DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

NATIONAL POLICY ANALYSIS SCOTLAND

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Digitalisation in Scotland and the wider UK

- Whilst much of urban Scotland and UK now enjoys superfast broadband speeds, there are still rural areas that suffer with a lack of a decent broadband connection (defined by UK Government as minimum10MBPS). This is despite initiatives and policies over more than a decade which promised to implement universal access to decent broadband in order to eliminate the urban-rural digital divide.
- Digital skills continue to be a problem in the UK, with many of those with poor digital skills located in rural areas. Poor digital skills are associated with demographic factors such as age, disability status and gender which correspond with rural demographics.
- In Agriculture and Forestry, initiatives and innovation hubs support digitalisation of the sectors. To date, digital tools are more widely adopted by large farms, and small farms are left behind.
- The UK's Network Readiness Indictor (NRI) score (76.27) is 12% higher than other high-income countries.

The digitalisation policy landscape

- Since the UK exited the EU it is no longer able to benefit from European digital policies such as the European Digital Strategy and Digital Agenda for Europe. The UK is updating its own 2017 Digital Strategy including the 2018 Digital Charter.
- Several policies and initiatives seek to provide universal broadband (of at least 10MBPS) across all of the UK (some policies relevant only to Scotland). These schemes total more than £6.7billion in funding commitment. This promises to improve connectivity in rural areas. However, urban regions are set to be served with even faster superfast broadband, hence it is unlikely that we will see a reduction in the urban-rural digital divide.
- Other policies and initiatives, such as Digital Bootcamps and UK Digital Toolkit seek to eliminate digital divides by improving digital skills and widening access to digital tools and opportunities. These schemes total more than £8million in funding commitment, and some are aimed at hard to reach areas, including rural.
- A number of policies, initiatives and innovations hubs, such as the Digital Catapult and Roots for Growth seek to boost digital innovation in the Scottish and UK economies. These total funding of over £6.6billion, both from public and private investments.

Digital Services

- The UK's public services are well integrated digitally. In an analysis across European countries (DESI Digital public services 2020), e-government services for businesses in the UK were one of the top 5 European countries. However, those with low levels of access or skills are excluded from key services, especially given the UK Government's commitment to all services being provided "Digital by Default".

1. Introduction

This report presents current policy and initiatives relevant to digitalisation in Scotland and the wider UK. As well as presenting the relevant policies and initiatives in this context, we also focus on those which are either directed at rural regions, or have particular relevance for rural Scotland and UK, in relation to agriculture, forestry and broader rural economies and communities.

The report presents the **context for digitalisation** at a national (Scotland and UK-wide) level. The report finds that, despite many initiatives and promises aiming towards universal broadband provision over more than a decade, there are still rural areas that suffer with a lack of a decent broadband connection (defined by UK Government as minimum 10MBPS) and hence struggle to participate in digital aspects of work and everyday life.

Digital skills are another area of disadvantage for some groups in Scotland and the wider UK. Many of those who lack in digital skills are located in rural areas. Poor digital skills are associated with a number of different demographic characteristics. Older people, women, people with low incomes and those with a disability are more likely to struggle with digital competencies. These demographic characteristics correspond with those often found in rural areas.

The **Agriculture and Forestry sectors** are supported through a number of strategies and innovation hubs. These aim at boosting innovation in these sectors through digitalisation. Evidence suggests that to date, digital tools (hardware, software, data) are more widely embraced by large farms, as these are most likely to have the capital to invest, and the farm size to see a return on investments more quickly. Small farms are not included and tend to be left behind, potentially placing them at a competitive disadvantage.

We outline a number of policies and initiatives based on **connectivity and infrastructure**. These typically seek to provide universal broadband (of at least 10MBPS) across all of the UK, or Scotland (where those policies and initiatives only apply at that level). These various schemes, mostly funded through public investment mechanisms, total more than £6.7billion in funding commitment. This promises to improve connectivity in rural areas. However, urban regions are set to be served with even faster superfast broadband, hence it is unlikely that we will see a reduction in the urban-rural digital divide.

There are a number of policies and initiatives, such as Digital Bootcamps and UK Digital Toolkit which are focused on **reducing the impacts of the digital divide**, by improving digital skills (particularly amongst disadvantaged communities, including in rural regions) and widening access to the digital tools and opportunities that require adequate levels of digital skills in their implementation. These schemes total more than £8million in funding commitment.

Finally, there are a number of policies, initiatives and innovations hubs, such as the Digital Catapult, the Agri-Epi centre, and Roots for Growth initiative which seek to **boost digital innovation** in the Scottish and UK economies. These total funding of over £6.6billion, both from public and private investments. These are more typically found in urban-centric settings (with the exception of those aimed at Agriculture and Forestry), though rural innovation hubs (offering more broad support) exist in a number of rural regions and offer a limited amount of digital skills support.

The report also discussed the current situation of **digital services** in Scotland and the wider UK. The UK's public services were found to be well integrated digitally overall, in the DESI 2020 report. In the analysis across European countries (DESI Digital public services 2020), e-government services for businesses in the UK were one of the top 5 European countries. This arguably makes the UK one of the best places to work and run a business in Europe. However, there is an increasing concern that for those with low levels of digital access or skills, engaging with key services will be increasingly difficult, given the UK's ongoing commitment to their "Digital by Default" policy. This is another reason for the pressing importance of digital inclusion for the most vulnerable and disadvantaged members of Scottish and UK society, to ensure that they are not further marginalised by the rapid pace of digital developments.

Governance in Scotland and its place in the wider UK

In this report we present information relating to both Scotland as a devolved nation, and the wider UK (where policies and initiatives are relevant in Scotland as a devolved nation). Localism and devolution have been a strong theme in UK governance for over two decades, since the devolution of governing powers to the national administrations of Scotland, Wales and Northern Ireland, and to the English regions in the 1990s (Brooks et al. 2019). In 1997, a referendum was held in Scotland. The Scottish electorate voted in favour of a Scottish Parliament; the Scottish Parliament was set out in the Scotland Act of 1998 and established in 1999. The Scottish Government has responsibility for many domestic policies, with all other matters dealt with at Westminster.

The National Context in Scotland

In comparison with the rest of the UK, Scotland is characterised by having a larger proportion of rural regions and residents, particularly in terms of remote rural communities (Townsend et al. 2013). Spatial injustices are frequently discussed relative to deprivation, with reference to the Scottish Index of Multiple Deprivation (SIMD), and these often correspond with remote rural regions. The SIMD is used extensively by support agencies to provide support where it is most needed. In 2015, Highlands and Islands Enterprise (HIE) developed a fragile areas classification which describes regions which suffer from a number of key issues, including declining population, declining youth, lack of employment and problems of access to transport and other key services. Not surprisingly, these regions are all located in remote rural areas (Brooks et al. 2019).

Scotland and UK – their place within European policy

In this report, we sometimes refer to European policy in relation to its impacts at a national (Scotland or wider UK) level, particularly in rural regions. However, the exit of the UK from the EU (Brexit) means that many European policies are no longer applicable at a Scottish and UK level. We refer to policies where they may already have had impact or influence, or where they might continue to do so (for example the impacts for the wider UK of being excluded from the benefits of European e-commerce supported by the European Digital Strategy and Digital Agenda for Europe), but there are a number of digital policies at EU level which do not apply in our report. The UK is updating its own 2017 Digital Strategy including the 2018 Digital Charter.

2. Context for (rural) digitalisation

2.1 Current context for digitalisation

- **What is the current situation of the digitalisation process in your country?**

Rural areas in Scotland have historically had, and continue to have, poor digital infrastructure in comparison with urban or peri-urban areas. This is largely due to the topography of rural land and dispersed rural populations, which means that it has not been cost effective for internet service providers to install high speed fibreoptic broadband (OECD, 2018[1]). This has consequently left the rural population on the periphery when compared to urban areas. In turn, this has a detrimental effect on the sustainability and potential for growth of rural communities and economies.

A number of policies are in place to provide better digital infrastructure in rural areas, by making these areas more viable to internet service providers through government intervention subsidising the costs of rural internet infrastructures. These have not yet succeeded in providing country-wide reliable access to the Internet.

Since some rural populations have not been provided with the ability to connect to the internet on a consistent and reliable basis, rural attitudes are sometimes dismissive towards digital technologies. Rural communities continue to face numerous significant challenges (Creaney et al., 2021), especially when these communities tend to be made up of ageing populations. The failure of government and internet service providers to implement reliable connectivity has hindered possible digital solutions to this issue.

In terms of Agriculture, the situation is somewhat different. Large farms have taken up a range of digital tools and platforms, e.g. Variable Rate Precision Farming technologies. Most Smart Farming Technologies (SFTs) are only accessible (in terms of cost) by the largest farms. Arguably these technologies are designed with the larger farms in mind (and hence aimed at those) as these have the most capital to invest in technologies, and larger number of acres to see a return on the investments more quickly (Townsend and Noble, In Press). This disparity between which farms can and cannot access SFTs contributes to an intra-rural divide amongst agricultural businesses in rural Scotland (Cowie et al. 2020).

In the Forestry sector, digital technologies promise to contribute to growth and the potential for the sector to increase its contribution to the Scottish rural economy over the next 10 years. To this end, two innovation centres have been implemented - Construction Scotland Innovation Centre[2] and Industrial Biotechnology Innovation Centre[3] (Scottish Forest and Timber Technologies Industry Leadership Group, 2018). These innovation centres aim to develop new and innovative wood-based

[1] https://www.oecd-ilibrary.org/development/development-co-operation-report-2018_dcr-2018-en

[2] https://www.cs-ic.org/

[3] https://www.ibioic.com/

value-added products and processes and markets for them. They also aim to inspire adoption of technologies across the sector.

- **How many people or what percentage of population has access to broadband?**

The Ofcom (2020) Connected Nations (Scotland) report[4] highlights that in Scotland, 94% of the population can now access superfast broadband. Scotland has a higher proportion of properties with gigabit capable broadband – 42% compared to 27% in the UK as a whole, but lags slightly behind when we compare residential premises with access to superfast broadband – 94% at September 2020, compared to 96% for the rest of the UK. In addition, circa 437,000 (17%) premises in Scotland now have access to full-fibre broadband. The report argues that the number of premises in Scotland without access to decent broadband is shrinking. 4% of premises cannot get access to decent broadband through a fixed line. Factoring in coverage from both fixed and fixed-wireless networks, the report estimates around 34,000 (1.2%) premises in Scotland do not have a decent broadband connection. This is higher than the estimate for the UK as a whole – an estimated 155,000 UK properties (0.5%) were unable to get decent broadband in 2019 – a significant decrease compared with 677,000 UK properties (2%) in the previous year (Ofcom 2019). Finally, the report estimates that around 10,650 premises in Scotland cannot access either a decent fixed broadband service or good 4G coverage indoors.

Nations	All	Rural	Urban
England	2% (412,000)	8% (273,000)	1% (138,000)
Northern Ireland	6% (50,000)	19% (44,000)	1% (6,000)
Scotland	4% (98,000)	19% (89,000)	0% (9,000)
Wales	3% (50,000)	12% (42,000)	1% (8,000)
Total	2% (610,000)	10% (449,000)	1% (161,000)

Source: Ofcom analysis of operator data

Figure 1: Premises unable to receive a decent broadband connection from a fixed line

Figure 1 illustrates that those unable to access decent broadband across the UK are more likely to reside in rural areas – a significantly larger number of premises in rural areas are without decent broadband in all cases. This is supported by the DESIRA Pan-European report on Digitalisation Assessment[5], which found a strong relationship between ruralisation and poor broadband access in the UK, along with other countries across Europe (de Clercq et al. 2021).

- **Main differences of connectivity/use of digital tools/access to digital services between rural and urban areas?**

Because rural areas historically have not had access to the same kinds of Internet speeds as those in urban areas, digital skills and developments in rural areas lag behind significantly in comparison with urban areas. This is what is referred to as the urban-rural digital divide, and it has a number of consequences for rural communities and economies which already find themselves at a disadvantage

[4]https://www.ofcom.org.uk/__data/assets/pdf_file/0021/209442/connected-nations-2020-scotland.pdf
[5]https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12900-Europe%E2%80%99s-digital-decade-2030-digital-targets/F1965844_en

due to the unique challenges found in rural regions, including remoteness, poor access to key services and increasingly ageing populations. The digital divide has put rural populations in a pre-disposition to be left behind (Cowie et al., 2020). As a lack of decent broadband prevents rural populations from advancing at the same pace as urban populations therefore, reliable high-speed broadband will be required in these areas to ensure that they can participate in digitalisation and reap its benefits to the same extent as those living and working in urban environments. This slow pace of digital development in rural areas also means that they typically see less digital innovations and have poorer access to digital services (Townsend et al. 2013; Roberts et al. 2016).

- **Has the digital divide been analysed and/or addressed?**

The urban-rural digital divide has been seen extensive academic research (Cowie et al. 2020; Wilson and Hopkins 2019; Townsend et al. 2015). A number of policies implemented to improve broadband connectivity and skills in rural areas have referred to the issues of the digital divide in their rationales. For the last two decades a number of Scottish Government policies have aimed to address the digital divide. In 2016 the Scottish Government implemented its initiative to serve 100% of premises with superfast broadband by 2021 under the "Reaching 100%" (R100) Programme[6], aimed at procuring digital infrastructure in rural regions where speeds of greater than 30 Mbps are not currently available. At community level, there have been attempts to try and address issues regarding the digital divide via the implementation of community-led broadband schemes, such as those developed in Cybermoor[7], Knoydart[8] and Cromarty[9].

In the 2017 "Europe's Digital Progress" report[10] for the UK, it is stated that the UK has reached 100% coverage of broadband at minimum 2 megabits per second (MBPS). However, this broadband speed is no longer considered adequate for everyday living and working, since digitalisation has progressed according to the affordances of superfast broadband which is experienced by many premises (particularly in urban areas). Therefore, rural areas in Scotland and the wider UK are characterised by a number of "notspots" which cannot access decent broadband connectivity (Ofcom defines "decent broadband" as having speeds of 10 MBPS at minimum). Those unable to access such speeds are at a disadvantage as many aspects of work and daily life become more digitalised and depend upon superfast broadband. Rural businesses are unable to keep up with their urban counterparts. Therefore, despite significant efforts to improve connections across Scotland and all of the UK, it is argued that the digital divide is widening based upon the large disparities between broadband speeds in urban vs. certain rural regions (Cowie et al. 2020).

[6] https://www.gov.scot/news/delivering-r100/

[7] https://www.facebook.com/CybermoorAlston/

[8] https://knoydart.org/2009/07/22/community-broadband-access/

[9] https://www.cfwn.co.uk/

[10]https://digital-strategy.ec.europa.eu/en/news/european-digital-progress-report-review-member-states-progress-towards-digital-priorities

Network Readiness Index (NRI)

The Network Readiness Index (NRI) developed by the World Economic Forum is one of the leading global indices on the application and impact of information and communication technology (ICT) in economies around the world. In its latest version of 2020, the NRI Report[11] maps the network-based readiness landscape of 134 economies based on their performances in four different pillars: Technology, People, Governance, and Impact. Each of these pillars is itself comprised of three sub-pillars that have been populated by a total of 60 variables.

The report does not give information about Scotland, rather it reports at a UK level. The report shows that compared with 133 other countries, the UK has particular strengths in digital readiness in a number of areas: *"when it comes to Technology (8th), which is due to an impressive level of Access (3rd) to ICTs and strong showings in both the Content (8th) and Future Technologies (14th) sub-pillars. These factors seem to have a positive Impact (10th) on the society, especially in terms of sustainable development (5th in SDG Contribution)."* The UK does not do quite as well in terms of People and Governance (ranking 14th in both pillars). The report suggests that the UK has high levels of digital inclusion and trust, compared with other countries.

The report points to evidence of weaker regulation in the UK, when examining policies that have been unsuccessful in closing the digital divide (because they have allowed certain industry-leading companies to monopolise). This is perhaps because the UK's digital strategy has aimed to avoid restrictive regulation which might hinder technological advances. The report also indicates that laws in the UK do not offer the same right of privacy that other countries have such as Norway. This lack of privacy calls into question the safety of online connections in the UK, which is something that the Digital Charter (2018) had aimed for. On the other hand, the report indicated that the UK has the best E-commerce legislation in regard to electronic transactions, consumer protection, privacy and data protection, and cybercrime. It is interesting to note how privacy related policy linked to commerce related activity is so successful while laws relating to personal privacy are not. Overall, the report, in comparing the UK to other high-income countries, highlights that the UK has been relatively successful in preparing for digitalisation. The UK's network readiness score of 76.27 is 12% higher than other high-income countries.

Digital Economy and Society Index (DESI)

DESI is a composite index elaborated by the European Commission that summarises relevant indicators on Europe's digital performance and tracks the evolution of EU Member States in digital competitiveness. It attends to five different areas: **Connectivity, Human Capital, Use of Internet Services, Integration of Digital Technology, and Digital Public Services.**

The Digital economy and society index (DESI)[12] highlight the UK's all-round balance in digital performance, with the exception of economic performance. Connectivity encompasses fixed broadband take up and coverage, mobile broadband and broadband price index. In terms of Connectivity (combined across these indicators), the UK ranks quite low across the 29 countries (21st).

[11] https://networkreadinessindex.org/wp-content/uploads/2020/11/NRI-2020-V8_28-11-2020.pdf

[12] https://digital-strategy.ec.europa.eu/en/policies/desi

In terms of Human Capital, the UK ranks fifth highest of the 29 countries analysed. In terms of Use of Internet Services, the UK ranks 5th. In terms of Integration of Digital Technology, the UK ranks 8th. Finally, for Digital Public Services, the UK ranks quite low, in 18th position.

- **Are there age or gender differences, both in general and in the rural areas?**

In the UK, gender and age differences are evident in relation to digital participation, skills and access. A 2020 UK Parliament report[13] stated that age is one of the most important factors influencing digital exclusion, alongside region, disability status and socioeconomic status. Age is of particular importance when considering that rural areas tend to be made up mostly of an ageing population (Cowie et al., 2020).

The **Women in Digital Scoreboard 2020**[14] provides an analysis of the digital divide by age and gender. The scoreboard (2020) shows the level of participation of women in activities within digital economies. Overall, the UK ranked 2nd with a score of 71.4 which was a third higher than the average European country score of 54.5. This suggests that the UK has been more successful in supporting the inclusion of women in the digital world than most European countries.

Although this high rank may showcase the positive qualities within the UK's digital strategy in the past 10 years, the report also points out issues that are still prevalent within contemporary society that must be addressed for the UK to truly be deemed as digitally inclusive.

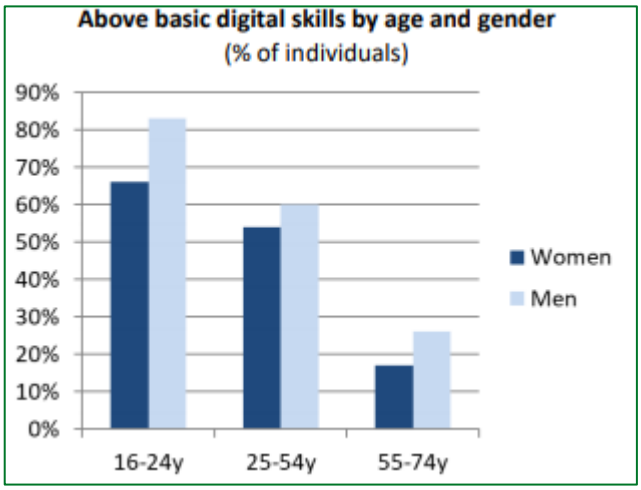

Figure 2 (Source Women in Digital Scoreboard 2020 European Commission 2020)

The report notes that on a consistent basis a lower proportion of women have above-basic digital skills. For example, 25% of males aged 55–74 were viewed to have digital skills above the basic level, while only 18% of women of the same age had a similar level of skill. Furthermore, age didn't seem to have much of an effect on this as there was still a clear disparity between genders regardless of young or old age as 81% of 16-24 year old males had above average digital skills compared to only 66% of 16-24 year old females. Moreover, this report highlights a widespread level of inequality that is proportionately highlighted within gender differences regarding levels of digital skill. As shown in Figure 2, the report highlights age as a strong demographic variable for digital inequality, but also demonstrates that gender should also be recognised as a contributary factor.

Conversely, the Women in Digital Scoreboard 2020 showcases an improvement for women regarding access. In 2009 the percentage of the population who had never accessed the internet was 12% (male)

[13] https://post.parliament.uk/covid-19-and-the-digital-divide/

[14] https://digital-strategy.ec.europa.eu/en/library/women-digital-scoreboard-2020

and 17% (female). Over 10 years (up to 2019) these figures for both genders have reduced and equalled out at 3% of the population who have never accessed the internet. This is significantly better than the EU average which is at 9% for males and 10% for women. This suggests that the digital inclusion policies implemented by the UK within this 10-year span of time have been more effective on average than other European countries.

3. Policy framework for (rural) digitalisation

This section aims to identify how general policies boosting digitalisation, not specific for rural areas influence these areas and also how rural and agricultural policies foster digital transition.

3.1. European Digital Policies

This section explores how the different European policies and strategies aiming to boost digital transition, are shaping the national policy scenario (at Scotland and UK levels). A common theme in this section is how Brexit has impacted on the UK's potential to benefit from European policies. Many European-level policies are no longer relevant to the UK, or they are only relevant in the sense that Scotland and the UK is disadvantaged at no longer being able to benefit from them.

Example: the **Digital Single Market** (DSM) is a four-year strategy encompassing various policy areas, regulations and directives. It establishes a set of ground rules for online businesses in Europe, in areas including taxation, copyright and online privacy. The UK was set to benefit significantly from involvement in the DSM, but Brexit means that the UK is no longer involved. This has had a number of worrying implications, including UK-based firms relocating in other European countries, and firms in the UK struggling to do business online with the rest of Europe. This has the potential to negatively impact on rural-based UK businesses, including in Scotland which rely upon e-commerce with countries in Europe.

Since exiting the EU, the UK are no longer able to benefit from the **Digital Europe Programme, Europe's Digital Strategy** and the **Digital Agenda for Europe**. It has been recognised that in developing a UK-based digital strategy for the future, UK government should continue to follow the guiding principles in the EU Digital Strategy, for example around the commitment to use open source and transparent digital policies[15]. Human capital is one DESI indicator on which the UK is performing relatively well, in comparison with EU member states. However, exiting the EU has likely triggered a reduction in movement of people between the UK and the EU.

The benefits of a common digital market, which UK businesses may now be excluded from, include[16]:

1. better access to products and services across partner countries at reduced costs
2. common data protection and data laws allowing cross border communications

[15] https://www.computerweekly.com/opinion/Where-is-the-UKs-digital-strategy

[16] https://businessculture.org/blog/2015/05/26/digital-agenda-for-europe/

3. digital by default public sector could increase public funds efficiencies and make politics more transparent

For the rural digital economy, a low level of alignment with Europe's digital strategies promises to disadvantage their potential for economic growth, both in terms of the challenges in working with, and doing commerce with businesses in the EU, and in terms of the potential for new start-ups in rural areas. Moving forward, rural Scotland (and rural UK) will need significant support in overcoming these barriers to source business inputs or to reach global markets with their services and products, and to enable rural communities to thrive.

3.2. National Policies boosting digitalisation

In this section we present national policies (at UK and devolved Scotland level) and their impacts on digitalisation in rural regions.

3.2.1. National Digital Agenda or similar strategies

The **UK Digital Strategy** was published in March 2017 with its main aim being to prepare the UK for digital transformation by building a world class digital infrastructure, increasing digital inclusivity and security. One of the key component's outlined in the UK's digital strategy report (2017) discussed the need for a user focused initiative. £1 billion has been allocated in order to accelerate the development and uptake of next generation digital infrastructure - including full fibre and 5G. The UK government have since updated these plans within the 2018 Digital Charter, including increased funding for research and development by an additional £7 billion for 2020/21 that focuses on investing in digital skills. It revolves around 7 key strands:

- Building world-class digital infrastructure for the UK.
- Giving everyone access to the digital skills they need.
- Making the UK the best place to start and grow a digital business.
- Helping every British business become a digital business.
- Making the UK the safest place in the world to live and work online.
- Maintaining the UK government as a world leader in serving its citizens online.
- Unlocking the power of data in the UK economy and improving public confidence in its use.

The update of the Digital Strategy also included the implementation of the Digital Charter as a way to respond to emerging technologies, with the aim of making the UK the safest place in the world to be online. Some other ethical ambitions of the Charter include:

- the internet should be free, open and accessible
- people should understand the rules that apply to them when they are online

- personal data should be respected and used appropriately
- protections should be in place to help keep people safe online, especially children
- the same rights that people have offline must be protected online
- the social and economic benefits brought by new technologies should be fairly shared- due to an uneven adoption of connectivity as a result of lack of vialbility in rural areas his has meant benefits from new technologies haven't been beneficial for all but rather based on the area someone may live in ad the quality of internet signal they have

3.2.2. Other policies and strategies influencing (rural) digitalisation

This section presents an overview of other policies and strategies that are not specific for rural areas but that aim to boost digitalisation and as such might have an influence on agriculture, forestry, and rural areas.

The UK Government has published a **5G Strategy for the UK**. In a report published in 2017[17] it announced an ambition to be a global leader in 5G technologies, in order to create "a world-leading digital economy that works for everyone". It aims to deliver on:

- accelerating the deployment of 5G networks;
- maximising the productivity and efficiency benefits to the UK from 5G;
- creating new opportunities for UK businesses at home and abroad and encouraging inward investment.

The report also recognises that delivering on these ambitions will not be easy, since 5G technology is still in development, and the huge and varied potential of 5G means a much larger demand will be placed on networks, suggesting the need for large-scale investments and developments of network technologies. A business case is still under development, whilst the UK government argues that the capital investment will need to come largely from the private sector. However, UK government have launched a programme of 5G testbeds and trials, in both urban and rural areas – in order to understand the infrastructure requirements in different regions and in urban vs. rural settings. In 2021 it was announced that this investment would be £28million.

The Universal Service Obligation for Broadband (USO)[18] is a UK-wide scheme which entitles all UK residents decent broadband connection at a reasonable price . The USO presents broadband as a right rather than a luxury, and define decent broadband as a connection with 10MBPS download speed, and 1 MBPS upload speed, at minimum. The scheme is aimed at both households and businesses, and provides a grant of maximum £3,400 to enable premises to achieve this goal. It aims to support households to access broadband as a human right, and to help all businesses to transition to digital.

The UK Digital Strategy and associated schemes outlined above are clearly applicable to rural areas, and particularly remote rural regions where broadband connectivity is still lacking, with a number of

[17]https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/597421/07.03.17_5G_strategy_-_for_publication.pdf

[18] https://researchbriefings.files.parliament.uk/documents/CBP-8146/CBP-8146.pdf

"notspots" unable to access what is now considered a decent broadband speed. Indeed, it is likely that the majority of applicants to the USO scheme will be located in rural areas.

According to the Future Telecoms Infrastructure Review (2018) the UK government plan to adopt an 'Outside In' strategy, meaning that while network competition serves the commercially feasible areas (most often urban), the government will simultaneously support investment in the most difficult to reach areas making them more viable opportunities for broadband providers. These difficult areas are normally rural areas that have are not attractive to service providers (often due to challenging topography and small dispersed populations, making the installation of fibre infrastructures costly, with little hope of a return on investments). The Outside In strategy aims to address a number of challenges of rural areas. For example, the policy can help to address population decline, simply by making rural areas more attractive areas for younger people to live and work in (a lack of decent broadband can account for outmigration of businesses and young people from rural areas – Cowie et al. 2020). The strategy aims to support the diversification of rural economies, for example by making rural areas are more viable for new business start-ups and enable them to work on a global level.

In a further initiative, the UK Government is collaborating with major mobile network providers (Vodafone, 3 and o2) from 2020 to 2025, to extend 4G coverage to 4G blindspots across the UK. The Government has pledged £500million with an additional £532million being contributed by the mobile network providers. The initiative recognises that increasingly, notspot areas (including rural) will depend upon 4G coverage to reach a decent broadband connection. It aims for 95% geographic 4G coverage by 2025.

Table 1: National Policies

Ministry / Authority	Policy	Objective	Expected Impact
UK government	UK Digital Strategy	£28million investment in 5G technologies	Global leader in 5G technologies, boost digital economy.
UK government	The Universal Service Obligation for Broadband (USO)	Aimed at both households and businesses, provides a grant of maximum £3,400 to enable premises to achieve minimum 10MBPS	Universal access to speeds of mínimum of 10MBPS
UK government	Outside-In strategy	Up to £5billion funding. To connect up to 5 million premises, including hard to reach rural regions.	Aims to reduce barriers to deployment, remove network provider competition in hard to reach rural areas
Jointly funded by the mobile network (£532M) operators and UK Government (£500M)	Shared Rural Network (SRA)	2020- 2025 4G fund. £1billion+ to be spent to eliminate Total Non-Spots (TNS). 95% geographical 4G coverage in UK by 2025.	Attempts to remove narrative that certain areas are not commercially viable, thereby reducing digital marginalisation

3.2.3. Policies and strategies to boost digital literacy and tackle the digital divide

This section presents policies and initiatives aiming to boost digital literacy and to bridge digital gaps, including in rural areas.

The Good Things Foundation has published a 2021 Blueprint[19] petitioning UK Government to address the digital divide, by putting digital inclusion at the heart of Covid-19 recovery. They argue that fixing the digital divide would have a number of powerful impacts including:

- 67% of people that would improve their digital skills if they knew that support was available
- 2 million households helped, who are struggling to afford broadband
- 10 million people potentially helped, who do not have good digital skills

During the Covid-19 pandemic, the Department of Education within UK government realised that due to the digital divide, a large number of children may be disadvantaged in lacking the chance to connect with online education provided during periods when schools were closed. This initiative ensured that disadvantaged young were able to participate in lockdown education during Covid-19. The scheme funded laptops for children that could not otherwise access them (largely because of cost) during the school terms in 2020 and 2021.

In 2020 the UK government launched the Digital Skills Toolkit – this provided a free online learning platform for increasing digital skills in the workplace, beginning in 2020. At this point the UK government also invested £8million into Digital Skills Bootcamps which seek to provide training on cyber security, software development, DevOps and data engineering.

The Special Recognition Badge for Cyber Resilience – Internet Safety scheme in 2018 and 2019 which was led by Industry (HP, Microsoft and Intel) backed an initiative to encourage schools to integrate digital skills across the curriculum.

The Nobody in the Dark initiative, which began in 2020 and is ongoing, centres on reducing aspects digital divide in 20 locations across the UK – with a particular focus on regions where the digital divide has been exacerbated by the Covid-19 pandemic (e.g. through certain groups not being able to access key services which moved online during lockdowns).

These initiatives are summarised in Table 2.

[19] https://www.goodthingsfoundation.org/fix-the-digital-divide/

Table 2: Programmes and initiatives addressing digital literacy and digital divide. (*) International, National, Regional or Local

Initiative	Objective	Key words	Period	Area of impact	Link	Public / Private	Scale of action *	Rural / General
Good Things Foundation "A Blueprint to Fix the Digital Divide" 2021	Increasing skills in the use of new technologies and digital tools – petition to UK Government	Digital divide, digital skills	2021 onwards	UK	https://www.goodthingsfoundation.org/insights/a-blueprint-to-fix-the-digital-divide/	Public	UK-wide	G
Laptop provision to schoolchildren during Covid-19 – UK Government (Dept of Education)	Ensure that disadvantaged young people were included in lockdown education during Covid-19	Digital divide, laptops, education	2020-2021	UK	https://post.parliament.uk/covid-19-and-the-digital-divide/	Public	UK-wide	G
UK Government "Skills Toolkit"	New, free online learning platform to improve workplace skills.	Digital skills, workplace skills, digital divide	2020	UK	https://theskillstoolkit.campaign.gov.uk/	Private	UK-wide	G
Digital Skills Bootcamps - £8 million investment by UK Government	Training on cyber security, software development, DevOps and data engineering	Cyber security, software development, DevOps and data engineering	2020-ongoing	UK	https://www.qa.com/training/digital-skills-bootcamps/	Public	UK-wide	G
Special Recognition Badge for Cyber Resilience – Internet Safety	Industry (HP, Microsoft and Intel) backed initiative to encourage schools to integrate digital skills across the curriculum.	cyberbullying, social networking, schools	2018, 2019	Scotland, Norther Ireland, Ireland	https://www.digitalschoolsawards.co.uk/	Public	International	G
Nobody in the Dark initiative	Reduce digital divide in 20 locations across the UK – regions where digital divide has been exacerbated by the Covid-19 pandemic	Digital divide, Covid-19	2020 – ongoing	UK	https://edtechnology.co.uk/latest-news/nobody-in-the-dark-initiative-looks-to-pull-down-the-digital-divide/	Public	UK-wide	G

3.2.4. Policies and strategies that incentivise digital innovations

A number of policies and initiatives exist to boost digital innovations, or to boost innovation through the use of digital tools. Some examples of these are outlined in Table 3.

These initiatives are aimed at either supporting digital start ups (such as the Innovate UK-funded Digital Catapult or Tech City), or more broadly to boost industrial or economic innovation (e.g. the UK Government-funded Industrial Strategy Challenge Fund). Whilst some are aimed at industry and the economy broadly (across all sectors), others are aimed at specific sectors, such as the Roots for Growth initiative aimed at Scottish Forestry sector, or the four Agri-Tech centres[20] aimed at boosting digital innovation specifically for agriculture. Resources such as the Open Food Network are aimed at empowering local food networks, such as is the case in the Scottish Living Lab region where the platform has been used in the creation of an online local food network called The Green Bowl[21].

These initiatives function either at the national level (UK-based, as in the case of Digital Catapult, UK AI Sector Deal, Industrial Strategy Challenge Fund, Tech City UK and the four Agri-Epi centres; Scotland-based, as in the case of the Roots for Growth initiative), or globally, as is the case for the Open Food Network.

3.3. Contributions from the Structural and Investment Funds and the Cohesion Policy

The EU Structural Funds and Cohesion Policy provide funding for different initiatives to boost digital transition. Since the UK exited the EU, it is no longer eligible to benefit from these funds and policies.

Di Cataldo and Monastiriotis (2018) analysed how these EU funds have contributed to regional growth in the UK over the three programmed periods between 1994 and 2013. They found evidence that the funds have had a significant positive effect on economic growth in the UK, particularly in less developed regions. They concluded that their results have strong lessons for the development of regional and place-based policies after Britain exits the UK, and that these policies should borrow from those aspects of the EU Cohesion Policy which have been most impactful in the UK.

3.3.1. Broadband infrastructure

This section describes the policies or strategies addressing the broadband coverage in Scotland and the wider UK. We provide, where possible, information on the technology used, the budget, and the project timelines, as well as how these initiatives will impact on rural areas. Some of these can be seen in Table 1 which outlines national digitalisation policies.

[20] https://agri-epicentre.com/about/agri-tech-centres-of-agricultural-innovation/

[21] https://openfoodnetwork.org.uk/the-green-bowl/shop

Table 3: Policies that incentivize digital innovations

Initiative	Brief Description	Objectives	Area of impact	Period of implementation	Budget (if any)	Public / Private	Are rural areas specifically mentioned or addressed? Y/N	Link
Digital Catapult	UK's leading digital innovation centre, led by Innovate UK	Supporting digital start-ups and connecting them to industry	Economic	2013 – ongoing	From 2018, £780million across all Catapult centres (including the Digital Catapult)	Public	Y	https://www.digicatapult.org.uk/
UK AI Sector Deal	UK's Artificial Intelligence strategy	Actions to promote adoption and use of AI in the UK, through supporting economic and academic sectors	Economic, academic	2019 - ongoing	£0.95billion	Public	N	https://www.gov.uk/government/publications/artificial-intelligence-sector-deal/ai-sector-deal#executive-summary
Industrial Strategy Challenge Fund	UK government strategy to support industrial innovation (including digital)	Supports science-industry collaboration to jointly find solutions to major societal, environmental and industrial challenges identified by the government together with industry and academia	Economic, social, environmental, academic	2017 - ongoing	£5.6billion (£2.6billion public, £3billion industry funded)	Public	Y	https://www.ukri.org/our-work/our-main-funds/industrial-strategy-challenge-fund/
Tech City UK	Digital innovation hub	Aims to boost digital innovation across the UK	Economic	2017 – ongoing	Both public and private funding (amount unpublished)	Public	N	https://technation.techcityuk.com/about-us/
EPI-Agri	Agricultural digital innovation hub – focus on precision farming	Aims to trial and boost innovation in agriculture	Economic	2019 – ongoing	Share of £90million (over four centres in total)	Public	Y	https://agri-epicentre.com/about/
Agrimetrics	Agricultural digital innovation hub – focus on data	Aims to trial and boost innovation in agriculture	Economic	2019 – ongoing	Share of £90million (over four centres in total)	Public	Y	https://agri-epicentre.com/about/agri-tech-centres-of-agricultural-innovation/www.agrimetrics.co.uk
Crop Health and Protection (CHAP)	Agricultural digital innovation hub – focus on crops	Aims to trial and boost innovation in agriculture	Economic	2019 – ongoing	Share of £90million (over four centres in total)	Public	Y	https://agri-epicentre.com/about/agri-tech-centres-of-agricultural-innovation/www.chap-solutions.co.uk
Centre for Innovation Excellence in Livestock (CIEP)	Agricultural digital innovation hub – focus on livestock	Aims to trial and boost innovation in agriculture	Economic	2019 – ongoing	Share of £90million (over four centres in total)	Public	Y	https://agri-epicentre.com/about/agri-tech-centres-of-agricultural-innovation/www.CIELivestock.co.uk
Open Food Network	Open source platform for building a local food network	Aims to encourage the development of local food enterprises	Economic, social, health	2015 – ongoing	Free to use	Public	Y	https://about.openfoodnetwork.org.uk/
Roots for Growth	Forestry sector initiative for economic growth	Aims to boost innovation including through digitalisation	Economic (forestry)	2018 – 2030	N/a	Public	Y	http://www.forestryscotland.com/media/390514/roots%20for%20further%20growth%20-%20november%202018.pdf

The Scottish 4g infill programme is an on-going programme that started in 2018 with £25 million worth of funding provided by the European Regional Development Fund and the Scottish Government. The policy was introduced as a result of the findings of the Ofcom 'Connected Nations' report (2019) which found that approximately 20% of rural areas in Scotland do not have 4G coverage from any mobile company, contrasting sharply with the much lower figure of 3% in both England and Northern Ireland, and the 11% of Wales without 4G coverage. This averages at 9% of land in the UK without 4G. The programme aims to remove notspots in Scotland using future proofed infrastructure. This includes the aim to develop technologies that do not harm the environment, which are built from sustainable materials. Another goal is to ensure all technologies including 5G are future-proofed and will not require replacement in the coming years. This is a two-fold solution which results in giving both increased and future-proofed digital infrastructure to rural areas, to ensure they are better included in the digitalisation process.

Although the programme was meant to start in 2018, schedule delays meant the first masts were not in place until 2020. Currently, of the 11 sites that have successfully implemented 4G masts, 9 of them only have one provider (EE). There is a danger that, unless more providers get involved in these areas, the lack of competition may allow EE to monopolise and not strive to improve their service. Furthermore, 28 sites have planning permission in place and are currently waiting for masts to be built. Of the main four MNOs (O2, EE, Vodaphone and 3) 3 is yet to be involved in any of the current or planned 4G masts.

The **Shared Rural Network** policy began in 2020 and is set for completion in 2025. It has a budget of £1billion attached to it with half of this being funded by the government (£500million) and the other half (£532million) being provided by major network operators (MNO). It aims to eliminate connectivity hotspots provide 95% geographical coverage of 4G by 2025.

The **Outside-In strategy**, funded by UK government, delivers up to £5billion to connect up to 5million premises across the UK, including hard to reach areas such as rural regions. It aims to reduce barriers to deployment of infrastructure, remove network provider competition in hard to reach rural areas.

The **Better Broadband Scheme** is a UK-wide initiative (with £5million funding between 2015 and 2019) developed by the Department for Culture, Media, and Sport (DCMS). The scheme subsidised £350 of costs towards broadband installation. It was replaced by the **Universal Service Obligation for Broadband (USO)** funded by UK government which is aimed at both households and businesses and provides a grant to these of up to £3,400 to enable connectivity of a minimum of 10 MBPS.

Local Full Fibre Networks Programme (2018-2021) is a UK-wide initiative which focuses on having the relevant infrastructure in place to deliver full fibre networks before the end of 20/21 financial year. It has already successfully planned funding within 13 areas.

The **Digital Scotland Superfast Broadband (DSSB)** policy, which runs between 2017-2020 is a Scottish government funded initiative develpped by Digital Scotland. It aims to provide fibre broadband infrastructure to parts of Scotland not included in commercial providers' investment plans, in

collaboration with BT Openreach. Digital Scotland also lead **Delivering R100** which between 2017 and 2021 delivers £600million funding to provide superfast broadband access for every home and business in Scotland. This encourages companies to invest, regardless of issues with topography via:

- Specialised R100 Contracts
- The Scottish Broadband Voucher Scheme- Main Vouchers- up to £5,000 to deliver broadband to homes /businesses that government and companies have no plans to invest in
- Interim Vouchers - up to £400 if commercial/gov support planned before December 2021.
- Can be combined with the UK Government's Gigabit Broadband Voucher Scheme (Project Gigabit).

Project Gigabit, led by DCMS in UK government is a scheme running between 2021 and 2023 to give internet speed of one gigabit per second in rural areas. It includes the UK Government's Gigabit Broadband Voucher Scheme in which £210m worth of vouchers have been released to help those with slow speeds. There is also £110m to connect up to 7,000 rural GP surgeries, libraries and schools.

3.3.2. Digital Public Services

Since 2012 the UK government, through the then Government Digital Strategy, have implemented a Digital by Default policy, which aimed to bring all government and public services online[22]. The goal has been to bring more people online to use online public services. It should be noted that the Covid-19 pandemic has accelerated the use of digital for many services where face-to-face interaction was less desirable. For example, GP surgeries were keen to limit people coming into the building in order to limit the spread of the virus, therefore many surgeries implemented an online/phone consultation to replace face-to-face consultations.

The UK's public services are well integrated digitally. In the analysis across European countries carried out in the DESI 2020 report (DESI Digital public services 2020), e-government services for businesses in the UK scored over 90, being one of the top 5 European countries in this category showcasing a positive development in making every British business a digital business and aiding in making Britain the best place to start and grow a digital business as outlined in the UK digital strategy (2017).

Pre-filled forms which allow for the automatic retrieval and validation of data relating to individuals and businesses are becoming more commonplace in the UK. The DESI 2020 report (DESI Digital public services 2020) examines the extent to which data that is already known to the public administration is pre-filled in forms presented to the user. This can help make e-administration procedures simpler and more accessible for users. This is of special importance for rural populations, as simplifying tasks can provide a platform to make digitalisation more appealing and accessible. However, the UK's usage of pre-filled forms was on the lower end in comparison to other European countries, the UK scored 21 (out of a maximum score of 100) significantly trailing in the use of pre-filled forms compared to countries including Malta, Estonia and Lithuania who all scored above 85.

22 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/296336/Government_Digital_Stratetegy_-_November_2012.pdf

Previous research has shown the positive impact of UK-based policies including e-health (Cowie et al., 2020), which has helped in combatting social isolation and improving the well-being of rural populations by allowing them to easily access healthcare when required. Once again however, lack of Internet connectivity may prevent access to these services, marginalising rural communities on an essential aspect of everyday life.

Table 4 : Digital Public Services usage

		Extremely common	Very common	Fairly common	Not common for most of the population	It is not a possibility nowadays
e-Administration procedures	In general in the country				X	
	In rural areas				X	
e-Health	In general in the country		X			
	In rural areas			X		
e-Education	In general in the country		X			
	In rural areas		X			
Digital identity	In general in the country			X		
	In rural areas			X		
Digital signature	In general in the country				X	
	In rural areas				X	
On-line banking (account management, payments)	In general in the country	X				
	In rural areas		X			
Bills (council taxes, water, electricity)	In general in the country	X				
	In rural areas	X				

3.3.3. Digital Innovation Centres (DIH)

A number of digital innovation hubs exist in Scotland and the wider UK, examples of which are provided below. Some of these are summarised in Table 4 as they also represent relevant digital initiatives to boost innovation at a Scottish and UK level.

The four **Agri-Tech centres** implemented in 2019, are aimed at boosting digital innovation specifically for agriculture. £90million is dedicated to supporting the development, trialing and triggering of digital innovations across the four centres, which are:

- Epi-Agri (focused on data)
- Agrimetrics (focused on crops)
- Crop Health and Protection (CHAP – focused on crops)
- Centre for Innovation Excellence in Livestock (CIEP – focused on livestock).

In the Forestry sector, two innovation centres have been implemented - **Construction Scotland Innovation Centre** and **Industrial Biotechnology Innovation Centre** (Scottish Forest and Timber Technologies Industry Leadership Group, 2018). These innovation centres aim to develop new and innovative wood-based value-added products and processes and markets for them. They also aim to inspire adoption of technologies across the sector.

The **Digital Catapult**, funded by Innovate UK since 2013 (with £780million provided across all Catapult centres since 2018), is the UK's leading digital innovation centre. It supports digital start-ups and connects them to industry.

Tech City is a digital innovation hub which aims to boost digital innovation across the UK. Set up in 2017, it is funded through both public and private investment, though the level of funding remains unpublished.

A number of smaller digital innovation hub initiatives are active in Scotland and the wider UK, including **Scotland's Digital Health and Care Innovation Centre**[23], **Scotland's Digital Health and Care Institute**[24], CENSIS (Centre for Sensor and Imaging Systems)[25] and the Data Lab[26].

Rural digital innovation hubs are somewhat hard to find, though these often exist under the banner of community broadband initiatives which have expanded to include further rural digital services and training, such as Cybermoor[27] and B4RN[28]. In addition, many rural towns and regions have rural

[23] https://www.dhi-scotland.com/

[24] https://www.scotland.org/business/conferences-in-scotland/legends/health/dhi-scottish-digital-health-and-care-landscape

[25] https://censis.org.uk/

[26] https://thedatalab.com/

[27] https://www.facebook.com/CybermoorAlston/

[28] https://b4rn.org.uk/

innovation hubs, which often include the provision of digital services and support – such as Inverness Impact Hub[29] which serves the Highlands and Islands region of Scotland.

3.4. Data management

The Data Protection Act (2018) is the most important policy at UK level governing the regulation of data. It is the UK's implementation of the EU General Data Protection Regulation (GDPR). The Act states that "everyone responsible for using personal data has to follow strict rules called 'data protection principles'." This includes ensuring that information is:

- used fairly, lawfully and transparently
- used for specified, explicit purposes
- used in a way that is adequate, relevant and limited to only what is necessary
- accurate and, where necessary, kept up to date
- kept for no longer than is necessary
- handled in a way that ensures appropriate security, including protection against unlawful or unauthorised processing, access, loss, destruction or damage[30].

Furthermore, the Act ensures stronger legal protection in a number of cases where those relate to race, ethnic background, political opinions, religious beliefs, trade union membership, genetics, biometrics (where used for identification), health, and sex life or orientation.

Although the UK is generally considered to be a leader in terms of open data, there are a number of issues (including uneven data quality, data literacy) where progress remains slow. Some of these inadequacies have been addressed in UK Government's 2017–2020 Government Transformation Strategy[31]. Cybersecurity is governed by the UK government-funded National Cybersecurity Centre[32], which strives to make the UK the safest place to live and work in the world.

4. Challenges and Opportunities

4.1. Barriers to digitalisation

Connectivity: In Scotland and the UK, a number of initiatives and programmes over the last decade have promised to deliver universal broadband access and eliminate the urban-rural digital divide. For example, Broadband Delivery UK (BDUK) promised to do just this, and to reach even the most remote rural regions with broadband infrastructure. However, by the end of the programme the promise was not fully delivered. This is in part due to the involvement of Internet service providers who do not

[29] https://inverness.impacthub.net/
[30] https://www.gov.uk/data-protection
[31] https://en.wikipedia.org/wiki/Open_data_in_the_United_Kingdom
[32] https://www.ncsc.gov.uk/

expect to see a return on their investments in remote rural areas. This pattern may well continue. Further, the problem of certain providers gaining monopolies in certain regions is concerning, since they are not motivated to provide a quality or comprehensive service.

Example - Scottish 4G Infill Programme: The programme aims won't be fully realised until 2022, however the policy has come under scrutiny by Orkney MSP after receiving information that the work being done in Orkney as part of the 4G infill programme has been stalled, with no new proposals for mast locations being introduced since April 2019 and, despite regular engagement with mobile operators, no operator has committed to using any of the candidate mast locations suggested prior to April 2019. Although Orkney is not part of mainland Scotland, it is one of the northern isles which is a mix of both island and rural communities. Consequently, the lack of progress in Orkney could be seen as bias towards resolving connectivity in mainland Scotland rather than remote areas. Although planning is already in place for masts in Orkney the lack of willingness by providers to act upon this has significantly slowed down the progress.

Digital skills: The level of digital skills across the UK population is not even, and is impacted by demographics such as gender and age (DESI 2020, Women in Digital Scoreboard, 2020) as well as income and education levels. Given that rural areas in the UK are often characterised by ageing and low income populations, it is not surprising that rural UK sees some of the lowest levels of digital skills and awareness.

Digital services: the UK Digital by Default policy has rapidly progressed key services to being delivered online and encouraged the majority of the UK population to embrace digital tools and resources. However, there are those who are not able to access digital services because either they lack the connectivity, or they lack the digital skills required to use these online services.

Example: e-health services: Creaney et al (2021) noted that the fast-paced distribution of technology especially during the Covid-19 pandemic prioritises a need to ensure that technology being developed for use within the home (including digital public services) is beneficial to users, rather than detrimental and putting the well-being of rural ageing populations at risk (Creaney et al., 2021). To prevent this, Creaney suggests that the roll-out of new digital technologies such as e-health services must be gradual and run alongside, rather than replace existing healthcare practice in order to increase social acceptance. Currie (2015) gives further evidence to support a gradual integration of digital services, as she states that acceptance of technology is more likely when digital technology is supplemented alongside existing practice (Currie et al., 2015).

Covid-19 has rapidly accelerated the effects of digitalisation in Scotland and the wider UK. Since the pandemic led to repeated lockdowns, everyday life moved online. This included work, business and everyday civic participation as well as access to a number of key services including healthcare. For those already able to access these resources, digitalisation supported a transition to a new way of living and working. However, for those unable to access (either due to connectivity or digital skills problems), the lockdown periods have led to further isolation and marginalisation. In our Living Lab (working with a crofting community in a remote rural region in Scotland) we have seen aspects of life

that have been enabled (e.g. more opportunities for women to contribute to community actions whilst carrying out childcare duties, where these have taken place online), and situations where rural residents have been further marginalised during Covid-19 due to digital developments (including elderly residents without the skills to use e-health services online being excluded from basic healthcare provision).

Table 5: Barriers to digitalisation

Barriers to digitalisation		Influence of COVID-19
Technical	Access to connectivity remains uneven especially in remote rural regions	Rural residents excluded from key services which moved online; socially isolated when unable to connect to friends and family, etc.
Training / Education	Lack of digital skills continues to be an issue, especially in rural areas	Those with low level digital skills excluded from the move to online for communications, work, e-commerce and e-health.
Economic	Connectivity issues and digital skills problems	Businesses and individual workers economically disadvantaged when unable to work online or meet collaborators.
Economic	Low-income households unable to afford basic technology (e.g. laptop) or broadband connectivity	Disadvantage for those unable to complete education or work online; social isolation when unable to connect with friends and family.
Digital services	Majority of key services online (Digital by Default) – many are excluded	Covid-19 led to even more services moving online, with many (those with poor digital skills or connectivity) being excluded from key services including basic healthcare provision.

4.2. Actions to boost sustainable digitalisation

Based on the principles identified by the DESIRA project's first RDF briefing, Table 6 outlines our ideas of actions that should guide the new generation of rural policies that boost sustainable digitalisation of agriculture, forestry and rural areas in Scotland and the wider UK.

Table 6: Actions to boost sustainable digitalisation

	Key rural development domains			
	Human capital	**Innovation**	**Investments**	**Governance**
Creating the basic conditions for digitalisation	Education & training for basic digital skills	Encouraging peer-topeer networking	Public support for digital infrastructures	Monitoring digitalisation progress on ongoing basis – set up equivalent of DESI in UK
Anchoring digitalisation to sustainable development	Raising awareness; Education & training for above basic-level skills; Training of local digital champions	Alignment with Responsible Research and Innovation (RRI)	Linking investments with sustainability goals	Monitor the sustainability performance of digitalisation projects
Adapting digitalisation to different context	Profiling digitalisation users according to skills and needs	Encourage interactive innovation	Align support to investments with local strategies	Community based approaches to digitalisation strategies
Favouring digital inclusion	Mapping vulnerable groups including in rural areas	Encouraging peer-to-peer networking and cross-age peer-to-peer support	Support where it is most needed – i.e. vulnerable groups in rural regions	Monitoring equivalents of DESI indicators progress
Developing digital ecosystems	Training and digitalisation brokers.	Encourage Living Lab approaches; Peer learning among digitalisation brokers and align them to RRI	Prioritise support based on cooperation and multi-actor projects	Encourage the development of Smart Villages and Local Digital Innovation Hubs
Developing adaptative governance models	Planning, coordination and networking among rural digitalisation agencies, Digital (and Rural) Innovation Hubs, Data lab, etc.			
Designing policy tools for sustainable digitalisation	Develop fast and flexible supporting mechanism or policy instruments to support local/regional multi-actor cooperation processes for digitalisation. Support should be provided for all preparatory work around digitalisation			

	such as animating stakeholders, facilitating engagement processes, feasibility assessments, prototype and project development, etc.

5. Conclusions

The situation of rural digitalisation is mixed. A number of initiatives that have taken place over more than a decade (including the UK government-funded Broadband Delivery UK, or BDUK) have aimed at reducing the disparities between urban and rural connectivity, with only partial success. Therefore, there are rural regions with good connectivity, digital awareness, uptake and skills. Other rural regions still suffer from inadequate broadband connectivity (defined by UK Government as minimum10MBPS), and have populations characterised by low levels of digital skills. Hence, those living and working in these regions are struggling to participate in digital aspects of work and everyday life. Across Scotland and the wider UK, many of those with low levels of digital skills are located in rural areas. This is because poor digital skills are associated with demographic characteristics relating to age, gender, income levels and disability status which correspond with those often found in rural areas.

A number of policies and initiatives are in place to support the rapid digitalisation of UK society. Since exiting the EU, the UK is reframing its 2017 UK Digital Strategy, and 2018 Digital Charter. There are also policies and strategies (including the Universal Service Obligation, the Scottish 4G Infill Programme, and the Shared Rural Network) which seek to provide universal broadband (of at least 10MBPS) across all of the UK (some policies relevant only to Scotland). Finally, a number of policies are in place to boost digital innovation and increase digital skills, including Digital Skills Bootcamps and the Nobody in the Dark initiative. Many of these policies are aimed at the whole (UK or Scottish) population (or vulnerable groups across the entire country or UK). A small number are specifically aimed at rural regions.

The extent to which these policies support rural regions will depend upon their implementation. We argue that not enough policy support is currently provided specifically for rural regions. Over the last 10 years, despite the promises for rural areas offered by policies such as BDUK, it can be argued that the digital divide has become wider, given that urban areas now have much faster superfast connections, compared with the relatively slower connections speeds of rural areas (even if those speeds are faster than they once were). If this pattern persists, we will continue to see digitalisation further exacerbate the challenges felt by rural communities, rather than meeting its potential to actually alleviate these challenges and help rural economies to thrive.

Therefore, the recommendations of this report are as follows:

- The review and reframing of current policies to bias support where it is most needed, including vulnerable groups and rural (especially remote rural) regions;
- The provision of policies which specifically seek to provide support in digital connectivity, skills and uptake in rural (and especially remote rural) regions, including the funding of future-proofed

infrastructures to enable rural communities to access connectivity (now and in the future) of speeds comparable to those in urban centres.

6. Annex

6.1. Annex A

Table A.1: Policies influencing digitalisation in Scotland and wider UK

Areas being addressed / supported by the policies	Policy	Brief Description	Objectives	Area of impact	Period of implementation	Budget (if any)	Public / Private	Address rural areas (Y/N) Specify how	Link
Broadband, connectivity, affordability	USO	Providing universal access of speeds of minimum 10MBPS	Aimed at both households and businesses, provides a grant of maximum £3,400 to enable premises to achieve minimum 10MBPS	Economic, social, cultural.	Ongoing	£3,400 per premises	Public	Rural residents who access poor connectivity for higher prices are now entitled to a better broadband service. Enables them to take advantage of opportunities provided by digitalisation	https://www.bt.com/broadband/USO
	Scottish 4G Infill Programme	Scotland's 4G infill programme	The programme aims to remove notspots in Scotland using future proofed infrastructure. This includes the aim to develop technologies that do not harm the environment, which are built from sustainable materials. Another goal is to ensure all technologies including 5G are future-proofed and will not require replacement in the coming years. This is a two-fold solution which results in giving both increased and future-proofed digital infrastructure to rural areas, to ensure they are better included in the digitalisation process.	Economic, social, cultural.	2018-2022	£25 Million	Public	Gets rural areas involved in digital opportunities and prepares them for later technological developments ensuring they won't be left behind	Scottish 4G infill programme: progress update - gov.scot (www.gov.scot) Digital: Broadband and mobile - gov.scot (www.gov.scot) Delivering Rural Telecoms Structures for the Scottish 4G Infill (S4GI) Project - Swann Group (swanngroupltd.com)

	Shared Rural Network	4G provision programme	It aims to eliminate connectivity hotspots provide 95% geographical coverage of 4G by 2025.	Economic, social, cultural.	2020-2025	£1billion	Public	Gets rural areas involved in digital opportunities and prepares them for later technological developments ensuring they won't be left behind	https://srn.org.uk/
	Local Full Fibre Networks Programme	UK-wide initiative which within 13 areas.	Focuses on having the relevant infrastructure in place to deliver full fibre networks before the end of 20/21 financial year. It has already successfully planned funding	Economic, social, cultural.	2018-2021	£95million	Public	Gets rural areas involved in digital opportunities and prepares them for later technological developments ensuring they won't be left behind	https://www.gov.uk/guidance/local-full-fibre-networks-programme
	Delivering R100	Superfast broadband initiative	to provide superfast broadband access for every home and business in Scotland.	Economic, social, cultural.	2017-2021	£600million	Public	Gets rural areas involved in digital opportunities and prepares them for later technological developments ensuring they won't be left behind	https://www.scotlandsuperfast.com/
	Project Gigabit	1 GB broadband provision scheme	To ensure an internet speed of one gigabit per second in rural areas.	Economic, social, cultural.	2021-2023	£5billion	Public	Gets rural areas involved in digital opportunities and prepares them for later technological developments ensuring they won't be left behind	https://www.gov.uk/government/news/government-launches-new-5bn-project-gigabit
	Community-led Broadband Schemes	Various	Communities leading the delivery of broadband infrastructure in their local areas	Economic, social, cultural.	Ongoing	N/A	Public	Gets rural areas involved in digital opportunities and prepares them for later technological developments ensuring they won't be left behind	N/A

New digital business models in rural areas, agriculture, and forestry	Green Bowl/ Open food network	A digital platform that allows local businesses to sell produce outside of the local community Free to join, but once trading, a percentage is kept for the organising & admin of the scheme. Producers set their prices, interact with their customers, customers can have their produce delivered or pick-up from Elphin's tearooms	To break down the geographical barriers in rural areas that may be harder to reach .	Economic, social, cultural.	2018-ongoing	NA	Public	Enables a rural local food network, enables local producers. Ensures that produce is available for not only tourists but to local community as well.	The Green Bowl - Open Food Network
Digital Literacy and Digital Divide	Good Things Foundation "A Blueprint to Fix the Digital Divide" 2021	Digital divide initiative	Increasing skills in the use of new technologies and digital tools – petition to UK Government	Economic, social, cultural.	2021 onwards	N/A	Public	Only in the sense that digital divide is keenly felt in rural areas, has potential for greater impact	https://www.goodthingsfoundation.org/insights/a-blueprint-to-fix-the-digital-divide/
	Laptop provision to schoolchildren during Covid-19 – UK Government (Dept of Education)	Laptop provision scheme	Ensure that disadvantaged young people were included in lockdown education during Covid-19	Economic, social, cultural.	2020-2021	Various	Public	Only in the sense that digital divide is keenly felt in rural areas, has potential for greater impact	https://post.parliament.uk/covid-19-and-the-digital-divide/
	UK Government "Skills Toolkit"	Digital skills scheme	New, free online learning platform to improve workplace skills.	Economic, social, cultural.	2020	N/A	Public	Only in the sense that digital divide is keenly felt in rural areas, has potential for greater impact	https://theskillstoolkit.campaign.gov.uk/
	Digital Skills Bootcamps -	Digital skills scheme	Training on cyber security, software development, DevOps and data engineering	Economic, social, cultural.	2020-ongoing	£8 million	Public	Only in the sense that digital divide is keenly felt in rural areas, has potential for greater impact	https://www.qa.com/training/digital-skills-bootcamps/
	Special Recognition Badge for Cyber Resilience – Internet Safety	Internet safety scheme	Industry (HP, Microsoft and Intel) backed initiative to encourage schools to integrate digital skills across the curriculum.	Economic, social, cultural.	2018, 2019	N/A	Public	N/A	https://www.digitalschoolsawards.co.uk/
	Nobody in the Dark initiative	Digital divide scheme	Reduce digital divide in 20 locations across the UK – regions where digital divide has been exacerbated by the Covid-19 pandemic	Economic, social, cultural.	2020 – ongoing				https://edtechnology.co.uk/latest-news/nobody-in-the-dark-initiative-looks-to-pull-down-the-digital-divide/
Open data, standardisation of data, data access, etc…	Data Protection Act	Data protection regulation in UK	Aims to protect indivduals' and company data	Economic, social and cultural	2018 – ongoing	N/A	Public	N/A	https://www.gov.uk/data-protection

Digital policies boosting innovation	Digital Catapult	UK's leading digital innovation centre, led by Innovate UK	Supporting digital start-ups and connecting them to industry	Economic	2013 – ongoing	From 2018, £780million across all Catapult centres (including the Digital Catapult)	Public	Y	https://www.digicatapult.org.uk/
	UK AI Sector Deal	UK's Artificial Intelligence strategy	Actions to promote adoption and use of AI in the UK, through supporting economic and academic sectors	Economic, academic	2019 - ongoing	£0.95billion	Public	N	https://www.gov.uk/government/publications/artificial-intelligence-sector-deal/ai-sector-deal#executive-summary
	Industrial Strategy Challenge Fund	UK government strategy to support industrial innovation (including digital)	Supports science-industry collaboration to jointly find solutions to major societal, environmental and industrial challenges identified by the government together with industry and academia	Economic, social, environmental, academic	2017 - ongoing	£5.6billion (£2.6billion public, £3billion industry funded)	Public	Y	https://www.ukri.org/our-work/our-main-funds/industrial-strategy-challenge-fund/
	Tech City UK	Digital innovation hub	Aims to boost digital innovation across the UK	Economic	2017 – ongoing	Both public and private funding (amount unpublished)	Public	N	https://technation.techcityuk.com/about-us/
	EPI-Agri	Agricultural digital innovation hub – focus on precision farming	Aims to trial and boost innovation in agriculture	Economic	2019 – ongoing	Share of £90million (over four centres in total)	Public	Y	https://agri-epicentre.com/about/
	Agrimetrics	Agricultural digital innovation hub – focus on data	Aims to trial and boost innovation in agriculture	Economic	2019 – ongoing	Share of £90million (over four centres in total)	Public	Y	https://agri-epicentre.com/about/agri-tech-centres-of-agricultural-innovation/www.agrimetrics.co.uk
	Crop Health and Protection (CHAP)	Agricultural digital innovation hub – focus on crops	Aims to trial and boost innovation in agriculture	Economic	2019 – ongoing	Share of £90million (over four centres in total)	Public	Y	https://agri-epicentre.com/about/agri-tech-centres-of-agricultural-innovation/www.chap-solutions.co.uk
	Centre for Innovation Excellence in Livestock (CIEP)	Agricultural digital innovation hub – focus on livestock	Aims to trial and boost innovation in agriculture	Economic	2019 – ongoing	Share of £90million (over four centres in total)	Public	Y	https://agri-epicentre.com/about/agri-tech-centres-of-agricultural-innovation/ww

									w.CIELivestock.co.uk
	Roots for Growth	Forestry sector initiative for economic growth	Aims to boost innovation including through digitalisation	Economic (forestry)	2018 – 2030	N/a	Public	Y	http://www.forestryscotland.com/media/390514/roots%20for%20further%20growth%20-%20november%202018.pdf

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