State of the Art Review (WP2)

Higher education institutions/Universities
Responses to Digitalization (IO1)

UK Country Report

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Contents

List of Abbreviations

AI	Artificial Intelligence
CBI	Confederation of British Industry
CEBR	Centre for Economics and Business Research
DCMS	Digital, Culture, Media and Sport
DESI	Digital Economy and Society Index
DfE	Department for Education
Dig.IT	Digital Futures at Work Research Centre
DSP	Digital Skills Partnership
EPSRC	Engineering and Physical Sciences Research Council
ESCALATE	Coordinated Higher Institutions Responses to Digitalisation, Erasmus+ KA2 - Cooperation for innovation and the exchange of good practices, KA203 - Strategic Partnerships for higher education
ESRC	Economic and Social Research Council
EU	European Union
HEFCE	Higher Education Funding Council for England
HEI	Higher education institution
IDSAI	Institute for Data Science and Artificial Intelligence
IoC	Institute of Coding
KA	Key Action
LEP	Local Enterprise Partnerships
ONS	Office for National Statistics
PC	Partner Country
SOTA	State-of-the-Art
SME	small and medium-sized enterprise
SWIOT	South West Institute of Technology
UK	United Kingdom
ULF	Union Learning Fund
UNIMIB	Universita' degli Studi di Milano-Bicocca / The University of Milano-Bicocca
US	United States
UUK	Universities UK
WP	Work Package

1 Summary

1.1 Context

The United Kingdom (UK) ranks fifth out of the 28 EU Member States in the European Commission Digital Economy and Society Index (DESI) 2019[1]. Its score increased from 7th place in 2018 due to an improved performance in all of the DESI dimensions. The UK performs particularly well in the use of internet services, where it ranks fifth among EU countries - thanks to a very high rate of regular internet use and a strong uptake of a wide variety of online services. The UK ranks 10th in Connectivity, above the EU average, but lags behind on ultrafast broadband coverage and take-up. The country ranks 7th in Integration of digital technology by businesses. While use of social media and cloud services are high, uptake of electronic information sharing is low and uptake of other technologies is average. The UK ranks 11th in Digital public services, performing somewhat above average for the EU.

In terms of human capital, the UK ranks sixth in the DESI, behind only Finland, Sweden, Luxemburg, Estonia and the Netherlands. The percentage of the population with at least basic digital skills is 71%, compared to an EU average of 57%, and the percentage of those with above basic digital skills is 46%, compared to an EU average of 31%. Since 2019, the UK has seen a slight increase in ICT specialist employment as a percentage of total employment, now 5.1%, compared to an EU average of 3.7%. However, women remain under represented, with only 1.8% of employed women categorised as ICT specialists, compared to an EU average of 1.4% and the top ranking country, Finland at 3.1%. Despite strong demand for ICT graduates, the UK ranks poorly in the percentage of graduates with an ICT degree, with only 3.6% of all UK graduates graduating with an ICT degree. This equates to 16th in the rankings, just above the EU average of 3.5% and markedly below the top ranking country Finland, at 7.1%.

However, despite its high ranking in the DESI, the UK currently faces a digital skills gap - where workers simply do not have the skills to meet the demands required by business and industry in this age of digitalization, and this is impacting on the country's businesses, commerce and productivity.

1.2 Methodology

We searched the online literature for articles, web-pages and data which describe the impact of digitalisation on the future of work, and how the UK higher education sector is responding to it. We sought the most up-to-date national data and describe UK policies and interventions that aim to address the nation's digital skills gap. Finally, we spoke with seven experts from higher education and business and sought their views on how higher education institutions could better provide their students with the digital skills required by our future labour market.

1.3 Findings

It is estimated that 88% of organisations across Great Britain are currently lacking in digital skills, with many expecting these shortages to increase in the next five years. The future of work is also changing, and on average, employers expect that 37 per cent of the roles in their workplace are likely to alter significantly

within the next five years as a result of digital disruption. Productivity is deemed to be the most pressing impact of digitalisation amongst business leaders, with more than half believing that the digital skills shortage has already had a negative effect on the productivity of their workforce, and a further 40 per cent expecting this to happen in future. Meanwhile, there is a clear relationship between where people live in the UK, their socio-economic circumstances and whether they have basic digital capability.

Since a 2015 independent review into the way Computer Science is taught in UK universities, there have been a plethora of UK-wide policies and strategies which aim to tackle the digital skills gap. The UK's Digital Strategy aims to "build a stronger, fairer country that works for everyone, not just the privileged few". The strategy promises a reform of the technical education system, including the creation of a specialist digital route, with employers setting standards and specifying the knowledge, skills and behaviours that individuals will need. The UK's Industrial Strategy also makes a commitment to put the UK at the forefront of the Artificial Intelligence (AI) and data revolution and is supported by significant investment in education institutions to support the advancement of AI.

The UK's national response to digitalisation comprises a complex organisational landscape that includes the Open Data Institute, the Digital Catapult, the Alan Turing Institute and various infrastructure investments, each with a different focus, but all aimed at improving the nation's digital capability and reducing digital exclusion. Regionally, Local Digital Skills Partnerships bring together regional businesses, large employers, charities, and public sector organisations to tackle local digital skills challenges and build thriving and inclusive local economies. In the South West of England, the University of Exeter is collaborating on a number of initiatives which aim to drive regional growth by building Exeter as an international centre for environmental intelligence and data analytics. The Data analytics skills escalator describes a replicable model whereby regional partners work together to provide the digital skills at all levels. The South West Institute of Technology (SWIOT) is one component of the escalator, and brings together a number of partner organisations each investing in the development of state-of-the-art facilities for training in technical subjects to create Britain's next generation of highly skilled technicians and engineers.

2 Methodology

2.1 Literature Review

We searched the online literature for articles, web-pages and data which describe the impact of digitalisation on the labour market, future of work, and higher education in the UK. We sought the most up-to-date national and European data from the UK's Office for National Statistics (https://www.ons.gov.uk/) and the European Commission (https://ec.europa.eu/) and included data from key publications by organisations such as the Centre for Economics and Business Research, Lloyds Bank and the Open University. We also expanded our search through forward and backward citation searching of articles already known to us.

We searched the UK Government web pages for UK policies and initiatives that aim to address the nation's digital skills gap. Local initiatives were identified via local experts at the University of Exeter. All references cited were up-to-date and were freely available.

2.2 Expert Interviews

Experts from a range of backgrounds were chosen for their knowledge of policy or teaching of digital skills in the higher education sector and / or the use of innovation and technology in the workplace. The following questions were used to guide each of the interviews:

Given the potential and likely impacts of digitisation and artificial intelligence on jobs and work

1. Do you think enough is happening nationally to improve digital skills in society?
2. Are you aware of particular national policies that are driving university activity in this area?
3. Do you think University senior leaders are well-informed about these changes?
4. How can HEIs better identify future labour market needs, and make sure that all students gain the digital skills they need in their curricula e.g. humanities students?
5. Do you know of any interesting examples of how universities are providing students with the digital skills they need?
6. Are you aware of any particular good practice in other areas?
7. Are Degree Apprenticeships part of a possible solution?
8. Where are the gaps? i.e. who is slipping through the current provision of digital skills both in HEIs and more broadly in society?
9. Covid-19 has catalysed the pace of change of digitalisation across most sectors. Is this driving the rate of take-up and expansion of delivery of digital skills?
10. Have you anything else to add and would you like to be kept informed of this piece of research?

2.2.1 Kevin Richardson, Local Academy, and Visiting Fellow at the Centre for Urban and Regional Development Studies Newcastle University

Kevin Richardson previously worked for Research England, the new national statutory body, established in April 2018, which is responsible for funding universities to deliver research and knowledge exchange

activities. Prior to that, he was Local Growth Consultant within the Higher Education Funding Council England (HEFCE) where he designed and managed the delivery of the Local Growth Academy, a collaborative capacity development programme involving universities, local and combined authorities, and local National Health Service bodies. Kevin also led the strategic development of Leading Places, an action learning programme, in partnership with the Local Government Association and Universities UK.

2.2.2   Robert Camp, Director of Strategic Innovation at Stephens Scown, Exeter

Robert is a qualified solicitor and was Managing Partner of Stephens Scown LLP, since 2011. Robert has transformed the firm, which is now ranked among the best employers in the UK according to the Sunday Times 100 Best Companies to Work For survey. Robert was also instrumental in introducing employee ownership at Stephens Scown. Robert stepped down as Managing Partner in 2019 and took up the new role of Director of Strategic Innovation.

2.2.3   Andy Doyle, Senior Account Manager, JISC

As a Senior account manager within the London and M4 corridor region at JISC, Andy is responsible for helping Further and Higher education Institutions drive value and embrace best practice through the use of digital technologies in the learning environment.

2.2.4   Jamie Cole, IBM

Jamie leads the Industrial Sector within IBM Cognitive group in the UK, where he helps Industrial clients understand how cognitive solutions can transform their business processes. As an Executive Partner in IBM with 20 years' experience, Jamie works with organisations to innovate how they optimise their use of data, information and analytics.

2.2.5   Greg Wade, Universities UK

Greg Wade is a policy manager at Universities UK leading on Innovation, growth, employability and skills. This work includes the Higher Education Innovation Fund, the economic impact of universities, English devolution and local growth, supply and demand for graduates and degree apprenticeships. During his career at Universities UK Greg has led policy in areas such as leadership, management and governance, teaching and learning, teacher education and better regulation.

2.2.6   Professor Richard Everson, Director of the Institute for Data Science and Artificial Intelligence, University of Exeter

Professor Richard Everson is Professor of Machine Learning at the University of Exeter, and is Director of the Institute of Data Science and Artificial Intelligence. He is also an Alan Turing Institute Fellow in Data Science for Sustainable Development: Environment, Climate and Health.

2.2.7   Kate Doodson, Joint Chief Executive, Cosmic

Kate manages the team that delivers wide variety of Cosmic's projects that focus on digital inclusion & transformation, including the Growth Support Programme, Princes Countryside Fund as well as a wide range of private consultancy projects. Kate is a key member of the training team and regularly presents at workshops and events at regional, national and international stages.

3   The potential impact of digitalization

Digital transformation is generating a fierce debate among education providers, policy-makers, economists and industry leaders about its societal impact. As digitalization disrupts society ever more profoundly, concern is growing about how it is affecting issues such as jobs, wages, inequality, health, resource efficiency and security. Current estimates of global job losses due to digitalization range as high as 2 billion by 2030 (World Economic Forum). There is currently great uncertainty, with concerns also about its impact on wages and working conditions.

3.1   Digital Skills Gap

Despite our positive ranking within the EU, the UK currently faces a digital skills gap - where workers simply do not have the skills to meet the demands required by business and industry in this age of digitalisation. The 2018 Lloyds Bank UK Consumer Digital Index report estimated that 5.8 million people have never used the internet at all, and 21% of the adult UK population (equivalent to 11.3 million people) lacked the basic digital skills they need to participate fully in our digital economy[2]. It is projected that 6.9 million people will remain "digitally excluded" by 2028[3].

The 2019 Lloyds Bank UK Consumer Digital Index, reported that 54% of the UK population uses the internet to work, a 15% increase on the year before[4]. However, a recent study which analysed the number of organisations affected by the digital skills shortage, and the specific skills that are most lacking today, found that 88% organisations across Great Britain are currently lacking in digital skills, with many expecting these shortages to increase in the next five years [5]. The same study reported that one in three business leaders report that they do not have adequate cyber security capabilities within their organisation, and a similar proportion (31%) report that they are lacking the capability to successfully integrate new technologies or data sources. As more organisations look to move to a cloudbased digital infrastructure, many (33%) find that they are lacking in the development and management skills required to do this, while a similar proportion are struggling to find workers with the skills to manage emerging technologies such as automation and AI[6].

Almost 90% of new jobs require digital skills to some degree, and 72% of employers state that they are unwilling to interview candidates who do not have basic IT skills[3]. Two-thirds of 'datavore' businesses report that they have struggled to fill at least one vacancy when trying to recruit analysts over a 12 month period, and 93% of tech companies find that the digital skills gap affects their commercial operations[3].

The term "digital skills" covers a wide array of competencies, knowledge, and skills, making it difficult to design interventions to address specific digital skills needs. A 2019 report by Burning Glass Technologies attempted to illuminate this issue through analysis of millions of online job adverts in the UK to highlight the skills employers demand. It aimed to provide an overview of digital skills demand and provide a useful basis to inform an evidence-based skills development policy.[6]

The report distinguishes between baseline digital skills – those that are easily transferrable from one role to another, and specific digital skills - those that are role- or sector-distinguishing. The authors categorise

specific digital skills into seven clusters of related digital skills that are commonly required together to help job seekers qualify for jobs in a specific domain (see Table 1 in Annex 1). The research concludes that:

- Digital skills are near-universal requirements:
  - 'Baseline' digital skills are commonly required in jobs across all skills levels, with over 75% of job openings at all levels requiring digital skills.
- Digital skills carry a wage differential:
  - Overall, roles requiring digital skills pay 29% over those roles that do not (£37,000 p.a. vs £28,700 per annum). This difference is apparent at all skill levels, but the differential increases at higher levels.
- Digital skills are in demand everywhere:
- Digital skills are required in at least 82% of online advertised openings across the UK but the precise skills demanded are not uniform across the country.
- Specific digital skills may help workers avoid the risk of automation:
  - Workers in roles that require specific digital skills reduce their risk of automation by 59%.
- Specific digital skills promote career progression

Organisations report that the lack of appropriate digital skills at intermediate and senior management levels are having the most significant negative impact. This suggests that while there is still a need to increase basic or foundation level digital skills, employers should focus on building higher-level skills at management level, and even consider postgraduate qualifications where employees already have a degree. Nearly all (91%) senior leaders believe that their organisation has a responsibility to boost the skills of existing staff, and more than a quarter (28%) report redirecting their training budget to focus on building digital skills within their organization[5]. However, despite concerns about future job roles, not all employees would be interested in learning new digital skills. According to the Open University study, overall, just half (48%) of employees say they want digital training. This level increases amongst younger workers, with two thirds (67%) of 18-34 year olds saying that they would be receptive to digital training from their employers, and a fifth (22%) of younger employees are even funding their own training in this area. In contrast, just one in four (26%) over 55s say that they would like digital skills training.

3.2   The future of work

Automation can directly displace workers from performing specific tasks (the so-called displacement effect) and can also expand labour demand through the efficiencies it brings to industrial production (productivity effect). Displacement can lead to "work eradication" (e.g. robotic warehouses) but more commonly, leads to "work augmentation" - where AI teams up with people to improve work outcomes - but can also lead to "work intensification".

Thus, as a result of the evolving digital landscape, a number of job roles are likely to change or disappear, while some existing jobs are likely to be transformed. One 2017 study suggests that up to 30% of UK jobs could potentially be at high risk of automation by the early 2030s[7], while another study suggests that

automation is more likely to replace tasks instead of jobs, and estimates that only 10% of UK jobs are at risk of being automated[8]. On average, employers expect that 37 per cent of the roles in their workplace are likely to alter significantly within the next five years as a result of digital disruption, which means as many as twelve million employees across Great Britain could be affected (data based on ONS data).[5] These trends are likely to affect some social groups more than others, with young people[9] and women[10] likely to be disproportionately affected. Indeed, the ONS (2019) found that 70% of the roles at high risk of automation are currently held by women.

Several studies have sought to identify the skills that will grow in demand over the coming decade due to automation. In addition to technological skills (including digital skills but also scientific research and development, data analysis, engineering, and maintenance) MGI predicts growth in demand for the following skills across Europe[11]:

- **Social and emotional skills:** including entrepreneurship and initiative taking; leadership and managing others, advanced communication and negotiation skills, adaptability and continuous learning, interpersonal skills and teaching and training others.
- **Higher cognitive skills:** including creativity, complex information processing and interpretation, critical thinking and decision making, project management and quantitative and statistical skills.

Aside from those working in the information and communications departments, the employees most likely to be affected by automation in the next five years are those working in administration, operations, HR and training, and customer services. To maximise chances of success in the digital economy, job seekers need to develop more specific digital skills (see Table 1, Annex 1). This may include digital tools such as Adobe Photoshop for designers; computer-aided design for engineers and manufacturing workers; customer relationship management software for sales and marketing professionals; and computer programming and networking for IT professionals. These specific digital skills are required in 28% of low-skill jobs, 56% of middle-skill jobs, and 68% of high-skill jobs[6].

However, it is likely that jobs requiring coaching, caring or creativity will be less affected by AI or extensive automation. Specific digital skills commonly complement uniquely human skills such as design, writing or communication, which in combination are difficult to automate and critical to a firm's success. Therefore tasks less susceptible to automation are those that involve managing people or applying expertise, and those involving social interactions, where machines cannot yet match human performance. A 2017 study of the global job market found that the categories experiencing the highest growth due to automation include: healthcare providers; professionals such as engineers, scientists and analysts; IT professionals and other technology specialists; managers and executives; and educators and people in creative industries (artists, performers and entertainers)[12]. It is anticipated that economies like the UK and US, where creative occupations make up a large part of the workforce, may be better placed than others to deal with the disruption of employment from future advances in automation[13].

Broadly, the "Working Futures" projections expect expansion demand to be positive for almost all high-skill occupational groups (with the exception of protective service occupations) but the biggest expansion in absolute and relative terms will be in caring personal service occupations.

3.3 Productivity

Over three quarters of the UK economy is service-based and basic digital skills are intrinsic to the majority of roles in these sectors. The UK needs to maintain strong productivity growth in order to remain competitive in the international marketplace and to achieve economic growth. The average wage premium associated with having digital skills is estimated to be between 3% and 10% of annual earnings[14]. The earnings of employees are normally strongly related to their productivity – employers are willing to pay more to people who are more productive, because they stand to benefit from increased output. This implies that ensuring all UK adults learn basic digital skills would have an impact in terms of employability and productivity levels. Indeed, a report from the House of Commons Science and Technology Committee estimates that the digital skills gap is costing the UK economy £63 billion a year in the lost potential for additional GDP and that supporting the digital inclusion of the UK population by ensuring that all adults learn Basic Digital Skills could help erase this cost[15].

Productivity is the most pressing impact of digitalisation amongst business leaders, with more than half (56%) believing that the digital skills shortage has already had a negative effect on the productivity of their workforce, and a further 40 per cent expecting this to happen in future[5]. Close to half (47%) of business leaders think that the skills shortage is affecting ability to implement new time or cost saving technologies, and four in ten (41%) say that a lack of digital skills impacts on their competitive edge. The continued development of new technologies could widen the gap between the skills in the workforce and those required even further, leaving employers concerned about their organisation's future capabilities. Half (50%) of business leaders surveyed say that their profitability will be negatively impacted by the digital skills shortage and a similar proportion (52%) think that a lack of digital skills will affect their agility and ability to adapt going forward.

A 2016 report assessed the current state of digitisation of UK business with respect to improving the UK's productivity performance[16]. The report highlighted five key digital developments which were considered to be particularly important for the vast majority of UK businesses over the next three to five years: *cloud computing*; *mobility*; *unified communications*; *data exploitation*; and *cyber security.* The report claimed that each of these innovations were developing rapidly and were likely to have far reaching impacts on the way UK businesses operate, and on productivity.

The UK has long struggled with a productivity problem, and future UK growth will need to come from increased output from the existing work force. Despite leading in the development of digital technologies, the UK has historically lagged when it comes to deploying these technologies throughout economy, with business adoption trailing key international competitors. Indeed, the 2019 UK Government's Business Productivity Review reported that while the uptake of digital technologies has increased in recent years, with web-based accounting software and cloud computing being used by more than 40% of micro-businesses, the proportion of UK businesses adopting these fairly basic technologies is significantly below the EU's best performers[17]. For example, 42% of enterprises in the UK buy cloud computing services, compared with 65% in Finland, 57% in Sweden and 56% in Denmark[18]. Encouraging the digitisation of businesses is seen as a way of boosting innovation and improving productivity and is addressed under pillar four of the UK's Digital Strategy (see section 4.1.2)

3.4 Social divides

There is a correlation between where people live in the UK, their socio-economic circumstances and whether they have basic digital capability. For example, according to estimates in the Basic Digital Skills UK Report 2015[19], unemployed adults in the UK, are 5% more likely to lack the basic digital skills than the national average, and 24% more likely to lack these skills than high earners. There are similar geographical divides, with 22% of adults in Blackburn in the North reported not to have used the internet in the three months to August 2016, compared with 7% of adults in Surrey, in the South, for the same period[20]. Similarly, in 2018, Wales had the lowest proportion of people with all five basic digital skills (66%) and the highest proportion of those with zero basic digital skills (19%), while the reverse was true for the South East of England (86% and 5% respectively)[21].

Meanwhile a recent report by Lloyds Bank, reported that of the 4.1 million adults (8%) in the UK who are offline, almost half of these (47%) come from a low income household, and 16% of benefits claimants are digitally disengaged (down two percentage points since 2018)[22]. Employees from the Manufacturing, Construction, Utilities and Retail sectors are the least digitally skilled, while the West Midlands has the least digitally skilled workforce. Only 19% of the UK digital tech workforce is female[23], and in 2017, female programmers and software developers were estimated to comprise just 3.9% of tech and telco professionals in the UK[24].

The same report claims that half of UK employees (53%) do not have the essential digital skills needed for their work (e.g. share documents by attaching to an email, use online payments etc.) and one-third of the workforce lacks cybersecurity skills. Those earning more than £25,000 are more likely to have these essential workplace skills (61%) than those earning less than £11,499 (25%)[23].

According to OECD figures, the UK has one of the most regionally unequal economies of any in the advanced world, with London far ahead of all other regions - notably Wales, the north-east and Northern Ireland. In 2020, Boris Johnson's flagship election pledge was "levelling up," aimed at tackling regional economic disparities. Digitisation will be key to the Government achieving its aim of increasing output and continuing to grow the economy, and to improve opportunities and living standards outside of London and the South East[18]. The Office for National Statistics (ONS) has highlighted that labour productivity is highest in major cities, or those connected to major cities while the lowest levels of productivity are in areas such as Cornwall, the Isles of Scilly, Northern Ireland and areas in North East and North West[25]. As the UK leaves the EU the adoption of digital technologies will be vital for accessing new markets, with online platforms offering an excellent opportunity for small and medium-sized enterprises (SMEs) to expand their customer base. However at the moment just 18% of SMEs currently use digital channels to trade overseas, and a disproportionate number of the companies that use these technologies are based in London and the South East[18].

3.5 E-Commerce

Digitalisation has completely changed the way consumers behave. Worldwide ecommerce continues to grow rapidly every year, and buying products online is now seen as the preferred method of purchase in most countries. It is predicted that by 2040, 95% of purchases will be facilitated by e-commerce[26].

The UK is the third biggest e-commerce market in the world, behind only China and the US[27]. With 87% of UK internet users now expected to shop online, these online shoppers spent €3254 per person in 2018, and were predicted to spend €3620 in 2019. The business-to-consumer e-commerce turnover in the UK was worth €175 billion in 2018, and was predicted to reach over €200 billion by the end of 2019[26] representing 7.94% of the UK's gross domestic product. E-commerce currently accounts for 19.2% of the UK's total retail sales, and is predicted to rise to 53% by 2028[28]. In response, there is likely to be a significant decline in the numbers of physical shops, which is expected to further stimulate online growth as well as the merger of physical and online retail channels.

The UK is also the third largest mobile commerce market in the world. M-commerce in the UK is worth €55.9 billion and is the fastest growing channel[29]. This is driven by the fact that more and more consumers in the UK own a smartphone and have more confidence in the safety and ease of mobile purchases and payments. It is therefore also predicted that payments using e-wallets will play an increasingly important role within e-commerce in the UK.

4 Current policy and educational/universities responses

Digitalization is transforming the skills needed by Europe's working population to successfully engage in the world of work in a globalized modern economy. In this context, higher education institutions play a key role in providing the digital skills required by the labour market in the globalized modern economy. Consequently, national education systems must swiftly and appropriately respond to the challenges digitalization poses.

There have been many positive developments with responses to fill the digital skills gap, ranging from an increase in employer workplace training opportunities, to new technology institutes providing higher levels of technical education.

4.1 UK Digital Policy

4.1.1 Shadbolt Review

According to the European Commission, the UK ranks poorly for the number of graduations in ICT (16th in Europe; 3.6 % of total graduates)[30]. Moreover, data indicate that 13% of computer science students in the UK are still unemployed six months after graduating[31]. While employment outcomes improve significantly for computer science graduates 3.5 years after graduation, they are still low compared to other graduates.

In 2015, The Higher Education Funding Council for England (HEFCE) commissioned a major independent review into the way Computer Science is taught at UK universities due to the subject's

growing rates of graduate unemployment. Published in 2016, The Shadbolt Review focused on the purpose and role of degree accreditation, how the system can support the skills requirements of employers, and how the system can improve graduate employability[32].

The Review noted that the disparity in 'raw' unemployment rates was largely accounted for by prior achievement and socio-economic factors, and that rates of graduate unemployment were declining and varied considerably between geographic location and type of higher education institution (HEI).

Shadbolt made a number of recommendations to ensure the UK's Computer Science graduates are introduced to the materials and concepts that will help them find employment upon completion of their studies, and equip them with the tools for career progression that will last long into the future. Among the recommendations, was that HE providers and employers should consider how new models of provision, such as degree apprenticeships, may provide opportunities for students to develop work readiness skills alongside their academic studies; and that HE providers, employers, accrediting and professional bodies should work together to horizon-scan for future skills requirements of Computer Sciences graduates.

4.1.2   UK Digital Strategy

Published in March 2017, the UK Government's Digital Strategy is described as "a plan to build a stronger, fairer country that works for everyone, not just the privileged few"[33]. The strategy is based on seven strands: Building world-class digital infrastructure for the UK; Giving everyone access to the digital skills they need; Making the UK the best place to start and grow a digital business; Helping every British business become a digital business; Making the UK the safest place in the world to live and work online; Maintaining the UK government as a world leader in serving its citizens online; and Unlocking the power of data in the UK economy and improving public confidence in its use.

Chapter 2, Digital Skills and Inclusion, outlines the UK Government's plans to address the digital divide[20]. The document describes how the Government plans to support public, private and third sector organisations' delivery of digital skills training and to increase the digital capability of those who are digitally excluded, as well as those who are online but lacking the confidence and knowledge to make the most of it. These plans also included the introduction of a basic digital skills entitlement - which will offer free training to adults in England who lack basic digital skills.

The strategy describes plans to take a more targeted approach to digital inclusion, such as developing the role of libraries to improve digital inclusion, and the investment on projects with the NHS to support the most excluded groups such as the homeless, or those with disabilities. To support the implementation of the strategy, in August 2018 the UK launched a £1m Digital Skills Innovation Fund to pilot or scale up innovative programmes that aim to address local or regional digital challenges while supporting people from underrepresented groups and/ or disadvantaged backgrounds into digital roles. At the same time, it launched a Digital Inclusion Fund to help older and disabled people develop the digital skills – such as booking medical appointments and using online communication services and search engines.

The strategy promises a reform of the technical education system including the creation of a specialist digital route, with employers setting standards and specifying the knowledge, skills and behaviours that individuals will need. It also describes the introduction of digital degree apprenticeships, designed by groups of employers to give apprentices full occupational competence and which provide industry with the skills they need.

4.1.3   UK Industrial Strategy

The Government is supporting businesses to become more digital and adopt proven technologies that boost productivity through its modern Industrial Strategy[34]. Launched in November 2017, the UK Industrial Strategy makes a commitment to put the UK at the forefront of the AI and data revolution. Growing the AI and the data-driven economy are identified as one of four Grand Challenges within the strategy. To address this challenge it identifies four priorities:

1. Making the UK a global centre for AI and data-driven innovation;
2. Supporting sectors to boost their productivity through AI and data analytic technologies;
3. Leading the world in safe and ethical use of data and AI; and
4. Helping develop the skills needed for the jobs of the future.

To support the implementation of the strategy the government has agreed an AI Sector Deal with industry[35]. Amongst the many supporting actions, the strategy provides for a number of new institutions and bodies to support the advancement of AI including the Alan Turing Institute (see section 6.1.3) an Industry-led AI council to support uptake of AI across sectors, a new government office for AI and a new Centre for Data Ethics and Innovation. Investments are also foreseen for extra PhDs (£45m) and masters courses (industry developed and funded) in AI and related disciplines, for improving the teaching of computing (£84m) and driving up participation in computer science (£406m) and improving adults skills, in particular digital skills, to deal with a changing economy through the establishment of an adult digital skills entitlement and a new National Retraining Scheme (see section 5.2).

4.1.4   Postgraduate conversion courses in data science and artificial intelligence

In June 2019 the government announced that it would support the development of degree conversion courses in AI and data science technologies to help address the shortage of AI and data specialists in the UK[36].

In response, the Department for Digital, Culture, Media and Sport (DCMS) and the Office for Artificial Intelligence (OAI) have provided funding for eighteen universities across England to develop postgraduate conversion courses in these areas. In addition to helping address the skills shortage, these courses also aim to increase the number of people from groups currently underrepresented in the AI and data science fields, and to encourage graduates from diverse backgrounds to consider a future in these occupations.

4.1.5 The Skills Toolkit

In April 2020, in response to the lockdown activated due to the Coronavirus Pandemic, the Department for Education launched a collection of free online courses in digital skills[37]. The job-related online courses, teaching numeracy, coding and internet skills, have been made available to the millions of people furloughed from their jobs during the lockdown, giving them the opportunity to "improve their knowledge, build their confidence and support their mental health so they have skills they need to succeed after the coronavirus outbreak".

The Skills Toolkit, is a collection of training resources to help people use the lockdown to acquire jobs skills for when more businesses reopen. With uncertainty over the labour market in the months ahead, the adult training is focused on improving skills for online jobs in the post-virus economy, when digital-related jobs are expected to be more resilient than others and more people are expected to be working remotely. The Open University and Google are among the providers.

4.2 The impact of digitalisation in the South West of England

Researchers have shown that technology has, and is likely to continue to, exacerbate existing geographical inequalities. Both the ONS[9] and Centre for Cities[38] have explored the extent to which the risks of automation are distributed across the UK. Based on an assessment of the potential for tasks to be automated and the task composition of occupations, both sets of researchers applied the resultant "risk ratios" to the occupational make-up of local areas.

The ONS found that unsurprisingly, generally, the more jobs that require high-skilled workers in an area, the lower the risk of automation overall. Accordingly, within the Heart of the South West, Exeter had the lowest risk of automation (39.6) followed by Plymouth (44.5) and South Somerset (44.8). However, most of the other local authority districts in the Local Enterprise Partnership (LEP) area were among the second highest band of districts nationally in terms of their high risk of automation. Around 9% of employment across the Heart of the South West is in the sub-major groups that includes the four occupations at most risk of automation: waiters and waitresses, shelf-fillers, elementary sales occupations and bar staff.

The Centre for Cities research found that one in five (19%) jobs in Exeter were likely to shrink (as a proportion of all jobs) due to automation. The figure for Plymouth was slightly higher at 21%. Both studies concluded that already successful areas: such as those in the M5 corridor were among those least likely to be 'at risk' from technological change.

The spatial distribution of displaced and emerging job opportunities will also depend on business demography and in particular the prevalence, or otherwise, of enterprises that are willing and able to adopt new technologies. The vast majority of companies in the Heart of the South West are SMEs, which tend to be technology 'laggards' suggesting that tasks and occupations may be automated more slowly locally than in areas containing greater numbers of early adopters of technology, the so-called "frontier" companies. It is important that measures are taken to support these smaller enterprises to adopt new technology and help them unlock the digital potential of the region.

With two world class universities, and links to national initiatives such as the Digital Catapult and the Institute of Coding (see section 6.1), as well as more local initiatives such as the South West Institute of Technology and the Impact Lab (see section 6.2) the South West region is well equipped to cope with automation and the increasing demand for digital skills. These initiatives focus on smart specialisations, which aim to boost regional innovation and give the region a competitive advantage. This is exemplified by Exeter's Data Analytics Skills Escalator which draws on the region's distinctiveness, economic and innovation strengths to provide the digital skills to help deliver local and regional ambitions for productivity-led growth (see section 6.2.1). However, as the world emerges from the Covid-19 Pandemic, there are risks that the South West, with its high percentage of low skilled workers and SMEs, suffers disproportionately from a high level of job losses and business closures.

4.3   UK University response to digitalisation

4.3.1   New courses in digital topics

Unsurprisingly, there are widespread calls for education systems to better prepare individuals to meet labour market needs and in particular the development of 'future ready curricula' which promote linguistic, mathematical and technological literacy, as well as supporting the development of critical thinking, problem solving and creativity skills[39].

A growing number of UK universities offer under- and postgraduate courses in digital subjects such as data science and data analytics, as they respond to the increased demand for topics such as machine learning, big data and applied statistical modelling. Some institutions have partnered with industry or technology companies to better understand what skills employers are wanting from graduates. For example at the University of Exeter, The MSci Data Science, has been developed in collaboration with industry partners including IBM, using current methods, platforms, software and data, to ensure that students are fully prepared for workplace practice upon graduation[40].

Other courses are available that have a slightly different focus, such as the cyber security implications of big data, the role of cloud computing, or how big data impacts on business leadership. For example, King's College London runs an MA Big Data in Culture & Society[41], which looks at the subject from an arts and humanities perspective, while the University Exeter runs an MSc in Applied and Social Data Science which offers rigorous data analytic training alongside a specialisation in a policy subfield (e.g. social and family policy, or criminal justice)[42].

Also at the University of Exeter, the Institute for Data Science and Artificial Intelligence (IDSAI) provides a hub for data-intensive science and AI activity within the University and the wider region[43]. The Institute is an interdisciplinary research institute with data scientists, mathematicians, and computer specialists across many of the university's Colleges, Research Institutes, and Departments. The Institute's vision is to develop innovative approaches to the use of data and AI in modern society, covering the entire spectrum from collection through interrogation and analysis, to interpretation, visualisation and communication.

4.3.2   New student support/careers support materials

JISC is the UK's higher education digital technology agency which supports post-16 and higher education, and research, by providing relevant and useful advice, digital resources and network and technology services[44]. JISC is funded by a combination of the UK further and higher education funding bodies, and individual higher education institutions.

JISC has produced a guide to support institutions to develop the culture, infrastructure and practices in core areas of activity that support both organisational growth in digital capability and enable individual digital capabilities to flourish[45]. This guide explores what a digitally-capable organisation might look like and presents 15 institutional case studies that show different approaches to developing digital capability.

For example, Lancaster University in the north-west of England has set out a Strategic Plan for 2020 which articulates how digital practices will enable the university to achieve its targets through key 'digital enablers':

- Digital fluency: to ensure staff and students have the digital skills they need
- Digital infrastructures: to ensure the technology, people, services and infrastructure needed
- Digital innovation: to maximise the opportunities offered by digital technology
- Digital governance: to integrate Digital Lancaster into the university's existing structures

A digital services stream is also moving Lancaster towards a 'dot.everything' approach whereby all processes – from student admissions and assessment to requesting travel and managing payroll – are carried out online. This requires systems and practices to be updated, and everyone to have the digital skills they need to carry out their role.

In the next iteration of the strategic plan there is a further focus on distance and online learning and on supporting learners at partner institutions who may never attend the physical campus but nonetheless expect an equivalent learning experience.

The Digital Fluency steering group is made up of senior staff from the library, student experience and the colleges, the directors of HR, staff development and IT, and a representative of the student union (LUSU). Having so many senior staff involved has given digital capability issues a high profile. It also means that an inclusive approach is taken, with the digital skills of manual and professional staff considered alongside those of academic teaching staff and researchers.

4.3.3   The impact of digitalisation on Higher Education provision

Higher education institutions in the UK constantly seek to harness new technologies to better serve students and to reach new student populations. Teaching digitally, through online classes, video calls, or seminars offers a convenient, flexible method of delivering most course content, and until recently, the adoption of online, flexible and technology-enhanced modes of learning has been varied across the sector. A recent (2019) paper presents a new conceptual model for framing difference in three key educational processes (content, delivery and recognition) related to the potential of digitalisation to make these processes more flexible and more open[46]. Based on the results of a global survey of 69 higher education

providers, the findings reveal six distinct archetypes of technology-enhanced higher education which vary according to the extent to which digitalisation is harnessed for content, delivery and recognition, and suggest different institutional strategies of digital adoption. This study suggests that the majority of HEIs across the world are "currently in the process of experimenting with digitalisation and applying new technologies to certain parts of their operation".

4.3.4   Impact of the 2020 Coronavirus pandemic

In 2020, Covid-19 has brought major disruption and has changed the way we work and study across the world. The UK has more than 2 million students enrolled in higher education institutions, out of which almost half a million are international students coming from all corners of the world[47]. As a result of the coronavirus pandemic, the need to "social distance", and the desire of many home and overseas students to return home, all universities in the UK have moved their classes online. Universities have had to rapidly develop online platforms to enable them to deliver lectures, seminars and tutorials virtually, for large numbers of students to access the content from their own home. Universities have quickly evolved their digital tools and platforms in a matter of weeks to ensure uninterrupted educational delivery to their isolated students.

Some UK universities, such as the Open University, have been conducting and researching online teaching and learning for decades, while others have more recently begun exploring innovative ways of using technology to deliver their classes. A survey was recently launched by QS, which aimed to understand the challenges higher education professionals face during the coronavirus crisis, and how they are embracing online learning opportunities[48]. Early results indicate that 50% of the survey respondents had already switched some of their scheduled courses online prior to the crisis.

The coronavirus outbreak has been a catalyst, forcing educators to revolutionize the way they teach and speeding up the transformation to total online provision. It is likely that long-term, when everything is finally back to 'normal', and universities have perfected the technology, and students have got used to the non-traditional learning, some will continue to deliver a blended approach of online-based and face-to face teaching.

5 Critical points and Gaps in Policy Response

Within the European Union, the European Commission's Digital Economy Society Index for 2018 shows that EU countries face deep digital development gap and therefore "it should invest more in digital and also complete the Digital Single Market as soon as possible to boost Europe's digital performance". Even more, the same disparity is seen on digital skills, "while Nordic countries and the UK have populations with notably advanced digital skills, almost half of all Europeans still lack basic technical competences", according to the index.

5.1 Building digital capability and lifelong learning

Digital techniques and technologies are constantly evolving and there is a concurrent need to up-skill people across their working lives. If the UK is to grasp the challenges of regional economic development, rapid advances in technology, and an ageing population, more people of all ages should be given opportunities to upskill, retrain and develop the higher level skills employers need. The Centre for Economics and Business Research (CEBR) have identified five areas in which individuals who acquire basic digital skills are able to benefit, compared with their digitally disengaged peers - earnings benefits; employability benefits; retail transaction benefits; communication benefits; and time savings[3].

However, while digital inclusion has been increasing in recent years with clear benefits for both individuals and wider society, inequalities in learning persist in the UK with the adults who could most benefit from learning the least likely to do so. This is particularly the case among certain groups, including older and disabled people and those not living in private households[49]. Those from lower socioeconomic groups, those with fewer years of initial education, and those furthest from the labour market also remain under-represented in learning. A lack of inclination (64%) and a lack of skills (20%) are frequently reported as reasons for not engaging with the digital world[50], suggesting that part of the education for digital skills may need to start by highlighting the benefits of being online and overcoming any apprehension to engagement. However, the fact that people remain digitally excluded highlights the importance of ensuring that non-digital alternatives continue to be made available to enable everyone to participate fully in society.

Kevin Richardson, of the HE development consultancy Local Academy, believes that current policies designed to improve digital skills in the UK are not currently doing enough to reach all corners of society. He explains that due to the nebulous nature of digitalization, it is hard for research to inform policy design in this area, and as a result, a lot of policy in this area is being developed at a relatively low level and is therefore rather superficial.

A recent review of post-18 education in the UK claimed that the government should introduce a "lifelong learning loan allowance" at levels 4, 5 and 6 for adults without a degree[51]. The Auger Review proposed a financial amount equivalent to four years' full-time undergraduate degree funding – up to £30,000 that could be used for vocational or academic courses from levels 4 to 6 at any stage of an adult's career for full and part-time students. The review also suggests that a more modular approach to learning is needed, alongside more flexible funding routes. The UK Government's Digital Strategy promised to ensure that

adults who lack core digital skills will be able to access specified basic digital skills training free of charge, where it is made available by providers as part of the publicly-funded adult education offer[33]. Current UK initiatives which support lifelong learning in the workplace include:

(i)   The Union Learning Fund (ULF). Established in 1998 to support a learning society[52]. The ULF is managed and administered by unionlearn, the TUC's Learning and Skills Organisation, under an agreement with the Department for Education (DfE), which directs the level and type of learning activity that should be supported by the Fund. The Fund has supported more than 50 unions in over 700 workplaces and remains a flagship mainstream government programme - regarded as pivotal by unions, the Government, employers and partner organisations in the learning and skills world. The ULF has enabled workers to access a wide range of learning activity in innovative ways.

(ii)   The National Retraining Scheme is the UK government's programme to help adults retrain into better jobs, and be ready for future changes to the economy, including those brought about by automation[53]. The government announced £100 million in the autumn budget 2018 to support the development of the scheme which aims to: support people already in work to move into better jobs through training and tailored advice; complement existing training programmes for adults; and encourage people to develop their flexibility and resilience in the world of work, so they can take advantage of new opportunities

(iii)   Workplace Digital Champions are used by many charities and SMEs who lack the digital capability they need, to cascade digital skills through their organization. Digital Champions are increasingly being used in sectors where staff are expected to work from home and use ICT in a way they never have before. UNISON's Digital Champions are trained volunteers who support colleagues in the workplace to learn digital skills or undertake digital learning, development or training[54].

5.2   Lifelong learning in Higher Education Institutions

Despite an increased demand for lifelong learning, the provision of adult education by UK higher education institutions has been declining in recent years. Indeed, there has been a 61 per cent drop in part-time learners in UK HEIs since 2010[55]. As the vast majority of part-time learners are over 21, the decline might be regarded as a proxy for the retreat from adults in higher education[56]. There are therefore calls for the higher education sector to move towards a more flexible system that meets the needs of adult learners and reverses the decline in the numbers of part-time and mature learners.

A 2018 project by Universities UK (UUK) and the Confederation of British Industry (CBI) looking at the decline in part-time student enrolments and the changing needs of students and employers, highlighted the need for more people to reskill and upskill[57]. Like the Auger Review, the research revealed that the current regulatory and funding systems are simply not designed to promote more flexible ways of learning. In a joint statement to government, UUK and the CBI made a series of recommendations, including: evolution of the Apprenticeship Levy into a more flexible 'Skills Levy' so that it can cover a wider range of training, including more flexible study; greater support for students moving between work and study across their lifetimes, with the education system supporting shorter and more flexible courses; and

more collaboration between employers and higher and further education, to help learners progress on to qualifications between A-levels and a university degree. In response to this research, UUK are calling for the introduction of a pilot scheme that will test how modular funding could address local skills gaps, with a view to bringing about longer-term change to the higher education system[58]. As Greg Wade from UUK explains, the flexibility to move easily between the different levels of qualifications and education systems is key to enabling us to respond to the rapidly changing labour market.

However, Professor Richard Everson, Professor of Machine Learning at the University of Exeter is cynical about the role of universities in lifelong learning and believes that it would require a complete rethink to enable students to dip in to take individual modules. Similarly, Kate Doodson of Cosmic questions whether HEIs are the right place to support lifelong learning of digital skills, as she feels that they are often not closely enough linked to local community other than the business community.

In the Heart of the South West, the region's HE and FE providers have been working directly with employers to ensure curriculum development is responsive to current and future skills needs. Particular emphasis has been given to the development of higher and degree level apprenticeships, as well the design of a range of modular and continuous professional development (CPD) opportunities. However, as Richard Everson explained, there are limitations to offering CPD courses in a rural region like the South West of England, as individual employers have different and disparate needs, and courses are not economical unless they are offered online.

5.3   Are UK universities doing enough?

Increasingly, UK universities are collaborating with FE providers, businesses and industry to identify what skills employers need, and where the skills gaps are (see sections 4.3 and 6). But could they do more? Preparing graduates for a digital workplace has become essential for HEIs, with many listing this among their top priorities[59], yet only 41% of students feel that their courses adequately prepare them for the digital workplace, and only 69% thought that digital skills would be important for their career[60]. A recent QAA survey on graduate skills which explored the graduate skills through the lenses of equality and diversity, readiness for employment, and global perspective suggested that universities are doing well, but could do better[61].

Kate Doodson thinks there is still a significant issue about how we describe and articulate digital skills, and is keen that HEIs start to unpick students' digital needs and how they can enhance their employability. She supports the teaching of digital in soft skills such as digital productivity, digital presentations and digital time management. As Greg Wade of UUK explains, technology and skills needs changes so rapidly that in order to produce work-ready graduates, it is imperative that universities engage in intimate collaboration with employers on the delivery of the programme, with internships and placements. However, he points out that there is a huge gap in the number of employers who want graduates with work experience, and those willing to offer them. This is exacerbated in the digital sector due to the large number of SMEs, particularly in more rural areas like the South West. Greg believes that boosting engagement with SMEs is key to providing more opportunities for graduates and apprenticeships in the digital sector. One English university that has successfully engaged with the local SMEs on its digital degree

apprenticeship programme is Nottingham Trent University. However, as James Flynn of IBM points out, true collaboration should be for mutual benefit. The UCL Industry Exchange Network[62] is founded on the understanding that experience of real-world interdisciplinary applications, in conjunction with taught modules, is vital to a good education. The programme enables students to apply their degree training to a variety of projects that are relevant and useful to industry.

All experts interviewed for this report agreed that degree apprenticeships could be part of the digital skills solution. However, as Greg Wade explained, in a sense, the digital degree apprenticeships are very specialised and are therefore not doing anything to boost skills overall. While a UUK survey showed 100% of employers saw degree apprenticeships as a route of increasing diversity of the workforce, the figures don't corroborate this. Indeed it is questionable whether degree apprenticeships are attracting new talent into higher education, or simply diverting people that would have gone on to do a traditional degree. Prof Richard Everson of University of Exeter is also concerned about the tension between education and training in these programmes and points out that while these students who follow this route gain employability skills in the short term, they may miss out on learning the fundamental principles of their subject which may put them at a disadvantage in ten years' time when their skills get out of date. Nonetheless, whatever the route, Greg Wade strongly believes that the single best thing for enhancing employability is a placement or internship. He therefore sees that focusing internships on the most disadvantaged groups would be one approach to tackling the social digital divide.

Kevin Richardson believes that the fixation of UK universities on research, the Research Excellence Framework (REF) and cash, prevails over the question of whether they are actually in the best possible condition they can be to teach: *"Universities are too lazy when thinking about the offer for the student. They have ben massively coalesced, offering vanilla styles and delivery, with very little diversification. Universities need to start thinking differently and more bravely about how to deliver and how to diversify and deliver more tailored and more nuanced programmes."*

Kevin also believes that the UK needs to stop thinking that "Britain does it best" and should look overseas, particularly to the American HE sector for examples of how digitalization is being used to deliver lectures to a huge audience "like a performance".

Kevin is particularly critical about the legislative framework, and the week corporate management in the HE sector, which is preventing imaginative ways of thinking about learning in its own right, and in relation to the wider environment.

5.4   Lessons from Covid-19

There are no doubt going to be lessons and opportunities gleaned from the intense period of change during the 2020 Covid-19 Pandemic, which has forced so many employers and educators to work and deliver content remotely. As Robert Camp, Director of Strategic Innovation for Exeter based Solicitors Stephens Scown explained Covid has been the catalyst for radical change and has accelerated the need and desire for people to upskill as quickly as possible. For many professions, the main driver to embrace digitalisation is linked to the desire to improve efficiency and reduce the laborious processes. The covid pandemic has identified some such opportunities through necessity, such as the use of remote systems

in court hearings, and the use of remote triaging and appointments by the medical profession, but has also highlighted other opportunities that remote working can bring. As Robert Camp suggested:

> *"The logical conclusion is that you have different teams for different hours. We have more female entrants in law than male. We lose some through maternity leave. There are opportunities to keep them engaged remotely, embracing technology, providing out of hours service for private clients - Qualified solicitors who would love to work but can't find the time during the usual working day. …..if you can keep people engaged, when they come back, they will be even better."*

However, the crisis has also highlighted social and digital divides which are only likely to widen as the effects of lockdown continue. Andy Doyle pointed out how JISC has played a part in lobbying the UK government to put more money into Further Education to provide laptops for home use, and also in lobbying 4G providers to provide free data to students to enable them to continue to study remotely.

6 Good practice identified locally and nationally

6.1 National Initiatives

6.1.1 Digital Skills Partnerships

In 2017 the UK government launched a Digital Skills Partnership (DSP) together with businesses, charities and voluntary organisations to help increase the digital capability across the whole skills spectrum of individuals and organisations in England[63]. One of its key aims is to increase motivation and digital capability among SMEs and charities, with the work overseen by a cross-sector Digital Enterprise delivery group. Since its launch it has provided 2.5 million free training opportunities to develop basic digital skills, coding and cybersecurity skills etc. It has developed four delivery groups focusing on 1) increasing the national coherence of digital skills provision, 2) supporting the development of Local Digital Skills Partnerships in English regions, 3) increasing digital enterprise by helping small businesses and charities to upskill their employees and 4) convening industry and other partners to support the teaching of the new computing curriculum in English schools.

Local Digital Skills Partnerships (Local DSPs) bring together regional businesses, large employers, charities, and public sector organisations to tackle local digital skills challenges and build thriving and inclusive local economies. The Heart of the South West is one of six 'trailblazer' Local DSPs which have now been launched to boost their local economies and share best practice with other Local Enterprise Partnerships and Combined Authorities. The Heart of the South West Digital Skills Partnership was launched in June 2018, bringing together the public, private and third sector to tackle the digital skills divide in Somerset, Devon, Plymouth and Torbay.

This local partnership is responsible for coordinating and delivering a digital strategy that raises digital skills for the community, working to eradicate social and geographical imbalances to ensure everyone has access to digital services[64]. The partnership also focuses on workplace mobility; ensuring the right digital training is available for young people, those outside of the workforce, work returners, employees looking to retrain and supports a workplace where the region's highly skilled digital employees can continue to

learn. The partnership works closely with the region's education providers to ensure young people are aware of the diverse range of careers and are supported to enter into digital jobs, and that teaching staff are supported to teach digital subjects that keep pace with new technologies.

The local partnership also works in tandem with the National Digital Skills Partnership Board to ensure that the Government's UK Digital Strategy is responsive to local needs and in return the local area can make the most of national opportunities, sector analysis to inform delivery, cross-government department collaboration and funding opportunities to overcome digital challenges.

6.1.2   Digital catapult

The Digital Catapult is the British government innovation agency for the digital and software industry[65]. Digital Catapult is part of Innovate UK's Catapult network, supporting Government's aim of achieving 2.4% of GDP on research and development by 2027[66]. The organisation coordinates knowledge transfer from British universities and helps drive the early adoption of advanced technologies in computing startup companies.

Focusing in the manufacturing and creative industries, the Digital Catapult supports early adopters through acceleration programmes and programmes that match corporates looking to solve business challenges with start-up and scale-up innovators. The major programmes focus on early adoption of AI, Future Network and Immersive Technologies, as well as more experimental work in distributed ledger technologies.

6.1.3   Alan Turing Institute

The Alan Turing Institute is the United Kingdom's national institute for data science and AI[67]. It was founded in 2015 and is a joint venture between 13 British Universities (including University of Exeter) and the Engineering and Physical Sciences Research Council (EPSRC). The Alan Turing Institute fits into a complex organisational landscape that includes the Open Data Institute[68], the Digital Catapult[65] (see section 6.1.2) and infrastructure investments.

The Alan Turing Institute takes a leading role in data science and AI training, provides the expertise and fundamental research into mathematics and algorithms needed to solve real-world problems. In the first two years the Institute recruited more than 75 students through their doctoral studentship schemes. Students are also able to participate in an enrichment scheme which enables those already undertaking PhDs to spend a year or less at the Turing to boost their skills in data science. Meanwhile Turing Research Fellows are independent researchers, employed by one of the Turing's partner universities and based at the Institute. The Research Fellows develop a personal research programme to innovative research in data science and AI, develop internationally significant outcomes, and act as project leaders, playing a prominent role in advancing the research programmes of the Institute and its partners. The Turing Institute also run training sessions for industry, public sector, and third sector participants, in important practical skills and the latest scientific developments in data ethics, machine learning, and AI.

6.1.4   The Institute of Coding

The Institute of Coding (IoC) is a new £40m+ initiative by the UK Government to transform the digital skills profile of England[69]. The university-industry collaboration is a response to the data that shows that the UK has unemployed computing graduates, despite a digital skills shortage across a variety of sectors[70]. This large-scale national consortium, currently comprises 33 universities and over 100 businesses including IBM, Cisco, BT and Microsoft, SMEs, and professional bodies such as the British Computer Society and CREST across England and Wales. The IoC aims to address some of the perceived contradictions between formal education versus industry skills and training, for example: technical skills versus soft skills, industry-readiness versus "deep education". Its work ranges from the development of specialist, in-demand digital skills to the provision of work experience, and ensuring work-readiness of computing graduates, and the provision of digital skills for those from a non-digital background. It is also helping to address under-representation and under-achievement by a variety of groups, notably women, and ethnic minorities.

The Institute of Coding is centred on five core themes:
1. University learners: to boost graduate employability through a new industry standard targeted at degree level qualifications. IoC programmes will incorporate real-world business problems and develops business, technical and interpersonal skills in equal measure.
2. The digital workforce: to develop specialist skills training in areas of strategic importance.
3. Digitalising the professions: to transform professions undergoing digital transformation (e.g. helping learners retrain via new digital training programmes provided through online and face-to-face learning)
4. Widening participation: to boost equality and diversity in technology-related education and careers (e.g. tailored workshops, innovative learning facilities and other outreach activities).
5. Knowledge sharing and sustainability: to share outcomes and good practice and ensuring long-term sustainability of the IoC.

The Institute of Coding has collaborated with the social learning platform, FutureLearn, and Innovation Foundation Nesta, to bring together a consortium of industry partners, educators and technologists to develop the Digital Skills for the Workplace online courses[71]. These courses are designed to help individuals learn new career-focused digital skills through practical and accessible learning resources that address the challenges faced by employers, students and workers across the UK.

6.1.5   Q-Step

Q-Step is a national strategic programme designed to promote a step-change in quantitative social science education and training in the UK[72]. Funded by the Nuffield Foundation, Economic and Social Research Council (ESRC) and Higher Education Funding Council for England (HEFCE), the Q-Step programme launched in 2013 as a systematic response to the shortage of quantitatively-skilled social science graduates.

Seventeen universities across the UK run Q-Step Centres that support the development and delivery of specialist undergraduate programmes. This includes the creation of new courses, work placements, and pathways to postgraduate study with an emphasis on improving and growing undergraduates' high-level quantitative skills. Q-Step Centres deliver new forms of quantitative skills training that provide a deep and secure grasp of the quantitative research methods needed to evaluate evidence and analyse data. New courses include four-year degree programmes providing training equivalent to a combined Bachelors and Masters course. Q-Step Centres also offer a broad range of summer schools, research placements and internships and many are engaged in outreach work with schools to support teachers and encourage student recruitment.

The Exeter Q-Step Centre[73] builds on the core disciplines of Politics and International Relations, Criminology and Sociology. Programmes aim to increase the number of students undertaking quantitative methods training in social science by embedding research skills into substantive degree programmes and modules.

6.1.6   Digital Futures at Work Research Centre

The Digital Futures at Work Research Centre (Dig.IT) aims to advance our understanding of how digital technologies are reshaping work, impacting on employers, employees, job seekers and governments[74]. It is led by both University of Sussex Business School and Leeds University Business School with partners from Aberdeen, Cambridge, Manchester and Monash Universities. It is funded by the Economic and Social Research Council (ESRC). Drawing resources from different academic fields of study, Dig.IT will provide an empirically innovative and international broad body of knowledge that will offer authoritative insights into the impact of digitalisation on the future of work.

Dig.IT will establish a Data Observatory on digital futures at work to promote findings through an interactive website, report on a series of methodological seminars and new experimental methods and deliver extensive outreach activities. It will act as a one-platform library of resources at the forefront of research on digital work and will establish itself as a focal point for decision-makers across the policy spectrum, connecting with industrial strategy, employment and welfare policy. It will also manage an Innovation Fund designed to fund novel research ideas, from across the academic community as they emerge over the life course of the centre.

6.2   Local Initiatives

6.2.1   Exeter's Data Analytics Skills Escalator

Since 2015, successive reviews[75] of the South West's distinctiveness, economic and innovation strengths have concluded that an opportunity exists to drive regional growth by building Exeter as an international centre for environmental intelligence and data analytics.

These conclusions arise both from assessments of the economic opportunities in these growing sectors and from an appreciation of the region's unique ability to exploit these opportunities, due to the presence

of strategically important assets, including the Met Office; a Russell Group University; an 'outstanding' College and one of the nation's two specialist Maths Schools; and world-leading enterprises, such as Oxygen House and Equiniti Data.

People who have the combination of coding skills, statistics, communication skills and business nous are hugely valued and so rare that they have come to be referred to as 'unicorns' by some in the industry. The Data Analytics Skills Escalator addresses the important task of getting young people with mathematics and coding skills out into business, through work experience, placements and internships which will enable them to acquire the much sought after business acumen and employability skills.

The Data analytics skills escalator is based upon 8 principal objectives:

- Raising young people's awareness, interest and attainment in data analytics
- Establishing an Institute of Technology (see section 6.2.2)
- Developing an apprenticeship pathway in Data Analytics
- Establishing a data Science Institute
- Boost employability and graduate retention
- Raising business awareness of the value of data
- Deliver training to data professionals
- Providing high-end analytical talent and support to business

Figure 1 provides an overview of how the University of Exeter is working with its regional partners to provide the digital skills to help deliver local and regional ambitions for productivity-led growth.
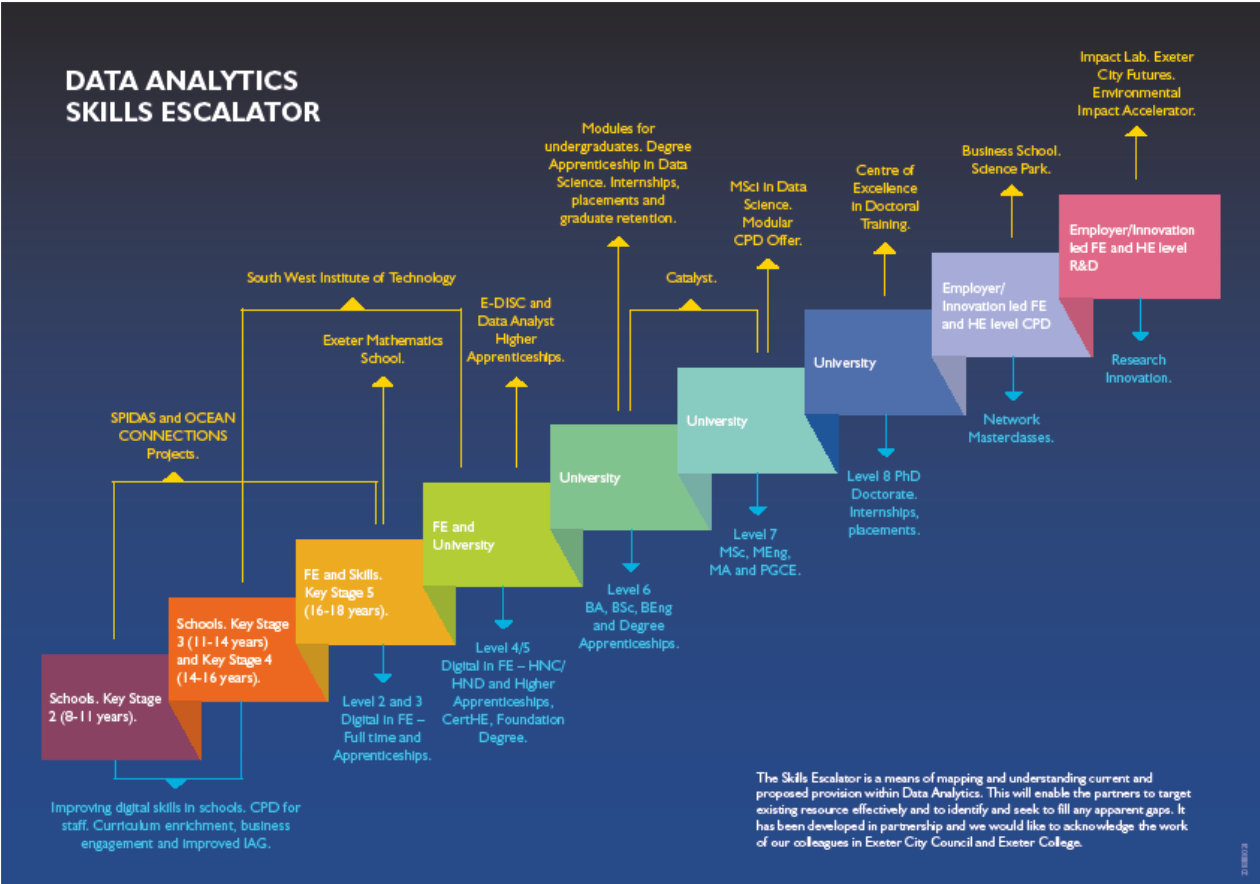
Figure 1. Data Analytics Skills Escalator - overview

6.2.2   South West Institute of Technology (SWIOT)

The South West Institute of Technology (SWIOT) is a unique collaboration between a number of partner organisations, including the University of Exeter, University of Plymouth, Bridgwater & Taunton College, City College Plymouth, Exeter College, Petroc and Truro & Penwith College, each investing in the development of state-of-the-art facilities for training in technical subjects to create Britain's next generation of highly skilled technicians and engineers[76]. The SWIOT also draws on expertise from a group of 'anchor employers' who will lead its strategic direction and ensure focus on the latest industry skills – they include Oxygen House and the Met Office in Exeter, Babcock in Plymouth and TDK Lambda in Ilfracombe, with investment from the Local Enterprise Partnerships (LEPs) for the Heart of the South West and Cornwall and the Isles of Scilly.

SWIOT is one of 12 new Institutes of Technology across the country, funded by the Department for Education (DfE) through a £170 million investment, to deliver a range of higher level courses across the digital, engineering and manufacturing sectors.

Catering for up to 2,500 students in apprenticeship and full-time courses, from post-16 to Master's degree level, the SWIOT's combined facilities will help put the South West region at the forefront of digital and engineering education. They will include virtual and augmented reality environments, digital learning

laboratories, AI arenas, new clean workspaces, workshops, emergent manufacturing spaces with industry level equipment, and shared learning spaces.

Funding for the new Institute of Technology will create a series of new buildings across the region, including a £3.1 million facility on the University of Exeter's Streatham Campus containing an AI Arena, and Computer Learning Laboratory and a new multi-million-pound Digital and Data Centre for Exeter College which will provide courses on data analysis, cyber security and software development for post-16s.

Charles Ewen, Director of Technology at the Met Office, said: "The Met Office relies on the talent of our people in order to deliver world-class technology supporting world-leading science and services. An Institute of Technology in the South West will align the delivery of very high quality technology education and skills from a range of higher and further education providers in the region with significant benefits to learners and employers".

6.2.3   Impact Lab

The Impact Lab is a partnership comprising seven Devon based organisations: the University of Exeter, Exeter City Futures, the Met Office, the University of Plymouth, Plymouth College of Art, Plymouth Marine Laboratory, and Rothamsted Research[77]. The Impact Lab provides a wide range of specialist technical support to businesses in Devon to help them develop new products, services and processes.

The Impact Lab is part-funded by the European Regional Development Fund and has a total funding of £6.4 million, which enables their services to be provided free of charge, although the grants require a match funding contribution from the business. Each company receives a bespoke package of resources for collaborative projects to help them solve a key technical challenge in the development of a new product, service or process. Project work is led by a core team of technical specialists and scientists, with academic specialists from within the seven Impact Lab partners providing specific skills and subject-matter expertise where needed. The Impact Lab also provides access to a network of 'Entrepreneurs in Residence', who provide in depth guidance to businesses as they develop their ideas and start to grow.

7 Good practice identified internationally (lead partner only) (3-5 pages)

8 Recommendations for action

In recent years, the UK Government have set out a number of policies and strategies designed to build digital capacity across all sectors of society. There has also been investment in a number of national collaborative initiatives, all aimed at improving the nation's digital capability and reducing digital exclusion. Despite this, the UK workforce does not have the skills to meet the demands required by business and industry in this age of digitalisation.

Higher Education Institutions need to adapt to better prepare individuals to meet future labour market needs. Greater collaboration with employers, industry and government is needed to help identify and deliver the skills of the future. This includes basic, and specific digital skills, but also the soft skills and competences, and attributes such as resilience, entrepreneurship and creativity which should be embedded into all HE courses, not just in those in ICT. Knowledge fields such as English language, Administration and Management, Sociology and Anthropology and Education and Training are all strongly associated with occupations predicted to see a rise in workforce share, and the education system should better prepare individuals to meet the needs of these markets. The World Economic Forum (WEF)[39] has proposed a series of practical measures to align education and training with the future workplace. These include the development of 'future-ready' curricula which promote linguistic, mathematical and technological literacy, as well as supporting the development of critical thinking, problem solving and creativity skills.

With this in mind, Higher Education Institutions need to boost their activity that is 'place-based', in particular more intimate collaboration with employers and engagement with regional SMEs needs to be encouraged. External partnerships are vital to ensure that digital skills training keeps apace with changing technologies, but also to facilitate internships and work placements, which are seen as the single most important factor for increasing student employability. More investment and support for disadvantaged groups to undertake internships could be part of the solution for tackling the social digital divide.

Meanwhile, mechanisms need be put in place to ensure individuals can engage in continual learning/lifelong learning to remain employable in a market with an accelerating rate of technological change. In the UK, lifelong learning has not received the policy attention and funding that other areas of the education system have benefitted from. Therefore we should consider a funding stream to guarantee access to digital skills via workplace support and consider more flexible, modular in options in Higher Education to facilitate this. We also need to build workplace resilience through, for example, workplace Digital Champions and peer to peer support and learn from the enforced and often serendipitous opportunities that the Covid-19 pandemic has presented us with.

The unique demographic and business make-up of a region needs to be considered and understood so that smart specialization can be deployed to boost regional innovation and give the region a competitive advantage. Initiatives such as the Data Analytical Skills Escalator could be scaled-up in niche areas of economic and social need or replicated in other specialisms such as clinical skills. Universities could also benefit from being more active in their localities, using digital and online platforms and capabilities as an enabler of greater community cohesion, enabling collaboration, sharing and inclusion of skills and other academic and non-academic knowledge.

Policy-makers, regulators and educators will need to play a fundamental role in helping those who are displaced to repurpose their skills or retrain to acquire new skills. We also will need to invest heavily in the development of new agile learners in future workforces by tackling improvements to education and training systems, as well as updating labour policy to match the realities of the 'Fourth Industrial Revolution[86].'

It is difficult to predict which policies will be the most effective in the long term. The OECD recognise, for example that "There is no magic bullet for increasing adults' participation in learning", and instead stress the value of a comprehensive programme of measures, as it may be a combination of reforms rather than any singular reform that is most likely to make the positive impact[78]. This in turn requires the input and action of a number of stakeholders across different fields.

Annex 1

Table 1 Digital Skill Categories

Digital Skill Type	Digital Skill Cluster	Description	Common Occupations
Baseline	Productivity Software	Productivity software skills such as Word and Excel, Enterprise Resource Planning (ERP), Project Management Software, SAP	• Administrative Occupations • Customer Service
Specific	Software & Programming	Programming languages such as Java, SQL, and Python	• Programmers • Software Developers • Database Administrators
	Computer & Networking Support	Set up, support and manage computer systems and networks	• Network Administrators • Software Developers • IT User Support Technicians
	Data Analysis	Data analysis tools like R or Stata, Big Data, Data Science	• Management Consultants • Economists • Statisticians • Business Analysts
	Digital Design	Digital production, graphic design, online advertising Professionals skills	• Marketing Associate • Graphic Designers
	CRM	CRM software, such as Salesforce or Microsoft Dynamics	• Sales Professionals • Marketing Associate Professionals • Customer Services Managers
	Digital Marketing	Digital marketing technologies, such as social media platforms and analytics tools, such as Google Analytics	• Sales & Marketing Professionals • Marketing Associate Professionals • HR Officers
	Machining & Manufacturing Technology	Machining and engineering software and tools such as CNC machining and computer-aided design	• Machine Operators • Civil Engineers • Quality Control Planning Engineers

Table 2 Skill Levels

Skill Level RQF	Levels included	Example qualifications
Low-Skill	Entry level, Level 1, Level 2	Entry level certificate, GCSE, Level 1/2 certificate, intermediate apprenticeship, Functional Skills28
Middle-Skill	Level 3, Level 4, Level 5	A level, Advanced Apprenticeship, Higher National Certificate (HNC), Higher National Diploma (HND)
High-Skill	Level 6, Level 7, Level 8	Degree Apprenticeship, Bachelor's Degree, Master's Degree, Postgraduate Degree, PhD

Source: Nania et al (2019). No Longer Optional: Employer Demand for Digital Skills

9   Expert Interviews

Name of organisation	Type of organisation	Expert's position	Interview date	Mode of interview (telephone, mail, etc.)
JISC	Not for profit which provides digital advice, resources and services to UK further and Higher education sector	Account Manager	30.04.20	Video Call (Zoom)
Local Academy	Offers challenge-led capacity development to anchor institutions across the United Kingdom	Lead for research, development & innovation	01.05.20	Video Call (Zoom)
IBM	Multinational technology company	Global Lead Account Partner	12.05.20	Video Call (WebExe)
Stephens Scown	Solicitors	Director of Strategic Innovation	12.05.20	Video Call (Zoom)
UUK	The representative organisation for the UK's universities.	Policy Manager, leading on Innovation, growth, employability and skills	28.05.20	Video Call (Zoom)
University of Exeter	HEI	Director of the Institute for Data Science and Artificial Intelligence	21.05.20	Video Call (Microsoft Teams)
Cosmic	An ethical IT social enterprise	Joint Chief Executive	01.06.20	Email Correspondence

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