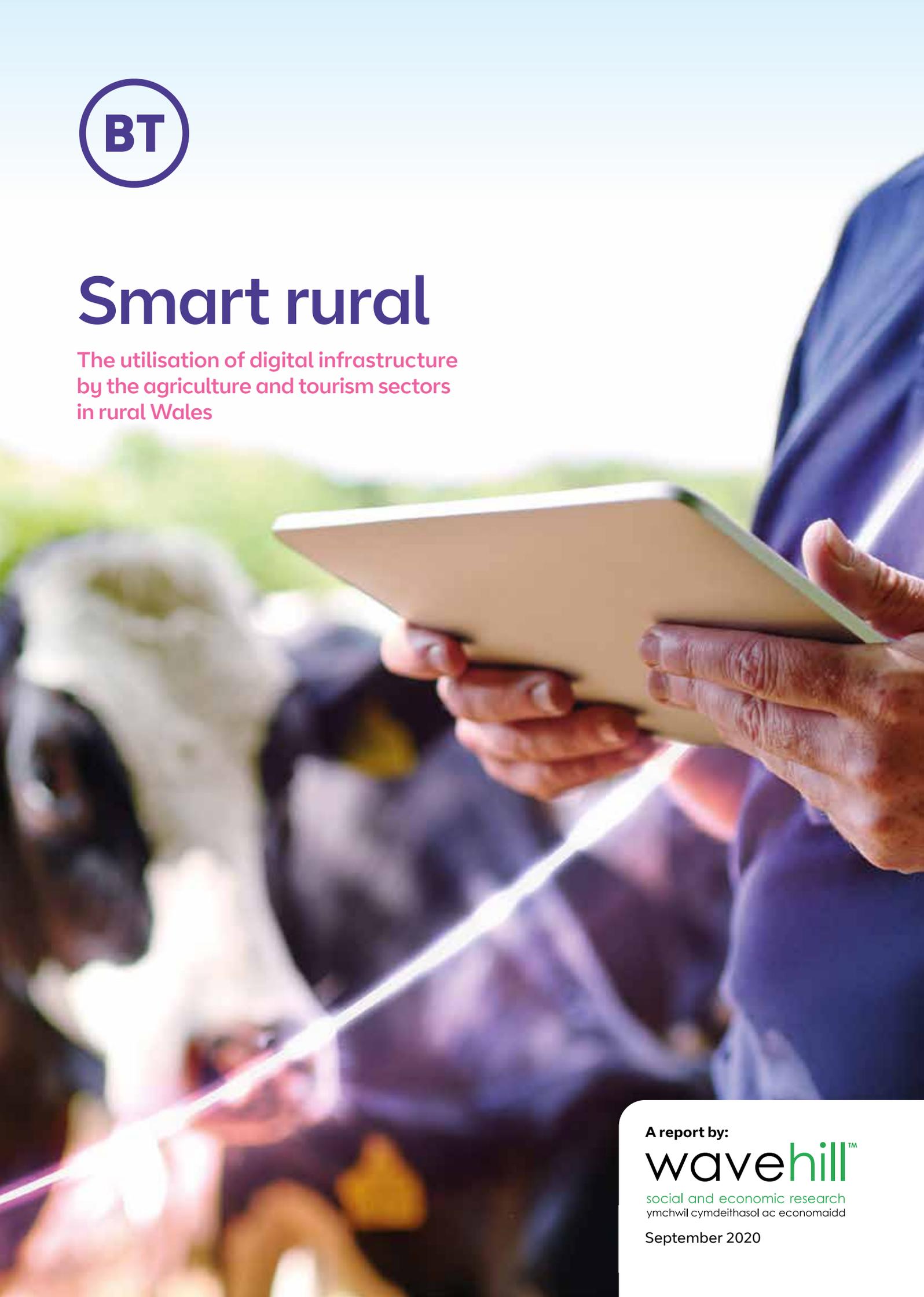




# Smart rural

The utilisation of digital infrastructure  
by the agriculture and tourism sectors  
in rural Wales



A report by:

**wavehill**<sup>™</sup>

social and economic research  
ymchwil cymdeithasol ac economaidd

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ymchwil cymdeithasol ac economaidd

Wavehill is a social and economic research company that has been working across the UK since 1992. The company's head office is located in Aberaeron on the west coast of Mid Wales, with offices also in Newcastle, Bristol and London. The company sees its role as being to use research services to help organisations to make better decisions and, thus, improve the services that they provide and the outcomes that they generate.

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## Foreword

The research for this study was undertaken before the outbreak of the Covid-19 pandemic in early 2020, which has and will have a significant impact on individuals, businesses, and communities across all parts of Wales. More of our lives have moved online, making the resilience and capability of our digital networks more important. The introduction of self-isolation and social distancing in response to the pandemic has led to a greater than ever reliance on digital technology, with an emphasis on cloud computing, digital communication, and online collaboration platforms. The issues discussed in this report have therefore risen up the agenda in recent months and are likely to remain there for the foreseeable future. We have seen a growing recognition that making the best possible use of the opportunities enabled by digital infrastructure will be vital to the rural economy and sustainability of our communities.

This report is focused on the utilisation of digital infrastructure and the opportunities that it creates, particularly in the agriculture and tourism sectors. Its focus is not digital connectivity itself in rural Wales. That's not to ignore that issue – we fully recognise the need to go further, to close the urban-rural divide and make sure that as new technologies are deployed, the hardest-to-reach parts of the country are not last in the queue. However, the full potential impact of the investment in digital infrastructure will only be realised if businesses and organisations in rural Wales utilise the opportunities that it creates. That's the focus of this report.

In commissioning this independent study of how rural Wales is positioned to make the most of the opportunities through increased use of digital technology, we wanted to move beyond the perennial questions of access. Our starting point then is to ask what more we can do to help rural Wales realise its full potential? What are the skills that are required? And how do we better support early adopters of new technologies so that others can learn and follow? We tasked our research partners Wavehill to review the landscape and identify the success stories, the trailblazers who are making digital work so that we can learn from their experiences of learning new skills and innovation.

Before Covid-19, there was already a live conversation as to how we level up the economy, which recognised that connectivity would be key. Our hope is this report contributes to an accelerated pace of change we have witnessed through the pandemic. Technology in the 2020s isn't just about smart cities. It's about how we get to smart rural too.

**Nick Speed**  
**BT Group Wales Director**  
September 2020

# Executive summary

Improved digital connectivity has the potential to help address a number of the longstanding issues facing rural areas, both in terms of economic development and in terms of quality of life/wellbeing issues such as access to key services. Those opportunities involve both fixed broadband and mobile infrastructure, especially with the emergence of 5G. Having comprehensive mobile and fixed-line infrastructure in place is, however, not enough – more needs to be done to realise the opportunities that it creates.

The case studies in this report demonstrate that businesses in the rural areas of Wales are being innovative and utilising the opportunities provided by improved digital infrastructure in a range of exciting ways. Interviewees for this study described how digital connectivity is already revolutionising the agriculture sector and significantly enhancing the offer of businesses in the tourism and hospitality sector. Those businesses are, however, ‘early adopters’ in the main and not common across rural Wales. But it is clear that digital connectivity provides the opportunity to reinvent the cornerstones of the rural economy and see communities in those areas thrive.

The key finding of this study is that the ability to harness the potential of digital connectivity is shaped by a number of different factors. This means that a wide range of support is likely to be needed but tailored to meet the specific needs of businesses as well as the characteristics of rural areas. Time is, however, probably the biggest constraint and underlies all others. Most barriers can be overcome if sufficient time is allocated to the issue, for example, the time needed to become familiar with new technology (especially for those with less expertise) and assess its potential role within the business. Maximising the benefit (and value) derived from the time that it is possible to commit is therefore perhaps the critical issue.

**Recommendation 1:** Businesses, organisations and communities need support from the business support system in Wales to review their needs and develop an action plan for improving their utilisation of the digital infrastructure. This would allow them to focus their limited time on taking actions to deliver that plan and achieve a well-defined goal.

**Recommendation 2:** Support should be available to raise digital skill levels in a range of different ways (online videos, mentoring, training courses, etc.) in order to make its provision/access as flexible as possible. This support should be promoted via a range of different networks (not only technology-related) to maximise awareness and ensure that it’s not restricted, for example, to those with an interest in new technology or working within a particular sector.

**Recommendation 3:** ‘Early adopters’ should be offered specific support to help them take advantage of the opportunities created by digital infrastructure improvements. This support should offer examples (and inspiration) that others within their sectors can follow. Those early adopters should subsequently be supported to become ‘champions’ for the technology within their sectors and regions, proactively promoting the benefits that utilising the digital infrastructure can bring.

**Recommendation 4:** A series of plain-language case studies should be developed and maintained within a range of different sectors that are focused on demonstrating how businesses and communities have benefited as a result of utilising the digital infrastructure. The focus should be on the outcomes for the businesses and organisations in question, rather than on showcasing the technology.

**Recommendation 5:** We are not in a situation where no support is currently available – far from it. There would, however, seem to be an opportunity to encourage greater sharing of information and cooperation amongst those providing the support. The potential to build on existing structures and create a network of ‘support providers’ operating in rural areas should be explored as a means of sharing information and encouraging closer cooperation.

**Recommendation 6:** Recognising that research shows that the divide between rural and urban areas in the adoption of superfast broadband, whilst declining, still exists. The potential to increase the provision of digital skills training, specifically for businesses and other organisations in rural areas, and/or ‘rural-proof’ its provision should be given serious consideration.

**Recommendation 7:** Digital connectivity can have a significant role in community regeneration and placemaking in rural Wales. Projects designed to support groups of businesses or whole communities/towns should be created and supported, as well as one-to-one activities with businesses, to allow organisations that may be too small to implement projects on their own to benefit from the opportunities created by digital connectivity.

**Recommendation 8:** The emergence of digital connectivity has eroded a number of the barriers to locating in rural areas. The potential for the development of the digital services sector in rural areas should therefore be capitalised upon. Support for the development of the sector in rural areas should be considered.

**Recommendation 9:** The potential for improved digital connectivity to help address a number of the longstanding issues facing rural areas relating to both economic development and quality of life/wellbeing should be recognised. Drawing on the examples of good practice that exist in Wales as well as internationally, actions to promote the utilisation of digital connectivity should therefore include support for communities to utilise the potential of digital connectivity to overcome issues such as poor access to key services, as well as support for businesses and commercial organisations.

**Recommendation 10:** Research undertaken by the Welsh Economy Research Unit (Cardiff University) as part of the Superfast Broadband Project includes an annual survey of businesses across Wales regarding how they are adopting digital technologies enabled by broadband access (including the differences between SMEs in urban and rural locations). This research should continue and maintain tracking of the gap in the adoption of digital technology by rural businesses compared to their urban counterparts.



# 1. Introduction

This report explores the utilisation of digital infrastructure by businesses and organisations in rural Wales for both economic and societal gain. In particular, it examines the opportunities that this creates and the barriers that businesses and other organisations need to overcome. Whilst the focus is on agriculture and tourism as key sectors in rural Wales, the findings can be applied more broadly.

The research that we undertook for this study included:

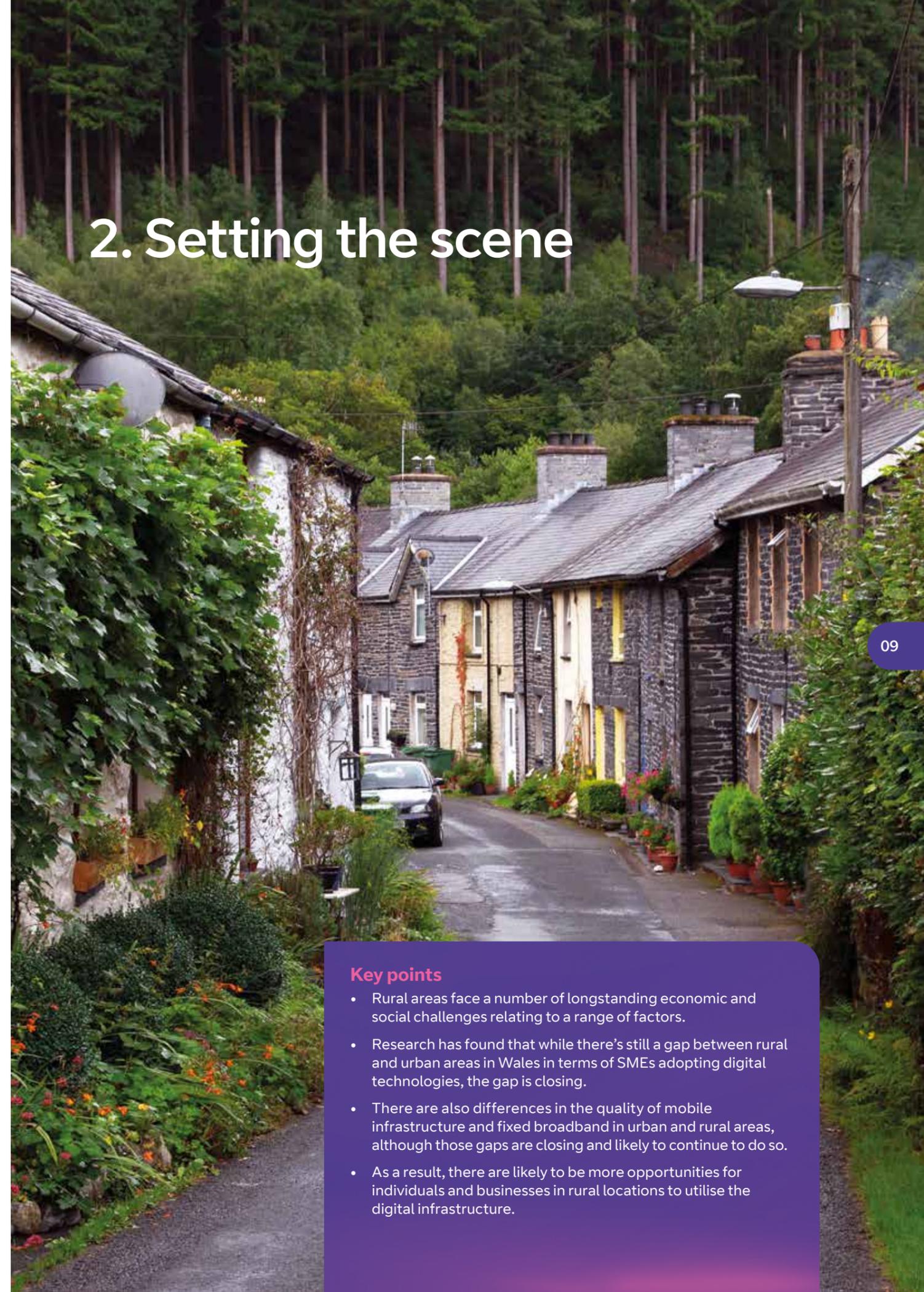
- a review of relevant literature
- telephone interviews with a range of stakeholders – nine in total
- an invitation to stakeholders to provide comments via social media

- a questionnaire distributed to stakeholders in the tourism sector via Visit Wales (to which we received 53 responses)
- telephone interviews with agriculture, tourism and other rural-based businesses, including those providing technology-based services (eight interviews)
- the creation of a number of case studies with businesses and projects that illustrate the benefit of utilising the opportunities created by improved digital connectivity
- a roundtable discussion with key stakeholders from across Wales held at Aberystwyth University in February 2020 (see photo below).



A list of contributors to the research can be found in Appendix 1.

# 2. Setting the scene



## Key points

- Rural areas face a number of longstanding economic and social challenges relating to a range of factors.
- Research has found that while there's still a gap between rural and urban areas in Wales in terms of SMEs adopting digital technologies, the gap is closing.
- There are also differences in the quality of mobile infrastructure and fixed broadband in urban and rural areas, although those gaps are closing and likely to continue to do so.
- As a result, there are likely to be more opportunities for individuals and businesses in rural locations to utilise the digital infrastructure.

## 2.1. Introduction

This chapter sets the scene for the discussion that follows. It begins by providing a brief overview of ‘rural Wales’ today (including the key challenges that it faces over the coming years). We then briefly review the findings of the latest Digital Maturity Survey for Wales before summarising the situation in Wales as it stands regarding both mobile infrastructure and fixed broadband.

## 2.2. Rural Wales

Rural parts of Wales face challenges arising from a range of factors, including low productivity, low-paid jobs, a low skills base, transport and IT infrastructure weaknesses, a lack of affordable homes, an ageing population, and climate change. These challenges are due, at least in part, to a lack of varied employment opportunities and services. There’s also an outmigration of young people who feel the need to leave in order to find the work and services that they want. The changes that will happen as a result of Brexit could also have a significant impact, with the support being provided to rural areas and sectors likely to change dramatically. There are, however, also opportunities (including improved digital connectivity) which have the potential to transform the rural economy and improve the quality of life of those living and working in rural areas, as well as visitors to the areas.

The agriculture sector is a key part of rural Wales, which is important for both the production of food and the management of the large majority of land in the country. The geography and climate of Wales mean that agriculture is dominated by grazing livestock, with production tending to be concentrated within a relatively small number of larger farms. The broader context for the agriculture sector has constituted a general movement away from support based on direct intervention, with an increasing emphasis on improving efficiency in production, adapting to agricultural change, and recognition of the indirect benefits of agricultural activities (such as conservational and environmental benefits).

A report published by the Senedd Research Service<sup>1</sup> finds that diversification activity on Welsh farms has grown over the past decade.<sup>2</sup> However, diversification revenues on Welsh farms continue to lag behind those in England. The proportion of total farm business revenue deriving from non-food or non-crop diversification activity in Wales remains low.

A conclusion is that a reliance on increased farm diversification to build resilience in Wales remains an optimistic strategy. In the worst-case post-Brexit scenario, diversification revenues might need to increase up to tenfold in order to replace other lost revenues. In summary, farming household resilience relies not only on food and diversified non-food income streams, but also on other income streams that are external to the business.

Both inland and coastal tourism is an integral part of the rural economy, creating and sustaining a considerable number of jobs. In some local authorities, for example, tourism accounts for nearly one in every five jobs (Conwy and Pembrokeshire).<sup>3</sup> The Welsh Government’s Rural Development Programme for Wales recognises that the sector attracts large numbers of visitors but must be managed in a sustainable way to ensure that it’s sensitive to the environment. It states that rural areas can achieve higher-value sustainable tourism by improving accommodation, realising the potential of marine, leisure and outdoor activities, and enhancing the attractiveness of market towns and the mosaic of small settlements.

Rural tourism faces a range of challenges including the need for investment in infrastructure that supports the sector, such as transport connectivity and local amenities. The sector tends to provide insecure, seasonal employment and struggles to offer more reliable and skilled opportunities.<sup>4</sup> This issue is compounded by the lack of all-weather attractions and the reliance on outdoor recreation as a draw for visitors, which can lead to fluctuations in visitor numbers. On top of that, the majority of visits are relatively short, with domestic day trips constituting a significant proportion of visitor expenditure. Lengthening stays and increasing visitor expenditure are seen to be key to long-term sustainability of the sector, including in improving occupancy rates.

## 2.3. Findings of the Digital Maturity Survey for Wales

The Welsh Economy Research Unit (WERU) of Cardiff Business School undertakes research on the economic benefits associated with the take-up of superfast broadband-enabled technologies by businesses in Wales. The Digital Maturity Survey for Wales 2019 report<sup>5</sup> provides findings from the fourth annual survey of SMEs in Wales, as well as their adoption and use of digital technologies enabled by broadband. The survey is of a representative sample of SMEs in Wales based on 513 responses, 216 (42%) of which were from a rural area in 2019.

The 2019 survey finds positive trends in terms of SME adoption of superfast broadband, with 63% of businesses reporting access through a fixed connection (an increase of 10 percentage points on 2018). These results are set in the context of a growing number of premises now having access to superfast broadband, and highlight the ongoing potential to encourage more SMEs to access such infrastructure.

However, while the overall picture is one of businesses increasingly adopting and using digital technologies in Wales, the report also concludes that the transition towards digitalisation is “likely to be bumpy” because there are regional inconsistencies across Wales, with some indicators going up but others going down. A multi-year decline in the skills indicator, alongside a decline in several aspects of the digital maturity index, is also highlighted as a potential cause for concern and an indication of the ongoing challenges for businesses to maintain their digital maturity, as well as for policy intervention to support this.

The key findings of the 2019 report in respect of rural-based SMEs are that:

- The proportion of rural businesses adopting superfast broadband<sup>6</sup> increased by 20 percentage points from 37% in 2018 to 57% in 2019. During the same period, the percentage of urban businesses with superfast broadband remained unchanged at 68%, providing evidence that the divide between rural and urban areas in the adoption of superfast broadband still exists but has decreased.
- 6% of rural businesses were only able to achieve download speeds of less than 2Mbps in 2019. However, this represents an improvement on 2018, during which the equivalent figure was 14%.
- Over two fifths of rural businesses (44%) reported being able to achieve download speeds of 30Mbps or more in 2019. This was an increase of nine percentage points on the 2018 figure.
- Urban-based businesses were more likely to achieve faster upload speeds, with nearly two thirds (64%) reporting 10Mbps or more in 2019 as compared to nearly one half (48%) of rural SMEs. The percentage of SMEs in rural areas achieving upload speeds of less than 2Mbps fell by 15 percentage points from 2018 to 2019 to 35%.
- SMEs located in urban areas were more likely to use advanced cloud services than were rural SMEs (82% and 73% respectively).
- A larger percentage of urban-based businesses (90%) had a website than rural businesses (81%). Urban-based SMEs were also more active in using social media than were rural SMEs.
- Two thirds of both rural businesses (64%) and urban businesses (68%) reported at least half of their employees possessing intermediate IT skills or above.
- External ICT support was more likely to be engaged by SMEs in urban areas (64%) than in rural areas (53%).
- 40% of rural businesses and 49% of urban businesses made at least half of their purchases online.

## 2.4. Mobile infrastructure and fixed broadband in Wales: the current situation

This section summarises the key points in Ofcom's Connected Nations 2019: Wales report, originally published in December 2019 but refreshed in March 2020, which measures progress in broadband and mobile services in Wales.<sup>7</sup>

### 2.4.1. Mobile infrastructure

The report identifies what it describes as the substantial differences between urban and rural areas in Wales in respect of mobile infrastructure. It highlights the following examples:

- 97% of premises in urban areas have outdoor mobile telephone services from all operators, while services in rural areas are available outside only 75% of premises. However, the report also notes that in rural areas, mobile services from at least one operator are available outside almost all premises.
- In urban areas of Wales, 4G data services<sup>8</sup> are available from all operators outside 98% of premises, while in rural areas, 4G services from all operators are available outside only 76% of premises. In rural areas, 4G data services from at least one operator are available directly outside 98% of premises.

Indoor coverage is described as remaining poor in many rural areas in Wales. In urban areas, for example, mobile services are available from all operators in 96% of premises, while services in rural areas are available from all operators in only 69% of premises (an increase of three percentage points on the previous year). However, Ofcom notes that in rural areas, mobile services from at least one operator are available in 98% of all premises (in line with the previous year). In addition, 4G data services in urban areas are available from all operators within 83% of premises (an increase of 4% on the previous year), while 4G services in rural areas are available from all operators in only 38% of premises (an increase of 2% on the previous year). In rural areas, good 4G data services from at least one operator are available inside 92% of premises. The situation in rural areas, therefore, seems to be improving.

The continued differences in coverage between urban and rural areas are identified too. In urban areas of Wales, 4G data services are available from all operators in 90% of the landmass (an increase of one percentage point on the previous year), while 4G data services in rural areas are available in only 54% of the landmass (an increase of one percentage point on the previous year).

The report refers to the Shared Rural Network (SRN), which has been agreed since the report was published. It's an arrangement between the UK Government and the four mobile networks which is set to "transform mobile coverage in rural areas".<sup>9</sup> The network will see all four providers share infrastructure to provide coverage to an additional 280,000 premises and 16,000km of roads in the UK. The biggest coverage improvements are expected in rural parts of Scotland, Northern Ireland, and Wales.

The emergence of 5G technology will further enhance the mobile infrastructure.<sup>10</sup> BT installed one of the first permanent 5G networks in Europe at a Royal Welsh showground in Llanellwedd, allowing visitors to the 2019 show to engage with demonstrations including a connected, driverless pod. Announced in March 2020, the Connected Communities in the Rural Economy (CoCoRE for short) project will assess how state-of-the-art technology can improve various aspects of life, from tackling rural isolation to improving farm security and bolstering the tourism industry. The project is described as a 5G testbed in South East Wales and will receive £5m in UK Government funding to connect rural communities across Monmouthshire and Blaenau Gwent. Its objective is to provide innovative solutions in areas such as immersive tourism and farming security (as key parts of the rural economy), while leveraging related technologies such as artificial intelligence, the Internet of Things, and cybersecurity (as part of an 'innovation platform'). CoCoRE is one of nine projects across Wales, England and Scotland receiving a share of £35 million from the UK Government's rural and industrial 5G competitions.

### 2.4.2. Fixed broadband

Ofcom reports that across the UK there is a significant difference between the availability of superfast broadband<sup>11</sup> in urban and rural areas, with 97% of residential premises in urban areas having access compared to 79% in rural areas.

The report identified these key points for fixed broadband in Wales:

- Superfast broadband coverage to residential properties stands at 93%.
- 12% of premises (165,000) now have access to a full-fibre connection, capable of delivering much higher download and upload speeds; 15% of these premises are in urban areas and 8% in rural areas.<sup>12</sup>
- Around 50,000 (3%) homes and businesses in Wales are still unable to access a fixed broadband service that delivers a decent broadband connection.<sup>13</sup>

Ofcom references a 2019 report by the Centre for Economics & Business Research (Cebr) for Openreach,<sup>14</sup> which estimated that the Welsh economy could benefit by almost £2bn as a result of connecting everyone in Wales to full-fibre broadband by 2025. The report claims that almost 25,000 people could be brought back into the workforce through enhanced connectivity. This could include roles within small businesses and entrepreneurs, as well as allowing thousands more people to work remotely.

Of particular relevance to this study, the Cebr research also highlights the positive impact that full-fibre broadband would have on rural towns and villages from which people have traditionally moved away in search of work. Being able to work from home or set up a home-based business would make these areas more appealing to workers, boosting the local economy as well as reducing transport and housing pressures in cities.

<sup>1</sup> Senedd Research is an expert, impartial and confidential research and information service designed to meet the needs of members of the Senedd and their staff. [senedd.wales/en/bus-home/research/Pages/research.aspx](https://senedd.wales/en/bus-home/research/Pages/research.aspx)

<sup>2</sup> Henley A. and Morris W. (2019). Diversification and resilience of Welsh farming: prospects after Brexit. Cardiff: Senedd Research.

<sup>3</sup> Source: Rural Development Programme for Wales 2014-2020, Welsh Government.

<sup>4</sup> See recommendations in FSB (2018). [fsb.org.uk/docs/default-source/fsb-org-uk/fsb\\_tourism\\_eng.pdf?sfvrsn=0](https://fsb.org.uk/docs/default-source/fsb-org-uk/fsb_tourism_eng.pdf?sfvrsn=0)

<sup>5</sup> Henderson, D. et al. (2020). Digital maturity economic impact report 2019. Project Report. Cardiff: Cardiff University. [cardiff.ac.uk/superfast-broadband-project/digital-maturity-survey](https://cardiff.ac.uk/superfast-broadband-project/digital-maturity-survey)

<sup>6</sup> Defined as a data service that delivers download speeds of at least 30Mbps.

<sup>7</sup> [ofcom.org.uk/\\_\\_data/assets/pdf\\_file/0020/186410/connected-nations-2019-wales-report.pdf](https://ofcom.org.uk/__data/assets/pdf_file/0020/186410/connected-nations-2019-wales-report.pdf)

<sup>8</sup> Fourth generation of mobile systems, which can provide download speeds of over 10Mbps and is used to deliver voice, text and higher-speed data services.

<sup>9</sup> [gov.uk/government/news/shared-rural-network](https://gov.uk/government/news/shared-rural-network)

<sup>10</sup> 5G will be the fifth generation of mobile technology and is expected to deliver faster, lower-latency mobile broadband and enable more revolutionary uses in sectors such as manufacturing, transport and healthcare.

<sup>11</sup> Superfast broadband: a data service that delivers download speeds of at least 30Mbit/s.

<sup>12</sup> A form of fibre optic communication delivery in which the optical signal reaches the end user's home or office.

<sup>13</sup> Decent broadband is defined as one that delivers a download speed of at least 10Mbit/s and an upload speed of at least 1Mbit/s.

<sup>14</sup> Cebr (2019). Full fibre broadband: A platform for growth. London: A report for Openreach. [openreach.com/content/dam/openreach/openreach-dam-files/images/hidden-pages/full-fibre-impact/CebrReport\\_online.pdf](https://openreach.com/content/dam/openreach/openreach-dam-files/images/hidden-pages/full-fibre-impact/CebrReport_online.pdf)

# 3. Case studies

## Key points

- The case studies highlight how businesses have utilised digital connectivity and the benefits that it has generated.
- The farm-based case studies emphasise the efficiency benefits that improved use of digital connectivity can provide, described as having the potential to ‘revolutionise’ the sector.
- Having a personal interest in (or being passionate about) technology is often a key factor when businesses have utilised the opportunities created by improved digital infrastructure.
- Being able to access support, advice and guidance is important. As is having an awareness of the support available and being part of the correct social network.
- Training is highlighted as being important.
- There are both ‘supply’ and ‘demand’ issues that need to be overcome for the benefits of the digital infrastructure to be fully realised – demand on the part of the businesses (or, more often, individuals) concerned and supply in respect of a good connection and the availability of appropriate hardware and software.
- Benefits often only become apparent after the investment in digital infrastructure has been made – they can be difficult to anticipate and are, to an extent, therefore a ‘leap of faith’ on the part of the businesses concerned.
- Digital connectivity can allow businesses committed to being located in rural areas to realise their potential without needing to relocate or compromise in terms of their development.
- Utilising digital connectivity has a positive impact on the working environment/culture of a business, making it easier to recruit and retain staff.
- Finding the time to commit to undertaking the necessary background research and keeping abreast of the latest developments is a key barrier that businesses investing in digital infrastructure find challenging to overcome.
- A combination of fixed and mobile connectivity is required for businesses to maximise the benefits that they derive from digital connectivity.
- The social (keeping in touch) and environmental (reducing travel) benefits of digital connectivity are apparent from the case studies and can be important motivations in addition to the ‘business case’ for investment.
- Tourism businesses in particular highlight the value of digital connectivity as a marketing tool.
- Online trading can create out-of-season markets for businesses traditionally restricted to/dependent on tourism seasons. Businesses can also now operate almost exclusively online, removing previous barriers in terms of location.
- Businesses are increasingly able to undertake activities themselves, rather than having to rely on (and pay for) external companies to provide a service. For example, businesses are developing and maintaining their own websites and producing and distributing their own marketing materials.
- The developments in Cardigan demonstrate how a community and local businesses can cooperate to exploit the benefits that digital connectivity can provide.

## 3.1. Introduction

This chapter includes case studies that illustrate how businesses and communities located in rural parts of Wales have been able to utilise digital connectivity to develop and improve. Seven case studies are included: three for farming/land-based businesses, three in the hospitality sector, and one for a market town which has utilised digital connectivity for the benefit of all users of the town.

The case studies are based on interviews undertaken in late 2019 and early 2020 with the individuals concerned. It’s important to note that the interviews were all undertaken prior to the Covid-19 pandemic, which does not, therefore, feature in any of them.

Figure 1:  
The location of the  
case studies



### 3.2. Fferm Glynllifon, Caernarfon

Owned by Grŵp Llandrillo Menai College, Fferm Glynllifon is located six miles west of Caernarfon in Gwynedd. The 283 hectare lowland farm consists of 162 hectare of farmland and 121 hectare of woodland and is run as a fully commercial unit. Its unusual mix of dairy, beef, sheep and pig enterprises brings together the main sectors of Welsh farming.

#### 3.2.1. Utilising digital connectivity

Rhodri Owen is the Farm Manager. He believes that the starting point for innovation with digital technology is to have a fast, reliable connection to the internet. Fferm Glynllifon benefits from a fibre connection to the farm, as well as good 4G coverage that allows Rhodri and his colleagues to access real-time information relating to the farm anytime and anywhere.

Since 2017, Glynllifon has worked closely with Arloesi Gwynedd Wledig<sup>15</sup> to develop the farm into what they describe as a 'digital playground' by utilising LoRaWAN. 'LoRa' is a wireless technology and stands for 'long range'. LoRa devices are able to transmit and receive data over large distances. 'WAN' stands for 'wide-area network'. The network provides a way of linking sensor devices and applications together.

Rhodri believes that LoRaWAN will be the network that allows farmers to unleash the potential of the Internet of Things on farms and in rural areas in Wales.



Figure 2: Rhodri Owen, Farm Manager, Glynllifon Farm

*"It's one of the biggest opportunities we have to make farms more efficient, safer and healthier. The data generated from these sensors will allow farmers to make better decisions quicker. I really hope to see more farmers getting involved in developing high-value applications in the future, as the agri-tech scene is booming in many parts of the world at the moment."*

The farm has sensors monitoring the fridge temperature where vaccines are stored, humidity and temperature sensors in the calf shed and pig units, a range of contact sensors monitoring gates and cattle grids, and a tracking device installed on a ram to monitor its movement and whereabouts. Fferm Glynllifon is also part of a cutting-edge project to look at how LoRaWAN sensors can monitor field conditions to guide farmers in making better decisions on when slurry can be applied, as well as to log the conditions for when it's applied as an automated self-auditing tool.

Although an enthusiast about new technology, Rhodi would not describe himself as an 'IT person' and has found that it can be difficult to keep abreast of the latest developments. Finding the time to commit to getting up to speed is challenging, as is deciding where best to invest time and money, as well as ensuring that any technological investment is cost-effective.

He identifies a lack of hardware that is both reliable and robust enough to withstand the harsh environmental conditions found on a farm as an issue. Software is also a problem.

Integrating technology so that one piece of kit works seamlessly with another has also proved challenging, leading Rhodri to be concerned that a lot of new technology is developing in isolation.

*"The value of IoT sensors is not in the hardware itself, but rather the logic or the software that computes the data to provide farmers with meaningful information. There is going to be an even-bigger demand for software architects in the future!"*

*“A surprising benefit is that technology has made work on the farm more interesting. We are now able to measure and monitor things that we never dreamt of being able to do so commercially 10 years ago. And because we’re a college farm, we aim to provide useful experiences to support the education of hundreds of students that will be working on farms for the next 30 to 40 years. We need to give them experience of emerging technologies.”*



### 3.2.2. The benefits

There are countless examples of how the farm has benefited from all of the digital work that it has undertaken. These include:

- Improving efficiency by recording and monitoring the performance of various aspects.
- Reducing costs.
- Easier communication with colleagues in other departments or workers working on the farm.
- A reduction in how much risk the farm is exposed to; for example, an alert is sent if the vaccine fridge starts to warm up, enabling Rhodri or staff members to save valuable vaccines and medication.

Embracing digital technology has opened new doors for Glynllifon and allowed it to offer new services and experiences.

### 3.3. Environment Systems, Aberystwyth

Formed in 2003, Environment Systems has become an established consultancy with an international reputation for expertise in environmental and agricultural data analysis, specifically geoinformatics and Earth observation. From its base in Aberystwyth, the company provides evidence and insight to governments and industries worldwide.

As an ecologist and Chartered Environmentalist, the company’s Environment Director, Dr. Katie Medcalf, has led on several innovations with the business in areas including environmental policy, agri-environment, ecology, GIS (geographic information systems), and remote sensing.

Recent projects undertaken by the company include the mapping of ‘light pollution’ in Pembrokeshire via satellite to create a baseline map for monitoring habitats on the Gwent Levels, mapping Welsh grassland using remote sensing to better inform grassland management and predict grass growth, and – in Colombia – supporting banana growers and their supply chains to make better use of Earth observation data to improve crop management and monitoring.

#### 3.3.1. Utilising digital connectivity

Environment Systems is currently one of the UK’s largest downstream Earth observation companies. This was made possible, in part, by the company’s choice to embrace the opportunities that a fast, reliable internet connection provides in terms of:

- a. how the business is run and structured
- b. creating a modern working environment for the team
- c. what the company can offer their customers across the world.

Up until 2014, the company was restricted by an inadequate 3Mbps download connection speed. This meant that it needed to be careful in respect of the datasets that it could stream to customers and the need to plan ahead for large data uploads or downloads. Poor connectivity had become a barrier to growth for the business.

Today, the company takes advantage of a connection speed of 100Mbps, provided via a FTTP (fibre to the premises) connection, which has revolutionised what it is able to do on a daily basis. It also provides the digital infrastructure for future scaling of the business in response to a growing market and demand for the business’ services.

Having their headquarters in Aberystwyth is important to Environment Systems, and the improvement of digital connectivity has overcome a barrier which could have limited the company’s growth in the local area, to which it is very committed.

Being able to host and serve large files has allowed the business to expand satellite and drone offerings to clients. Environment Systems is fully cloud-enabled, allowing the whole team to access data and consume software ‘anytime, anywhere’, which is particularly useful when working in the field or abroad. It is using sophisticated applications and handling large amounts of data, and since investing in the digital infrastructure, all of this happens seamlessly, which is critical for the business.





With a deep-rooted culture of innovation at Environment Systems, Katie could not identify major barriers that hamper their use of digital technology other than the usual patience that is required while installing new pieces of business infrastructure. Due to its nature, the company already had a “digital-literate team” and an excellent IT Manager and Operations Director who continuously drive things forward. As Katie put it, “you need excellent people to make things happen”.

The company considers “keeping ahead of the game” to be very important and, as part of that, it is keen to see improvements to the mobile network, especially in rural areas. Having a reliable rural 5G network would create further opportunities. For example, it would allow an improved data transfer of drone imagery from rural areas, providing a better service for their clients. As Katie explained:

*“We could offer premium services to better manage high-value crops that may need attention immediately (pending the drone scan). For example, a drone scan can highlight crop health issues in horticulture crops that needed remedy or action straight away to minimise the economic impact. It can currently take two to three days for a drone scan to be carried out, downloaded, analysed and sent to the client.”*

**3.3.2. The benefits**

Due to the investment in digital infrastructure, turnover at Environment Systems has grown year on year. The company can offer higher-value products and get more data to clients in real time, which is more valuable.

The business has shifted as much of its operations as possible to the cloud, allowing all staff to instantly communicate on projects wherever they are located. This has helped the company to retain staff and has made recruitment easier. Katie also identifies a knock-on benefit in terms of how much the team enjoys being involved in the development of a pioneering service and cutting-edge technology: “It’s a good place to be.”

*“I believe that an individual has to be interested and self-motivated to learn about new technology and possibilities. I was resistant to having a smartphone initially; however, I’m now on my fifth handset and would never go back.”*



Figure 3: Huw and Meinir Jones. Source: Farming Connect

**3.4. Bryn Farm, Cardigan**

Husband and wife Huw and Meinir Jones are the fourth generation to run the family farm at ‘Bryn’ since it first entered Huw’s family in 1896. A 101 hectare farm, the farming business focuses on sustainable beef production. Huw opts to cultivate most of the cattle feed on the farm, growing wheat, oat, barley, and a range of fodder crops such as turnips and kale. Huw’s emphasis on adding value to home-grown produce led to him, in 2007, launching an animal bedding enterprise with Meinir, selling a range of premium, natural animal bedding, which has been expanded year on year.

**3.4.1. Utilising digital connectivity**

Being passionate advocates of making the best use of technology, Huw and Meinir soon realised that the farm needed better connectivity if it were to benefit from digital developments. Like many farms, Bryn is several kilometres from the nearest ‘green cabinet’, which meant that conventional copper fibre broadband had diminished speeds by the time it reached the farmyard and the couple’s house. They knew that this would potentially hold the business back if it were not addressed promptly. Having previously struggled with speeds of only 3Mbps, it became a business priority to improve the farm’s connectivity.

After two years of research, discussions and planning, the farm’s digital infrastructure took a huge leap forward with the installation of an FTTP connection to the farmyard. They now use VoIP (voice over internet protocol) to make calls, using the internet line rather than conventional phone lines. This in itself has allowed the business to save significant costs, and the audio quality is better than it was previously.

The dedicated line to the farm also has many times additional capacity, offering the business digital resilience for the future as technology becomes more demanding on speed and data loads. In addition, the farm has excellent 4G coverage, which is also a key part of the business’ connectivity infrastructure, allowing access to real-time information about the farm via a smartphone.

The next stage in the development involves the installation of a LoRaWAN gateway on the farm later this year to deploy long-life Internet of Things devices on the farm, such as temperature, humidity and distance sensors, and use these to accelerate farm efficiency. There are also plans for a collaboration with Bangor University to trial a revolutionary nitrate sensor to improve the accuracy and efficiency of fertiliser application rates on farmland.

Some of the initial barriers that Huw and Meinir faced when improving the infrastructure were the setup costs and connectivity issues. The time and commitment needed to understand the technology were also highlighted.



*“Finding the time to properly understand options to improve connectivity and make good business use of technology can be challenging at times. It also needs some upfront capital investment, although the payback is usually months rather than years.”*

#### **3.4.2. The benefits**

Both the farm and the animal bedding business have improved efficiency significantly on the back of improved connectivity. For example, registering cattle passports on the Cattle Tracing System is now a more straightforward and quicker process. Huw and Meinir also use various apps to simplify and speed up other administrative processes, use online banking services and regularly use websites such as FAWL (Farm Assured Welsh Livestock) to update their records. It also allows them to make better and quicker decisions that save costs: “I can spend more time on other parts of the business, such as dealing with orders for the animal bedding.”

The couple have moved up a gear with digital marketing. Prior to an auction day, Huw sends his local auctioneer a short 10-15 second video clip of the livestock that will be on sale. Auctioneers can share this on their Facebook account, giving prospective buyers the opportunity to view the stock in advance. Making use of promotional and marketing strategies such as this has improved the couple’s business and profitability.

With the improved broadband, mobile and digital technology at Huw’s disposal, he is now looking at precision farming technology as a possible opportunity. Having initially questioned whether this would be viable for his family-run farm in terms of scale, he is now looking forward to working with Bangor University to improve fertiliser application rates, as well as seeing whether the use of LoRaWan will be of benefit both financially and environmentally.



### 3.5. Dioni Holiday Cottages, Snowdonia

Dioni Holiday Cottages are a self-catering holiday cottage agency based in Gwynedd that has been operating for 10 years. Their team consists of the founder, Gwion Llwyd, as well as four other part-time members of staff who represent and manage a total of 164 cottages.

#### 3.5.1. Utilising digital connectivity

Dioni have embraced cloud-based systems to such an extent that all of its staff work remotely, usually from the comfort of their own homes, only meeting together physically once a week. They have adopted various cloud-based systems including word-processing applications, an online booking system, and web design software, all of which can be accessed by any of their staff members as long as they have a laptop and an internet connection. This flexibility is an important part of Gwion's main motivation for establishing Dioni, ensuring an improved lifestyle for himself and his staff.

The internet and digital media have played an important role in Dioni's marketing strategy. The business have a presence on Facebook, Instagram, Twitter, and Google Plus, with Facebook being their most effective site for generating business. They also use their own website for marketing purposes and utilise Google Ads (which provide analytics including costs per click and interaction figures). This allows Dioni to determine how well a strategy is working and whether or not it's worth trying something else. They believe that through these marketing strategies, especially those on social media, they have been able to carve their own niche, where, despite not having as many followers as other companies, they feel they have developed a loyal following.

Once their broadband speeds and mobile phone coverage have improved further, they believe that they will then be able to make further strides in terms of their digital innovation, for example, being able to upload 4K imagery in a timely manner and to make the most of better mobile network coverage with regard to the day-to-day operations of the business.

Dioni have already begun work on their next digital venture, looking to develop an app that will allow tourists to plot a route through North Wales that is tailored to their preferences, one which they can then embark on in a VW Camper which Dioni has recently acquired. The app will ask questions such as 'Do you prefer beaches or mountains?' and 'What is your preferred form of accommodation?'. Using this data, it will then suggest routes and attractions for them to travel to.

Their continued interest in evolving alongside technological innovation is also part of Gwion's vision for the future of North Wales. He wants the area to lead the charge for rural connectivity, and believes that allowing organisations to have the same online resources as urban hubs such as Manchester and London will greatly increase their competitiveness. He believes that industries such as his own and, in particular, farming will need support, but by nurturing younger generations' desire to become entrepreneurs, North Wales can become a rural digital pioneer.

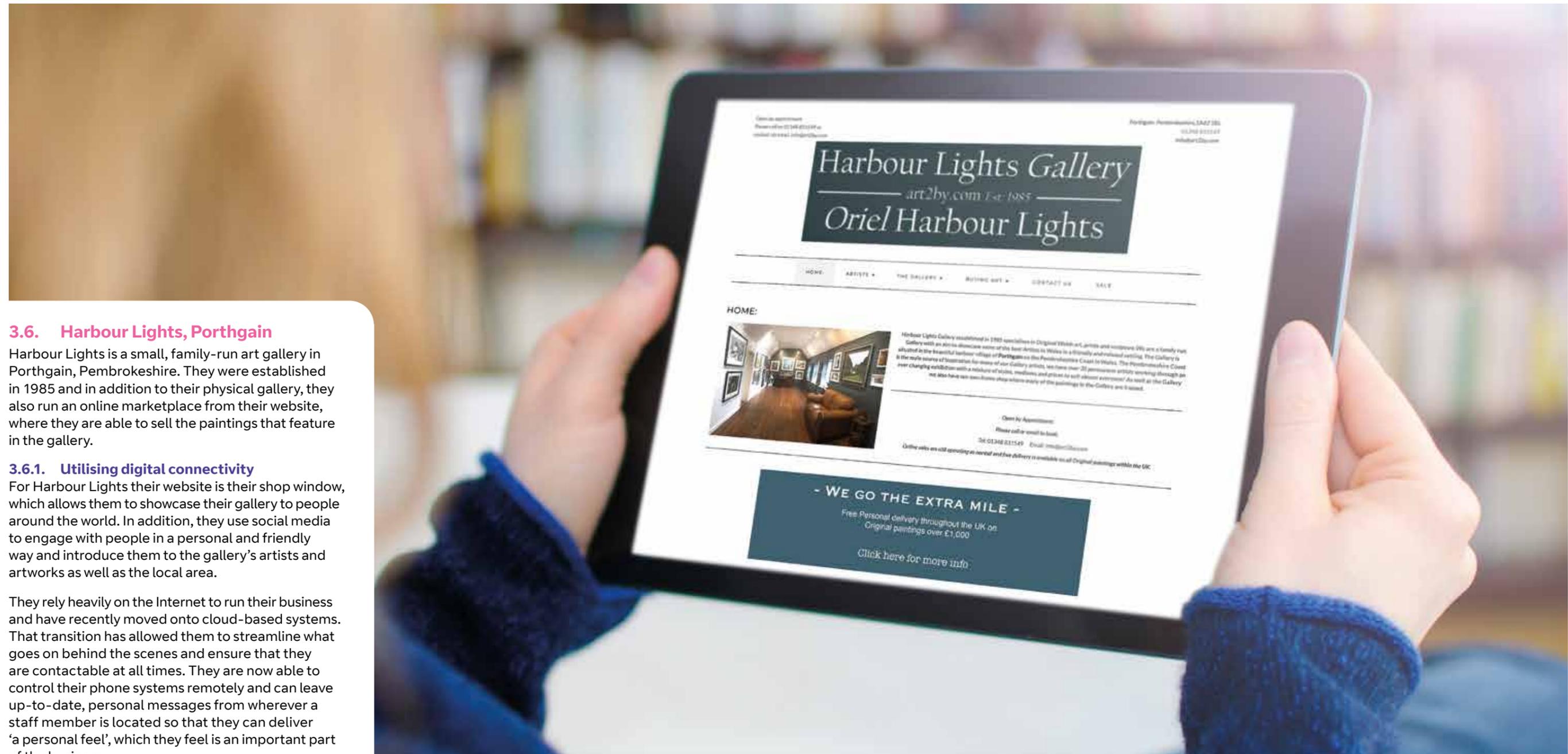
#### 3.5.2. The benefits

Gwion believes that without their current connectivity their business would not be able to function. He feels that it has allowed them to compete with larger companies and has increased their overall efficiency by allowing them to do things like having multiple people work on one document (rather than having to worry about attachments and sharing files during their revision processes), saving time. As remote working is a vital part of their operation, without it they feel that the company simply would not be able to function in its current form, which has been very successful for them.

*"We would have zero profit and zero turnover; it allows us to be efficient and allows us to move quickly if anything needs to happen."*



*"I think the main motivation for me was a better lifestyle. I have a corporate background and I wanted me and my staff to have a better life, which I feel technology has allowed us to do. We are all able to work from home or where we want, which is important as I believe the space in which you choose to work is very important to people."*



### 3.6. Harbour Lights, Porthgain

Harbour Lights is a small, family-run art gallery in Porthgain, Pembrokeshire. They were established in 1985 and in addition to their physical gallery, they also run an online marketplace from their website, where they are able to sell the paintings that feature in the gallery.

#### 3.6.1. Utilising digital connectivity

For Harbour Lights their website is their shop window, which allows them to showcase their gallery to people around the world. In addition, they use social media to engage with people in a personal and friendly way and introduce them to the gallery's artists and artworks as well as the local area.

They rely heavily on the Internet to run their business and have recently moved onto cloud-based systems. That transition has allowed them to streamline what goes on behind the scenes and ensure that they are contactable at all times. They are now able to control their phone systems remotely and can leave up-to-date, personal messages from wherever a staff member is located so that they can deliver 'a personal feel', which they feel is an important part of the business.

Their online presence and visibility are also very important to the business. Due to their location, many customers become aware of Harbour Lights while on holiday. Their website allows those customers to revisit once they have returned home. Customers are also able to look back at artists and works that they may have liked when they visited the gallery and access more information so that they feel confident enough to visit the website and make a purchase, which they may not have been able to do when they originally visited the gallery, especially if spending a substantial amount of money. The website is also obviously an important way to attract visitors to the gallery in person if and when visiting the area.

One member of staff underwent training in order to engage with people more effectively online. Since the training, they have been able to establish an increasingly active social media presence, which they use to engage with followers on a daily basis. These posts include information about new works that have arrived in the gallery, what the business is doing as well as the local area and other local businesses. This mix of content again serves to deliver the personal feel on which Harbour Lights pride themselves.

Much of the gallery's business is conducted online. Their website and social media platforms allow people to reach out and ask questions that they may be more comfortable asking online. During the winter (when footfall is low), especially during November and December, around 80% of the gallery's business is done online. This has meant that when the area is quiet, they are still able to remain open and continue to sell their work; therefore, their location in a rural area is much less of a barrier to the growth of the business.

#### 3.6.2. The benefits

Having an online presence and engaging with customers online has become an integral part of Harbour Lights and without it they feel as though they wouldn't be as successful as they are today. They feel that these new channels that are available to them have been critical to letting customers know more about the gallery and its business. Looking forward, they aim to continue to use the internet to show what they offer to the public and to promote the local area.



### 3.7. Royal Victoria Hotel, Llanberis

The Royal Victoria is a 104-bedroom hotel situated in Llanberis, Gwynedd, and was originally built in the 1830s to allow Victorian travellers to come and visit Snowdonia. The hotel began its digital transition in 2016 when the business decided to invest in improving its internet capacity, increasing it to 50Mbps from 1Mbps (which was proving less than satisfactory for the hotel's visitors).

Since then they have upgraded further to accommodate 1Gbps of usage and have transitioned to a cloud-based operating system. All of their data storage and servers are now online and can be accessed from any PC or other device connected to the network, whereas previously this was all based in London. Staff timesheets are now managed electronically using the cloud, as are the hotel's food and liquor stocks.

#### 3.7.1. Utilising digital connectivity

This transition was inspired by the desire to become the first hotel in the region to be able to offer a high standard of broadband, giving them a competitive edge. Faster internet speeds were identified as becoming more and more important to guests and the Royal Victoria did not want to disappoint those who were staying with them, as well as risking losing out on potential visitors.

Initially their knowledge and understanding of what technology was out there was limited; once the management team became more aware, however, the transition was straightforward.

Even when it came to implementing the new technology in the day-to-day running of the hotel, training staff members was a much simpler process than was originally anticipated.

*“The average age of our staff is probably between 18-30, so they are used to all of this technology. In terms of training, we only really had to focus on those of us who were between 50-60, who knew how to do their jobs, just not how to use the tech.”*

#### 3.7.2. The benefits

These innovations have led to a range of benefits for the hotel. In terms of the efficiency of the business, they have been able to introduce systems that have automated many of the processes that would have previously had to be carried out by a member of staff. An example of this is the hotel's new dynamic pricing system, which adjusts the prices of rooms depending on how many rooms are left available in a given week.

Financially, these innovations have led to the Royal Victoria Hotel remaining competitive in the region's tourism industry and not losing out on any business as a result of digital and technological issues. They believe that hotels in the current market need to be able to offer wi-fi to guests, and have automated pricing and stock systems in place and allow staff to readily access and modify data if they are to succeed.

The next step in the Royal Victoria Hotel's digital transition is to overhaul their website (which they feel is old and clunky) and replace it with one that attracts new guests. Staff have been made aware of contemporary marketing techniques and how best to appeal to people of varying demographics, which they want to make part of their advertising. In addition, the hotel is looking to expand their current stock management software so that it can predict when products need replacing (rather than having to rely on humans to check), allowing staff to get on with other tasks.

They believe that the secret to encouraging innovation in Wales' tourism sector will be to ensure that what is working for people is shared. A seminar format was believed to be the most effective method of doing this, as not only does it allow for these success stories to be told, it also creates an environment for discussion in which debates about which parts of these stories work and which don't work can be had by people from all over the tourism industry.

*“Today we had an engineer in to service our heating system. He reported a fault and sent me a photo of the problem part. Within an hour, using WhatsApp and screenshots, the part had been sourced, an appointment made, and a contract agreed to replace. Before, this would have taken at least a few days to go through the process.”*





### 3.8. Town wi-fi and analytics, Cardigan

Cardigan is a market town in south Ceredigion, on the border with Pembrokeshire. According to the 2011 census, the town has a population of just over 4,000 people in more than 2,000 households. It's described on the Visit Cardigan website as the gateway to the Teifi Valley and the Ceredigion and Pembrokeshire Coastal Paths.<sup>16</sup> The town sits on the estuary of the River Teifi at the base of Cardigan Bay. Key features of the town include Cardigan Castle (the site of the first competitive Eisteddfod in Wales in 1176) and the Guildhall, which was built between 1858 and 1860. It's estimated that the town includes around 100 shops.<sup>17</sup>

This case study is based on an interview with and information provided by Cllr. Clive Davies, who has been closely involved in all aspects of the work undertaken.<sup>18</sup> The projects in question are managed by 4CG<sup>19</sup> in association with the Town Centre Partnership, a forum for the development of Cardigan town centre.

#### 3.8.1. Utilising digital connectivity

Cardigan's town centre wi-fi scheme provides free web connectivity throughout the town centre via wi-fi units that have been placed on buildings at strategic points throughout the town. Use of the wi-fi is free and it can be accessed via a simple search for 'Cardigan Town' on your mobile device's wi-fi list.

The wi-fi project dovetails with a 'town app' that has been developed for Cardigan.<sup>20</sup> The app provides visitors with a range of information including details on shops, places to eat, a guided walk, and the history of the town. Importantly, the app also collects information. iBeacon<sup>21</sup> devices have been placed around the town in order to 'power' activities on the app (including a treasure hunt) and deliver location-specific messages to users, such as to draw attention to a historical building or notify shoppers about a special offer.

Using the combined data that the app and the wi-fi generate, the town allows a range of useful information to be gathered which is being used to help plan activities in the town as well as to measure the 'cause and effect' of visitors. For example, the data gathered allows the increase in footfall during events to be measured, whether free parking makes a difference to the number of people visiting the town, how long visitors stay, and from where visitors arrive.



Figure 4: Map showing where there are high numbers of people in Cardigan for a given time. Map data: Google, Maxar Technologies.

The data gathered includes:

- **Dwell time** – a value in minutes that shows the amount of time that visitors spend within the range of the wireless network (though not necessarily actually using it).
- **Source of visitors** – estimated using sign-in information and cookies.
- **New and existing visitors (loyalty levels)** – the database entry per visitor detects the number of repeat visits for a given time period. For example, if a visitor is seen four times within a month, they will be classified as a weekly visitor.

This information is clearly useful for a range of stakeholders, including local retailers, and this is an example of technology being used on a town-wide basis to the potential benefit of all and individual local retailers.

When discussing the wi-fi and app projects, Clive Davies described how it emerged from discussions amongst stakeholders about the future of the town. Whilst all businesses in the town now benefit from the project, it was the drive and motivation of a small number of individuals with a desire to see something happening in the town which were critical to its realisation.

#### 3.8.2. The benefits

The following are quotes from traders in Cardigan discussing how they have benefited from the data provided via the wi-fi and app and collected by the team managing the project.

*"It is a useful piece of information – keeps traders up to date on footfall in town."*

*"I do receive the analytics and always read them, thanks. It always make interesting reading. It will be valuable (as the information accumulates over time) to see how visitors' numbers correlates with turnover and the demographic."*

*"It is a useful information to see specific events or decisions make a difference, such as the free parking."*

*"Customers have said they like using the free wi-fi in town and it's fast, useful, too, with no mobile in parts of town centre."*

*"We align our social media and consider footfall for our nighttime opening offers."*

*"Always useful. Keep sending me them, please. The Quarterly News is useful for me to promote sales and offline offers at our online shop and high street shop."*

*"Good to know what the seasonal pattern is and what goes on in summer months, especially the American cruise ships."*

<sup>15</sup> The LEADER programme is a European Union initiative to support innovative rural development projects initiated at the local level in order to revitalise rural areas. Arloesi Gwynedd Wledig is the LEADER group for Gwynedd.

<sup>16</sup> [visitcardigan.com](http://visitcardigan.com)

<sup>17</sup> Source: Understanding Welsh Places website. [uwp.uksouth.cloudapp.azure.com/en/compare/W38000121/](http://uwp.uksouth.cloudapp.azure.com/en/compare/W38000121/)

<sup>18</sup> The following is a link to a podcast in which Cllr. Clive Davies discusses the project: [open.spotify.com/episode/0H2ICD7rNMk234W4iV20B7?si=rlp4sY4PSWW8M2XSTFi8eQ](https://open.spotify.com/episode/0H2ICD7rNMk234W4iV20B7?si=rlp4sY4PSWW8M2XSTFi8eQ)

<sup>19</sup> 4CG Cymru 2010 Cyf is a not-for-profit social enterprise which manages projects for the benefit of the town and community of Cardigan and the district.

<sup>20</sup> [play.google.com/store/apps/details?id=com.loclly9df799cf21e044889f83cf01644a8f28&hl=en\\_GB](https://play.google.com/store/apps/details?id=com.loclly9df799cf21e044889f83cf01644a8f28&hl=en_GB)

<sup>21</sup> iBeacon is a protocol developed by Apple. Beacon-compatible hardware transmitters are a class of Bluetooth Low Energy (BLE) devices that broadcast their identifier to nearby portable devices.

# 4. Building on the successes, exploiting the opportunities, and overcoming barriers

## Key points

- The opportunities created by digital connectivity are obvious. Realising those opportunities is, however, possibly better described as a necessity rather than an opportunity.
- There are examples of businesses in the agriculture and tourism sectors that are realising the potential that improved digital infrastructure provides. Those businesses are, however, early adopters and not typical within those sectors or in rural Wales more generally.
- The potential benefit to rural towns, villages and communities more generally is also increasingly apparent, demonstrating the potential of digital connectivity to improve the quality of life in rural areas as well as generate an economic benefit.
- The ability of businesses and other organisations in rural Wales to harness the potential of digital technology is shaped by a number of factors – there is no single issue that needs to be overcome.
- A lack of time on the part of small businesses is a key constraint.
- Stakeholders identified the need for plain-language case studies which businesses can relate to.
- Targeting support at early adopters may be more effective and more efficient than seeking to provide support to the population as a whole.
- Local networks could have a key role to play along with the effective sharing of information between the various support mechanisms that already exist.
- There should be an emphasis on developing technological companies in rural areas as well as supporting businesses to implement/utilise digital connectivity technology.

## 4.1. Introduction

This chapter builds on the case studies to discuss the opportunities that improved digital connectivity offers rural businesses and communities. It also draws on a review of relevant literature undertaken as part of the study, interviews with stakeholders, and discussions held in February 2020 at a roundtable with key stakeholders from across rural Wales.

## 4.2. Recognising the opportunities

As is apparent from the case studies, digital information and communications technologies offer businesses in rural areas the means to address some of the key challenges that they face and to harness important opportunities. There are a diverse range of applications, including software, hardware, and internet and mobile connectivity, which can be used to streamline and automate a broad range of tasks. This can serve to improve productivity and the overall quality of products and services on offer, as discussed below.

Stakeholders interviewed for this study had no doubt that digital technology will potentially revolutionise farming in Wales and, indeed, that this was already beginning to happen. Technology is being used in a range of ways within the sector in order to improve productivity and decision making. Thanks to digital connectivity, intelligent agricultural machines and remote sensors are enabling farmers to make more intensive and more data-driven decisions. This has enabled precision agriculture, shifting decision making from paddock and herd averages towards square metre and individual animals. Whilst the deployment of digital agricultural systems in livestock industries is generally less advanced than in other areas of farming, there are some important innovations. For example, services are available that use mobile connectivity and a remote sensor placed on the tail of a heifer to predict the onset of calving, potentially reducing mortality rates and improving animal welfare.

New wireless technology was being rolled out on 18 demonstration farms in Wales at the time of this report, providing Internet of Things capability on those farms. It's hoped that the Farming Connect initiative will become a catalyst for what is being described as 'a data revolution in Welsh agriculture', driven by the use of feedback sensors to improve the industry's accuracy and efficiency.<sup>22</sup>

Digital technology is also playing an increasingly important role in the tourism sector, again shown by the case studies in the previous chapter as well as by other research for this report. Businesses within this very diverse sector in Wales are becoming increasingly conversant and efficient in their use of emerging digital technologies in order to become more competitive, attract more tourists and provide them with a better experience during their stay. Furthermore, technology has helped to reduce transaction costs, enhance operational efficiency and improve customer experience. Ecommerce, for example, has created new opportunities for businesses to reach out to and connect directly with visitors. The emergence of platforms such as price comparison sites and online booking services has increased the potential reach of individual businesses, whilst also increasing local and global competition. What's more, travel review sites such as TripAdvisor and Yelp are also playing important roles in modern tourism.

Therefore, being aware of the power of these reviews and the effects that they can have on businesses in the tourism sector is crucial. It's equally important to act on the feedback that these reviews provide, whether they're positive or negative, in order to improve the service that businesses are providing and to remain competitive.

Technology has influenced, and will increasingly influence, the way in which visitors experience Wales. As an 'experience good', tourism is acknowledged to be information-intensive. The internet has opened up new ways for potential visitors to explore their options and make decisions with regards to their stay. Mobile systems such as GPS and mapping services have also transformed the way in which visitors explore the landscape, helping them to locate local attractions and services. These mapping services are now frequently incorporated into social media sites, an example of which is Facebook's check-in feature, allowing other users to see where people have been, which may, in turn, influence their awareness of different locations and businesses.

Augmented reality (AR) is a digital technology which makes changes to an individual's perception of their physical surroundings when viewed through a particular device. The technology has similarities to virtual reality; however, AR does not replace the real-world environment, but rather aims to enhance it by overlaying digital components. The potential of the technology from a tourism perspective is widely recognised and there are examples of projects in Wales that are already making use of the technology (see case studies below).

Interviews for this study have also demonstrated that digital technology isn't only about the 'outward-facing' side of tourism, with businesses highlighting how a transition to cloud-based systems has generated substantial benefits to the way in which they operate. These benefits sometimes go beyond the efficient operation of the business, including lifestyle or well-being benefits, as identified in the case studies.

Whilst clearly important, agriculture and tourism are obviously not the only sectors to be found in rural Wales, and the exploitation of digital infrastructure is equally important to all sectors. The development of digital infrastructure helps to overcome a number of barriers that have previously restricted the ability of a business to operate in a rural location. Research conducted by Cardiff University<sup>23</sup> highlights the productivity benefits that can be gained by businesses, as well as the opportunities that broadband resources provide for businesses to trade without needing to be close to major customer bases. In addition, it highlights that better connectivity may also help to encourage businesses seeking access to quality of life benefits to relocate to rural areas. This has the potential to introduce new types of business activities to rural areas and improve the diversity and resilience of businesses in the area. Furthermore, the provision of technological service is a sector in itself that can be developed in rural Wales.

The benefits of digital connectivity extend beyond businesses to communities more generally. The European Network for Rural Development (ENRD) argues that some of the most pressing challenges facing rural areas – including population decline and deteriorating local services – can potentially be addressed through the development of more 'smart villages'.<sup>24,25</sup> The EU Action for Smart Villages initiative was launched by the European Commission in 2017 to promote the development of smart villages and the exchange of good practice and lessons learnt.<sup>26</sup>

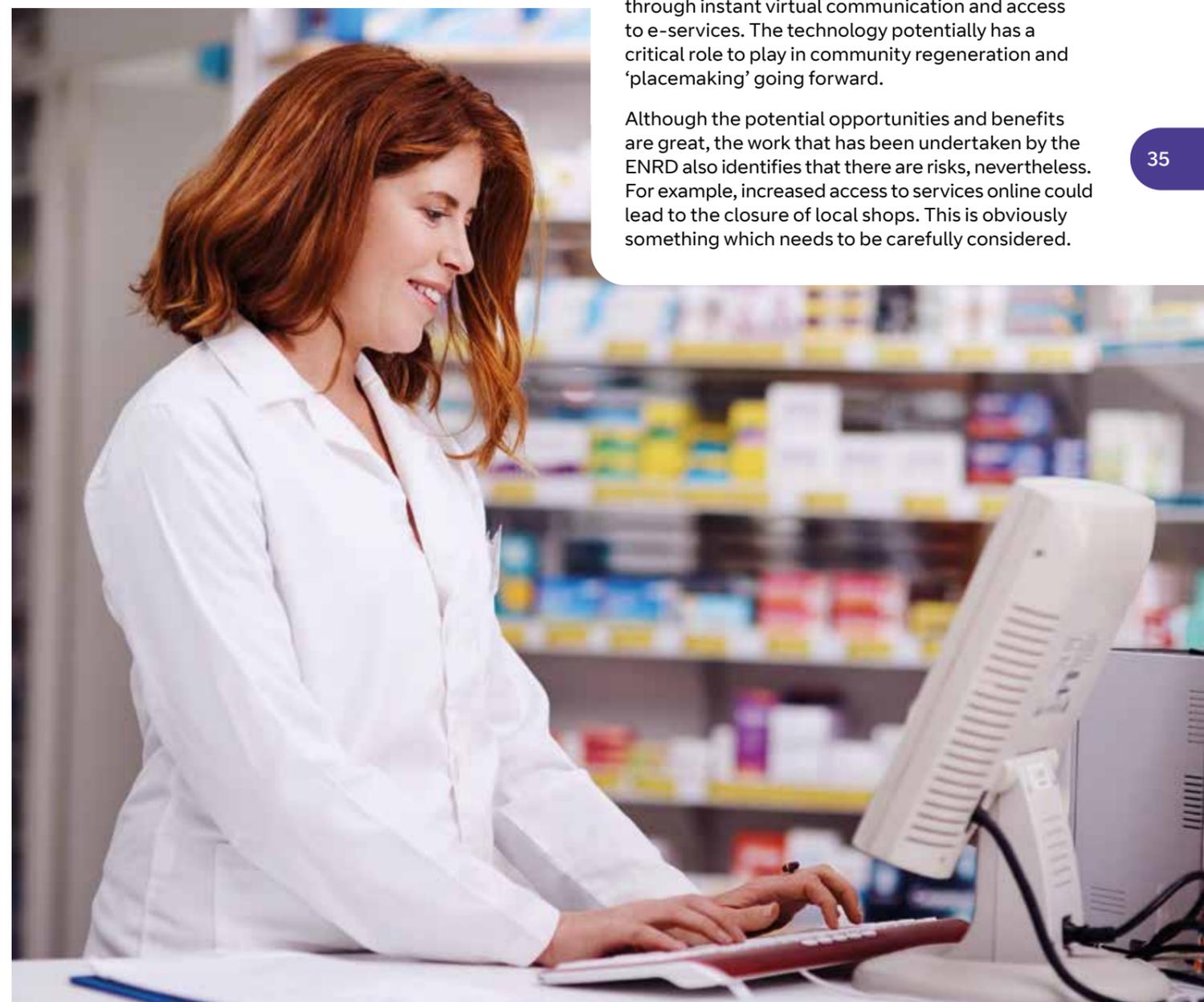
The ENRD has highlighted that many rural areas are locked into a 'circle of decline' by two mutually reinforcing trends: firstly, a shortage of jobs and sustainable business activity, and, secondly, inadequate and declining services. Nearly all approaches identified by the ENRD with respect to supporting smart villages seek to address both. Moreover, rural areas are often characterised as suffering from a triple digital divide: broadband connectivity, skills, and uptake. Smart villages have sought to address all three issues.

Actions supported by the Action for Smart Villages initiative across Europe include:

- a community carpooling initiative which uses a web platform and is managed by a local community cooperative
- remote classrooms in secondary schools
- equipping local pharmacies with smart technologies that allow remote diagnostics by hospital personnel
- smart devices that allow inhabitants to monitor landslides and strengthen civil protection.

Digital technologies have the capacity to radically transform the disadvantages that rural areas face in terms of distance and low population density through instant virtual communication and access to e-services. The technology potentially has a critical role to play in community regeneration and 'placemaking' going forward.

Although the potential opportunities and benefits are great, the work that has been undertaken by the ENRD also identifies that there are risks, nevertheless. For example, increased access to services online could lead to the closure of local shops. This is obviously something which needs to be carefully considered.



### 4.3. Overcoming the barriers and exploiting the opportunities

The ability of businesses and other organisations in rural Wales to harness the potential of digital technology is shaped by a number of factors (as discussed below) along with a number of suggestions made for overcoming those barriers.

#### 4.3.1. Connectivity issues

Connectivity and infrastructure issues can't be ignored and these issues were raised on a regular basis over the course of discussions with stakeholders for this study. For example, when respondents to the online questionnaire for tourism stakeholders were asked to rate on a scale of 0 (not at all) to 10 (completely) how successful the tourism sector in Wales had been in respect of utilising the opportunities offered by the improved digital infrastructure, the average rating was 4.8 out of 10. Infrastructure issues were frequently highlighted, although poor utilisation of the opportunities that did exist was also noted.

Connectivity is, however, only part of the picture, with participants at the stakeholder roundtable emphasising the need to focus on utilisation as well as provision (as discussed below).

Perceived weaknesses in connectivity (as well as actual issues) were, however, also highlighted during discussions with stakeholders. They mentioned the fact that individuals and businesses can underestimate what can be achieved with the connection that is available focusing too much on what they consider to be weaknesses in the provision rather than on its utilisation.

#### 4.3.2. Recognising that it's a combination of a range of factors rather than one thing

Exploiting digital technology requires businesses and organisations to invest in infrastructure and skills development. It requires, for example, the embedding of digital technologies into everyday business practices. Our interviews with stakeholders and discussions at the roundtable suggest that this can be a difficult 'leap of faith' for businesses and organisations to take for a number of reasons. Take-up in rural areas does, however, seem to be slower than amongst businesses in urban areas.

International research suggests that in agricultural settings, for example, with significant numbers of small producers, as is the case in Wales, the take-up of digital technologies tends to be slower than in the rest of the economy.<sup>27</sup> Theories have been put forth in order to try to explain the reasoning behind this slower take-up of digital technology amongst farmers, which identify the characteristics required for innovation.<sup>28</sup>



Factors that these theories identify include:

- the availability of finance
- 'time and effort resources' (often uncommon amongst farmers and microbusinesses)
- compatibility (often perceived) with existing practices – which for those who are unaware of the potential of technology may not be obvious or something that they can trial.<sup>29</sup>

Our interviews and discussions during the roundtable suggest that these constraints are not restricted to farming businesses, but rather are common across rural businesses. Recognising the range of barriers that businesses may be facing is important; there is no single issue that needs to be overcome.

#### 4.3.3. "It's not relevant to my business"

The sub-heading above paraphrases comments made by stakeholders that highlighted that businesses could find it difficult to see how new technology can be applied to their particular business, especially when they have no time to fully research the issue.

In some cases, such as some precision farming technologies, they may appear to those with limited knowledge and/or time to undertake the necessary research to be not as effective in improving productivity in real-world settings, making business owners reluctant to invest. Interestingly, even where they have been implemented, there is evidence to suggest that digital systems' capabilities are often underutilised in the farm setting.<sup>30</sup> This underlines the need to provide not only support for a business to identify and implement the right solution for itself, but also ongoing support to ensure that the benefit that should be generated for a business is maximised. There should, for example, be follow-up support to any training that a business undertakes to support its implementation of the learning and address any issues that emerge following the training session.

#### 4.3.4. "We just don't have the time"

Time, or the lack of it, was a regular theme in discussions with stakeholders (both individually and as part of the roundtable). It is also identified as a barrier within the case studies. Small businesses in particular are time poor and, even if key individuals have a strong interest in digital connectivity and are motivated to seek to integrate it into their business, struggle to find the time to explore the issue in detail and/or plan the steps that need to be taken; to paraphrase comments made by stakeholders, they're too busy running their businesses.

Overcoming this barrier is challenging, as it is not easy (if not impossible) to create additional time within any business. Therefore, the key is to help the individuals in question to maximise the value of any time that they can commit to enhancing their use of digital connectivity technology.

#### 4.3.5. Building confidence over time

Discussions during the roundtable identified that individual attitudes and confidence towards digital technology can also represent a barrier to adoption and that there are continuing issues with respect to digital literacy amongst the general population. As one participant put it, "people don't want to seem stupid". Concerns about 'future-proofing' potential investments in technology are also apparent, with stakeholders highlighting how businesses can be worried about committing to a technology that becomes outdated almost immediately.

Building the confidence of individuals and businesses is therefore considered important and this can be a long-term process, meaning that support needs to be provided not only on an ongoing basis but also in a way which allows individuals to progress in terms of their understanding of the issues (and so on) at a pace with which they are comfortable.

*"Some businesses have embraced digital infrastructure, using a good combination of adaptive websites and social media to improve their publicity. Others are still showing non-adaptive websites that don't work on mobiles and use very basic, old-fashioned styles."*

#### 4.3.6. Plain-language case studies

The need for case studies and to present businesses with clear evidence (in plain language) of the results that the implementation of new technology can generate was a constant theme in discussions during the roundtable. Their view was that ‘real’ case studies were required that emphasised the results that would be generated (such as the impact on the business) as opposed to the technology that would be utilised. The case studies should also be for companies (or organisations, communities, and so on) that other businesses can easily relate to so that the potential to replicate the experience (and outcomes) of that business within their own is clear and obvious. The need for a clear and consistent ‘narrative’ relating to the need to utilise the opportunities created by improved digital connectivity was also stressed.

#### 4.3.7. Targeting early adopters rather than the whole population

Working with early adopters has long been identified as being a key part of attempts to foster innovation. The classic analysis of early adopters can be found in the Diffusion of Innovation Theory. It proposes that the adoption of a new idea, behaviour or product (such as ‘innovation’) does not happen simultaneously; any product, innovation or idea will be adopted by some before others.<sup>31</sup> Furthermore, research shows that people who adopt an innovation early have different characteristics from those of people who adopt an innovation later, and the best way in which to engage with an individual depends on whether they are ‘innovators’, ‘early adopters’, ‘the majority’ or ‘laggards’.

The key group in respect of the issues being discussed in this report are perhaps the ‘early adopters’. Their role is to decrease the uncertainty surrounding new ideas by adopting them and then spreading their views on the technology (whether it works and is useful) to their peers and within their networks. The key is that the early adopters are the people with whom the majority will consult when they are considering adopting a new technology. They are therefore much more likely to have an influence on the decisions being made by the majority within a population than are ‘experts’, as they are more likely to be a trusted source of information. In agriculture they would be a neighbouring farmer or friend. In tourism, they would constitute a leading local hotelier, for example. They are usually the people with whom an individual ‘checks’ before adopting an idea themselves and, because of this, are often categorised as those with a particular level of influence or respect.

The key element of the theory is that the majority of a population (in this case, rural businesses) will not adopt a new technology until it’s being used and advocated by the innovators and early adopters. Therefore, the most effective route to achieving a change in the majority is by targeting and supporting the early adopters (as opposed to the population as a whole) to (1) utilise the new technology and (2) share their views about that technology within their social networks in an effective way. There was some discussion about this during the roundtable, with a general agreement that a focus on early adopters made sense. The link between targeting early adopters and the need for case studies (as identified previously) is also obvious.

#### 4.3.8. Creating local networks

The potential to bring businesses together to discuss the issues that they face, as well as ideas and solutions, was identified by stakeholders. Importantly, the suggestion was that these networks should not necessarily be restricted to any particular sector, for example farming, with stakeholders highlighting the potential benefits of bringing together businesses and ideas from across multiple sectors. The purpose of this would be to try to encourage cross-fertilisation of ideas across sectors. The sharing of information and experience was also identified as a key element of encouraging innovation.

Developing such sectors on a local (or at least a regional) level was also highlighted with a view to limiting any barriers for businesses to take part as well as allow any specific local issues and opportunities to be discussed.

*“Where it is available, it seems many micro and SMEs still seem to struggle to get to grips with maximising the true potential of the digital infrastructure.”*

#### 4.3.9. Developing digital sector businesses in rural areas

Another factor influencing the take-up and exploitation of digital technology which was identified during discussions with stakeholders as well as in the literature review is the extent and maturity of the digital economy that supports (or provides services to) businesses in rural areas. This was often described by stakeholders as a ‘chicken and egg’ situation – there isn’t sufficient demand from rural businesses (for example farms) to stimulate the development of local technological businesses to service them, but (at the same time) there aren’t enough technological businesses to stimulate/encourage rural businesses to adopt the new technology. Which should come first? The reality is that, probably, both the supply and the demand side of the market need to be supported.

The opportunity to develop and grow small technological companies in rural locations is, however, very clear and a number of such businesses already exist in rural Wales. Structures and facilities to develop those businesses also exist. For example, a science park, such as M-SParc, on Anglesey provides space for businesses of all sizes, from start-ups to large corporate companies, as well as business support services, providing flexible office space and laboratories on site. Making the most of these opportunities is obviously important. The potential to create a link between emerging technological businesses (and the support structures) is, however, also potentially important and fits with the network idea outlined above.

#### 4.3.10. How support is provided

A key finding of the discussion at the stakeholders’ roundtable was that a wide range of support to help businesses to overcome the barriers to utilising the digital infrastructure already exists in Wales. For example, the Superfast Business Wales service provides a range of support.<sup>32</sup>

Discussions with stakeholders for this study, however, suggested that more could be done to bring those networks and support structures together (especially across the different sectors) to share information and so on. The higher cost of delivering support to businesses in rural areas was highlighted, with the number of businesses participating at events, for example, being inevitably lower than it would be in more urban areas, where the population is greater and transport infrastructure is better. This was, however, something that support providers had to ‘live with’ if businesses in rural locations were to be supported. The need to pilot different approaches to delivering support and then share learning and insights with a wider group of support providers was also suggested.

<sup>22</sup> [businesswales.gov.wales/farmingconnect/sites/farmingconnect/files/documents/Llyfryn%20Saesneg%20Lorawan%20A5\\_1.pdf](https://businesswales.gov.wales/farmingconnect/sites/farmingconnect/files/documents/Llyfryn%20Saesneg%20Lorawan%20A5_1.pdf)

<sup>23</sup> Norris, L. and Henderson, D. (2019). Digital technologies and future opportunities for rural businesses and areas in Wales. Project Report. Cardiff: Cardiff University. [cardiff.ac.uk/\\_\\_data/assets/pdf\\_file/0008/1438802/Horizon-scanning\\_rural-opportunities-03.pdf](https://cardiff.ac.uk/__data/assets/pdf_file/0008/1438802/Horizon-scanning_rural-opportunities-03.pdf)

<sup>24</sup> [enrd.ec.europa.eu/sites/enrd/files/enrd\\_publications/smart-villages\\_orientations\\_leader-clld.pdf](https://enrd.ec.europa.eu/sites/enrd/files/enrd_publications/smart-villages_orientations_leader-clld.pdf)

<sup>25</sup> There is an important distinction between ‘smart villages’ and ‘smart cities’. The concept of smart cities focuses mainly on big data and the opportunities for transforming the way in which cities function through interrelated digital technologies. Smart villages are not simply an extension of this; they focus instead on empowering local communities to engage with their future, including the use (where appropriate) of digital technologies.

<sup>26</sup> [enrd.ec.europa.eu/news-events/news/eu-action-smart-villages\\_en](https://enrd.ec.europa.eu/news-events/news/eu-action-smart-villages_en)

<sup>27</sup> EU (2014). [europarl.europa.eu/RegData/etudes/note/join/2014/529049/IPOL-AGRI\\_NT\(2014\)529049\\_EN.pdf](https://europarl.europa.eu/RegData/etudes/note/join/2014/529049/IPOL-AGRI_NT(2014)529049_EN.pdf)

<sup>28</sup> For example, Innovation Theory (Rogers, EM (1995). Diffusion of Innovations. New York: The Free Press. 4th edition).

<sup>29</sup> Warren, Martyn. (2004). Farmers online: Drivers and impediments in adoption of Internet in UK agricultural businesses. Journal of Small Business and Enterprise Development 11. 371–381. 10.1108/14626000410551627.

<sup>30</sup> Rutt, K. (2011). Precision Farming braucht einen Neuanfang. DLG-Mitteilungen 9/2011.

<sup>31</sup> Developed by E.M. Rogers in 1962.

<sup>32</sup> [businesswales.gov.wales/superfastbusinesswales/](https://businesswales.gov.wales/superfastbusinesswales/)

## 5. Conclusion and recommendations

The importance of digital connectivity (both mobile and fixed-line), and its utilisation, as a ‘rural development tool’ going forward can’t be underestimated. Improved digital connectivity clearly has the potential to help address a number of the longstanding issues facing rural areas in relation to both economic development and, importantly, quality of life/well-being in terms of, for example, access to key services.

Those opportunities involve both fixed broadband and the mobile infrastructure (enhanced by the emergence of 5G) and this is important, with the case studies in this report highlighting how it is a combination of the two methods of accessing the digital network that provides the greatest opportunity. Having comprehensive mobile and fixed-line infrastructure in place is, however, not enough, with action being needed to realise the opportunities that it creates.

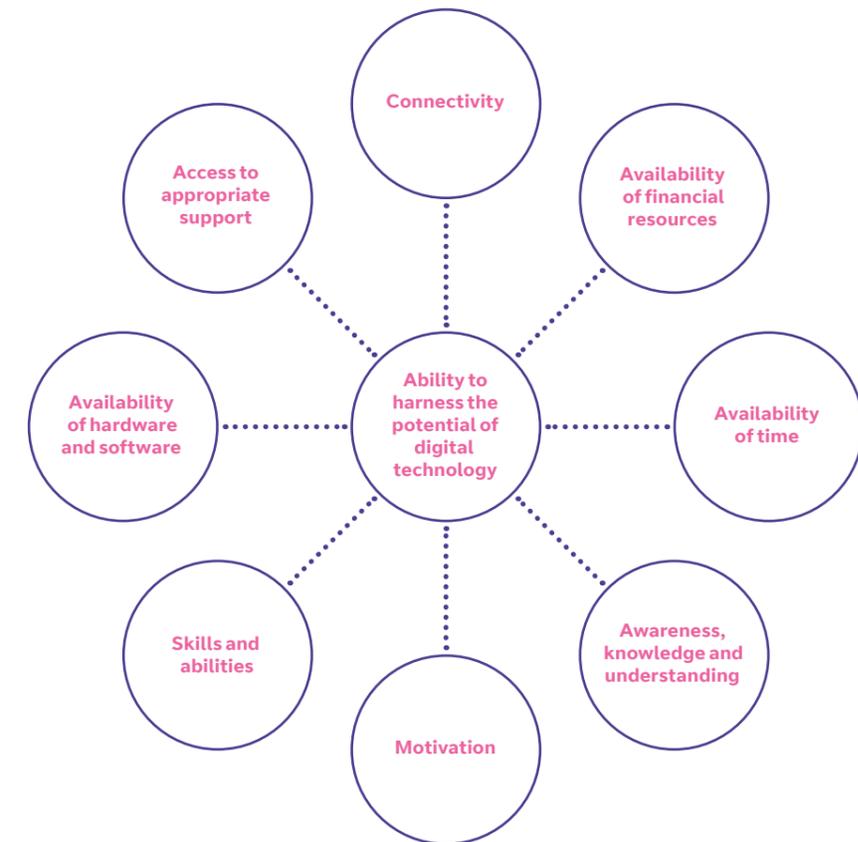
The case studies show that opportunities are already being realised in some instances to the substantial benefit of those involved. The concern is, however, that those examples are in the minority. That’s why it’s important to understand the barriers that may be restricting the ability to make greater use of the improved digital infrastructure which is increasingly available. There is also a clear argument that realising those opportunities is better described as a necessity for rural businesses to remain competitive (and perhaps for communities to remain viable) rather than an *opportunity*.

A key finding of this study is that the ability to harness the potential of digital connectivity is shaped by a number of different factors (as illustrated by the graphic opposite); there is no single main barrier that needs to be overcome. The existence of such a range of issues makes overcoming them challenging and suggests that a wide-ranging and flexible package of support is needed.

Time is, however, possibly the biggest constraint and underlies all other constraints; most barriers can be overcome if sufficient time is allocated to the issue, for example the time needed to become familiar with new technology (especially for those with less expertise) and assess its potential role within the business. You can’t, however, create more time for a business. Maximising the benefit (and value) that the individual and business can derive from the time that they are able to commit is therefore the critical issue. Again, this suggests that a flexible – but also multifaceted – approach is necessary. The need for a clear vision and a plan for the utilisation of new technology within a business or organisation is also obvious. Without such a plan, there is a risk that adopting technology can become unfocused, untargeted, and fail to achieve the anticipated benefit. This, in turn, can dissuade some from engaging with new technology again, so they become disengaged.

**Recommendation 1:** Businesses, organisations and communities need support from the business support system in Wales to review their needs and develop an action plan for improving their utilisation of the digital infrastructure. This would allow them to focus their limited time on taking actions to deliver that plan and achieve a well-defined goal.

Figure 5: Barriers to harnessing the potential of digital technology



**Recommendation 2:** Support should be available to raise digital skill levels in a range of different ways (online videos, mentoring, training courses) in order to make its provision/access as flexible as possible. This support should be promoted via a range of different networks (not only technology-related) to maximise awareness and ensure that it’s not restricted, for example, to those with an interest in new technology or working within a particular sector.

The stakeholders engaged in this study identified the need for plain-language case studies which businesses can relate to, with the discussion at the roundtable event returning this need again and again. Targeting support at ‘early adopters’ was also discussed and may be more effective and more efficient than seeking to provide support to rural businesses in general. Those early adopters could then be supported to become ‘champions’ for the technology within their sector and communities, building on the fact that businesses are more likely to value and trust advice that comes from businesses and individuals that have been in their situation.

**Recommendation 3:** ‘Early adopters’ should be offered specific support to help them to take advantage of the opportunities created by digital infrastructure improvements. This support should offer examples (and inspiration) that others within their sectors can follow. Those early adopters should subsequently be supported to become ‘champions’ for the technology within their sectors and regions, proactively promoting the benefits that utilising the digital infrastructure can bring.

**Recommendation 4:** A series of plain-language case studies should be developed and maintained within a range of different sectors that are focused on demonstrating how businesses and communities have benefited as a result of utilising the digital infrastructure. The focus should be on the outcomes for the businesses and organisations in question, rather than on showcasing the technology.

It's important to recognise that we're not in a situation where no support is being provided – far from it. There would, however, seem to be an opportunity to encourage greater sharing of information and cooperation amongst the organisations and schemes providing the support, which should also consider the advantages of pulling businesses and stakeholders from different sectors together with a view to encouraging the development of some innovative ideas. Piloting new and innovative approaches to providing support before 'mainstreaming' what has been proven to work should also be encouraged – an approach now being adopted with the trial CoCoRE 5G project in rural South East Wales.

The characteristics of rural areas need to be considered when considering the provision of support in those areas, particularly in respect of the disperse population and limited transport infrastructure. This makes delivering support to businesses and organisations in rural areas inevitably more expensive (or less cost-efficient) than in urban areas. This needs to be recognised and accepted as being part and parcel of delivering support in a rural area. One way of potentially reducing those additional costs is, however, by collaborating on events and so on, which, again, could be facilitated via a network of support providers. The potential to develop and support projects that can help groups of businesses (or whole communities) to benefit from the opportunities offered by digital connectivity should also be explored, following the example of the town wi-fi and analytics projects in

Cardigan. Such projects are potentially particularly important for individual businesses that may be too small to utilise digital connectivity opportunities individually. The fact that digital connectivity can have a significant role in community regeneration and placemaking in rural Wales should also not be overlooked.

**Recommendation 5:** There would seem to be an opportunity to encourage greater sharing of information and cooperation amongst those providing the support. The potential to build on existing structures and create a network of 'support providers' operating in rural areas should be explored as a means of sharing information and encouraging closer cooperation.

**Recommendation 6:** Recognising that research shows that the divide between rural and urban areas in the adoption of superfast broadband, whilst declining, still exists, the potential to increase the provision of digital skills training, specifically for businesses and other organisations in rural areas, and/or 'rural-proof' its provision should be given serious consideration.

**Recommendation 7:** Digital connectivity can have a significant role in community regeneration and placemaking in rural Wales. Projects designed to support groups of businesses or whole communities/towns should be created and supported, as well as one-to-one activities with businesses, to allow organisations that may be too small to implement projects on their own to benefit from the opportunities created by digital connectivity.

The focus of this study has been on the utilisation of digital connectivity by businesses and organisations in rural locations. The existence and potential for the development of the digital services sector in rural areas should, however, not be overlooked. The potential to support – and the benefit of supporting – the development of those businesses via resources such as the Aberystwyth Innovation and Enterprise Campus and M-SParc on Anglesey is clear with the emergence of improved digital infrastructure in rural areas overcoming some of the barriers which may have restricted the potential of those businesses to locate and grow in a rural area in the past, a clear example of which is the Environment Systems case study.

**Recommendation 8:** The emergence of digital connectivity has eroded a number of the barriers to locating in rural areas. The potential for the development of the digital services sector in rural areas should therefore be capitalised upon. Support for the development of the sector in rural areas should be considered.

To conclude, we would re-emphasise a point made at the beginning of this conclusion: improved digital connectivity has the potential to help address a number of the longstanding issues facing rural areas in relation to both economic development and quality of life/wellbeing. Making the best-possible use of digital connectivity should not therefore be seen only as an economic development opportunity.

**Recommendation 9:** Drawing on the examples of good practice that exist in Wales as well as internationally, actions to promote the utilisation of digital connectivity should include support for communities to utilise the potential of digital connectivity to overcome issues such as poor access to key services, as well as support for businesses and commercial organisations.

Research suggests that the gap between urban and rural businesses in respect of their adoption of digital technologies enabled by improved access to broadband has been closing over recent years, which is clearly positive; however, a gap continues to exist. Continuing to monitor this situation is therefore important.

**Recommendation 10:** Research undertaken by the Welsh Economy Research Unit (Cardiff University) as part of the Superfast Broadband Project includes an annual survey of businesses across Wales regarding how they are adopting digital technologies enabled by broadband access (including the differences between SMEs in urban and rural locations). This research should continue and maintain tracking of the gap in the adoption of digital technology by rural businesses compared to their urban counterparts.

# Appendix 1: Contributors to the research

Name	Business/organisation	Method
Abi Alexander	Hiut Denim	Business interview
Adrian Greason-Walker	Wales Tourism Alliance	Online questionnaire response
Alan Davies	Farmers' Union of Wales	Roundtable participant
Alan Harper-Smith	Wern Fawr Manor Farm	Online questionnaire response
Alun Jones	Menter a Busnes	Stakeholder interview
Alwen Williams	North Wales Economic Ambition Board	Roundtable participant
Andy Brice	Creative Work Place	Online questionnaire response
Arasen Appasamy	-	Online questionnaire response
Arwel Johnston	-	Online questionnaire response
Bradley Davies	Wales International Coastal Centre	Online questionnaire response
Bronwen Gardner	National Farmers' Union Cymru	Stakeholder interview
Carole Startin	Celtic Tours Wales	Online questionnaire response
Carwyn Jones-Evans	Ceredigion County Council	Roundtable participant
Catherine Cunnah	Boltholed & Hideaways	Online questionnaire response
Charlotte Priddy	Farmers' Union of Wales	Stakeholder interview
Cllr. Clive Davies	Ceredigion County Council	Case study interview and roundtable participant
Cllr. Ellen ap Gwynn	Ceredigion County Council	Roundtable participant
Craig Evans	Coastal Foraging	Online questionnaire response
Dafydd Gruffydd	Menter Môn	Roundtable participant
Dana Williams	Snowdonia National Park Authority	Online questionnaire response
Dave Ryan	Glan Morfa Lodge Ltd.	Online questionnaire response
David Elsmere	Superfast Business Wales	Roundtable participant

David Storer	Carmarthenshire Farm Group	Online questionnaire response
Decia	Cilfach Holidays	Online questionnaire response
Dewi Hughes	Menter a Busnes	Roundtable participant
Dr. Dylan Henderson	Cardiff University	Stakeholder interview
Dr. Will Stiles	Aberystwyth University	Stakeholder interview
Dr. Wyn Morris	Aberystwyth University	Stakeholder interview and roundtable participant
Duncan Gilroy	Seawake	Online questionnaire response
Evans	House in the Yard	Online questionnaire response
Gareth Callen	BT	Roundtable participant
Gareth Jones	Swansea Bay City Deal	Roundtable participant
Gareth Morgan	BT	Roundtable participant
Gaye Williams	Cefn-y-dre Country B&B	Online questionnaire response
Gwion Llwyd	Dioni Holiday Cottages	Online questionnaire response
Heather Brown	Barmouth Publicity Association	Online questionnaire response
Howard Browes	The Beach Hut Holyhead	Online questionnaire response
Huw Jones	Bryn Farm	Case study interview
Ieuan Wyn Jones	Digital Signal Processing Centre of Excellence	Roundtable participant
Jacqui Davies	Clydey Cottages Pembrokeshire	Online questionnaire response
James Parkin	Pembrokeshire Coast National Park Authority	Online questionnaire response
Jan and Roger Goodman	The Stableyard	Online questionnaire response
Jan Holmes	Beautiful Wales Limited	Online questionnaire response
Jane Evans	Llawr Betws Ltd.	Online questionnaire response
Jennifer Hulme	Oakenholt Farm, Flint	Online questionnaire response
Jim Gaffney	Oneplanet Adventure	Online questionnaire response
John Mercer	National Farmers' Union Cymru	Roundtable participant
John Whitehead	Bryn Elltyd Eco Guesthouse	Online questionnaire response
Katy Davies	Harbour Lights Gallery	Case study interview
Louise Barlow	Acorn Leisure	Online questionnaire response
Lowri Gwilym	Welsh Local Government Association	Roundtable participant
Lucy Miller	Llanfair Hall	Online questionnaire response
Marc Davies	Wales Cooperative Centre	Stakeholder interview and roundtable participant

Name	Business/organisation	Method
Mark Dames	BT	Roundtable participant
Matthew Macdonald-Wallace	Mockingbird Consulting	Business interview
Matthew Witt	West Wales Holiday Cottages	Case study interview
Meilir Pritchard	Menter Môn	Roundtable participant
Michael Thomas	Isle of Anglesey County Council	Online questionnaire response
Mike Cavanagh	Pembrokeshire County Council	Online questionnaire response
Neil Rowlands	Treysgawen Hall	Online questionnaire response
Nelson Haerr	Meadowsweet Hotel	Online questionnaire response
Nick Speed	BT	Roundtable participant
Nicola Arnold	Tyn Llain B&B	Online questionnaire response
Nicola Ruck	Yr Hen Stablau	Online questionnaire response
Paul Beddoe	Vale Resort	Online questionnaire response
Paul Lewin	Ffestiniog & Welsh Highland Railways	Online questionnaire response
Peter Williams	Welsh Government	Stakeholder interview and roundtable participant
Rachael Geddes	Humble by Nature	Online questionnaire response
Rhian Hayward	Aberystwyth Innovation and Enterprise Campus	Roundtable participant
Rhianne Jones	CLA Cymru	Stakeholder interview
Rhodri Owen	Glynllifon Farm	Case study interview
Robert Craven	Conwy Valley Holiday Lettings	Online questionnaire response
Robyn Lovelock	Llangollen & Dee Valley Good Grub Club	Online questionnaire response
Sally Stacey	The Woollen Mill	Online questionnaire response
Sam Parry	Tea Rooms at the Pet Cemetery	Online questionnaire response
Sharon Richards	Tan y Lan Fach Holiday Cottages	Online questionnaire response
Steve Hughson	Royal Welsh Agricultural Society	Online questionnaire response
Susan Jones	Bryn Marlais Cottage	Online questionnaire response
Tim Brace	FBM Holidays	Online questionnaire response
Tracey Woodbine	Woody's Glamping	Online questionnaire response
Victoria Mann	Near Me Now	Business interview

## Appendix 2: Glossary

- **4G:** Fourth generation of mobile systems. It can provide download speeds of over 10Mbps and is used to deliver voice, text and higher-speed data services.
- **5G:** Is the fifth generation of mobile technology. It's delivering faster, lower-latency mobile broadband and enabling more revolutionary uses in sectors such as manufacturing, transport and healthcare.
- **AR:** Augmented reality. An interactive experience of a real-world environment where the objects that reside in the real world are enhanced by computer-generated perceptual information.
- **Broadband:** A data service or connection generally defined as being 'always on' and providing a bandwidth greater than narrowband connections.
- **Decent broadband:** A data service that provides download speeds of at least 10Mbps and upload speeds of at least 1Mbps.
- **Superfast broadband:** A data service that delivers download speeds of at least 30Mbps.
- **Ultrafast broadband:** A data service that delivers download speeds of greater than 300Mbps.
- **Broadband USO:** Broadband Universal Service Obligation. This will give consumers and businesses the right to request a broadband connection capable of delivering a download sync speed of 10Mbps and an upload sync speed of 1Mbps.
- **Cloud service:** A service made available to users on demand via the Internet from a cloud computing provider's servers as opposed to being provided by a company's own on-premises servers.
- **FTTP:** Fibre to the premises. A form of fibre optic communication delivery in which the optical signal reaches the end user's home or office. Also known as full-fibre broadband.
- **GIS:** Geographic information system. A computer system for capturing, storing, checking and displaying data related to positions on Earth's surface.
- **GPS:** Global Positioning System. A satellite-based navigation system.
- **IoT:** Internet of Things. Embedded connectivity in everyday things, enabling them to send and receive data.
- **LoRaWAN:** Long-Range Wide-Area Network. LoRa devices are able to transmit and receive data over large distances. The network provides a way of linking sensor devices and applications together.
- **VoIP:** Voice over internet protocol. Technology that allows users to send calls using internet protocols, using either the public Internet or private IP networks.



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