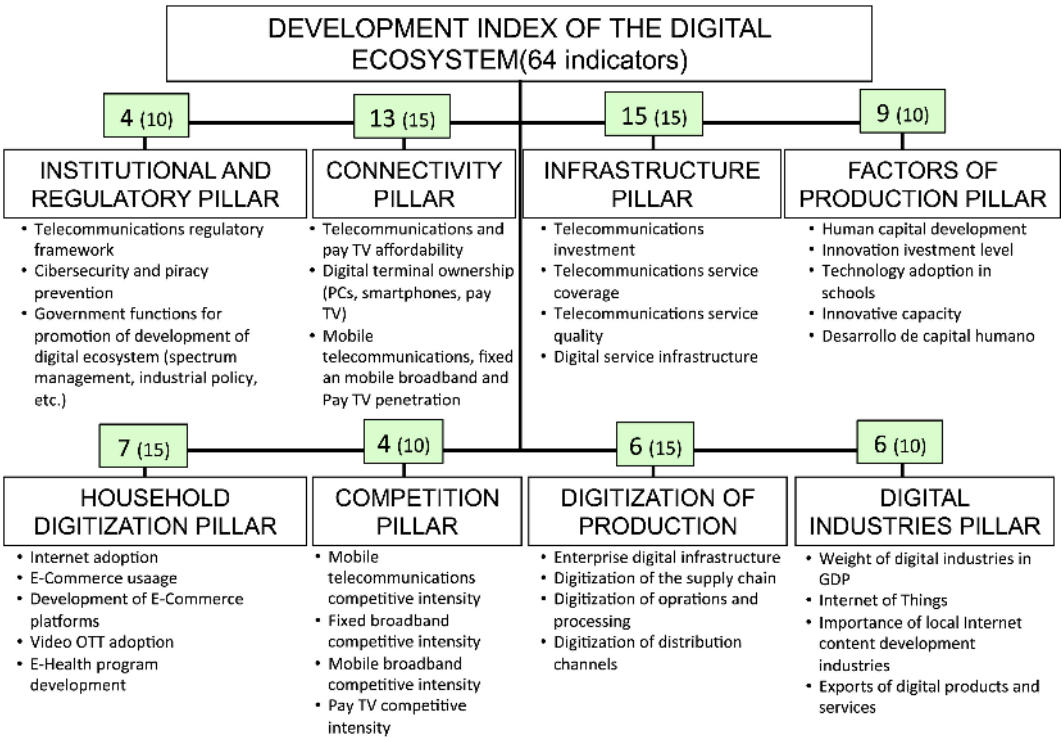

Figure 1. Structure of the Digital Ecosystem Index [28]

3) Citizen use of Internet and online transactions: the variety of activities performed by citizens already online;
4) Business digitisation and e-commerce: the digitisation of businesses and development of the online sales channel;
5) Digital public services: the digitisation of public services. It should be noted that DESI 2020 does not include ehealth as part of the Digital Public Services report as no new data was reported in [33]. It is unclear whether this is a consequence of the COVID19 pandemic or not.

Since 2018, an international version of DESI (I-DESI) was produced comparing the 28 countries in the EU with 17 non-EU countries [32]. DESI is based on data regularly collected by EU member states however in some cases, for example rural data, this may be based on aggregating a number of towns, semi-dense and sparsely populated rural areas based on the Nomenclature of Territorial Units for Statistics (NUTS). NUTS is a geocode standard for referencing the subdivisions of a country for statistical purposes. It aggregates towns and regions at a resolution level that may not be useful for town-level strategic planning.

Similar to DESI, the Digital Capital Index (DCI) focuses specifically on the digital evolution of a population. In the context of the DCI, digital capital is defined as an accumulation of both digital competencies and digital technologies (or digital access). The former seeks to measure the individual abilities of citizens based on the European Digital Competence Framework for Citizens i.e., information and data literacy, communication and collaboration, digital content creation, safety, and problem solving. The latter, digital access, includes indicators on the access to digital equipment, connectivity (quality and place), historical time spent online, and support and training. While not specifically focusing on towns or rural areas, Ragnedda, Ruiu and Addeo [34] find that urban users are more likely to have higher digital capital than rural users.

The Digital Evolution Index (DEvI), introduced in 2015, is an attempt to assess the progress and benchmark country-level progress towards a digital economy [35]. In the DEvI, the competitiveness of a country's digital economy is a function of two factors - (i) its current state of digitisation based on four drivers (supply conditions, demand conditions, institutional environment, and innovation and change) comprising between 99 and 170 indicators, and (ii) its pace of digitisation (momentum) over time measured by the growth rate of a country's digitisation score over a ten-year period (2008—2017) [36]. Based on these two factors, digital progress can be categorised as (a) rapidly advancing, (b) steadily advancing, (c) slow moving, and (d) declining [36]. Similar to the DEvI, Katz and Callorda developed the Digital Ecosystem Index (DEcI) [28] to address limitations in country-level frameworks that overly focussed on telecommunications infrastructure or a subset of an economy. The DEcI comprises 64 indicators organised in to eight pillars as per Figure 1.

More recently, there has been an effort to assess the state and evolution of digital progress at a city level. These efforts are largely in the *smart city* domain and as such often conflate both digital and environmental sustainability themes. The Smart City Index (SCI) assesses the adoption of smart technologies in a given city. SCI comprises two pillars, Structures and Technology, and each pillar is evaluated from five perspectives - health and safety, mobility, activities, opportunities, and governance. For comparison purposes, cities are

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also categorised against four groups based on the UN Human Development Index (HDI) score of the economy they are part of, and are ultimately given a rating for each pillar and overall, an overall ranking. Similarly, the EU-funded CITYkeys project propose a benchmarking framework, indicators, and associated data collection procedures for monitoring and benchmarking smart city solutions across European cities [37]. The CITYkeys smart city indicator framework is organised around five themes:

1) People - health, safety, access to services, education, diversity and social cohesion, quality of housing and the built environment;
2) Planet - energy and mitigation, materials, water and land, climate resilience, pollution and waste, ecosystem;
3) Prosperity - employment, equity, green economy, economic performance, innovation, attractiveness and competitiveness;
4) Governance - organisation, community involvement, multi-level governance; and
5) Propagation - scalability and replicability [37].

CITYkeys is the basis for the ETSI technical specification for standardised key performance indicators for sustainable digital multiservice cities [38].

As can be seen from the aforementioned indicators, many of the indicators are not within the control of local communities or municipal authorities at a town-level. Furthermore, the discussion of smart cities and related technologies is often conflated or combined with environmental sustainability and associated outcomes. Additionally, where indicators might be relevant, data may not easily be available or required at regional or national levels and therefore are not collected or easily accessible for town stakeholders. While we could not find robust town-level indicators for digital readiness, those we identified, for example Kalinka et al. [39], are designed for sustainable local area planning rather than digitisation purposes.

IV. The Digital Town Readiness Framework

The Digital Town Readiness Assessment framework was developed by the Irish Institute of Digital Business and the IE Domain Registry, the Irish national registry for ".ie" domains, to support stakeholders in towns outside FUAs to rapidly and cost-effectively:

- Understand current digital town readiness and digital competitiveness;
- Compare a town against national and international benchmarks; and,
- Stimulate stakeholder engagement on digitisation.

Based on desk research of existing frameworks for measuring digital adoption and use and consultation with stakeholders in target areas, an initial framework was developed. The framework comprises eight dimensions as per Figure 2, namely Connectivity, Digital Citizen, Digital Education, Digital Civil Society, Digital Business, Digital Public Services, Digital Tourism, and Horizontal Integration.

A. Connectivity

Based on extant indices and literature, we include a connectivity dimension with nine sub-dimensions relating to the deployment, quality, adoption and use of broadband. Firstly, we include two sub-dimensions relating to the availability of documented plans for both fixed and mobile broadband connectivity for the town. Secondly, in line with DESI [30], we include five sub-dimensions relating to equal access to fixed, mobile, wireless, and next generation access technologies in the town. As per [28], we assume greater competition between broadband and mobile phone services will result in lower prices to access these services as well as higher quality of service. Consequently, we include local competition levels between telecommunications service providers as a factor. Literature suggests that municipal and free public Wi-Fi access contribute to economic growth [40][41], promoting tourism [42][43], social inclusion [44][45], public safety [45]–[47], and improved public services [43][48]. Similarly, a number of commentators have emphasised the need for local economic policy to focus on encouraging teleworking in rural areas [49]–[51]. As such, we include two sub-dimensions relating to the availability of free public Wi-Fi and public Internet access in public and co-working spaces in the town.

B. Digital Citizen

The Digital Citizen dimension focuses on the competence and usage of digital technologies by citizens in a town. Again, we include two sub-dimensions relating to the availability of documented town-level plans for increasing digital competencies and usage by citizens in the town. To allow country-level and international comparability, we adopt and expand the sub-dimensions and indicators used in DESI and the European Commission Digital Skills Indicators. This includes the number and complexity of activities involving digital technologies including the Internet, as well as the availability of more advanced skills and development, and use of internet services, e-commerce, digital public services, and health and care services. Again, reflecting recent emphasis in scholarly literature and policy, we include a sub-dimension for teleworking, freelancing and other sharing economy work.

C. Digital Education

It is increasingly accepted that digital technologies and related affordances can directly change the nature of teaching and learning; this is particularly poignant against the backdrop of the COVID19 pandemic. The Digital Education dimensions relates to the support for use and sophistication of digital technology in education and the provision of training and education in digital technologies for all levels. Extant general digitisation measurement frameworks either focus nearly exclusively on Internet access and computer availability in schools as in DEcI [28] or, as per DESI [30], do not include digital adoption and usage in education at all. There are numerous benchmarking studies on ICT adoption by education which primarily focus on schools and higher education. These include reports and studies by the UNESCO Institute for Statistics [52], European Schoolnet [53], and more recently the European Commission's DG CONNECT [54]. As digital adoption and use are heavily influenced by the experience and skills of the user population, and older citizens may not have had the same opportunity to

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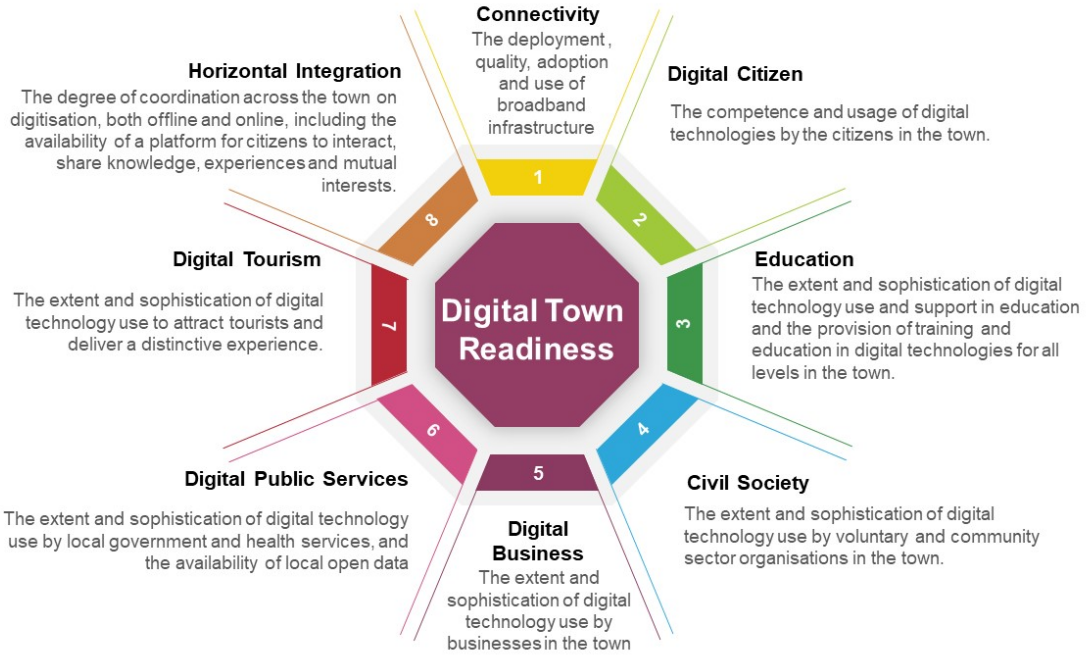

Figure 2. The eight dimensions of the Digital Town Readiness Framework

acquire these skills, we include 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. As such we include all education providers including pre-school, primary, post-primary, and other digital skills education providers including training provided by community organisations, local, regional and national agencies, and commercial organisations. To aid comparability, we adopt and extend sub-dimensions from extant benchmarks for ICT in Education including access to and use of digital technologies, digital activities and digital confidence of educators and students, ICT-related professional development for educators, and the availability of digital policies, strategies, and plans at town and institutional levels.

D. Digital Civil Society

Digital Civil Society refers to the use and sophistication of digital technologies by Voluntary and Community Sector Organisations (VSCOs) in a town. These include charities, sports and social clubs, political parties etc. While there are indices to measure digital social innovation, for example the DSI Index [55], 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 VSCOs, in their day to day activities. Again, such indices are often at a country- or city-level. VSCOs are rarely included in the mainstream digital indices. Similar to the literature in the commercial domain, extant literature suggests that digital technologies can transform VSCOs' organisational capacity and stakeholder engagement [56][57]. Like commercial organisations, VSCOs can generate value and exploit the same opportunities digital technologies present including cost savings, process efficiencies, new revenue generation, and improved quality of service [56]–[58]. Notwithstanding this, extant literature suggests that digital adoption by VSCOs is limited [59], with a substantial focus on the use of digital technologies for communication [57][59]–[61]. We include similar sub-dimensions as those for businesses adapted for the VSCO context in our framework e.g., the range of digital technologies used by VSCOs and their use of e-commerce. In 2019, more than half of charities (52%) surveyed in the UK didn't have a digital strategy. As such, we include a sub-dimension on the availability of a documented plan for towns and individual VSCOs on the use of digital technologies. Research has suggested digital adoption by VSCOs has been hindered by digital experience and skills [56][57][60][61] and that this has been especially damaging during the COVID19 pandemic [61]. Consequently, we include sub-dimensions on the confidence of VSCO officers and their completion of digital skills training in the previous two years.

E. Digital Business

It is widely accepted that the adoption and use of digital technologies by business can generate business value and improve competitiveness. So-called third platform technologies - cloud computing, Big Data analytics, social media and mobile technologies - can create new revenue generation opportunities through e-commerce, introduce new business models and faster time to market, reduce costs, generate and provide faster time to insight, and enable intelligent infrastructure [62]. This can often be accomplished with lower upfront investment, reduced risk, and improved organisational agility and efficiency [63]–[66]. The positive impact of broadband and ICT infrastructure, websites, e-commerce, social media, CRM, and other digital business technologies on small-to-medium sized businesses is well established [67]. However, a digital divide between

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urban and rural SMEs is also noted in the literature [67]. In line with DESI [30], the Digital Business dimension relates to the use and sophistication of digital technology use by local businesses. We include 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 DESI [30], we include sub-dimensions on business digitisation and e-commerce but also the availability of digital equipment and next generation technologies e.g. blockchain, the Internet of Things, 3D Printing etc. We expand the indicators on business digitation to include indicators for data protection, website security, and international business readiness. To capture the human capital dimension, we include sub-dimensions on employee confidence in their digital competences, and the recency of digital skills training.

F. Digital Public Services

Similar to DESI [30], we define digital public services as the use and sophistication of digital technology by local government and health services, and the availability of local open data.

1) E-government

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"* [68]. There is an extensive literature both on the measurement of the maturity of e-government [69] and relatedly the performance assessment of e-government projects [70]. Most e-government maturity models do not focus on local government and town-level e-government which often includes inherited national and regional e-government systems, as well as local initiatives. In their review of performance assessment frameworks for e-government projects, Singh et al. [70] note the importance of placing the citizen at the centre of e-government performance assessment. In particular, the note the prevalence of user satisfaction, and specifically ease of use and usefulness in e-government performance assessment. In our assessment of e-government readiness, we take citizen-centric approach largely following Belanger and Hiller's five-level maturity framework i.e., (i) information, (ii) two-way communication, (iii) transaction, (iv) integration, and (v) participation [71]. In addition, we include both mobile and desktop usability as an indicator of readiness. For comparability, we use similar indicators to DESI [30].

2) eHealth

eHealth can be defined as *"the use of Information and Communication Technologies (ICT) across the whole range of healthcare functions"* [72]. eHealth 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 [73]–[76]. At a macro level, studies suggest that eHealth can result in significant cost savings and improved service quality [77]. In rural communities, local doctors play a central role in facilitating access to, and delivery of, care [78][79] as they represent the main point of contact between the healthcare system and citizens. As such, they are in the position to gather important information which would constitute the basis of an IT-enabled integrated healthcare system [80]. For this reason, the EU, prior to 2020, mostly focused on the adoption of eHealth services such as e-Prescribing and data exchange by GPs when it comes to measuring the digitisation of healthcare across different countries [81]. However, other actors like pharmacies and specialised doctors (e.g., physiotherapists, orthodontists, etc.) may also play a critical role in fostering the adoption of eHealth services within communities [82]–[84]. As DESI, at least up to 2019, only recorded the eHealth adoption rate by GPs, this may lead to a partial picture of the current status of eHealth. To address this we expand eHealth indicators to include all medical practitioners and related actors.

3) Open Data

Open data is commonly defined as "data that can be freely used, shared and built-on by anyone, anywhere, for any purpose" [85]. Open Government Data (OGD) is specifically concerned with making public sector information freely available in open formats and ways that enable public access and facilitate exploitation [86]. Open data is heralded as means of delivering a wide range of political and social, economic, and operational and technical benefits [87]. Claims about OGD are equally effusive. For example, the EU impact assessment on the reuse of Public Sector Information (PSI) suggests PSI has the potential to achieve 1.7 billion in cost savings through better policy making, generate up to 52 billion in economic value, as well as bridging the gap between government and citizens in terms of information, and, in general, leading to increased social inclusion and empowerment, civic participation, and improved personal decision-making capabilities [88]. Due to the nascency of the OGD movement, there is limited evidence to support these claims however OGD remains an indicator in country-level digital indices including DESI [30]. With this in mind, we include an open data component that seeks to uncover evidence of local government availability of an open data plan, a systematic approach to collecting and publishing town level open data on local and/or national open data portals.

G. Digital Tourism

The travel and tourism industry has been at the front line of both digital disruption and transformation [89]. Tourism is a major contributor to rural economies and has long been seen as a counter-measure to the decline of traditional agrarian industries [90]. Digital Tourism is the use and sophistication of digital technology to attract tourists and deliver a distinctive experience. Typically, tourism is not addressed discretely from other industry sectors. However, given the idiosyncrasies of digital disruption to travel and tourism, its emphasis in rural economic development literature and policies, and the opportunities for digitisation both of tourism businesses and destinations, we include digital tourism as a discrete dimension. In line with other dimensions, we include the availability of a tourism plan for the town with specific digital aspects. For comparability, we adapt the sub-dimensions used for digital businesses above for the tourism sector including indicators relating to tourism-specific technologies including booking engines and reviews. We include a dimension relating to the availability of information online relating to local events and

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popular tourism destination sites, and a separate dimension relating to the availability of a dedicated website for the town and the quality of the information, features and functionality of that site. Smart tourism involves the use of digital technologies to create more intelligent, meaningful and sustainable connections between tourists and the destinations [91]. It includes digital signage and wayfinders, augmented and virtual reality integration, digital kiosks, amongst other technologies that are embedded and accessible in the public realm of a town. Consequently, we include smart tourism as a sub-dimension in the framework. Research has suggested that availability of free public Wi-Fi contributes to tourism promotion, [42][43] we include this as an additional sub-dimension at the destination site level.

H. Horizontal Integration

Reflecting the experience of existing digital town initiatives [7], we take the position that digital towns require a broad concept of community governance that, as per Leach and Percy-Smith [92], involves multi-agency working and self-organising networks that cut across organisational and stakeholder boundaries. In the Digital Town Readiness Framework, horizontal integration relates to the degree of coordination across the town on digitisation, both offline and online, including the availability of a platform for citizens to interact, share knowledge, experiences and mutual interests. In this way the sub-dimensions reflect the the UK Department of the Environment, Transport and the Regions definition of community strategy [93] in that we seek to identify and assess the existence of a governance mechanism, e.g., a Digital Town Working Group, a shared digital vision and documented strategy for the town and its inclusion in municipal and regional plans, and arrangements for monitoring progress of the plan against targets. Furthermore, recognising the role online town-based portals and platforms play in digital town initiatives [15][23], we assess the availability and quality of an online platform for stakeholders to interact, share knowledge and mutual interests.

V. Conclusion

This paper recognises the need to differentiate between digital policy interventions and planning for cities, towns outside of the functional urban area of cities, and rural areas. We propose a definition of a digital town and outline eight rationales for digital towns. Based on a review of extant literature, and digital benchmarking frameworks and indices, we present an initial framework for assessing the digital readiness of towns based eight dimensions. The framework was designed to address the need for community-based planning and to provide a tool for understanding the status of digital readiness in a town, comparing towns against domestic and international benchmarks, and stimulating multi-stakeholder engagement on digitisation. At the time of writing, an easy-to-use checklist for self-assessment has been developed for use by towns, and a process and enabling workflow has been developed for a more comprehensive assessment. The latter includes two versions, a rapid and full assessment. The rapid assessment has been piloted in five towns in Ireland reflecting different regional contexts and population trends. Furthermore, data was collected both pre- and post-COVID19 to enable an assessment of the short-term impact of the COVID19 pandemic on digital adoption and use in those towns. Further work is required on the weighting of dimensions, sub-dimensions and indicators before wider rollout.

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