BRISTOL-BATH INNOVATION CLUSTER

SQW

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Contents

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Foreword

The link between high-performing city-regions and knowledge-intensive activity is widely recognised on a global scale. City-regions promote the informal exchanges through which knowledge is generated and shared, and through which innovation frequently takes place. Cities become economic growth-engines by virtue of concentration and connectedness.

At the same time, cities are not simply aggregations of people and assets. They matter as places. They need to be attractive to those that live or study in them, to visitors and, increasingly important, to highly-skilled and highly mobile knowledge-workers. Quality of place is crucial both to economic performance as well as to wider objectives of social cohesion and well-being.

The Bristol-Bath city-region has substantial knowledge-based assets – including major research-intensive businesses, growing numbers of innovative small and medium-sized enterprises and four outstanding cultural assets that set it apart and help to define the wider quality of place. This mix has created a potent blend of innovation and creativity, linked intrinsically to place.

SQW's earlier work, such as The Cambridge Phenomenon and The Oxfordshire Innovation Engine, described the growth of knowledge-based clusters elsewhere. This new report explores how the Bristol-Bath innovation cluster has developed and grown. It considers achievements to date - already notable – and lessons for the future. Challenges remain – not least ensuring truly inclusive growth.

The scale of achievement and the trajectory of development are such, however, that the Bristol-Bath city-region already represents an innovation cluster of potentially global significance and one that could aspire, more ambitiously, to follow in the footsteps of North American power-houses such as Seattle or Boston.

Sir Michael Lyons
Chair
SQW Group

Executive Summary

INTRODUCTION

This report was commissioned by the University of the West of England with support from the University of Bristol, the West of England Local Enterprise Partnership and Oxford Innovation.

It relies on both quantitative and qualitative analysis and enquiry, much of which was completed in 2016 and 2017. This included over 50 one-to-one interviews; a survey of small businesses; and a review of existing evidence and literature.

At the outset, the study was structured by the analytical framework used previously by SQW in relation to studies of high tech clusters in and around Cambridge and across Oxfordshire. The scale of (particularly) Bristol, as a city, and the character of the innovation cluster across Bristol-Bath meant that the evolving urban narrative needed proper consideration too. The concept of creative cities – linked fundamentally to talent, technology and tolerance by an American academic, Richard Florida[1] – provided an important additional lens in this context.

KEY OBSERVATIONS

The Bristol-Bath innovation cluster has developed significantly over the last 25 years and it has key assets that ought to stand it in good stead over future decades. The growth of the cluster and the themes underpinning the area's success may be summarised as follows.

First, the innovation cluster may be understood through overlapping and evolving sectoral narratives. These are focused particularly on: high tech and digital sectors; cultural and creative industries; aerospace and advanced engineering; and financial and business services. Bristol-Bath has been a location for enterprise and innovation in and between these (and other) sectors, and for inward investment (including through relocation out of London, and through the decisions of major multinational companies). The area can point to a maturing ecosystem in which four universities – and many collaborative ventures linked to them – are increasingly central; and the "knowledge content" is strong.

Second, the growth of the innovation cluster is integrally related to the development of a very distinctive labour market which is rooted in "place". The area can point to cultural and creative assets which, for many, are a defining feature of an outstanding quality of life. This in turn has led to the development of a labour market that is characterised by its "thickness" (in the sense of the wide range of skills within it) and "stickiness" (with, for instance, high levels of graduate retention and a deep-rooted and tangible commitment to "the place"). The Bristol-Bath labour market constitutes a substantial knowledge-rich asset in its own right, and this is recognised by investors, both nationally and globally.

Third, the innovation cluster narrative is rooted in people. Networks have developed around outstanding individuals and the cluster has developed in response. Generally speaking, these individuals have spanned different organisations, linking (for example) key cultural assets to the process of enterprise, and/or established corporates to university departments, and/or nascent businesses (including freelancers) both to each other and to wider "anchor institutions". Well-established "anchors" range from the BBC Natural History Unit to Aardman Animations, Hewlett Packard and Oracle, as well as the four universities. Yet there is also a far newer group of "anchors" that – in some respects – are playing a similar role: amongst others, Watershed, Games Hub, Future Space and Engine Shed are formatively important in terms of the cluster's on-going evolution. Across this tangled web, the genealogy of different businesses is difficult to trace, yet the narratives tend to converge on the same individuals and the power of "the network" comes through. The Bristol-Bath innovation cluster has tremendous potential in this context. Yet there are significant tensions and challenges too.

Fourth, the recent growth of the innovation cluster has accompanied a physical transformation across parts of Bristol-Bath. Some of the major sites/locations that underpinned the growth of the innovation cluster

were previously run down and effectively redundant. Particularly in Bristol, they provided relatively low cost cultural and incubation environments close to the universities and/or the city centre, and these have been very important for the innovation cluster's recent growth.

CHALLENGES FOR THE FUTURE

Looking ahead, there are challenges in relation to the ongoing growth of the innovation cluster. Some of these are, effectively, symptoms of success – but they are problems nonetheless.

Over the last few decades, Bristol in particular has had low priced employment space in the city centre and this has been one key factor in the growth of the innovation cluster; but this space has largely disappeared and can no longer be described as "cheap". Similarly, housing is now very expensive and is in danger of pricing out the very individuals on whom the future growth of the innovation cluster depends. Both cities are also badly congested and connectivity between them is deceptively poor.

Other challenges relate to the partiality of the cluster's spatial and social footprint. There are concerns that the growth process has not been especially inclusive – particularly in terms of gender and ethnicity. Equally, there are areas within Bristol and Bath that have not seen the benefits of a high value-added knowledge-based economy (south Bristol in particular).

More generally, the data point to relatively faster growth in low value-added activities – in part as a consequence of the innovation cluster's success – but this means that the area's overall performance on productivity metrics has been unremarkable compared to elsewhere and processes of spatial and social polarisation are concerning. This is raising tensions and dilemmas, and as the West of England Combined Authority becomes more established, some level of response will be important.

PRIORITIES LOOKING AHEAD

The Bristol-Bath innovation cluster has substantial assets which bring with them the potential for sustained innovation, enterprise and investment. They include, for example, plans for a new Institute for Advanced Automotive Propulsion Systems at Bristol and Bath Science Park (led by the University of Bath) and the University of Bristol's proposed Temple Quarter Enterprise Campus in east Bristol.

Investments of this nature should position the innovation cluster for significant future growth, but it will be important that as they are delivered, attention is paid to the wider "cluster project". This is intrinsically related to, and inseparable from, the evolution of "the place". It ought to be reflected in the emerging Local Industrial Strategy.

Eight broad priorities follow:

- **Achieving "scale-up" businesses:** Although the evidence suggests that Bristol-Bath is at the forefront of a new economic model in which a high proportion of people are freelance, work highly flexibly between firms and sectors, and are not picked up by traditional measures of employment or productivity, it is important that more start-up and spin-out businesses from within the innovation cluster grow to medium size and beyond. To achieve more "scale-ups", there is a need for better access to risk capital and suitable employment space.

- **Attracting more investment:** Bristol and Bath have attracted substantial corporate investment in knowledge-based functions (e.g. Oracle is re-engineering its cloud architecture in Bristol; and Toshiba has its European Telecommunications Research Laboratory in the area). There is a need to leverage this more effectively as well as to ensure that other corporate R&D or venturing activity is actively encouraged.

- **Maintaining the flow of affordable incubator and grow-on space:** The growth of the innovation cluster was, in part, a function of the availability of relatively cheap space in and around the Bristol

docks. However, property conversion opportunities in most of Bristol's inner-city areas have now been exhausted, and the relaxation of planning regulations on conversion to residential, combined with increased house prices, make it unlikely that many more opportunities will come forward. Creative solutions will be needed to maintain the flow of affordable incubator and grow-on space.

- **Emphasising place making – particularly in north Bristol:** New development over the next 15 years will take place through intensification of use, and north Bristol (sometimes referred to as the "northern fringe") will feature strongly. Currently, this area is difficult to understand or admire as "a place". For the innovation cluster to thrive, it will need to be developed well, particularly the area around Filton.

- **Building specialist skills:** Bristol-Bath is already well endowed with both generic and specialist skills, but to continue to attract investment by major technology corporates and enable rapid growth by local firms, the supply of specialist skills will need to improve. The extent to which relatively small digital firms are developing their own responses is noteworthy and needs to be supported. In this context, the delegation of the adult education budget to the West of England Combined Authority should give more freedom to tailor adult skills provision to the needs of the innovation cluster.

- **Recognising the imperative for more inclusive networks:** The cluster needs more talented people; but there are areas across both cities that have so far been excluded from this growth process. Steps need to be taken to link these in more effectively. Ventures like Knowle West Media Centre and Bottle Yard Studios are extending the spatial footprint of the innovation cluster into south Bristol. Initiatives of this type need to be encouraged. More generally, greater inclusivity will be achieved when more people – particularly younger ones – can afford to live within Bristol-Bath. A radical approach to housing provision and delivery ought therefore to be seen as a policy initiative to encourage further growth of the innovation cluster.

- **Maintaining and replenishing the collaborative culture:** The area is renowned for its highly networked, collaborative, open, and, at times, "edgy" and alternative culture. This is a real competitive advantage. There is a need to ensure that a new generation of 'nodes' (people and places) develops to supplement (and in some cases replace) the current generation. Cross-sector networking (such as First Friday at Watershed) is particularly valuable because so many new opportunities develop at the interface between different technology and creative areas.

- **Acknowledging that Bristol and Bath are quite different:** Although they are very close, Bristol and Bath are quite different places, with different strengths and opportunities. Strategic planning for the whole area is important because of the scale of growth expected and the constraints on new development and infrastructure, but there are distinct differences between the business cultures of the two places, and this ought to be recognised.

1. Introduction

BACKGROUND

1.1. Within this context, the University of the West of England, with support from the University of Bristol, the West of England Local Enterprise Partnership and Oxford Innovation, commissioned SQW to complete a study with the following purposes:

- to tell the "historical narrative" of the city-region

- to understand better the knowledge-based strengths of the Bristol-Bath area, and to explain why technology-based multinationals are setting up knowledge-based functions locally

- to examine the process of innovation, including through networks and relationships within and between businesses, universities and other organisations

- to consider the nature and extent of "soft" interactions within and between knowledge-based sectors in the Bristol-Bath area; and to consider what this means in terms of how the area functions

- to suggest priority areas for policy, based on the evidence gathered.
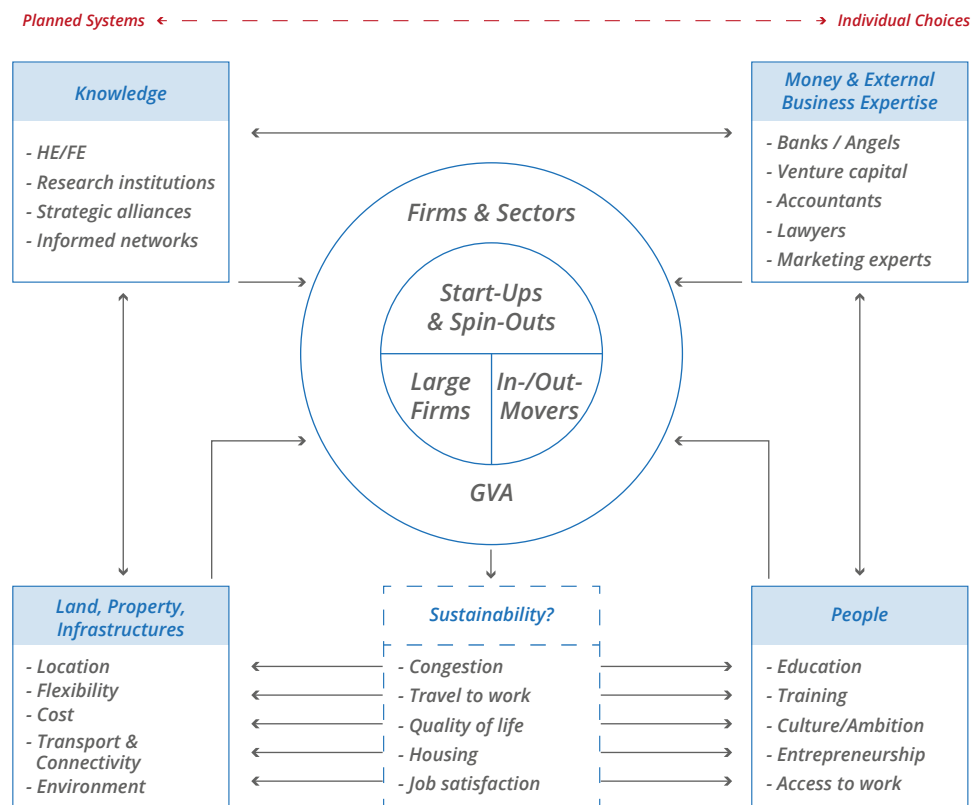
APPROACH AND METHODOLOGY

Analytical framework

1.2. SQW was commissioned to complete this study in part because of the firm's previous work on the growth of high tech clusters in and around Cambridge[2] and across Oxfordshire[3]. From this premise, we sought to use the framework depicted below which was developed originally through our work in the Cambridge area. It shows the main components of a place-based and knowledge-intensive cluster, including different types of firms and the supporting "hard" and "soft" infrastructures which enable those firms to be formed, to survive and to grow. The main chapters of this report are structured to focus on the different elements of Figure 1-1 insofar as they relate to the innovation cluster across Bristol-Bath.

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[2]*See for example "Cambridge Cluster at 50" – Report completed by SQW in 2011 for EEDA*
[3]*Oxfordshire Innovation Engine – Study completed by SQW in 2013 (and updated in 2016) for a group of partners led by the University of Oxford and Science Oxford*

Figure 1-1: Analytical framework to describe high tech clusters

Planned Systems ← — — — — — — — — — — — — — — — — — — → Individual Choices

Knowledge
- HE/FE
- Research institutions
- Strategic alliances
- Informed networks

Money & External Business Expertise
- Banks / Angels
- Venture capital
- Accountants
- Lawyers
- Marketing experts

Firms & Sectors

Start-Ups & Spin-Outs

Large Firms | **In-/Out-Movers**

GVA

Land, Property, Infrastructures
- Location
- Flexibility
- Cost
- Transport & Connectivity
- Environment

Sustainability?
- Congestion
- Travel to work
- Quality of life
- Housing
- Job satisfaction

People
- Education
- Training
- Culture/Ambition
- Entrepreneurship
- Access to work

Source: SQW

1.3. Compared to our previous cluster studies, it is worth reflecting that Bristol is a city which is at least three-times larger than either Cambridge or Oxford with a very different history (noting also that Cambridge and Oxford differ substantially from each other). Unlike Cambridge and Oxford, Bristol's recent growth narrative is bound up with a process of urban transformation that – whilst still underway – has generally been impressive. This urban narrative has been integral to the growth of the innovation cluster. **It is the indivisibility of the two processes which sets Bristol apart.** Whilst Bath is, in some respects, more similar to Cambridge and Oxford, Bristol is really quite different.

1.4. Hence whilst the framework depicted in Figure 1-1 was useful – certainly as a route into a complicated set of interdependent relationships – it was not, in itself, sufficient. The reasons for this are considered in outline in Chapter 2 and they inform the remainder of this document.

Research methods

1.5. The study involved both quantitative and qualitative research and analysis. We reviewed a wide range of existing literature, evidence and data relating to the innovation cluster in Bristol-Bath and spatial and economic policy across the city-region (and more broadly). We completed over 50 one-to-one interviews (mostly face-to-face) with firms and other organisations in the public, private and third sectors. Some of these interviews were developed into more in-depth case studies, which we have summarised in this report to illustrate how the innovation system works in practice, and to demonstrate its outstanding strengths and opportunities. In order to generate insights from smaller firms in particular, we also ran a targeted questionnaire survey which generated 22 responses.

Scope of the study

1.6. It is important to be clear about the scope of this study. This has not been a comprehensive audit of the entire industrial structure and all its component parts[4]. Instead – informed by Figure 1-1 – we have focused primarily on four broadly defined sectors and the inter-relationships between them: **creative and cultural;**

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[4] For a broader account, it is worth referring to the Science and Innovation Audit report which was completed for South West England and South East Wales and was published in 2016

digital and high tech; aerospace and advanced engineering; and **financial and professional services.** In addition, we have considered cross-cutting strengths such as the growth of the green economy.

1.7. Two other dimensions are important:

- the **geographical scope** of this study is the city-region (defined as the four unitary authority areas) but with a focus within this on the two cities (see Figure 1-2)

- in relation to **timeframes**, we have focused on the current situation whilst acknowledging the historical context and considering opportunities and issues which are likely to shape the innovation cluster's future evolution.

Figure 1-2: Map showing the West of England
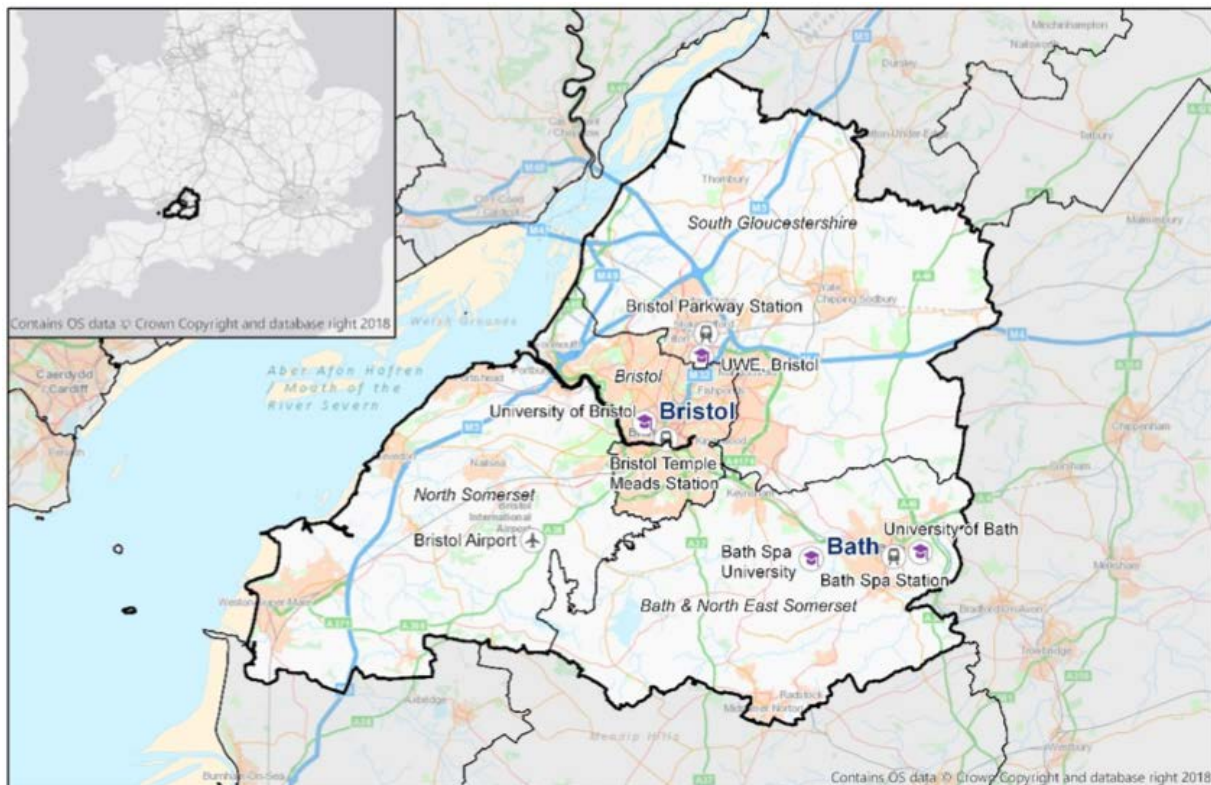
Source: Produced by SQW 2018. Licence 100030994 Contains OS data © Crown copyright [and database right] [2018]

REPORT STRUCTURE

1.8. This report examines how and why the innovation cluster has become one of the most exciting in the UK. It is divided into ten further chapters:

- **Chapter 2** provides an overarching evolutionary narrative, both empirically and conceptually, and it provides a framework for the report as a whole

- **Chapter 3** comments on the scale of the innovation cluster

- **Chapter 4** considers empirical evidence relating to the nature, structure and process of networks and networking across Bristol-Bath

- **Chapter 5** focuses on people, skills and the labour market and it examines more broadly the creation of talent within the local area

- **Chapter 6** reviews the research and innovation strengths of Bristol-Bath

- **Chapter 7** considers softer elements of the innovation cluster and specifically the availability of specialist services and funding

- **Chapter 8** reflects on the spatial and placed-based aspects of the cluster's evolutionary journey

- **Chapter 9** touches on wider infrastructural issues and it sets out the evolving spatial policy context

- **Chapter 10** considers issues relating to governance and institutions, which are particularly important looking ahead

- finally, **Chapter 11** distils key challenges and priorities for the innovation cluster through to the 2020s and beyond.

ACKNOWLEDGEMENTS

2. Evolutionary overview

Chapter Summary

Over recent decades, Bristol and Bath have evolved substantially – both as local economies (with a distinctive sectoral make-up) and as places. The indivisibility of these processes is a key feature of the innovation cluster as a whole. The evolutionary narrative can also be considered at a more granular scale: for example, the growth of the creative and cultural sector needs to be understood in relation to the re-use of the area around Bristol docks, while the evolution of the aerospace sector has shaped the economic geography of north Bristol.

At the micro level, the evolutionary narrative is equally compelling. Illustratively, in both the cultural and creative, and high tech and digital sectors, later businesses trace their roots to earlier ones and the role of key individuals and organisations – both historically and today – is clearly in evidence in driving the cluster's evolution. The networks that have been formed through these processes are enduring and they continue to be central to the functioning of the innovation cluster.

TAKING THE LONG VIEW

2.1.   The city-region has a long history of restructuring in the post-war period – both of its economy and its physical fabric.

The changing sectoral make-up

2.2.   Since the 1940s, major manufacturing sectors (tobacco; paper and packaging; food and drink; machinery; and some parts of the engineering sector) have all but disappeared; and dock-related activities have gone from central Bristol. Over this period, manufacturing and engineering have also disappeared from Bath's riverside.

2.3.   However, Bristol and Bath have not had to restructure their economies as fundamentally as other major cities. New sectors have emerged throughout. The 1960s and 1970s saw major expansion in financial and business services, much of it relocating from London to central Bristol in particular[5]. Key technology companies – notably Hewlett Packard and Inmos – invested locally at about the same time. The relocation of the docks and related activities from central Bristol opened up spaces for regeneration including office and residential, retail, culture and entertainment[6]. There was strong growth in knowledge-intensive business services. In parallel, the city evolved into one of the most creative and networked city economies in the UK with vibrant arts and cultural industries. Today it has a portfolio of dynamic, innovative, home-grown businesses; and increasing inward investment in technology and knowledge-based sectors, including both major companies (such as Oracle and Cray) and fast-growth companies (such as Strava and Just Eat) relocating from London and elsewhere. In parallel, Bath saw the growth of creative and business services; retail; personal services; and leisure activities.

The evolution of two cities

2.4.   In understanding the emergence and growth of the innovation cluster, it is also important to acknowledge the character of Bristol and Bath as places: both are cities in functional and attitudinal terms. Whilst Bristol (with an urban population of around 600,000 people) is much larger than Bath (about 80,000 people), a depth and vibrancy of culture and heritage underpins a strong sense of place in both, and a quality of life that is widely regarded as outstanding. This has attracted talented people and it helps to retain them. Indeed, although different from each other, both Bristol and Bath have many of the attributes of creative cities, defined around what the American academic, Richard Florida, has described as the *"3 Ts of economic development"*[7]:

- **talent** – a highly talented/educated/skilled population, emerging particularly from outstanding universities and a schools system which has improved

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[5]*Much more recently, some of these businesses have relocated to new premises in (or near) the city's Temple Quarter*

[6]*Boddy, M et al 2004 "Competitiveness and cohesion in a prosperous city region: The case of Bristol" in: Boddy, M. and Parkinson, M., eds. (2004) City Matters: Competitiveness, Cohesion and Urban Governance. Bristol: Policy Press, pp. 51-70*

[7]*The Rise of the Creative Class – Revisited, Richard Florida (2012), Basic Books, New York*

- **tolerance** – a diverse community, which is open-minded with a broadly "live and let live" ethos, and is wrapped up in the development of the cultural sector in Bristol especially

- **technology** – the technological infrastructure necessary to fuel an entrepreneurial culture and evidenced through the growth of clusters of technology-based industry which form the central focus for this report.

2.5.   Bristol and Bath also need to be understood in terms of their relationships with elsewhere. Paradoxically, they have the advantages of comparative isolation (from other cities of similar scale[8]) combined with good connectivity, particularly to London and the national motorway network. These locational attributes have been recognised consistently, including at a point in time when the West of England was nowhere near the economic engine it is today. As Peter Hall and others noted in the 1980s: *"…the area stretching west from London to Bristol is a natural transport corridor, and has been recognised as such for centuries. The area is relatively open and flat with very little in the way of major physical obstacles to movement. It was no accident that Brunel chose the area to build his Victorian high-speed train network, and his work has been followed by a great deal of subsequent transport investment[9]"*.

2.6.   This connectivity has been – and continues to be – formatively important. For example, with the designated Enterprise Zone including the area around Bristol Temple Meads station, links are being forged in financial and professional services and these are adding further "layers" to the two creative cities and the innovation cluster.

The "overlapping" narrative

2.7.   These different processes are overlapping, mutually reinforcing and ongoing. The vibrancy and dynamism of the Bristol-Bath innovation cluster needs to be understood *"as a whole"* and in this context. The narrative that follows is both an industrial/sectoral one and an inherently place-based account, played out over decades. It is illustrated in Figure 2-1 below.

Figure 2-1: Creative Cities and the Bristol-Bath Innovation Cluster
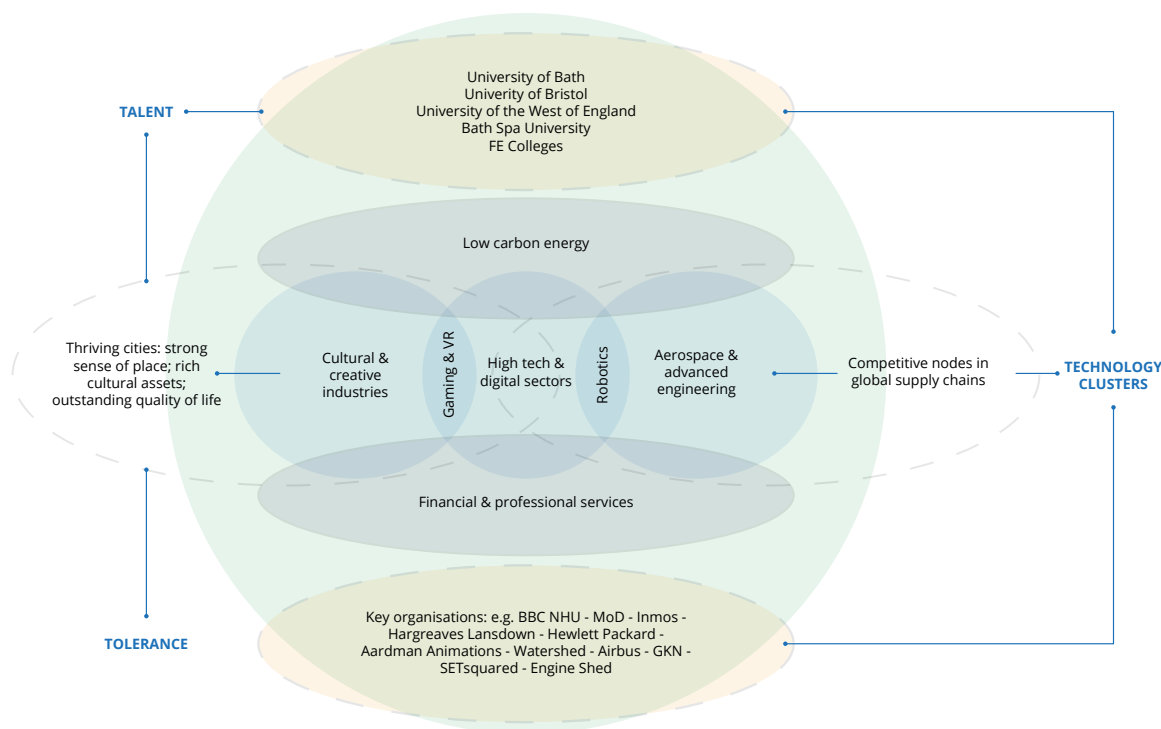
Source: SQW

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[8]For example, Bristol is 120 miles from London and 100 miles from Birmingham: Sheffield, a city of similar size to Bristol, is 40 miles from Manchester and 35 miles from Leeds
[9]Hall, P., Breheny, M., McQuaid, R., and Hart, D. (1987) Western sunrise: the genesis and growth of Britain's major high tech corridor Unwin Hyman

DIGGING DEEPER

2.8.   This broad account can be illustrated in more granular detail through reference to specific sectors highlighted in Figure 2-1 and their own spatial narratives.

2.9.   Concentrated in north Bristol (but also with an extensive supply chain) is a hub of **world class aerospace**. This is now dominated by global corporates, but the UK public sector (through the Ministry of Defence and support for civil aviation) played a formative role. A brief synopsis of its evolution is provided below.

Box 2-1: The development of aerospace in north Bristol

The origins of aerospace in the West of England are generally traced to 1910, the year in which the **Bristol Aeroplane Company** (BAC, formerly British and Colonial Aeroplane Company) was set up with the aim of manufacturing aircraft commercially. Its founder, Sir George White, was the chairman of Bristol Tramway and Carriage Company. The new venture was high risk – but unlike many others at the time, it was driven forward by an experienced business leader, not simply an aviation enthusiast. Two World Wars generated considerable demand for aircraft and the new business grew quickly. In the 1950s, its operations were split and a series of mergers followed. Eventually the aircraft element became a core part of, first, British Aerospace, and then BAE Systems. In parallel, its aero-engines business became part of Bristol Siddeley which in turn was acquired in 1966 by Rolls-Royce.

Throughout, Bristol Aeroplane Company was located at Filton, in north Bristol; over a century later, its direct lineage to BAE Systems, Airbus, Rolls-Royce and GKN – all of which continue to have major operations in the Filton area – is evident. Filton itself is a major location. The Airfield was established as the aviation sector developed, and it became an RAF Base. In the late 1940s, the runway was extended significantly and substantial hangars were constructed, enabling the development and maintenance of a series of aircraft. Its wind tunnel opened in 1957 and has played a role in the design and development of aircraft such as Concorde, the BAC One Eleven and, from 1982, new Airbus models – including the A380, A400M and the A350 XWB.

Today, it is estimated that the West of England accounts for around a third of all aerospace jobs in the UK[10]. Major businesses are operating at scale within the area. These include, inter alia:

- **Airbus:** Airbus has deep roots in the Bristol area although the history of the business is complicated (involving a series of mergers/acquisitions relating to different parts of the UK) and Airbus is fundamentally a European company. Currently over 4,000 people (2,000 of them engineers) are employed by Airbus at its Filton site. Together with Broughton (North Wales), Filton provides the focus for Airbus' commercial aircraft work in the UK (Airbus' defence-related work is located elsewhere, notably at Stevenage and Portsmouth). The Filton site is responsible for wing assembly. Core activities relate, inter alia, to design and engineering linked to Airbus wings, fuel systems and landing gear integration. In addition, Filton is a focus for aerodynamics research, development and test facilities[11]. It is also Airbus's worldwide centre of expertise for fuel systems design and testing. In 2011, it was announced that Airbus planned to build a £70m office facility at its Filton Plant with the aim of "bringing together 2,500 Airbus engineering and design employees in one area"; the new building was opened in 2013[12].

- **BAE Systems:** BAE Systems has a long history in the West of England. It currently has five different sites in Filton and across north Bristol. Although employment locally is lower than it has been historically, it too is a global player with a workforce of over 80,000 people across 40 different countries. It has around 35,000 staff in the UK.

- **Rolls-Royce:** The origins of Rolls-Royce in Bristol may also be traced back to the Bristol Aeroplane Company. Currently, over 3,000 people work for Rolls-Royce in Bristol in activities linked to the aerospace and naval sectors; across the UK, Rolls-Royce employs around 24,500 people and its global workforce is in the order of 50,000. Rolls-Royce businesses based in Bristol include Defence Aerospace, Turbines, Component Services, Marine and Aero Repair and Overhaul. The company has invested over £75 million redeveloping the Bristol site as part of *"a nationwide investment in world-class operations and assembly facilities"*[13]. In 2016, Rolls-Royce opened a new factory at Patchway to produce low-carbon components[14].

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[10]*Expand Bristol and Bath: Innovate, create, collaborate and grow, Invest Bristol and Bath (undated)*
[11]*http://www.airbus.com/company/worldwide-presence/airbus-in-uk/*
[12]*Airbus Bristol Headquarters re-opened after £70m investment for 300 engineers, South West Business – 27th September 2013*
[13]*http://www.fac.org.uk/wp-content/uploads/2012/12/Flyer-v-1.pdf*
[14]*Bristol Economic Briefing, September 2016, Bristol City Council*

- **GKN:** In 2009, GKN acquired the Airbus UK wing component and sub-assembly manufacturing operations in Bristol and along with it, 1,500 skilled employees and a world class manufacturing facility which became **GKN Aerospace**. In 2012, it was announced that GKN Aerospace had commenced production of precision-machined titanium structures for BAE Systems, a principal sub-contractor to Lockheed Martin[15]. Separately, **GKN Aerospace Services Ltd** produces composites components and employs 300 people at Western Approach, Avonmouth.

- **Boeing:** Boeing is the world's largest aerospace company and it directly employs over 2,000 people in the UK. It has two sites in the West of England. It identifies the University of Bristol – with a focus on aerospace, civil and mechanical developments, including unmanned aerial vehicles[16] – as one of six universities with which it works closely in the UK.

Box 2-2: Role of the Ministry of Defence in north Bristol

Another formatively important element of the growth of the aerospace sector relates to patterns of defence expenditure and, specifically, the role of the Ministry of Defence (MoD). The emergence of the *"military-industrial complex"* (which is strongly focused on the M4 (including Bristol) and M3 Corridors) has been linked to the use of substantial mid-20th Century defence budgets (which far outweighed investments in an (at the time) active regional policy).

In the 1980s, Bristol was home to several MoD "contact points" – namely, administrative centres where prospective contractors had to negotiate with MoD[17].

MoD Abbey Wood was formally opened in the mid-1990s. This followed a decision to relocate part or all of 15 different MoD sites to a central hub. Abbey Wood was selected from among 69 candidate locations. Many different factors underpinned this choice. One factor was that the area was *"deemed suitable due to the proximity of British Aerospace, Rolls-Royce and the Universities of Bristol, Bath and West of England (UWE Bristol). Also in Abbey Wood's favour was its location at the end of the 'M4 Corridor of Technological Activity'[18]."*

Subsequently MoD Procurement Executive disarmaments relocated to Abbey Wood. A Freedom of Information request from 2010 suggested 5,600 civilian staff and 1,100 military personnel were based at Abbey Wood[19]. In 2011, it was estimated that some 8,000 people worked there[20]. This number has fluctuated subsequently – but in general terms, a slight decrease in military numbers from 2012 to 2016 was offset by a similar rise in civilian staff (and in 2016/17, outsourcing was reduced in favour of retaining in-house talent). MoD Abbey Wood is a substantial local employer – and a major focus for defence-related procurement decisions which are *"amongst the largest and most complex to deliver in the UK"[21]*.

MoD Abbey Wood considers that it has a symbiotic relationship with the Bristol-Bath innovation cluster. *"It was selected as the home of Defence procurement, ultimately leading to the creation of DE&S [Defence Equipment and Support] in 2007, at least in part because of the area's strong technical skills-base. DE&S enjoys strong links with local higher education institutions as well as letting high-value contracts with Defence industry companies, locally and nationally. Finally, DE&S employs thousands of people from the local area, many in roles directly related to innovation"[22].*

2.10. Although they occupy different "spaces" across Bristol-Bath, parallel accounts have been developed for the **cultural and creative industries** and for the **high tech and digital sectors.** These have been distilled into two evolutionary "maps" which are presented below. Neither of these is comprehensive, but they provide an indication of the process through which the cluster has deepened and developed over time.

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[15]*GKN Aerospace – Filton commences production for F-35 Lightning Press Release, 2nd May 2012*

[16]*http://www.boeing.co.uk/boeing-in-the-uk/research-and-technology/universities-research-and-technology.page*

[17]*Western Sunrise: the genesis and growth of Britain's major high tech corridor Hall, P., Breheny, M., McQuaid, R., and Hart, D., (1987) London: Allen and Unwin – page 135*

[18]*Information set out in a letter from AVM Michael Quigley DE&S to SQW (dated 5th September 2017)*

[19]*Response to a Freedom of Information request on the number of military and civilian personnel, by military rank or grade, employed by Defence Equipment & Support (DE&S) at MOD Abbey Wood, October 2010*

[20]*Straight talking from the top, at MoD Abbey Wood BBC News 12th May 2011*

[21]*Defence Equipment and Support – Annual Report and Accounts, 2015/16*

[22]*Information set out in a letter from AVM Michael Quigley DE&S to SQW (dated 5th September 2017)*

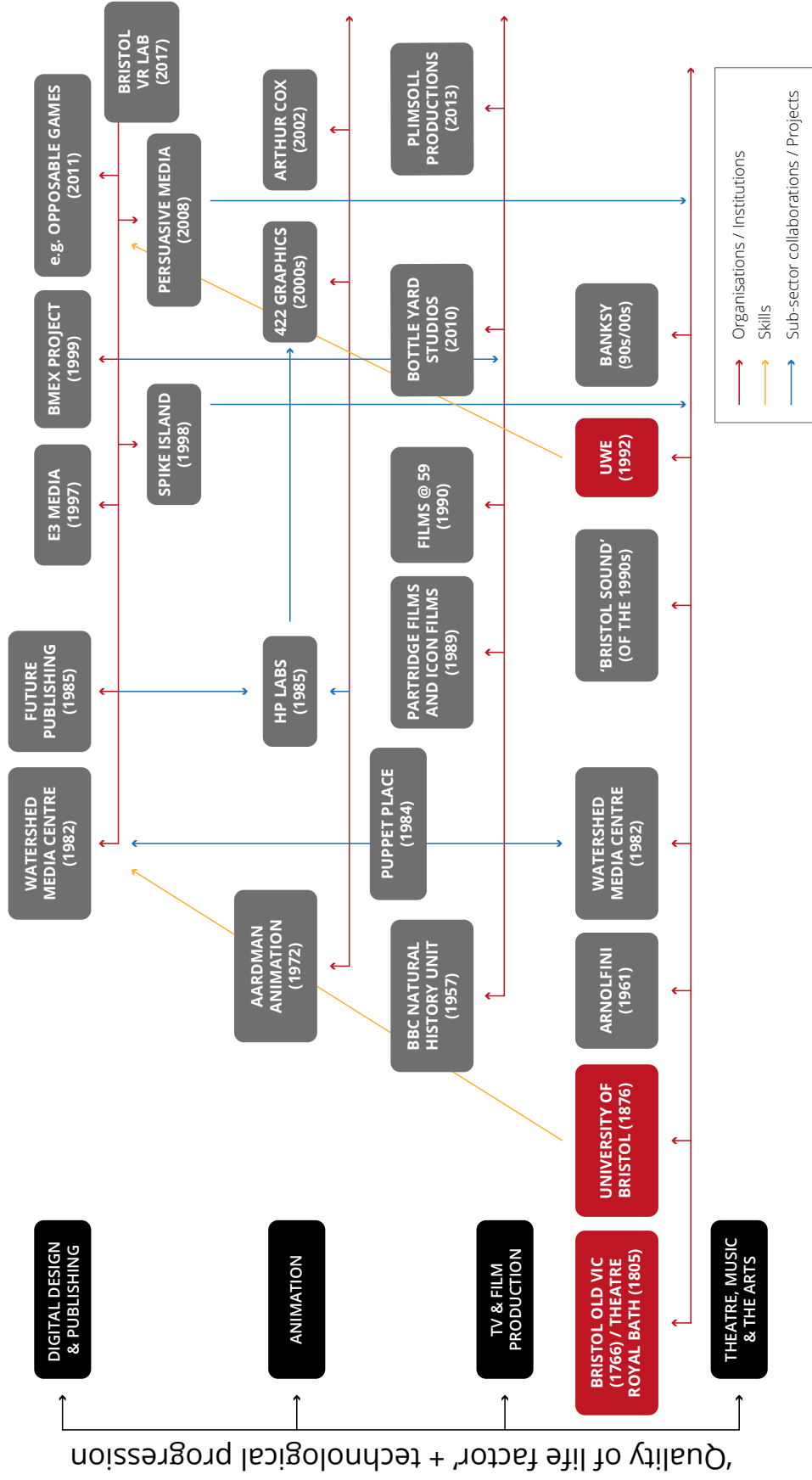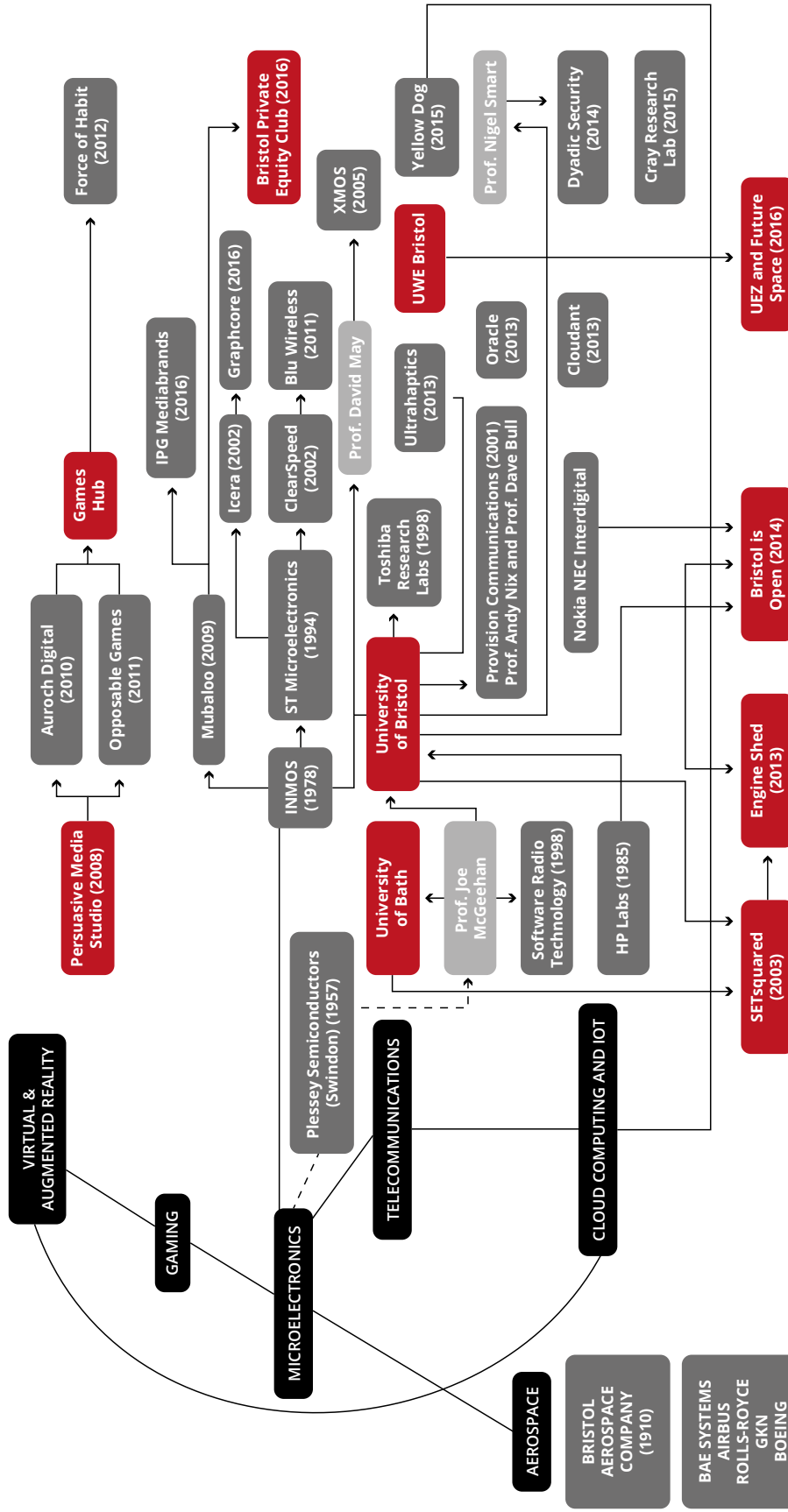**Figure 2-2: Evolution of the cultural and creative industries in Bristol-Bath**

Legend:
- Organisations / Institutions
- Skills
- Sub-sector collaborations / Projects

Digital Design & Publishing:
- WATERSHED MEDIA CENTRE (1982)
- FUTURE PUBLISHING (1985)
- E3 MEDIA (1997)
- BMEX PROJECT (1999)
- e.g. OPPOSABLE GAMES (2011)
- SPIKE ISLAND (1998)
- PERSUASIVE MEDIA (2008)
- BRISTOL VR LAB (2017)

Animation:
- AARDMAN ANIMATION (1972)
- HP LABS (1985)
- 422 GRAPHICS (2000s)
- ARTHUR COX (2002)

TV & Film Production:
- BBC NATURAL HISTORY UNIT (1957)
- PUPPET PLACE (1984)
- PARTRIDGE FILMS AND ICON FILMS (1989)
- FILMS @ 59 (1990)
- BOTTLE YARD STUDIOS (2010)
- PLIMSOLL PRODUCTIONS (2013)

Bristol Old Vic (1766) / Theatre Royal Bath (1805):
- UNIVERSITY OF BRISTOL (1876)
- ARNOLFINI (1961)
- WATERSHED MEDIA CENTRE (1982)
- 'BRISTOL SOUND' (OF THE 1990s)
- UWE (1992)
- BANKSY (90s/00s)

Theatre, Music & The Arts

'Quality of life factor' + technological progression

Figure 2-3: Evolution of the high tech and digital sectors in Bristol-Bath

Source: SQW

2.11. These "maps" are already complicated and further detail could doubtless be added. However, the maps highlight the influence of key individuals – sometimes from the universities, sometimes from elsewhere in the innovation cluster. They also show something of the chain of events that led to the development of the innovation cluster as it exists today: later businesses often have some kind of relationship to earlier ones and/or were supported through organisations like **Watershed** and **Engine Shed**. Equally, whilst much of the innovation cluster is "home grown", major corporates (e.g. **Toshiba, Oracle**) and institutions (e.g. **BBC NHU**) have had a formative influence; their role must be recognised as a central part of the wider cluster narrative. A detailed account of the growth of TV and film – a core part of the creative and cultural industries – is provided in Box 2-3.

Box 2-3: The early growth of TV and film in Bristol

The BBC's roots in Bristol may be traced to wartime relocation out of London. Subsequently – and building on the success of post-war radio programmes produced by Desmond Hawkins (such as *"The Naturalist"*) – the first wildlife TV series, Look, was filmed in Bristol in 1955. Hawkins proposed that a separate unit should be set up within the BBC in Bristol that 'tapped into' the core of wildlife specialists in the area[23]. The BBC Natural History Unit (NHU) was set up in 1957.

By the 1970s, the NHU had a sufficiently strong reputation to produce a major natural history series. Originally sketched by Chris Parsons, the 13-part *Life on Earth* was narrated by David Attenborough and released in 1979. *Life on Earth* marked the start of a period of success and rapid growth for natural history production in the Bristol-Bath area. The NHU became a separate department within the BBC, producing around 200 programmes a year, and employing around 70 people.

The 1990s was another crucial period in the development of the wider TV and film production cluster:

- Key BBC figures such as Peter Symes (Executive Producer with BBC Features) were instrumental in nurturing talent within the BBC in Bristol

- John Downer – a series producer in the NHU – won many awards for ground-breaking filming techniques (e.g. strapping cameras to trained buzzards, filming using a moving camera track around an animal frozen in time, and the famous 'Bouldercam'). He subsequently set up John Downer Productions in Bristol

- From 1989, Peter Salmon was the Head of Television Features at BBC Bristol. Salmon fostered wider relationships for the BBC in Bristol, including with the likes of Aardman Animations.

After the BBC, the second largest TV production presence in the area during 1980s and 1990s was Partridge Films. Founded in London, this moved to Wotton-under-Edge in Gloucestershire in 1989. In 1997, Partridge Films merged with Anglia Survival to form United Wildlife. Together these went on to form Granada Wild, the wildlife production arm of ITV, which was also based in Bristol and became a second significant draw for talent (together with the BBC NHU).

The 1990 Broadcasting Act established a new framework. It required each channel to procure no less than 25% of TV (by time) from independent producers. The consequence was a proliferation of freelancers and smaller production companies which were set-up in Bristol largely by ex-BBC staff. As well as producing programmes of their own, the independent professional TV and film production network around Bristol provided specialist production functions to the NHU and others, including the *Discovery Channel* in the US.

Activity focused on Clifton and the BBC presence on Whiteladies Road. By 2000, the BBC NHU had become the largest wildlife production unit in the world, employing around 300 people, and defining the centre of gravity around which many specialist TV production experts gathered.

Altogether, the cluster amounted to around 1,000 people[24] in the early 2000s. The "sense of community" among those working in natural history TV and film production was strong. Many had – at some stage – worked at the BBC. The same "sense of community" was actively maintained through events such as *Wildscreen* Festival.

Bottle Yard Studios – located in south Bristol and now a major facility for film and television – was established in partnership with Bristol City Council in 2010. Recent productions include Poldark, Wolf Hall, Broadchurch,

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[23]*Bassett, K, Griffiths R, and Smith, I. "Cultural industries, cultural clusters and the city: the example of natural history film-making in Bristol."Geoforum 33.2 (2002): 165-177.*
[24]*Bassett, K, Griffiths R, and Smith, I. "Cultural industries, cultural clusters and the city: the example of natural history film-making in Bristol."Geoforum 33.2 (2002): 165-177.*

Casualty and The Crystal Maze. Bottle Yard Studios includes premises for over 20 companies in digital, technical, audio-visual and other related services. It represents a significant focus of creative and media sector activity. It was also an investment in a part of Bristol which has relatively high levels of socio-economic deprivation.

A recent study has estimated that the commercial film and TV industry currently employs around 3,700 people in the West of England, and that *"Bristol is the third largest film and television cluster in the UK"*[25]. The study identified 131 organisations, working within six film and television sub-clusters in Bristol. Four of these (natural history, animation, factual, post-production) could trace their origins to the BBC or Aardman, while two (corporate and facilities) were thought to reflect *"the increasing size and gravitational pull of Bristol as a regional production centre"*. In practice, the cluster continues to evolve very quickly – and in a digital era, it is characterised by great fluidity.

THE INNOVATION CLUSTER TODAY

2.12.   What these evolutionary journeys *"add up to"* – sectorally and spatially – is the focus for much of the rest of this report. In Box 2-4, below, we provide one summative snap-shot, taken from our questionnaire survey. The number of respondents was not high. However, the findings provide some insight into *"how the cluster works"*. This process is explored in more detail in subsequent chapters.

Box 2-4: Perspectives on the Innovation Cluster from smaller businesses

A questionnaire survey was circulated via four organisations to firms in their networks: Bristol and Bath Science Park; Future Space; SETsquared; and UWE Bristol (specifically to firms participating in the I4G programme)[26].

The firms responding to the survey varied in age and size, with the earliest founded in 1959 and the largest employing 80 people. However, 19 of the 22 had been established since 2000, and most since 2010; 15 employed 10 or fewer staff, and nine employed less than five. All 22 firms expected to grow over the next two years.

Amongst survey respondents, the main areas of expertise were software development, electronics and engineering. These were applied in a wide variety of sectors, including aerospace and defence, medical technologies, security, games development and energy.

The primary reason given for locating in the Bristol-Bath area surrounded the homes of the founders. However, many also commented on the strength of the innovation ecosystem, the availability of advanced skills and the access to key markets (particularly in relation to aerospace and defence).

Most respondents to the questionnaire survey considered that there is a community of creative and tech-based businesses in Bristol-Bath – evidenced through numerous informal meet-ups and events, good opportunities for collaboration with local universities, and many examples of innovative high-tech start-ups in the area. Firms identified various influential people in the local tech scene, most of whom operate at the intersections between different networks and run key organisations or events such as SETsquared, the Engine Shed, Watershed, Bristol Games Hub, TechSPARK and the National Composites Centre.

Firms identified several distinctive characteristics of the innovation ecosystem in the Bristol-Bath area. For example:

- the fact that Bristol is **large enough to have a critical mass** of firms and supporting organisations, and **small enough to make it easy to get to meet ups and other events**, as well as to meet people informally in and around the main 'innovation hubs'

- the ecosystem is **outward looking**: external links with London are very strong, particularly for Bath businesses, and many also have strong international linkages

- there are **strong cross sectoral links and networks**, particularly between the cultural and creative, digital and high-tech sectors

- the large **aerospace and advanced manufacturing firms** in north Bristol are not well connected into local digital/creative networks. There are strong links within the sector and to local universities. External

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[25]*Spicer, A. and Presence, S (2017) Go West! Bristol's Film and Television Industries Project Report. UWE Bristol*
[26]*The 22 respondents included 10 from the Bristol & Bath Science Park, three from Future Space, two from firms linked to SETsquared and seven from firms which participated in I4G*

links to rest of UK and internationally are also strong, but not across sectors in Bristol. This is primarily because the major companies such as Rolls Royce, Airbus and GKN have a national/international perspective, not a Bristol perspective. Their supply chains are organised through a small number of Tier 1 suppliers which could be located anywhere, and in turn source their inputs from anywhere

- business links between **Bristol and Bath are limited**, despite the proximity. The business mixes and cultures of the two cities are distinctly different, although there is significant commuting between the two.

In response to a question about whether there are other locations in the UK that might be better for the firm, a third of firms responding to the questionnaire mentioned London, mainly due to access to markets. Two mentioned Wales because they considered public sector financial support to be more readily available there.

3. Measuring the innovation cluster

Chapter Summary

The overall economic performance of Bristol-Bath has been good over recent decades, but it has not been outstanding. This is particularly noticeable on metrics linked to productivity. The innovation cluster has done well, but – paradoxically – it has tended to generate demand for services which in turn are linked to low wage jobs. This process has been compounded by the more general growth of the two cities. The consequence, however, has been some polarisation in economic, social and spatial terms. This will represent a challenge going forward.

The innovation cluster itself is impossible to define very precisely and it is therefore difficult to measure. Estimates of employment by sector are possible – but these are likely to underestimate its true scale, particularly given the incidence of freelancers and the limitations of standard data-sources. Taken at face value, the data suggest that of late, employment in the sectors linked to the innovation cluster has grown at a slightly slower rate than the Bristol-Bath economy as a whole. However there is evidence to suggest high levels of employment concentration at a local level.

3.1.   The innovation cluster is, by its nature, difficult to pin down. Indeed, the fluidity and porosity of its boundaries are central to its character. This means that it is difficult to quantify in ways that are meaningful (certainly using conventional statistical measures) with the consequence that different attempts at measurement have generated vastly different estimates and conclusions.

3.2.   However it is defined, the innovation cluster needs to be understood within the context of the West of England more broadly. In the paragraphs below, we reflect briefly on the growth of the region before considering key sectors within it; these are relevant to the innovation cluster, but they are not the totality.

THE EVOLUTION OF THE LOCAL ECONOMY...

3.3.   One perspective on the long-term growth of the Bristol-Bath area can be gleaned from a longitudinal study, funded by the Economic and Social Research Council (ESRC). The study relied on Travel to Work Areas (TTWAs) as the spatial unit for analysis. Bristol TTWA (which is smaller than the West of England and excludes Bath) formed a case study[27]. Overall, the authors concluded that over the 30-year period from 1981 to 2011, Bristol TTWA was one of the best performing of the "Core Cities"[28] in terms of employment. However, over a longer time frame (between 1971 and 2014), it saw *"about average"* levels of GVA growth (when compared to 84 other cities in the UK)[29]. Cutting across this narrative were some structural economic changes charting, fundamentally, the growth of a service-based "city economy" and the decline (although not disappearance) of some more traditional sectors (noting that aerospace, in particular, remains strong). The city's economic success reflected the growth of knowledge-intensive business services together with the growth of the creative and digital sectors.

3.4.   The analysis also shows that whilst employment in the defined area grew over the period 1971-2014 compared with the national average, *output* (measured by GVA) has fluctuated and has seen modest growth compared with the national picture. Across the economy as a whole, *output per head* has increased less strongly than the national average over the whole period. The implication is that whilst employment has grown, productivity has declined relatively. This suggests that employment growth has been concentrated in low productivity sectors and low wage jobs (e.g. retail, leisure, entertainment and personal services).

3.5.   This is not inconsistent with the simultaneous growth of a high tech, knowledge-based and creative economy. It does suggest however that **there has been polarisation with the emergence of the**

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[27]Hence although the study is useful, the insight it provides is only partial, for it focuses on a geography that is smaller than the one we are interested in
[28]See https://www.corecities.com/about-us
[29]Sunley, P., "Case Study Report – Bristol" (Draft dated July 2017) – part of the ESRC research programme entitled "Structural Transformation, Adaptability and City Economic Evolutions"
[30]The relationship between the growth of advanced sectors and the growth of non-tradeable jobs was explored across Travel to Work Areas in the UK through a report by the Resolution Foundation. Overall, it estimated that nationally, the 234,000 advanced jobs that were added between 2009 and 2015 created 147,000 non-tradeable jobs (e.g. roles in hotels, restaurants and hair salons). However, the balance between these two processes varied by TTWA. On this analysis, both Bristol TTWA and Bath TTWA were amongst those that saw an increase in "advanced employment" between 2009 and 2015. In Bath TTWA (and unusually), the number of "non tradeable service jobs" fell over the same period. Conversely, in Bristol TTWA, the number of "non tradeable service jobs" rose at a similar rate to the number in "advanced industries". See "A rising tide lifts all boats? Advanced industries and their impact upon living standards", Resolution Foundation Report by Neil Lee and Stephen Clarke, July 2017

"high-end" economy more than outweighed by the growth of low-wage, low-productivity jobs in the service economy. In part at least, the two are linked, with the latter expanding to meet the growing needs and demands of the former[30] (although technological change and globalisation have also played a role). This same phenomenon has been noted in other dynamic growth economies internationally[31].

3.6. In a second study, UWE Business School compared the economic performance of the West of England (and its constituent places and sectors) with the national situation and with other sub-regional areas. It provides a more complete view spatially although over a shorter time frame. It concludes that the area performed relatively well over the 13 years from 1998 to 2011[32]. Over this time, productivity performance was better than: the UK (excluding London) average, the average across seven other "core cities", and the average across five comparable southern local enterprise partnership (LEP) areas. Only the Thames Valley Berkshire LEP area (benefiting from proximity to London and Heathrow Airport) performed better in relation to productivity. Part of the explanation for the West of England's performance surrounded a favourable sector composition (i.e. the area has relatively strong representation in high productivity sectors such as aerospace).

3.7. Taking both studies together, the overall conclusion is that the West of England has performed strongly over (roughly) the last two decades. But this followed a period of weaker relative performance. **So, if we take the "long view" – over about forty years – the overall narrative is one of average growth; but the more recent narrative is more bullish.**

MAJOR SECTORS WITHIN THE INNOVATION CLUSTER

3.8. Within this context, what of the major sectors identified in Figure 2-1? Again, measurement is not easy but one perspective on scale is provided in Table 3-1 below. The metric used here is employment[33] and the main focus is the period 2011-2015 (so the "window" is short).

3.9. It suggests that five priority sectors account for between a quarter and a fifth of total employment across the West of England; that employment in those sectors has grown slightly more slowly than the West of England economy as a whole; and that in the period to 2015, the West of England grew more slowly than the average across England (both in the priority sectors and across the wider economy). Of the five priority sectors, close to half of all employment was in professional and legal services. Two sectors – high technology and professional and legal services – saw an absolute decline in employment between 2011 and 2015; and all but aerospace and advanced engineering grew more slowly in the West of England than nationally[34].

Table 3-1: Employment in the West of England in priority sectors and overall, 2011-15, and 2016

Sector	2011	2015	Total change 2011-15	% change 2011-15	% change England, 2011-15	2016
Aerospace & advanced engineering	24,000	30,000	6,000	25%	6%	28,000
Creative	16,000	17,000	1,000	6%	16%	18,000
High tech	18,000	17,000	-1,000	-6%	5%	20,000
Professional & legal services	58,000	57,000	-1,000	-2%	11%	53,000
Low carbon	6,000	6,000	0	0%	5%	5,000
All priority sectors	122,000	127,000	5,000	4%	10%	124,000
All sectors	548,000	575,000	27,000	5%	7%	588,000

Source: ONS Business Register & Employment Survey. Note that 2011-2015 data are from one dataset (which excludes units registered for PAYE only), and the 2016 data are from a second dataset. There is therefore a discontinuity in the data series – hence showing 2016 data separately

[31]See "Job polarisation and rising inequality in the nation and the New York-Northern New Jersey region", Jason R Abel and Richard Deitz (2012) Current issues in economics and finance, Federal Reserve Bank of New York, 18.7

[32]An econometric study of the West of England LEP priority sectors: Report to the West of England LEP March 2014, Professor Don Webber & Damian Whittard, Bristol Business School, University of the West of England

[33]As defined, this includes employee jobs and some, but not most, self-employment jobs

[34]It is important though to recognise that the level of rounding applied to BRES data by ONS affects calculations relating to growth rates. This is particularly problematic when data are disaggregated sectorally and spatially (as is the case here)

3.10.   In 2016, the relative incidence of employment in the West of England in the priority sectors was either close to, or greater than, the national average (suggesting some level of concentration)[35]. However locally, patterns of employment concentration were notably higher. For instance, employment in creative industries was particularly highly concentrated in Bristol and in Bath and North East Somerset; conversely, advanced engineering and aerospace had a location quotient[36] that was over three-times the national average in South Gloucestershire.

Table 3-2: Employment location quotients in priority sectors, 2016

	Bath & North East Somerset	City of Bristol	North Somerset	South Gloucestershire	West of England
Advanced Engineering and Aerospace	1.3	0.9	1.0	3.1	1.5
Creative Industries	1.3	1.3	0.5	0.5	1.0
High Tech	0.8	1.0	0.9	1.7	1.2
Professional and Legal Services	0.7	1.5	0.6	0.7	1.0
Low Carbon	1.6	0.6	1.2	0.9	0.9

Source: ONS Business Register & Employment Survey; area for comparison is England

3.11.   From other ONS datasources, it is possible to estimate the number of enterprises and local units. Across the priority sectors, these point to rapid recent growth. This is a picture which is seen nationally and in part at least, it reflects changing business structures (and the growth of the gig economy).

CONCLUSION

3.12.   This narrative raises some questions about the performance of the city-region. Overall, the West of England saw continued jobs growth throughout the credit crunch-precipitated recession. Evidence of slower subsequent jobs growth must be understood in this context (i.e. slower growth, but from a higher relative starting point).

3.13.   Beyond that, it highlights the care that needs to be taken in the interpretation of statistics. Data tell only part of the story:

•   for individual sectors, location quotients that are unremarkable at the West of England scale are notably higher at the scale of individual unitary authority areas

•   a low location quotient within the "noise" of a city-region economy does not signal that a given sector is of little consequence: in absolute terms, it may be nationally significant

•   dynamic innovation and growth in particular sub-sectors can be "drowned out" statistically by more broadly-based sectoral trends.

[35]*Note that there have been other attempts at measurement although sometimes on a different spatial footing. An important one in this context has been the work completed by Nesta in relation to creative clusters which was published early in 2018. Note however that this is based on TTWA boundaries rather than the local authority district (unitary) boundaries used here*
[36]*Location quotients are a measure of relative patterns of concentration, in this context, in relation to employment (i.e. how many jobs are observed in the local area compared to how many we would expect to see if the local picture mirrored the national one)*

4. Networks and networking

Chapter Summary

Within the innovation cluster, there are many examples of networks and networking. Within each of the main sectors, specialist networks have emerged. Some of these have been planned but more have grown organically, linked to particular organisations, institutions and people.

From within the innovation cluster, there are many examples of companies growing through networks and being actively nurtured by them. There are also examples of "the network" itself being a source of innovation and competitive advantage.

Patterns and processes of networking do however vary – both by sector and location. Some parts of Bristol and Bath are ensconced within vibrant networks, but there are cold spots too. These in turn tend to be associated with socio-economic disadvantage and they ought to be a cause for concern.

NETWORKS AND ORGANISATIONS DEFINING THE INNOVATION CLUSTER

4.1.   Bristol and Bath are characterised by strong formal and informal networks across and within the innovation cluster. These were referred to frequently in our consultations and background research. A flavour of the evidence is provided in Box 4-1 below.

Box 4-1: Evidence relating to networking within and beyond the Innovation Cluster

Evidence from our consultations

- John Manley, formerly of HP Labs, noted that Bristol is *"small enough and big enough"* for the kinds of collaborations in ICT/aerospace/creative to occur *"comparatively naturally"*. *"London is too big. Exeter is too small."* *"Really it is all driven by key individuals though…"* Bristol is a *"sticky attractor"* because people like living there so much

- Neil Bradshaw, University of Bristol, considered that Bristol networks are strong, including some good cross sector initiatives with key people at nodes of connectivity – e.g. growth in virtual reality coming out of the interface between digital and creative

- Phil Bates of Oracle considered that the developer community in Bristol is closely-knit, and big firms such as Oracle have experienced *"tremendous results from close collaborations with small start-up firms because of their tech expertise"* These collaborations are made possible because of the close-knit nature of the cluster - *"we all have the same meet-ups"*

- Andrew Kelly of Bristol Cultural Development Partnership said that *"Bristol works well together, there is a strong sense of collaboration"*

Evidence from background research

- There are strong international connections, partly through Invest Bristol and Bath but also through many companies which trade internationally: according to work undertaken for the West of England LEP, 59% of the area's companies with an annual revenue of over £1m have overseas subsidiaries[37]- indicative of Bristol's global reach across 80 countries

- Organisations including the BBC Natural History Unit, Airbus and Aardman are major exporters with strong global connections

[37]*Sourced from Bureau Van Dijk, quoted in the analytical study undertaken 2016/17 as input to the review of the West of England Economic Strategy*

- A survey of digital firms in the Bristol-Bath area undertaken for the TechNation 2016 report revealed that *"81% of local business owners stated collaboration as a benefit, while 5,000 people regularly attend tech Meetups in the area, the third most in the UK".* TechNation 2017 reported that TechSPARK, High Tech Bristol and Bath, and Venturefest were all notable meetups

4.2. The strength of local networks has much to do with the way in which the innovation cluster has evolved and diversified over time; the business culture that has developed within the two cities; and the presence of particular individuals who have acted as focal points in building networks and networking organisations. It is also facilitated by the relatively small size of the cities and the spatial concentration of most of the key sectors within the central and inner areas. In short, **the pattern and incidence of networking is strongly grounded in place**[38].

4.3. Historically, *The Society of Merchant Venturers* was of considerable importance – and it continues to have some influence (particularly in the education and charitable sectors). Today, *Business West* is an umbrella body for the Chambers of Commerce; *West of England Initiative* is a membership-based business leadership organisation; and there is a range of other organisations too (e.g. *Institute of Directors*). However, in explaining the character of the innovation cluster, there is a key group of organisations which act as hubs in business and personal networks across Bristol and Bath. Examples include:

- in the **creative and cultural sectors:** *Watershed, Pervasive Media Studio, Arnolfini, Films@59, Bristol Cultural Development Partnership, the BBC (particularly the Natural History Unit), Aardman Animations, Spike Island, Hamilton House, The People's Republic of Stokes Croft, Bottle Yard, Bristol Media, RTS West, Knowle West Media Centre, West of England Design Forum* and *Creative Bath*

- in the **high tech and digital clusters:** *High Tech Bristol and Bath, TechSPARK and BathSpark, Engine Shed, the Games Hub* and various special interest groups (SIGs) such as for cloud computing

- in **aerospace and advanced engineering:** *West of England Aerospace Forum, the National Composites Centre, the Bristol Robotics Laboratory*

- in **professional and financial services:** *Bristolfintech.*

4.4. Across the piece, the private sector is increasingly playing the lead role. Our consultations suggested that some networks that were originally seeded by public sector funding are now largely supported by paying members and private sector organisations (e.g. High Tech Bristol and Bath, Bristol Media), suggesting that the cluster is becoming more self-sufficient. Most of the networks are healthy, growing and well regarded.

4.5. There are also various organisations which are playing a key role in increasing connectivity and inter-relationships across the whole innovation cluster. Within this context, the importance of the four universities has grown as their orientation to the local economy and links with locally-based firms have increased. These processes are considered in detail later, but in brief:

- **University of Bath** has always had a strong industry focus. Latterly, the scale of research funding by industry has increased. The university maintains very strong relationships with many major companies. In general, these are national or international rather than local in orientation.

- At **University of Bristol**, the involvement with industry and the local economy has grown rapidly, particularly over the last decade. It has been stimulated most immediately by the current Vice Chancellor and, previously, by senior staff with strong industry connections (e.g. David May, Professor of Computing, ex-Inmos and founder of XMOS; and Joe McGeehan, Emeritus Professor of Communications Engineering at University of Bristol (see Chapter 6)). With other leading universities, the University of Bristol founded SETsquared and it was also responsible for Engine Shed; these two ventures have been important catalysts for the wider innovation cluster.

- **University of the West of England (UWE Bristol)** has a strong record of collaborative research. As described in detail later, key initiatives include Bristol Robotics Laboratory (BRL), support for innovation and business growth through Knowledge Transfer Partnerships, the EU-funded iNet innovation networks,

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[38] *The significance of incubator facilities and other forms of physical workspace is considered separately in Chapter 8*

grant-funding of business innovation and, more recently, the West of England University Enterprise Zone (including Future Space).

- **Bath Spa University** is a smaller and more specialist institution, with research and collaborative links in the cultural and creative sectors, humanities and education.

4.6.   In relation to networking and collaboration, it is also noteworthy that different universities are increasingly working together. Examples of on-going collaborative initiatives between the four universities in the West of England are considered further in Chapter 6.

Events

4.7.   Alongside the networks, more *ad hoc* events are stimulating local networking and collaboration. During our consultations, the most frequently quoted event was the monthly **First Friday** networking meet-up at **Watershed**. This brings together people from all sectors and organisations on a regular, but informal basis. Examples of other events include Voxxed Days in Bristol, which feature the latest topics in Java and cloud development (the 2016 event was held at the Watershed and attended by 230 developers, and was repeated in 2017); a conference on autonomous control systems organised jointly with UWE Bristol in January 2017; VR World Congress 2017 (held at three Bristol venues); and the 100th anniversary of the Bristol Aeroplane Company in February 2017. Bristol's bids for both EU Capital of Culture in 2008 (in which it came 3rd) and EU Green Capital, which was won in 2015, also helped build networks and collaborations across the city and externally. The Capital of Culture bid led, for example, to the Bristol Festival of Ideas (an initiative of the Bristol Cultural Development Partnership).

People

4.8.   Many of these networks, organisations and events are inextricably linked with specific individuals. Those that were identified frequently in discussion included, *inter alia*, **Dick Penny (Watershed); Nick Sturge (SETsquared, The Engine Shed); Ben Trewhella (The Games Hub); Ben Shorrock (TechSPARK);** and **Paul Appleby (LEP's Creative and Digital Sector Group).** The centrality of a few individuals is both a strength and a potential problem. Several of those interviewed suggested that it may undermine the effectiveness of existing networks unless others step forward (including those at an earlier stage in their careers), so that contextual knowledge is both maintained and shared. Latterly, a new generation of potential sector leaders has started to emerge through fast growth businesses and active meet-ups across both Bristol and Bath. New organisational nodes are also emerging including, for example, Bristol VR Lab, Bottle Yard Studios and Future Space. This suggests resilience is growing and also that the process of innovation is evolving.

THE POWER OF "THE NETWORK"

...as incubator

4.9.   Within the innovation cluster, there are many examples of new firms emerging from within "the network". In many cases, entrepreneurs have engaged with many different elements of this. In the process, they have helped to strengthen it.

4.10.   One example is **Reach Robotics**. Its growth narrative – summarised below – illustrates how different organisations (in this case including *SETsquared, the Games Hub, Pervasive Media Studio, Bristol Robotics Laboratory* and *UWE Bristol/Future Space*) combined to support the formation and growth of an innovative local firm. This example also highlights how important "the network" can be to entrepreneurs.

Box 4-2: Case Study – Reach Robotics and its co-founder, Silas Adekunle[39]

In his first year as an undergraduate studying robotics at UWE Bristol, Silas Adekunle saw the opportunity to take robotics into schools in and around Bristol. He secured some funding for this programme from UWE Bristol, The Prince's Trust and Hewlett Packard, and he recruited other undergraduates to support its delivery. Initially, the students enjoyed building robots, but this didn't capture their attention for long. So, Silas started to integrate gameplay mechanics into his lessons. He discovered that by gamifying robotics, his students were far more interested and engaged.

As Silas's undergraduate studies drew to a close, he sought to set up his own company with the aim of revolutionising robotics, gaming and entertainment.

Silas received both support and encouragement from his Head of Module at the Bristol Robotics Laboratory, and the suggestion was made that he should join SETsquared. Through SETsquared, he attended various events and was introduced to John Rees, an engineer who then worked for Airbus in north Bristol and was interested in the possibility of entrepreneurship. He was joined by Chris Beck from Bristol Robotics Laboratory – in the role of Chief Technology Officer – and Reach Robotics was born. This all happened in 2013.

Silas made significant efforts to attend a wide range of networking events, mostly around Bristol. As part of this, he attended a South West Founders event. There he met Ben Trewhella (from the Games Hub) who suggested that Silas ought to be talking to two different people at Pervasive Media Studio.

Through Pervasive Media Studio, Reach Robotics developed quickly, aided by accessing various grants. The first of these was very small (£500) but it allowed Silas and his colleagues to start to formalise their ideas. Quite quickly they secured funding for a £30k project and then for a £50k piece of work. Both were supported through the REACT Programme (a collaboration between UWE Bristol, Watershed, and the Universities of Bath, Bristol, Cardiff and Exeter, which was one of four Knowledge Exchange Hubs for the Creative Economy funded by the Arts and Humanities Research Council (AHRC)).

Each successive award allowed for the further testing, development and "smartening" of the prototype which had multi-functional, connected battlebots with augmented reality capabilities. Reach Robotics was eventually able to take it to various events in London. In London, Silas and colleagues met members of the Techstars Incubator and from that contact, they entered a competition which eventually resulted in Reach Robotics joining Qualcomm Robotics Accelerator in San Diego, USA.

The business moved to North America for six months and the Accelerator programme supported the Reach Robotics team in the further development of its Mecha Monsters robot gaming system. This phase in its development allowed for connections to be made, and for awareness of the firm to grow substantially. Reach Robotics was also able to raise significant venture capital funding (some from as far afield as Singapore). Once the Accelerator programme was complete, the business returned to the UK and, specifically, to Bristol.

In summer 2016, it moved from the Bristol Robotics Laboratory's incubator space to Future Space (next door) where it occupied a dedicated unit. Reach Robotics' product – MekaMon – was available for sale in Apple stores by late 2017. By the end of that year, Reach Robotics had outgrown Future Space. It moved to commercial space nearby. In 2018, Silas was recognised by Forbes Media in its list of "30 under 30" entrepreneurs from across Europe.

How important was the ecosystem in and around Bristol in explaining the formation and growth of Reach Robotics? Silas considers it to have been critical – particularly in relation to the networks of informal referrals and advice. He considers the ecosystem to be strongly developed on the technology front but perhaps less effective in relation to finance. When Reach Robotics needed significant capital, it looked to London, North America and beyond; it raised $7.5m in the company's first funding round to enable a step-change in growth and development. However, it is strongly embedded in Bristol (most staff have been recruited locally, and many have links with UWE Bristol). The intention is that it should continue to grow within the city.

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[39]Note that this case study was completed in spring 2017. Subsequently, the company has secured new funding and achieved further growth

4.11. A second example is **Mubaloo**. Its founders came from different parts of the innovation cluster and they brought with them different skills sets and networks. They combined these very effectively through the firm's formation and growth. Although the company was sold in 2016, Mubaloo's growth narrative is embedded within formal and informal networks that exist across (in this case) Bristol. The founders' narratives – both before and after Mubaloo – are important across the wider innovation cluster, with formative links to *Opposable Games* and *Bristol Games Hub*, and with connections also to *Pervasive Media Studio, UWE Bristol, and University of Bristol.*

Box 4-3: Case Study – Mubaloo, its founders (Mark Mason and Ben Trewhella) and wider cluster dynamics

Mubaloo was established in 2009 by Mark Mason and Ben Trewhella. It was a marketing driven, tech-based business developing innovative mobile strategies and intelligent mobile apps for major firms in various sectors. It undertakes project management, design, integration, development and testing of mobile apps which help to strengthen and improve the efficiency of supply chains and other business processes, staff productivity and customer engagement.

In 2016, Mubaloo was sold to IPG Mediabrands, a US-based, global brand development and marketing company. This gave Mubaloo a more secure basis for further growth and access to many more corporate customers and larger scale projects. As a result, Mubaloo is likely to diversify into B2C as well as B2B apps development. The motivation for the acquisition for IPG Mediabrands was to build mobile capability, which has become an essential part of its offer. It can now pitch to clients with a strategy which incorporates mobile and with people from Mubaloo involved.

The founders of Mubaloo

Mark Mason

Mark graduated with a degree in electronic engineering from City University and joined **Inmos** in 1985 as a graduate marketing engineer, where he worked for five years. Inmos provided a very entrepreneurial environment: it was a well-funded, exciting new venture with big ambitions and a lot of young people were recruited and given lots of responsibility. In his role at Inmos, Mark travelled extensively and made many contacts within and outside the organisation.

In 1990, Mark left Inmos to set up a subsidiary business in Bristol for Anderson & Lembke, a London B2B advertising agency specialising in tech company clients. After five more years, he left Anderson & Lembke to set up **Mason Zimbler** with Simon Zimbler (a colleague and friend from Inmos) in a similar market segment. Mark grew Mason Zimbler for 11 years before selling the business in 2007 to Harte Hanks, a large US marketing Group.

After leaving Mason Zimbler in 2008, Mark established Mubaloo in 2009 after a short break and grew it to 60 employees before selling in 2016.

Mark has continued as part time Chairman of Mubaloo under the new ownership structure, but is also now involved in other ventures, including:

- **ForestBrown:** an R&D tax credit consultancy

- **Bristol Private Equity Club:** This was set up with five others to make investments in the £100k to £500k range. The Club has around 50 high net worth individuals as members, operates an EIS scheme, and takes a cut on all investments. The Club has recently invested in Yellow Dog

- a fund for young entrepreneurs who want to set up a marketing agency.

Mark is also a Governor of UWE Bristol. He sees his role as helping to make courses and graduates more business-oriented, and has helped with the setting up of the new business school. Firms need a combination of skills, including computer scientists, graphic designers and project managers. App developers are in great demand, and there are some big growth areas in the market such as security.

Ben Trewhella

Ben Trewhella first came to Bristol as an undergraduate and he studied Computer Science at the University of Bristol. Immediately after graduating he worked for a major financial services company (in Bristol) developing software and working in IT consultancy. He then worked for Macquarie Bank and the Startlight Children's Foundation in Sydney, in the latter securing $7m funding and creating a social network for isolated and chronically ill children (including an organisation of psychologists and technologists to support it).

On his return to the UK, he began developing mobile applications, recognising that the iPhone and Android phones were going to change how consumers and businesses operated. He then met Mark Mason who was prepared to invest in the new business and this became Mubaloo. The business grew quickly.

Ben left Mubaloo to embark on a PhD in Artificial Intelligence, specialising in neural networks which now power most of the fastest advancing areas of the field. During this time, he set up a video games company called **Opposable Games**.

Opposable Games began to grow as the company developed its own games and for a variety of brands, broadcasters and emerging social media operators, as well as developing games that provided structured mental health therapies with University researchers. During its growth, the company took offices at Paintworks, UWE Ventures and the Pervasive Media Studio, where Ben began to believe in the benefits of start-ups and SMEs working collaboratively in shared spaces.

In 2013, Ben worked with Tomas and Debbie Rawlings (of Bristol-based games developer, Auroch Digital) to open the **Bristol Games Hub**, which now – four years later – houses over 50 games developers and designers and has been an anchor point in Bristol's reputation as a hot house of independent games studios.

When Oculus launched the Rift VR headset, Ben set up a sister company, **Opposable VR**, under the **Opposable Group**. This grew rapidly, developing VR experiences, applications and games for companies like IBM, Vodafone, AT&T, ENGIE and the Cartoon Network. Opposable Group also started a series of meetups called South West VR, which grew to become the industry leading global conference (VR World Congress).

Ben has played a key role in establishing the **Bristol VR Lab**, a joint venture with Watershed, UWE Bristol and the University of Bristol which secured development funding from West of England LEP. The Bristol VR Lab provides residents and members with access to VR, AR and MR equipment and experience, and is developing partnerships with technology firms, researchers and government agencies to develop the next generation of immersive technology.

...as "innovator"

4.12.   As well as effectively generating and growing new businesses, "the network" has demonstrably been a source of innovation in its own right as different groups of existing organisations have worked together. The links have been cross-sectoral in various senses – between sectors of industry, and between organisations of different types.

4.13.   For example, over the last thirty years, **Hewlett Packard** has had a substantial formative influence on the cluster, most immediately in moulding the specialist labour market (considered in Chapter 5). But it can point to examples of working with *Watershed, BBC, Aardman, 422 South and Films at 59* in developing an application for a new era of computing. The outcome was "The Painter", a five-minute animated film that was completely rendered using a CGI-rendering service running in HP Labs. This was shown to Dreamworks in California and quickly led to a significant workstream. This is a genuine example of different parts of the innovation cluster coming together to effect real innovation.

4.14.   There are examples of other, quite different forms of innovation emerging from equally different collaborations within the cluster. For example, *'Bristol is Open'* was established as a joint venture project between Bristol City Council and University of Bristol with the aim of building an open programmable

city. The project created its own high bandwidth fibre network around the city, created open wireless, and installed data sensors to provide real time, open information on issues like congestion, waste management, entertainment events, e-democracy, and energy supply. Although the pace of development has been uneven, it was considered by one consultee to be *"a very useful beacon"*.

DIMENSIONS OF NETWORKING

...by sector

4.15. In practice, the strength and depth of networks and networking across the Bristol-Bath innovation cluster needs to be understood across several dimensions. Most immediately, it varies by sector.

4.16. It is strongly in evidence in the **creative and cultural**, and **digital and high-tech** sectors – as the case studies above illustrate amply. More generally, the fluidity of the workforce in the cultural, creative and digital sectors also makes for strong firm-to-firm, and firm-to-HEI/institution relationships. Across many of these areas – ranging from theatre, music and arts to animation, digital design and publishing – much of the activity, business or otherwise, is undertaken by small groups of people with different skills working flexibly in different teams, often on a freelance (or sometimes voluntary) basis. In many instances, these skills could be applied across multiple sectors making for strong relationships between them as people move around. Individuals move between employers (including organisations such as Inmos and HP which have since reduced in size or disappeared); but they generate networks and contacts which are sustained throughout their careers.

4.17. Such forms of networking are less apparent in **aerospace and (related) advanced engineering**. This sector is defined around multinational companies operating within global supply chains (see Box 2-1). Although there is a strong concentration of activity in north Bristol – and within it, some movement of people from one employer to the next – the depth of networking has been relatively limited as firms' operations are vertically integrated and supply chains are international in scope. This does not mean that aerospace and advanced engineering is not committed to (particularly) north Bristol; however, the nature (and perhaps depth) of that commitment is different from that of (say) the creative and cultural sectors vis-à-vis the city centre. The latter is ensconced in networks and relationships and has a strongly social dimension; conversely, the former is concerned much more with accessing a specialist labour market (in more narrowly instrumentalist terms) and with formal supply chain links. These patterns are largely sector specific – although we might speculate that despite the long history of aerospace and advanced engineering in north Bristol, its attachment to place is more tenuous and less embedded than in the creative and cultural sphere (presenting obvious risks, not least in the context of Brexit). Whilst one is "in" the place; the second, perhaps, is more fundamentally a product "of" it.

4.18. In some respects, **financial and professional services** collectively occupy an intermediate position. Bristol and Bath are both well established as centres for professional and financial services. This reflects, fundamentally, their attributes as long-established cities serving extensive and overlapping catchments, and their complex relationship to each other. In the 1970s and 1980s, growth was driven by central government measures to decentralise economic activity from London and the South East – coupled with lifestyle attractions, comparatively low property prices, and relative proximity. The character and make-up of these sectors is evolving quickly, resulting from technological change, service innovation, wider organisational/corporate changes, local policy priorities (relating particularly to land use) and a changing relationship with London.

4.19. Bristol-Bath is home to some large-scale operations linked to global corporates. **Aviva**, located in north Bristol, is one example. Bristol (Stoke Gifford) is one of the firm's five "core locations" in the UK[40], and it is a major local employer. Within it is a "digital space" which is aiming to provide a catalyst for digital innovation[41]. However, the area's most successful home-grown financial services business to date is **Hargreaves Lansdown**, which is profiled in Box 4-4 below. What is both interesting and important in this context is its links to the innovation cluster more broadly. Although now a FTSE 100 business in financial services, Hargreaves Lansdown could equally be regarded as an IT business – and one that depends on the *"thickness"* and *"stickiness"* of the labour market in Bristol-Bath in ways that are (in some respects at least) similar to companies like Oracle (see Box 5-3). A key point in this context is the extent to which different elements of the innovation cluster are, in practice, converging.

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[40] *Aviva location strategy update – press release from Aviva, 15th June 2015*
[41] *Digital First – press release from Aviva, 27th October 2017*

Box 4-4: Case Study – Hargreaves Lansdown

Through Hargreaves Lansdown, the West of England has grown a FTSE 100 business in financial services from what was a start-up business in 1981. Its origins lay in coupon return, but the point at which the company grew quickly was when the mass market of small investors was created. Previously, investing in the stock market had been the preserve of a wealthy elite, generally involving the use of stock brokers. However, with the emergence of self-invested personal pensions (SIPPs) and individual savings accounts (ISAs), the investment industry was transformed.

Hargreaves Lansdown was genuinely in the vanguard. Its investment platform was set up in 2000 and it has grown to become the UK's leading investment supermarket; it has invested £70.0 billion by 876,000 clients. Within Bristol, it currently employs around 1,000 people.

Although now part of the financial establishment, Hargreaves Lansdown has certainly been an industry disruptor over the last three decades: it has transformed the "industry of investment" and its impacts need to be recognised in these terms. Although in sectoral terms it sits firmly within "financial services", Hargreaves Lansdown could also be regarded as an IT business and specialist software developer. It has a large and rapidly-growing team of IT professionals, particularly software engineers, and recruitment is important. In many respects, this is a national issue and it is not specific to the West of England, but it does demonstrate the extent to which different elements of the innovation cluster are converging, certainly in labour market terms

...by place

4.20.   The strength, effectiveness and character of networking also varies spatially. The evidence suggests that relationships which are essentially social ones have distinct spatial forms and footprints. This bites at various scales.

Between Bristol and Bath

4.21.   In general terms, our research pointed to the distinctive identities and ambitions of the two cities and the organisations within them, and it highlighted local rivalries. The vantage point from which Bristol and Bath appear closest is arguably that of the 12-minute journey on the London-bound train while road-based travel takes a good deal longer (and must confront significant congestion). The inference is that the two cities appear closer *"from the outside"* (and *"to the outsider"*) than they do *"from within"*. This should not be over-stated – there is evidence of commuting flows between the two cities and the complementarities between them should also be acknowledged. But – as the case study below illustrates – city-level "identity" is both strong and important. Beyond that, the fact that two different Travel to Work Areas are identified through official statistics emphasises the "distinctiveness" of the two places.

Box 4-5: Case Study – Deep Blue Sky

In relation to digital technologies, Jim Morrison is essentially self-taught: he studied physics as an undergraduate but "didn't really get on with studying" and instead discovered that he "liked computers". He returned to his home town, Bath, and built websites for ten years, working with one other person. He enjoyed the work but came to the view that taking it further would require more capacity and a more varied set of skills. His company, Deep Blue Sky, was formed in Bath in 2008.

Although the origins of the firm were in website design, Deep Blue Sky has evolved and its main focus now is on building systems for companies which can lead to automation and streamlining, and to the rapid scaling of client businesses. Much of Deep Blue Sky's own business has been won through referrals. It has worked in sectors ranging from fintech to pharmaceuticals. Deep Blue Sky has some local clients – in both Bristol and Bath – but it also works elsewhere in the UK (including London) and internationally (USA, France). Currently the business employs 15 people in Bath and it also has a small network of freelancers (although in general, it prefers to employ people directly as its team is close-knit). Looking ahead, Deep Blue Sky's aim is to grow the headcount to around 20 in the core business; but also to develop software products as a spin-off.

In developing Deep Blue Sky, the biggest challenge has been recruitment. Deep Blue Sky itself has gone to some lengths to provide a very pleasant working environment in order to attract and retain talented people; and if staff leave, it is generally to do something very different (usually to go travelling). It has taken the view that a degree in computer science is not essential (in part because of the speed with which the technology is developing); a knowledge of applied mathematics is useful, but much more important is the attitude and energy of staff, and recruits have many different backgrounds. Most staff are in their 20s and 30s.

Jim's view is that Bath is "getting much better" in relation to the labour market for (broadly defined) digital skills. Although the lack of commercial premises in Bath is a problem, there is now a lot going on in the city, with specialisms ranging from robotics to artificial intelligence. In part, this is explained by an influx of "people wanting to get out of London" who recognise that there is a "good tech scene in Silicon Gorge" defined (in both Bath and Bristol) around, for example, the BBC, TechSPARK, TEDEx events and the Bath Digital Festival.

The relationship between Bristol and Bath is important but complex. In Jim's view, Bath is "like a little brother". Deep Blue Sky has been apprehensive about recruiting people who live in Bristol because of the practical challenges of commuting. Bristol has attracted both people and businesses, however, and "the energy and heat of Bristol have brought benefits to Bath". The two Bristol universities – both UWE Bristol and the University of Bristol – have been very active in this context and both have been very visible; in Jim's view, the role of the universities in Bath has been more limited.

Within Bristol and Bath

4.22. During our consultations, the point was made that connectivity and networking *within* the two cities – particularly Bristol as the larger place – itself has very strong spatial dimensions:

- **North Bristol** is separate from the city centre in relation to the functioning of the innovation cluster. Both are important places, but the flows between them – of people, knowledge, money and ideas – continue to be quite limited. Ventures like Future Space (see Box 8-3) and Bristol and Bath Science Park are helping, but as it stands, the sense of "separateness" remains.

- In **east Bristol**, Paintworks has emerged as a self-styled creative quarter – with studios, offices, live-work space and apartments in a combination of converted industrial space and new build. It represents a radical change of use, being located in an area of traditional industrial uses. Paintworks is within the **Temple Quarter Enterprise Zone** and close to developments around Temple Meads Station. This area is an increasing focus for financial and professional services. It will also be the location of the planned University of Bristol Temple Quarter Enterprise Campus.

- The innovation cluster as a whole has "cold spots" within Bristol, of which the most challenging is the **southern** part of the city. There are exceptions (e.g. Knowle West Media Centre and Bottle Yard Studios), but in general, this area has long been the least well connected.

The inclusivity of networks and networking

4.23. Whether the perspective is sectoral or spatial, one of the current weaknesses of the innovation cluster relates to levels of inclusivity. There are significant areas of Bristol (especially in the south of the city) and, to an extent, Bath, which experience high levels of socio-economic deprivation and exclusion. Here, there is little connection to the dynamic networks described above.

4.24. Equally – from a sectoral perspective – there is an evident lack of diversity within the principal networks (particularly in terms of ethnicity and gender). Reporting the findings from their own survey of freelancers in Bristol's film and TV industries, Spicer and Presence noted the following: *"The overwhelming majority of freelancers identified as White; the proportion of Black and Minority Ethnic (BME) freelancers was only 2.6%. This compares to 3.6% of the working population in the South West and 5.4% of workers in the creative industries in the UK as a whole. 25% of freelance respondents had attended a fee-paying school. This is significantly higher than the 14% in the creative industries nationally and more than three times the proportion of the UK population as a whole (7%). Diversity in the creative industries has been subject to much scrutiny elsewhere. Though we were unable to investigate this complex issue in any depth, it should be noted that social*

characteristics such as race and class often intersect and that the barriers to entry for marginalised social groups are interwoven and embedded within the short-term, project-based, freelance-dependent structures of film and television production"[42] .

4.25.   Although there are some exceptions, these social and spatial characteristics raise questions as to the extent to which Bristol and Bath can – genuinely – claim to be a truly *"tolerant"* places, in the terms used to define creative cities elsewhere (see paragraph 2.4). In this context, there will be a need to refresh the pool of networks and "networkers".

CONCLUSION

4.26.   In many respects, the strength of networks and networking – and the formal and informal collaborations arising from both – is the defining feature of a genuine cluster.

4.27.   Well over a century ago, the economist Alfred Marshall observed that once the process of local specialised industrial concentration has begun, it becomes both cumulative and socialised such that *"the mysteries of the trade become no mysteries; but are as it were in the air"*[43]. Marshall attached great importance to shared rules and conventions which are social and cultural in character – and largely or generally based on tacit knowledge and trust. Over a century later, these continue to be rehearsed in the academic literature through concepts such as *"untraded interdependencies"*, *"institutional thickness"* and the powerful – albeit double-edged – *"ties that bind"*. Within a productive and competitive context, these social and cultural dimensions are the lifeblood of clusters – and despite the possibilities of digital connectivity, these are intrinsically related to place. As an American economist observed, ideas cross corridors and streets more easily than continents and seas[44]. Bristol and Bath provide many examples.

4.28.   The relationship between *"the spatial and the social"* is at the core of the Bristol-Bath innovation cluster – and it fundamentally defines both its current character and, arguably, its principal strengths and weaknesses. It is very important in relation to the wider political economy of the growth narrative, and it is considered further in later chapters.

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[42]*Spicer, A. and Presence, S (2017) Go West! Bristol's Film and Television Industries Project Report. UWE Bristol – page 43*
[43]*Marshall, A (1890) Principles of Economics, London: Macmillan – page 271*
[44]*Glaeser, E (2011) The Triumph of the City: How Our Greatest Invention Makes us Richer, Smarter, Greener, Healthier, Macmillan*

5. People and skills

Chapter Summary

The people who live and work in Bristol and Bath (and surrounding areas) are a substantial part of the innovation cluster's asset base. Apart from London, the West of England has the best qualified population of any of the major city-regions.

The four universities have played a key role in generating this labour market resource and it is one factor that has attracted the interest of inward investors. In general, the West of England does well in retaining its graduates – in part because the quality of opportunity provided by the innovation cluster and the area's quality of life.

However, there are skills shortages. Addressing them will be important if the innovation cluster is to continue to grow.

5.1.   The people who live and work in Bristol and Bath (and the surrounding areas) are a substantial asset for the innovation cluster. They are a central part of the wider growth narrative. The *"thickness"* of the labour market (in terms of the range of skills) and *"stickiness"* (in terms of the ability of Bristol and Bath to retain people) are key features.

5.2.   In headline terms, the number of people who are in employment and resident in the West of England (defined as the four unitary authority areas) is around 580,000. On local enterprise partnership boundaries, this is smaller than Greater Manchester (1.2 million) and much smaller than London (3.1 million) – but it is notably bigger than, say, Oxfordshire (350,000). Moreover, the figure has grown by about 50,000 (close to 10%) over the last decade[45].

5.3.   Overall, about 44% of the working age (16-64) population is qualified to degree level or above (NVQ4+). This is similar to the figure for the Hertfordshire and Enterprise M3 (broadly, north Hampshire and Surrey) LEP areas; it is around ten percentage points higher than for Greater Manchester and Greater Birmingham and Solihull (i.e. other "core cities") LEP areas; but it is eight percentage points lower than London (which is the highest across 38 LEP areas). The inference is that – outside of London – the workforce of the West of England is the best qualified of any of the major city-regions; and it is on a par with strongly-performing areas of the Greater South East.

5.4.   The scale of the city-region – coupled with the concentration of well-qualified residents – is a potent combination. It has helped to fuel the growth of the innovation cluster; but equally, the success of the cluster has in turn been a key reason why Bristol and Bath have attracted and retained well-qualified people. In cluster terms, skills and employment across key sectors support a virtuous circle which is likely to attract both investment and talent. It makes it easier – both for businesses to find and recruit the people they need, and for individuals to find the right job or opportunity for career development. This chapter explores some of the underlying processes.

THE ROLE OF THE UNIVERSITIES WITHIN THE LABOUR MARKET

5.5.   The area's four universities are a major source of skills for the innovation cluster[46]. Between them, they have around 75,000 students (full time plus part time), with nearly 28,000 at UWE Bristol, 23,000 at University of Bristol, 17,000 at University of Bath, and over 7,000 at Bath Spa University[47]. Over 53% of students at the area's four universities study science, technology, engineering and mathematics (STEM) subjects, compared with an average of 46% nationally[48]. There is also a strong concentration in cultural and creative subjects. Between 2008 and 2012, over 3,500 PhDs were awarded, including 951 at the University of Bath (15% of which were in engineering) and 2,202 at the University of Bristol (with the highest proportions in chemistry and engineering).

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[45]Based on data from ONS Annual Population Survey
[46]The universities' role in relation to research and technology is considered separately in Chapter 6
[47]Source: the universities' websites
[48]HESA 2014/15 Student Return, presented in the SWW SIA, Annex M: Skills and Labour Market Analysis Report – Marchmont

5.6.   The universities are widely regarded as good sources of skilled labour – and either directly or indirectly, many of our case studies allude to their role (see, for example, Box 5-3). They are also positively involved in the *"people dimensions"* of the innovation cluster. UWE Bristol, for example, is part of the wider creative and digital economy through collaborations at the various hubs (such as Pervasive Media Studio (with University of Bristol)), resident art students at Spike Island, and work placements in companies across the different sectors. UWE Bristol also trains apprentices for the aerospace sector.

5.7.   Crucially – and perhaps as a consequence – a high percentage of students stay in the region after graduating[49]. A higher proportion of those who come from elsewhere in the country to study in the local universities stay and work in the city-region than is the case for other cities apart from London. This signals both the range of opportunities available for new graduates within Bristol and Bath *and* the quality of life that many young professionals appear to recognise and enjoy. It is also formatively important in building a *commitment to place* which is material to the innovation cluster as a whole.

SKILLS ACROSS THE INNOVATION CLUSTER

5.8.   Reflecting in part the specialisms of the universities, but also the interests of businesses within the innovation cluster (including some very large and influential ones), distinctive skills specialisms have emerged. These include:

- **A large and diverse specialist labour market in the cultural and creative sector:** UWE Bristol has courses ranging from fashion and drawing to product design and games technology. Bath Spa University is a further source of creative talent, whilst University of Bath's Centre for Digital Entertainment has doctoral researchers placed within businesses involved in the games, animation, VFX, simulation and cultural industries.

- **A depth of talent in TV and film:** BBC NHU has long been the most important source of TV and film production skills in the area, particularly for natural history and graphics. However, UWE Bristol and University of Bristol run relevant courses[50], and students from both universities benefit from work placements at the BBC and production companies (such as Icon Films).

- **A concentration of expertise spanning both 2D and 3D animation:** Major firms like Aardman have attracted animation talent to Bristol, and have also fostered significant talent of their own. UWE Bristol has a School of Animation. Ventures like Bristol VR Lab are supporting skills development more broadly (see Box 4-3 in the previous chapter).

- **Skills in digital design and publishing:** Both UWE Bristol and University of Bristol teach digital design subjects; and they have links to Pervasive Media Studio and Spike Island. The BBC Graphics department has played a significant role in this space, as have major employers such as E3 Media, Hello Charlie, and companies set up by ex-BBC employees such as BDH. One survey of the design community in Bristol and Bath identified designers working in 59 industry categories (which suggests a very wide and deep labour market).

- **A major national focus for skills in aerospace and advanced engineering:** The aerospace and advanced engineering sector has over 25,000 employees in the West of England LEP area, and over 1,800 businesses[51]. City of Bristol College offers courses in aeronautical engineering; and aerospace engineering manufacturing[52]. In the higher education space, according to the South West England and South East Wales Science and Innovation Audit (SWW SIA), multiple Centres for Doctoral Training are housed in the region's universities, including those in Advanced Composites for Innovation and Science, and Composite Manufacture (Bristol), Catalysis (Bristol and Bath), and Autonomous and Robotic Systems (Bristol and UWE Bristol).

- **A large pool of computer scientists and engineers:** This reflects partly the history of the sector (including the role of companies like Hewlett Packard (see below) and Inmos) and partly the strengths of the area's universities. The associated skills underpin, and are reinforced by, the focus on software design, high performance computing, cloud technologies, and software development activities in the area.

- **Entrepreneurial and business development expertise:** There has also been an important and

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explicit focus on support for the development of entrepreneurial and business skills including through SETsquared incubators in Bristol and Bath and, more recently, through Future Space and the UWE BRL and Launch Space incubators.

5.9. Across this talent pool, the role of major companies has been very important. Uppermost amongst these has been **Hewlett Packard** (see Box 5-1). Equally though, it is possible to find examples of smaller companies – that have grown up in Bristol-Bath – actively moulding the labour market on which they depend. One example is the Bath-based company, **Mayden**, which is considered in Box 5-2.

Box 5-1: Case Study – Hewlett Packard

For over 30 years, Hewlett Packard has been a major part of Bristol's technology landscape. Its impact has been felt in many different ways through the thousands of engineers, scientists and consultants it has brought to the city, many of whom have stayed there even after leaving HP to join other companies and organizations, or to start their own.

In 1983, HP wanted to create a European offshoot of a division in Boise, Idaho, that designed and built computer disk drives. This new offshoot was to create a new market in tape drives for data back-up. Many different sites in Europe, around 70, were being considered. Bristol had a development office at that time led by Mike West, a very resourceful individual. He understood the great potential impact of successfully attracting HP to set up in Bristol. The City Council had control of a 180 acre site in north Bristol: Wallscourt Farm. This had originally been a model farm on land owned by the Duke of Beaufort. Mike West hired a helicopter to take HP executives on a tour of the land. That sealed the decision – a decision that changed Bristol. Originally HP had planned to build three groups of three buildings spread over parkland with 8,000 employees. As the high-tech world changed, the plans changed and only one group of three buildings was completed.

At the same time, HP Labs (the long-range research laboratories of HP) wanted to create a second major site (the first being Palo Alto in California). It was natural that this would be part of the new Bristol campus. HP Labs had never been the largest part of HP in Bristol – that had always been the mass storage division – but HP Labs was always more conspicuous (reflecting the nature of its research and its strong links to the city's universities).

The mass storage division was responsible, in collaboration with Sony Japan, for creating the DAT (digital audio tape) standard for data backup. For many years this was a very significant product business with the devices being assembled in Bristol. Over the years, subsequent enhancements came out of the R&D lab supported by some fundamental research from HP Labs, such as compression algorithms and security mechanisms. This division now has responsibility for the StoreOnce technology that achieves very high levels of compression on disks now instead of tapes, although the technology has its roots in tape technologies. HP's global Chief Technology Officer for Storage Systems is in Bristol.

HP Labs started recruiting at the end of 1984. The first recruitment cycle took the labs to 170 scientists and engineers. Don Hammond, a close early colleague of Dave Packard and Bill Hewlett, was the Centre Director for the first two years to ensure that HP Labs Bristol was a true mirror of HP Labs Palo Alto, but with a European approach to research. Dr John Taylor was appointed as the first Lab Director with the expectation that he would take over from Don Hammond. John had been the Director of the Alvey Programme, the UK's response to the Japanese 5th Generation Project. Amongst the initial research areas were Artificial Intelligence, Software Engineering, and Networks and Communications. With student interns, HP Labs peaked at about 400 employees.

Some very early work on what is now known as Cloud Computing started in HP Labs in 1997. The platform was built using the powerful SmartFrog configuration management platform, originally developed for the control of large-scale distributed ATM (Asynchronous Transfer Mode – a networking technology at the heart of the global telecoms network) network controllers. In seeking an application to test, but also to publicize this new era of computing, it became clear that the massive computing requirements of CGI rendering (the process of taking the wireframe models, textures, lighting models created by animators) and turning them into frames of films was ideal. So began a collaboration with several different partners in the city: Watershed, BBC, Aardman, 422 South, Films at 59. The first success was The Painter, a five-minute animated film that was completely rendered using a CGI-rendering service running in HP Labs.

The Painter was followed by a very large, multi-party collaboration called SE3D that had 10 animation companies from around the UK using a market-based system.   The "cost" of rendering depended on demand.   The animators had to bid in auctions for rendering time. Over 12 years later this is still not realized in most Cloud services.   The use cases were expanded to CFD (Computational Fluid Dynamics) with Williams F1, oil reservoir modelling and Monte Carlo simulations with investment banks.   In time, this led to the creation of HP's Public Cloud business, a major part of its software development in Bristol.

Bristol City Council and the Universities have been critical partners and collaborators.   HP and the University of Bristol created BRIMS (Bristol Research Institute in the Mathematical Sciences) which brought talented mathematicians and physicists to Bristol, many of whom are still there.   Several HP Labs researchers have taken professorial positions at the University of Bristol.

Capital assets have also been recycled with the Bristol Robotics Lab (joint University of Bristol and UWE Bristol) and, more recently, UWE Bristol's Future Space (providing office, workshop and lab space) and Health Tech Lab, located in one of the repurposed HP buildings that was acquired by UWE Bristol.

Box 5-2: Case Study – Mayden, and Mayden Academy

Mayden was founded in 2004 by Chris May. Previously, Chris had worked on IT systems from within the NHS and he recognised that the appropriate use of IT could potentially transform many different aspects of healthcare delivery. In 2007, Mayden secured an NHS contract focused on patient management systems in mental health, and on the back of this, it launched a new product, called iaptus. By 2010, this was being used by more than 60 NHS clients and 5,000 therapists, and it had achieved a market share of 50%. Mayden's headcount has grown quickly, and the company continues to develop healthcare-related software. Currently Mayden employs just over 70 people, all in central Bath, and turnover is around £4m. Mayden works with many NHS Trusts in England, using cloud-based platforms to support psychological therapies with a view to expanding into other areas of healthcare. It is looking now to break into international markets, with an initial focus on mental health.

The narrative surrounding the growth of Mayden points to the challenges of securing talented people, and the importance of location. After being home-based, Mayden's early years were spent in premises in Biddestone (near Chippenham, Wiltshire). The company secured more office space in 2011, at Box (to the east of Bath). It continued to grow reasonably quickly, doubling its turnover from £1m to £2m between 2010 and 2013, by which time it employed about 40 people. In 2014, it acquired a large (seven storey) townhouse in central Bath, and it moved all its activities to that site in February 2015. The town house could potentially accommodate around 80 staff members in total.

This decision to relocate to central Bath was made in the context of significant recruitment difficulties. Mayden's own research in c. 2014 suggested that, at the time, its premises were simply "in the wrong place": with little public transport available, the location was a real deterrent. Instead, it found that developers wanted to be in the city centre, at a location with good public transport. When it made its move, it did consider relocating to Bristol; however, it decided against this, owing to the number of staff members who lived to the east of Bath (which was a legacy of its previous locations).

The move to central Bath made a very significant difference. The building itself is used flexibly, matching the ethos of the company. Beyond that, Mayden considers itself to be firmly part of a tight-knit "Bath tech scene" which it defines around TechSPARK; the Guild; the University of Bath Innovation Centre; the Bath Digital Festival; and a regular programme of "meetups". Within Bath, *"everyone knows each other"*, and the meetups are as much social as they are business-focused. Mayden considers that Bristol is good for growing the network, but – simply by virtue of scale – links are not as strong.

Reflecting in part its own difficulties in relation to the recruitment of software developers, Mayden set up a training academy (**Mayden Academy**) in 2015, initially with some resource from the Skills Funding Agency (SFA). Its courses have evolved, but they are now designed to last 16 weeks and they are very practical; the teaching is provided in-house by its own developers. The first programme was structured around six students and at the end of it, Mayden itself recruited all six. The next course was for eight students, two of whom found subsequent employment in Mayden whilst the others all found jobs with other local employers. Now the number of trainers has been increased, as has the number of courses run per year. Most of the students who

enrol on the course are self-funded, and in the main, they are seeking a change of direction in their careers. The course has attracted interest from around the UK and also internationally (Ukraine, Bulgaria, etc.). To date, all of the graduates have been recruited by local employers in the digital sector. As of summer 2017, Mayden Academy was operating from the University of Bath Innovation Centre (managed by SETsquared); hence it is now physically separate from (although close to) Mayden's main offices.

THE WIDER IMPACT OF THE AREA'S "PEOPLE ASSETS"

5.10.   The scale of expertise in the area has been a key factor in attracting recent inward investment. For example, **Just Eat** considered 10 locations across the UK for its technology development team. It came to Bristol because it could recruit from the top 5% of the talent pool, whereas in London there is more competition and a higher turnover of staff. Similarly, **Oracle's** decision to build a strategic cloud product development centre in Bristol resulted in part from the strength of networking within and between relevant companies and organisations (large and small), *combined with* the strength of the local labour market (and here too, the universities are identified as playing a crucial role – see Box 5-3).

Box 5-3: Case Study – The recent growth of Oracle in Bristol

Oracle Corporation, an original Silicon Valley founder, has one of its strategic cloud product development centres in Bristol (others are located in San Francisco, Seattle, Bangalore and Cape Town). Oracle's development teams in Bristol build business analytics, data visualisation and cloud computing infrastructure services which support the company's customers worldwide.

Oracle has also based its UK cloud start-up acceleration programme in the city, identifying Bristol as *"one of the most exciting digital clusters in the world, with a wealth of technology companies pioneering the development of cloud computing, analytics, digital media and high-performance computing"*.

According to Oracle, Bristol has established expertise in these areas and a strong technology ecosystem. This is defined by Oracle in terms of:

- three of the area's universities – Bristol, UWE Bristol and Bath – which produce a large number of highly trained computer science graduates

- large technology companies (including HPE, IBM, Amazon, Cray) with expertise in high performance computing

- numerous interesting start-ups and small companies, and strong networks to link the component parts of the ecosystem together.

According to Phil Bates of Oracle, there is also a highly innovative and attractive creative media scene and a flourishing urban culture (including world class street art, food and music scene) which challenges the status quo, and attracts younger software developers and entrepreneurs.

The Bristol technology cluster *"works together closely."* There is close and frequent collaboration between big firms and start-ups across the city, and *"collaboration leads to innovation"*. This is possible because of the close-knit nature of the cluster: *"we all have the same meet-ups."* The developer community in Bristol is also closely-knit.

Oracle has had *"tremendous results from close collaborations with small start-up firms because of the ability to combine Oracle's tech expertise with local start-up innovation."* For example, Oracle's collaboration with Yellow Dog helped launch Oracle's next generation cloud data centres. These successful collaborations led Oracle to base its UK start-up accelerator programme in Bristol – helping start-ups gain access to technology, expertise, markets and customers.

However, there are some weaknesses too. Oracle identified a lack of a global profile as a challenge - the city is not as well-known as it should be by developers and investors worldwide given the strength of the local tech ecosystem. There is a need for a greater awareness, both within the city and externally, of the strengths and growth potential of the technology cluster. There is also a need for greater diversity and inclusion (gender, ethnic) of local communities in the opportunities created by a fast-growing tech ecosystem.

5.11.   More generally, Bristol and Bath are places to which it is possible to attract talent from London and elsewhere in the country. This is partly due to the quality of life; and it is notable in this context that Bristol has been identified as *"the best place to live in the UK"* by The Sunday Times[53]. But it is also because the area has an existing critical mass of talented people and growing firms, and a reputation for offering an alternative lifestyle.

5.12.   In some sectors, the range of organisations in Bristol is a source of *"stickiness"*: for example, the concentration of production companies and strong BBC presence minimise the risks associated with TV production contracts being generally short/medium in length. Bristol is therefore a relatively "safe" option – when a contract finishes, or during the time "between contracts", there are other places that people can find work. This isn't true of many places outside London. It is however a defining feature of a genuine cluster.

5.13.   The changing role of Bristol and Bath in relation to the legal sector is also causally connected to the *"thickness"* and *"stickiness"* of the talent tool: as well as providing an outstanding quality of life, the area is increasingly seen as a place in which careers can be advanced, even compared to London, and this is both the cause and consequence of the sector's growth (see Box 5-4). Historically, Bristol-Bath was considered largely in "back office" terms; latterly, however, it has developed nationally significant specialisms and associated expertise.

Box 5-4: The importance of the labour market in the recent growth of the legal sector in Bristol

In the legal sector, there are several long-established – and relatively large – legal practices based in Bristol: Burges Salmon, Osborne Clarke and TLT are three examples. In 2010, Burges Salmon re-located to its current head office at One Glass Wharf in the Bristol Temple Quarter Enterprise Zone. Osborne Clarke is based at Temple Quay and TLT is nearby on Redcliff Street. There are also significant numbers of smaller legal practices in the vicinity.

This pattern is – essentially – what might be expected of any large city, but what is notable is the recent addition of some significant inward investors. One example is Simmons & Simmons. In 2012, it opened its second UK office (and its first outside of London) in Bristol, *"allowing us to staff matters flexibly in order to deliver greater efficiency to our clients, while maintaining our reputation for excellence"*[54]. Simmons & Simmons' Bristol office is at Temple Quay, very close to Osborne Clarke and also to Bristol Temple Meads station. Subsequently, the legal press reported a *"sharp hike in [Simmons & Simmons'] Bristol head-count"*[55] – and as of June 2017, some 32 Bristol-based members of staff were listed on its website, 16 of them partners[56]. In another case, Bristol-based Bond Dickinson merged with a US law firm in November 2017 to create a transatlantic global Top-100 firm (Womble Bond Dickinson).

A study by CBRE (published in 2016) found that Bristol accounted for more legal floorspace than any UK city outside of London, a finding which has led some to comment that Bristol's legal sector is the largest outside of London[57]. This is a bit misleading. Outside of London, the same study found that Bristol ranked third (behind Manchester and Birmingham) in terms of the number of legal fee earners. CBRE estimated that law firms were paying just under £22 per sq. ft. for premises in Bristol, a figure that was lower than in Birmingham, Manchester, Leeds, Edinburgh and Glasgow, and very much lower than in London (where prime office rents were estimated at £80 per sq. ft. at King's Cross, £120 in the West End, and £45 in Docklands)[58].

Financial and professional services are changing. Driven in part by the enormous costs of office space in London, the phenomenon of *"near-shoring"* has grown. With office rents which continue to be *relatively* low (compared to other major cities) – and also with a strong local labour market – Bristol has benefitted, particularly over recent years. In this context, it is important to recognise that the function of regional offices has changed substantially – *"from back-office support tasks to fee-earning"*. It is also wholly consistent with the observation that Bristol can now offer not just an outstanding quality of life, but also a full range of career opportunities.

[53]see http://www.bbc.co.uk/news/uk-england-39320118
[54]http://www.simmons-simmons.com/es-ES/About-Us/Our-History
[55]QC Legal – "Nearshoring to Northshoring", July 2016 http://qclegal.com/news/nearshoring-to-northshoring/
[56] www.simmons-simmons.com/en/people (June 2017)
[57]See https://www.bristol247.com/business/features-business/sector-spotlight-legal-industry-bristol/
[58]Law in the Regions, CBRE (2016)

In the legal sector, the relationship with London is clearly important and it is evolving quickly:

- In discussion, the point was made that the average employee of a legal firm in the West of England is probably older than his/her peers in London – partly because there is a reverse flow of professionals seeking to relocate to Bristol and Bath in their late 20s/30s. The consequence – as one consultee explained – is that *"people are more sticky"* – meaning that legal practices in the West of England have a more constant and experienced workforce and that, as a result, *"whilst they might not work on the biggest deals, they tend to focus on the most significant and interesting ones"*.

- A second element is that legal practices in Bristol and Bath tend to have specialisms that reflect the wider structure of the West of England economy. Hence, for example, there is specific legal expertise locally in relation to defence-related work. This depth of knowledge and insight has helped to define the distinctive specialisms of the locally-based legal practices, but it was also being recognised and absorbed by the inward investors. It means, effectively, that the West of England's specialisms are reinforced through their relationship to the wider professional services community.

CONCLUSION

5.14. Underpinned by four universities generating large numbers of graduates in two cities with a quality of life that is widely regarded as outstanding, Bristol and Bath's *"people assets"* are amongst the best in the UK. Moreover, the fact that they can compete with London to retain "the best" arguably sets them apart – and it is evidenced through, for example, patterns of inward investment. A commitment to "place" – which often seems to have been engendered during undergraduate years – sits at the core of this (including in relation to those who may return to the area after a period in London).

5.15. There is, however, increasing evidence of pressures within the labour market. According to the *West of England Business Skills Survey* (2015), some 43% of all firms surveyed said that skills are a barrier to future growth. The percentages were particularly high in advanced engineering, manufacturing and aerospace (61%), creative and digital (51%) and health and life sciences (50%). The inference is that while the talent pool is significant, demand is still high relative to the available supply. There was also reference specifically to the level of housing rents (as well as house prices), making it potentially harder to recruit mobile early career talent that is not yet wanting (or possibly able) to pursue home ownership.

5.16. In response, in the opinion of Phil Bates (Oracle), there is a need to *"democratise the skills pool"*, broadening the appeal of technology sectors beyond university graduates to develop technical skills across the workforce: *"you don't have to be a graduate to learn code"*. This principle appears to be being embraced within the innovation cluster: for example, Mayden (Box 5-2) and Deep Blue Sky (Box 4-5) – two digital companies in Bath – have developed bespoke responses to on-going recruitment challenges. More generally, there is a need to reflect on what might be achieved if the innovation cluster's principal networks could be extended to embrace fully some of the more challenging and under-used areas within the city-region, most notably south Bristol.

6. Research and technology strengths

Chapter Summary

Together, the four universities – University of Bristol, University of Bath, UWE Bristol and Bath Spa University – have substantial research and technology strengths. Although historically, relationships with the local area have varied, all four have been formatively important in shaping the innovation cluster. Within this narrative, the role of key individuals has often been important.

Increasingly there are examples of cross-university linkages and the development of applied research and technology centres which are likely to be central to the cluster's on-going evolution. All four universities can now be seen as "universities of place" to a degree that would have been unrecognisable even a decade ago.

THE FOUR UNIVERSITIES

6.1. The area's four universities have different and distinct research specialisms. According to the SWW SIA, regional highlights from the 2014 Research Excellence Framework (REF) include:

- **University of Bath**'s submission in Aeronautical, Mechanical, Chemical and Manufacturing Engineering, which represents 5.3% of the UK's REF-submitted staff

- **University of Bristol**'s submission in General Engineering, which represents 5.0% of the UK's REF-submitted staff.

6.2. Historically, the four universities have varied considerably in their engagement with the local economy. University of Bristol and University of Bath both modelled themselves on traditional academic excellence; and they were national/international in focus. Conversely, UWE Bristol and Bath Spa, because of their different origins, were strongly engaged with the local economy; they took a higher proportion of students from the local area, and ran courses more directly focused on local business needs. However, this historic pattern is changing. In the paragraphs below, we describe each university's evolving role within the innovation cluster.

University of Bristol

6.3. Over recent decades, the University of Bristol has become increasingly engaged with industrial sectors as technology-based investment has grown in the city-region.

6.4. The University has recruited some key professors from industrial backgrounds. Notable examples include **Joe McGeehan** as Professor of Electrical and Electronic Engineering, who was ex-Plessey although immediately previously was at the University of Bath (see Box 6-1); and **David May** as Professor of Computing, who was ex-Inmos and founder of XMOS.

Box 6-1: The significance of key individuals in animating the cluster – Professor Joe McGeehan

Professor Joe McGeehan has been very influential in researching and developing new communication technologies and applications throughout his career.

Following a PhD at Liverpool University and work for Plessey, in 1972 he took up an appointment at the **University of Bath**, attracted by its new model of working with industry.

In 1984, Joe was appointed Professor of Communications Engineering at **University of Bristol**, where he set up the Centre for Communications Research (CCR). In 1998, he became Dean of the Faculty of Engineering and

was also appointed by **Toshiba** to head its new research laboratory in Bristol, whilst retaining his role at the University. He has held various other positions, including being a Business Board Member for High Tech for the West of England LEP and chair of Invest Bristol and Bath, the inward investment agency which he established for the region. He received a CBE in 2004 for services to the communications industry.

Professor McGeehan has made numerous ground-breaking contributions to research and its practical application in the area of mobile communications technologies and systems since 1971. Three main characteristics define his approach to research:

- a focus on making big breakthroughs rather than incremental progress

- a desire to see practical applications which make a difference and lead to growth and jobs

- a commitment to work across traditional disciplines, on the basis that the big breakthroughs usually come at the interface between different areas of science and technology.

Professor McGeehan's research and networks have been instrumental in attracting some major firms to the area, including **Motorola, Lucent Bell Laboratories** and **Toshiba**.

In the case of Toshiba, its intention was to set up a facility in Cambridge, headed by Professor McGeehan, but he successfully persuaded Toshiba that Bristol was the ideal site to establish a Telecommunications Research Laboratory. Toshiba Research Labs now employ some 30 people and it continues to work closely with the University of Bristol and other leading UK universities.

Within the University, Professor McGeehan also had a major influence on cross departmental research. When he became Dean in 1998, it was the first executive deanship in the University and this gave him more influence and resources to enable and shape cross departmental collaborative research in the Faculty. He then established (with some difficulty and after much discussion and persuasion) the Bristol Laboratory for Advanced Dynamic Engineering with some £15m funding support from the Joint Infrastructure Fund. The intention was to bring about close collaboration between engineering departments in key research areas such as composite materials, dynamics and control and systems by creating large shared and well-equipped laboratories.

6.5.   The University of Bristol's enhanced role in the local economy started under a previous Vice Chancellor in the early 2000s. It was greatly strengthened, however, following the appointment as Vice Chancellor of Professor Hugh Brady in September 2015, formerly Vice Chancellor of University College Dublin (where he led a major programme of reform and development).   In 2016, the University set out an ambitious and wide-ranging strategy for the future *(Our Vision, Our Future)* and launched plans for a new campus, the Temple Quarter Enterprise Campus. This will focus mainly on postgraduate students with a strong emphasis on digital technologies, business and management, innovation, enterprise and engaging with business partners. The overarching theme is the role of the university in the city, with the new campus providing a portal for the university into the wider city-region.

6.6.   Key initiatives by the University of Bristol include:

- **Bristol Innovation Programmes:** The University is now offering degrees which combine a technical discipline such as engineering or computer science with entrepreneurship and innovation programmes. The proportion of the course devoted to the entrepreneurship and innovation modules increases during the degree programme to reach 40% in the final year. The first intake was of 60 students in 2016, increasing to an expected intake of 400 by 2018.

- **Strategic Alliance Framework:** This is codifying relationships with partners, many of which have a local footprint. The University is using Impact Acceleration award monies to encourage more joint projects between business and academics.

- **National Composites Centre (NCC):** Located on the site of Bristol and Bath Science Park, the NCC was developed through a collaboration between the University of Bristol and various public sector partners (including then-South West Regional Development Agency (SWRDA), then-BIS and then-HCA, and with EU funding support). Five founding members (GKN Aerospace, Airbus, AgustaWestland, Rolls-Royce and

Vestas) signed long-term partnerships with the NCC. It was formally opened in November 2011. Today, the NCC is the primary UK facility for technology development in advanced composites manufacture. It is also a key partner of the High Value Manufacturing Catapult. Through its work, the NCC provides direction and focus for fundamental research and collaborative links with UK universities. It also engages closely with industry at all levels, supporting supply chain development, and working closely with trade bodies and sector organisations to advance and inform composites take-up and development in every sector. As of January 2017, it employed 225 people.

- **Engine Shed:** The Bristol SETsquared business incubation centre operated in 10,000 sq. ft. premises within the University precinct for 10 years, but in 2013 it moved to the 30,000 sq. ft. Engine Shed building to accommodate growth and additional activities. It is a collaboration between the University of Bristol, Bristol City Council, and the West of England Local Enterprise Partnership. The Engine Shed also houses the LEP and Invest Bristol and Bath, and acts as a meeting point for academics, entrepreneurs, investors, firms of all sizes and public sector organisations. The location (immediately adjacent to Bristol Temple Meads station and within the Temple Quarter Enterprise Zone) is ideal for business and networking. All four universities are members of the Engine Shed community.

  Engine Shed 2 will involve expansion into a converted office building nearby. It will provide more space for firms to grow and for partners (including third party incubators and accelerators).

- **Commercialisation:** The Research and Enterprise Development (RED) Group is responsible for supporting commercialisation of University research, whether through licencing, spin-out or other means. The University has had a relationship with IP Group for the last 12 years to identify commercialisation opportunities, support the process and where appropriate provide funding.

- **Access to finance:** The University has put in place an Enterprise Investment Scheme (EIS) fund with Park Walk. Some £1m was invested in 2015/16, and this increased to £2m in 2016/17. The fund is available to University of Bristol spin-outs and members of the Bristol SETsquared Centre.

University of Bath

6.7. In part owing to its origins as an Apprentice College to service the aerospace sector supply chain some 50 years ago, 60% of students at Bath complete a year in industry (very much higher than the average across universities in the UK). These placements are at companies such as Airbus, Ford, JLR, and McLaren.

6.8. Industry connections for the University – and therefore revenues from contract research (and work placements for students) – are increasingly with automotive companies rather than aerospace. In terms of R&D, the University of Bath has been collaborating with automotive companies to the value of around £2 million a year; in relation to aerospace the figure is lower. Much of the work is on engine dynamics and "digital heavy" technologies; the power train aspects of engine development increasingly are done in the virtual world.

6.9. The University of Bath's Mechanical Engineering Department is very strong in these areas. In Autumn 2017, it was announced that the University had secured £39m (from HEFCE and the West of England Combined Authority) to establish a new **Institute for Advanced Automotive Propulsion Systems** at Bristol and Bath Science Park. Working closely with business partners, this will be a major initiative for research, innovation and skills development.

6.10. SETsquared in Bath has always been mainly for people wanting to set up their own company rather than spin-outs direct from the universities. Some students do take intellectual property (IP) from the university to set up a company, but it is quite uncommon. However, the comment was also made that there is an *"entrepreneurial zeal"* that is quite is well established in the academic community at the two Bath universities.

6.11. Several years ago, the University of Bath took a decision to focus its resources on attracting contract research funding, and also to some extent on start-ups by new graduates. Spin-outs tend to need a lot of capacity and money that the University doesn't have. The problems associated with a lack of space for business growth in Bath are being addressed through the Quays development, and this may stimulate more University related spin-outs.

6.12. The University of Bath has a major collaboration with Loughborough on digital engineering, with the facilities based at Loughborough's campus in London. University of Bristol is involved with this work as well, and also the Centre for Doctoral Training. The Centre for Digital Entertainment (CDE), founded in 2009 with Bournemouth University as partner, funds doctoral researchers in games, visual effects and animation, with trainees based in companies that require these skills (largely in the local area).

6.13. University of Bath is also very strong on motion capture, including through the Centre for the Analysis of Motion, Entertainment Research and Applications (CAMERA), which is based in the Department of Computer Science. CAMERA is seeking to help take the concentration of motion pictures and VR expertise in the local labour market into gaming, health and other areas; its website states that *"we specialise in collaborative, applied research with industry and academia in; Motion Capture, Visual Effects and Video Game Research, Virtual and Augmented Reality, and Performance Analysis for elite sport, health and rehabilitation"*[59]. A key company involved is Imaginarium (known for its work on The Lord of the Rings movies), which works very closely with University of Bath.

Bath Spa University

6.14. Bath Spa University started over 160 years ago as the Bath School of Art, formed shortly after The Great Exhibition of 1851. It gained degree awarding powers in 1992, university title in 2005 (previously Bath Spa University College) and research degree awarding powers in 2008. It now has over 7,000 students, three-quarters at undergraduate level and 86% full time.

6.15. The University has a strong focus on creativity, culture and enterprise. It has been designated a National Centre for Excellence in Teaching and Learning in the creative and cultural sector, and contributes significantly to Bath's vibrant arts scene, both as a leading institution – for example, in partnership with the Bath Contemporary gallery – and as a source of creative talent. According to the *Complete University Guide,* the new academic building on Newton Park campus *"has the best resources for teaching digital media-related courses in the south-west, equal to anything found at cutting-edge commercial organisations and broadcast companies"*[60]. The new TV Studio and Post Production Complex provides opportunities for commercial use outside of teaching time.

6.16. The University is also increasingly engaged in research. Examples include the Centre for Creative Computing, which was established in 2014 as part of a strategic initiative by the Vice-Chancellor to engage fully with current and future developments in digital technology, and the Media Convergence Research Centre, which interrogates the creativity, culture and enterprise of the media.

University of the West of England

6.17. In terms of student numbers, UWE Bristol is the largest of the four universities in the area. It has always had very strong local links. Its innovation related initiatives can be considered under four main headings:

- **Educating people in subjects and in ways relevant to the local economy:** UWE Bristol's biggest contribution to the local economy is the 7,000 students who graduate annually. Compared to Bristol and Bath Universities, a high proportion of UWE Bristol students come from the local area, and close to half of UWE Bristol graduates find jobs locally. A high proportion of students have contact with firms as part of their courses, and industry advisory groups are used to guide the development of curricula.

- **Managing support programmes for innovative SMEs:** UWE Bristol has run two major support schemes for SMEs over recent years:

  » **iNets** provided relatively small amounts of funding and support to firms in the South West. UWE Bristol managed the programme in relation to two sectors – microelectronics (in partnership with University of Bristol) and environment. It was also a partner in the aerospace and advanced engineering iNets. The funding was from ERDF and has now ended. Some of the firms supported through this scheme have grown at the heart of the innovation cluster; for example, the microelectronics iNet provided early support to Reach Robotics (see the case study, Box 4-2).

  » The **I4G** programme has provided larger grants (up to £75,000) to firms from across the South West in a series of phases. A total of £10m has been available through a combination of ERDF and Regional

[59]*http://www.bath.camera/*
[60]*See http://www.thecompleteuniversityguide.co.uk/bath-spa/*

Growth Fund over the initial two phases for projects involving product or process innovation. Phase 2 of the I4G programme is still on-going, and further ERDF funding has been secured for a third phase focused specifically on the Bristol-Bath city-region. The programme has worked well, increasing links between researchers, students and graduates, and the business community, including in some cases KTPs and collaborative research.

- **Knowledge Transfer Partnerships (KTPs):** These are an important part of UWE Bristol's links with industry and a mechanism through which it supports graduates into jobs locally. UWE Bristol has been consistently in the top 15 universities in the UK in terms of the number of KTPs per year, with over 150 since the scheme's inception in 2003.

- **University Enterprise Zone:** This is the most recent initiative to support innovation, business incubation and growth. UEZ designation has generated £16.5m of funding in total, including £4m from the government, £4.5m from the LEP and £8m from UWE Bristol. Together with additional EU funding, this is supporting a variety of existing and new activities and the conversion of one of two former HP buildings on the Frenchay campus to accommodate them. These include **Bristol Robotics Laboratory (BRL)** (see Box 6-2); **Future Space**, an adjacent incubator and innovation centre (see Box 8-3 in Chapter 8); **BRL Incubator** (with space and business support for robotics and tech-related early stage start-ups) and the ERDF-funded **Launch Space** (with space and business support for those within three years of graduating); and a **health technology hub** which is located alongside BRL and Future Space, where UWE Bristol will work with industry partners on health technology and assisted living projects.

6.18. In addition to robotics, UWE Bristol has several other specialist areas of applied research with the potential for major local economic impacts. These include bio-sensing and biosciences, health technologies, cultural industries and digital technologies, and environmental sustainability including water research and air quality (see Box 6-3).

APPLIED RESEARCH AND TECHNOLOGY CENTRES

6.19. Generally through collaborations between two or more of the universities, the West of England now has a substantial complement of applied research and technology centres. Various examples (some of which have been mentioned already) are listed in Table 6-1.

Table 6-1: Applied research and technology centres across the West of England

Key facilities

Bristol Robotics Laboratory, a collaboration between the Universities of Bristol and the West of England, and accommodating the EPSRC Centre for Doctoral Training in Future Autonomous and Robotic Systems (Farscope) (see case study at Box 6-2)

Bristol VR Lab, a newly established partnership between UWE Bristol, University of Bristol, Watershed and Opposable Group (see case study at Box 4-3)

Centre for Digital Entertainment at University of Bath, the EPSRC Centre for Doctoral Training in Games, Visual effects and Animation

David Bullett Nanofabrication Laboratory at the University of Bath, which hosts the UK's Electron Beam Lithography Service

Institute for Advanced Automotive Propulsion Systems (IAAPS) which is being built on Bristol-Bath Science Park, led by the University of Bath, and is due to open in 2020

Institute for Sustainable Energy and Environment at the University of Bath

Institute of Bio-Sensing Technology, a collaboration between UWE Bristol and University of Bristol (see case study at Box 6-3)

Media Convergence Research Centre at Bath Spa University

National Composites Centre, owned by the University of Bristol, and part of the High Value Manufacturing Catapult

Powertrain and Vehicle Research Centre (PVRC) at the University of Bath, focused on improving the efficiency and emissions of diesel and petrol engines, and powertrain integration developed in partnership with Ford and JLR

6.20. The process through which these institutes/organisations were formed has itself been both a product of the innovation cluster and a contribution to its further deepening and development. In most cases, different partners have been involved and key individuals have played a catalytic role. As the institutes/organisations have become operational, they have tended to develop close links to emerging and/or established local businesses from within the principal sectors at the core of the innovation cluster. The whole process is therefore cumulative in its impact. Funding and resources provided by the local enterprise partnership, the EU, other public sector sources, businesses and direct from the universities have – collectively – been critical. Two important examples are set out in the case studies below.

Box 6-2: Case Study – Bristol Robotics Laboratory

Bristol Robotics Laboratory (BRL) is the most comprehensive academic centre for multi-disciplinary robotics research in the UK. It is a collaboration between the University of the West of England (UWE Bristol) and the University of Bristol. It is home to a community of over 200 academics, researchers and businesses, and operates from a 50,000 sq ft state-of-the-art laboratory at UWE Bristol's Frenchay campus.

The Laboratory houses specialist facilities, workshops and wet labs, including a driverless car workshop and simulation suite, assisted living studio, hazardous environments test suite, flying arena with multiple 3D motion capture systems, and 16,000L pool for testing underwater robots. The lab itself has 34 research bays equipped with numerous robots. It is designed so that different research teams can see what others are doing, aiding collaboration.

Businesses and researchers are welcomed into it, and through BRL Technology Solutions and BRL's Technology (hardware) Incubator, provision is also made for innovation space for entrepreneurs. These activities are supported by the **West of England Robotics Network**, which brings together a diverse range of interested stakeholders to accelerate the development of the local robotics, autonomous systems and AI cluster, bringing mass, scale and coherence to grow the region's expertise and investment potential.

BRL operates around three key "pillars":

- **Teaching:** It has 60+ PhD students (linked to the EPSRC-funded Central for Doctoral Training in Robotics and Autonomous Systems) and a similar number of masters' students (who are awarded degrees jointly by the two universities). It has a sizeable intake of undergraduate students who are attached to (and awarded degrees by) UWE Bristol. BRL also works with a range of exciting public engagement projects across Bristol and the West of England.

- **Research:** The Laboratory addresses key areas of robot capabilities and applications. It has 16 research themes, ranging from assisted living to robot vision, artificial intelligence to human-robot interaction, and soft robotics to tactile sensing. Its research has application in many areas which are societal priorities – e.g. health and social care, connected autonomous vehicles, energy efficiency, smart automation and nuclear/hazardous environments.

- **Innovation and enterprise:** BRL is involved in the innovative application of robotics for commercial and industrial purposes, and collaborates with many different firms. Students from BRL are also encouraged to set up their own businesses.

BRL's Technology (Hardware) Incubator has 50 desks providing physical space and facilities for early stage, high tech start-up companies. It has supported a number of multi-award winning start-ups, including: Reach Robotics, Open Bionics and Perceptual Robotics. All three start-ups appeared in the Disrupt South West Index 2017 of the

region's 25 most disruptive firms. The founders of Reach Robotics and Open Bionics also appeared in the Forbes 30 under 30 Europe list 2018.

BRL's research and commercial activity has been boosted by UWE Bristol's University Enterprise Zone, which adjoins the robotics laboratory, and comprises Future Space and the Health Tech Hub, which collectively, provide a further 50,000 sq ft of incubation and grow-on facilities for businesses specialising in Robotics and Autonomous Systems, Biosciences, Health Science and related high-tech sectors. Both Open Bionics and Reach Robotics took accommodation in Future Space (although Reach subsequently outgrew the facility and moved to a nearby business park to ensure close links with BRL).

The scope and potential of robotics is substantial. Speaking alongside some of the most influential people in UK politics and business at the CBI Annual Conference, BRL's founder, Professor Chris Melhuish, reconfirmed the possibilities for new markets and future industries.

"If we define a robot to be a physical entity with intelligence capable of interacting with humans, or perhaps as an autonomous entity, then this really represents a phenomenal element which can fit into many areas. If you take that element and begin connecting it, you have a fusion of the digital world with the physical. Businesses have an opportunity to join in, to discover how new technologies can affect how they operate and, importantly, how they can adapt."

Box 6-3: Case study – The Institute of Bio-Sensing Technology

The Institute of Bio-Sensing Technology (IBST) was set up in 2008, stimulated partly by encouragement from the then-UWE Bristol Vice Chancellor for more cross-faculty working. The IBST combined the expertise of two UWE Bristol Professors, Richard Luxton (biochemistry) and Janice Kiely (electronic engineering), coupled with many researchers across the Faculties of Health & Life Sciences and Environment & Technology. It sought to establish collaborative partnerships with industry to develop novel technology for detection and measurement of, and/ or using, biological systems. The work has applications across a range of sectors including healthcare, agri-food, security and the environment. The IBST has secured over £30m of research funding since 2008 involving over 50 projects, of which 8 are on-going.

The absence of large bioscience or life sciences firms in the South West means that the region's strengths in these areas are largely unrecognised. But there are many small firms, significant employment and a great deal of innovation. The West of England Analytical Survey identified 48,600 employees in human health activities in the LEP area (including hospitals), and 20% growth of employment 2010-15 (8,300).

The IBST ran two of the iNets South West networks for innovative SMEs, for biomedical and microelectronics, which helped crystallise the ethos of working at the biosciences/electronics interface and the importance of engagement between academia and business. Richard Luxton was instrumental in setting up Medilink SW and CATIM (Centre for Alternative Testing and In Vitro Monitoring), a project part-funded by ERDF and dedicated to supporting business to develop and apply alternative testing technologies. The IBST also has a strong partnership, both through research activities and postgraduate teaching, with the University of Bristol. IBST has now established the Health Technology Hub at UWE Bristol.

The Health Technology Hub will have space in the same building as the Robotics Centre and Future Space. It will act as an "innovation hotel" enabling firms, the two Bristol universities and healthcare partners to work together on projects. The Hub will deliver new collaborations, additional R&D projects and new healthcare products, resulting in economic growth in the West of England region.

The Hub partners are UWE Bristol, University of Bristol, the West of England AHSN and several small firms including Designability, P3 Medical, Sirona and Dycem. HP is also peripherally involved through the NHS testbed programme for home diabetes care. The Hub is supported financially by ERDF/LGF/UWE Bristol, Bristol and has a core team of approximately twelve staff. It became operational in March 2018 and includes workshop and lab facilities for electronics, fabrication, cell biology and biochemistry, and a living laboratory which will replicate the environment of a one-bedroom apartment in order to provide a practical testbed for assisted living technologies.

6.21. Additional proposals for applied research centres emerged from the SWW SIA in 2016. These focused on five themes: aerospace and advanced engineering; new energy systems; next generation microelectronics; digital living innovation; and resilience, environment and sustainability. Specific proposals – some of which are now underway – included:

- Implementation of the proposed **Institute for Advanced Automotive Propulsion Systems (IAAPS)**, and **Composites Excellence** – with National Composites Materials Centre.

- Investment in **High Value Engineering Design and Systems Integration** capabilities, initially focused on the aerospace sector, but also designed to support the automotive, nuclear, marine engineering / energy and microelectronics sectors. This has strong industry support and significant commercial leadership.

- Establishment of an integrated network of **Digital Innovation Hubs (DIHs)** to bring together academic and industry expertise in underpinning technologies, such as cloud computing and digital communication, with a focus on smart cities, digital media, autonomous systems, digital manufacturing, and digital health. In the first phase of implementation, the intention is to establish a Digital Innovation Hub in Bristol, bringing together academic and industry expertise in underpinning technologies.

CROSS UNIVERSITY LINKAGES

6.22. Deepening linkages *between* individual universities are a key component of a maturing innovation cluster. There are examples of initiatives across several universities in addition to the joint research centres mentioned above. Some of these extend outside the region. Various examples are provided below:

- **SETsquared**, an enterprise activity and new business creation initiative jointly supported by the Universities of Bath, Bristol, Exeter, Southampton and Surrey, was established in 2003 with funding from the Higher Education Innovation Fund (HEIF). Its roles include running incubator/innovation centres in each city, providing mentoring, networking and other support to firms both within the centres and in the wider economy, and embedding entrepreneurial thinking and behaviour within the five universities. In February 2018, SETsquared was ranked as the *"world's top business incubator – managed by a university"*, maintaining its position from 2015[61]. This followed a benchmark study of university-linked business incubators and accelerators conducted by UBI Global, a company specialising in performance analysis of business incubation and acceleration.

- **GW4 Alliance** brings together four leading research-intensive universities: Bath, Bristol, Cardiff and Exeter. It has received funding from the Arts and Humanities Research Council (AHRC) to carry out a project to encourage collaboration between universities, cultural organisations and local authorities to grow the cultural and creative economy in South West England and South East Wales[62].

- **REACT Programme** ran for four years as a collaboration between UWE Bristol, Watershed, and the Universities of Bath, Bristol, Cardiff and Exeter, as one of four Knowledge Exchange Hubs for the Creative Economy, funded by AHRC.

- The **Bristol & Bath Creative R&D programme** combines research from UWE Bristol, University of Bristol, Bath Spa University and the University of Bath, with the reach and community of Watershed, and companies working across design, broadcast, performance, technology, publishing, and other sectors. It is a multi-million pound investment from AHRC's Creative Industries Clusters Programme, to support, connect and amplify the regional innovation cluster.

- **Bristol VR Lab** is a collaboration between UWE Bristol, the University of Bristol, Watershed Media Centre and the Opposable Group that provides shared workspace and equipment and provides support for collaborative R&D across business, higher education and other stakeholders, with funding from the Local Enterprise Partnership.

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[61]*See http://setsquared.co.uk/news/201802/setsquared-partnership-ranked-world's-top-business-incubator*
[62]*http://www.bristol.ac.uk/news/2016/november/creative-and-cultural-economy.html*

CONCLUSIONS

6.23. As set out earlier (paragraph 2.4), *"the technological infrastructure necessary to fuel an entrepreneurial culture"* is one of the defining features of creative cities. From the discussion above, it is apparent that all four of the region's universities have become *"universities of place"* to a degree that would have been unrecognisable a decade ago (and in this context, arguably the biggest transformation has been with regard to the University of Bristol). Through research, they are (and long have been) at the forefront of scientific discovery and – as considered in Chapter 5 – through teaching, they build the skills and capacities of young people. But it is also through their roles as "anchor institutions" in their localities and through collaborative initiatives that they are helping to connect businesses and communities with both people and technology. It is this role that has evolved substantially and is materially driving the development of the innovation cluster across Bristol-Bath. It will be important that it continues to be nurtured, funded and enhanced.

7. Seed, angel and venture funding

Chapter Summary

Across Bristol-Bath, there is evidence to suggest that a cycle of investment is starting to emerge (i.e. where the previous generation of entrepreneurs becomes the next generation of investors). In addition, London-based venture capital firms appear to be increasingly active locally. However, compared to elsewhere, this element of the wider innovation ecosystem is still under development.

7.1.   Access to finance for would-be entrepreneurs and innovative businesses is a critical part of any knowledge-based cluster. Where it works best (as perhaps in Cambridge), the previous generation of entrepreneurs tends to become the next generation of investors in early stage businesses. In the process, money and, crucially, expertise, insight and networks, are constantly being recycled and replenished.

7.2.   Across Bristol-Bath, a "cycle of investment" is starting to emerge, but is still under development. According to the 2017 Tech Nation report, the Bristol-Bath area attracted £109 million of investment in digital tech firms in 2016. This compares favourably with Oxford (£106m), Manchester (£78m) and Sheffield (£61m) but lags behind Cambridge (£153m), Edinburgh (£159m) and London[63].

7.3.   At the early stage of business formation and growth, the various incubator facilities and networks provide guidance and links to funding sources. **SETsquared**, for example, has links to IdeaSquares (an accelerator programme with access to crowd funding). Alongside TechSPARK, **University of Bath Innovation Centre** and others, it supports the Silicon Gorge Fair (where young firms pitch for funding from prospective angel funders). **Future Space** has developed links with, and points businesses towards, potential funders. Later stage investment is still largely London-based or international in origin, although local sources now include the **Bristol Private Equity Club**, established by Mark Mason of Mubaloo (see Box 4-3). The University of Bristol also has its own fund for alumni, providing up to £250k with matched funding.

7.4.   Various London based venture capital firms are active in the Bristol-Bath area, including **Eden Ventures** (founded by Bath-based entrepreneurs) and **Amadeus Capital** (founded in Cambridge and now one of the largest UK specialist VC funds for the technology sector). **Accelerated Digital Ventures** (a nationally networked organisation) and London-based **Downing Ventures** are recent entrants into what is still a fluid and evolving local venture funding market. In this context, Bristol has been described by one of our consultees as *"amazing right now: loads of raw ingredients (talent, creative people, scientists); costs are lower so runway is longer; lifestyle is good so less burnout potential"*. Within the investor community, Bristol is considered livelier than Bath. Opportunities are identified through a few key organisations (SETsquared, Webstart Bristol, Bristol Robotics Lab, Future Space, Bristol and Bath Science Park, etc.), but most come from being visible (particularly in a market where there are few alternatives).

7.5.   Although the situation now seems to be changing, many firms in the Bristol-Bath area have struggled to attract the attention of specialist funders largely because the area has not been on the radar of many specialist funding sources in the same way as London, Oxford and Cambridge. When Reach Robotics (see Box 4-2) needed significant capital, it looked to London and then to north America. It secured early stage venture funding by moving to San Diego for six months to join the Qualcomm Robotics Accelerator, before returning to Bristol. More recently, Reach Robotics secured $7.5m from the international tech investment market. Evidence relating to the funding package put together by a spin-out from the University of Bristol is provided in Box 7-1 below; this highlights the importance of London-based firms and (in this case) public sector funding.

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[63] *http://technation.techcityuk.com/*

Box 7-1: Case Study – Ultrahaptics

Ultrahaptics has developed human machine interface technology which uses ultrasound to project sensations onto the hand that can then be used for touch free control of machines, switches, dials, etc. There is very strong market traction in the technology, particularly from major firms producing automotive control systems, industrial controls and gaming and computer products. Potential markets are very wide ranging – for example, to control machinery or appliances without having to touch hot or dirty surfaces, and in healthcare, to avoid transmission of hand borne infections, or to assist the blind or people with Parkinson's disease to trigger switches or dials without having to touch them.

Ultrahaptics was formed in 2013 as a spin-out from the University of Bristol. Its founders were:

- Professor Sriram Subramanian, formerly Professor of Human-Computer Interaction at the University of Bristol, and now Professor of Informatics at Sussex University;

- Dr Tom Carter, a student from the University of Bristol's Computer Science Department who started exploring ultrasound technology during a study in the final year of his Master's degree and developed the concept further for his PhD. Tom is now Chief Technical Officer;

- Dr Ben Long, a post-doctoral researcher in the Computer Science Department.

Tom Carter was introduced to Steve Cliffe by Greville Commins, entrepreneur in residence at SETsquared and who also taught the entrepreneur course in the Computer Science Department at the University of Bristol. Greville and Steve knew each other from 10 years previously when they were on the same company Board, and Greville's colleague at SETsquared, Rick Chapman, was on the same university course as Steve. So, there were strong connections. Steve's experience of working with tech start-ups and corporates previously, in a variety of areas ranging from fibre optics to HDTV over Wi-Fi and decoders, was highly complementary to the founders' technical expertise.

Initial funding of £105,000 for proof of concept was secured from IP Group. Steve worked with Tom to develop a business plan, which several months later enabled the firm to secure another £0.5m of seed funding, also from IP Group. With this secured, Steve Cliffe formally joined the business as CEO.

Subsequently, another £10.1 m of venture funding was secured from IP Group and Woodford Investment Capital, both of whom are long term investors seeking to grow capital value. In addition, a grant of nearly €1.5m was secured from the European Commission under the Horizon 2020 programme.

Ultrahaptics started in the SETsquared incubator, housed in Engine Shed at Temple Meads. It then moved to the current modern office premises in the Temple Quay Enterprise Zone. Since then, employment has grown quickly. Recruitment has been from the local area – including several University of Bristol graduates – the rest of UK and internationally. The company employs people of 22 nationalities, including from mainland Europe and the rest of the world, and there is also a good gender mix.

CONCLUSIONS

7.6.   In relation to seed, angel and venture funding, the nature of the innovation cluster is evolving. A local "cycle of investment" is starting to emerge and London-based investors are being attracted. However, this is one aspect of the innovation cluster that is currently under-developed compared to elsewhere. There are though signs that this situation is changing. For the continuing growth of the innovation cluster, this process will be very important.

8. Quality of life, quality of place, and the evolution of "innovation spaces"

Chapter Summary

Bristol-Bath is associated with a very good quality of life linked to a quality of place. This is recognised locally and also through national reports.

The quality of life has – in part – been created through the innovation cluster (including, for example, through the "edginess" of the arts and cultural scene). This process has been profoundly spatial and different types of innovation spaces have developed across the two cities over time.

However, this process is not a complete one. Parts of the area (notably south Bristol and inner east Bristol) are currently excluded from this narrative. Moreover, new innovation spaces will need to be found as the cluster continues to evolve.

"COOL, CLASSY AND SUPREMELY CREATIVE..."

8.1.   One of the most important factors underpinning the current health of the innovation cluster has been the ability of Bristol-Bath to attract, nurture and retain a highly qualified and motivated workforce, and a growing cadre of entrepreneurial talent. A constant refrain from our consultations has been that in explaining the quality of the "people asset", the "quality of life" that the two cities provide is critical.

8.2.   What constitutes "quality of life" is a personal judgement. From our consultations, the attributes that are valued appear to include the "edginess" of the arts and cultural scene, coupled with relatively easy access to outstanding countryside; to this, we might add the strength of the leisure and entertainment sectors, and the variety of residential neighbourhoods in the two cities and beyond. Bath is different in character from Bristol but equally attractive as a place to live and work; it is a small city with outstanding Georgian architecture in a beautiful valley setting, and with strong cultural and leisure infrastructures. Both cities have very lively though different cultural, entertainment and recreation offers. Significantly, the city-region as a whole has multiple attributes and environments that appeal across a wide range of different groups with different lifestyles and aspirations – from city-living through historic architecture to beautiful countryside and rural living.

8.3.   This narrative is not simply about consultees *"'talking up' their city"*. Alongside these personal reflections, Bristol was named as the UK's most desirable location in the *Sunday Times Best Places to Live Guide for 2017*[64]. The annual guide, which combines data such as crime rates, house prices and school performance, described Bristol as *"a small city that feels like a big city"*, with lots of *"glamorous, creative, hi-tech and professional"* jobs on offer and great food and drink - the city *"crams in all the culture you could wish for"*. *Sunday Times* home editor, Helen Davies, wrote: *"The city is a worthy winner thanks to its ideal combination of extraordinary culture, impressive schools, buzzing culinary scene, exciting redevelopment and community spirit. We sum the city up as cool, classy and supremely creative"*. Separately, it was voted as Rough Guides' Top City of 2017 on the basis that *"the city's first-rate nightlife, thriving creative and tech industries and proximity to the great outdoors made it an obvious choice. Think London, but smaller and (dare we say it) cooler – or at least more committed to its offbeat counterculture, and with an enormous gorge cutting an improbable chunk through part of the city"*[65].

8.4.   *"Cool, classy and supremely creative"* are attributes that have been fashioned; they are not an endowment and nor are they – in any sense – an entitlement. They have been energised and animated by individuals and they have emerged as *"talent, tolerance and technology"* have evolved together. This process has been social and economic, but it has also been profoundly spatial, vested in specific – and shifting – locations within Bristol-Bath. The importance of different places has really mattered.

8.5.   However, accolades of *"cool, classy and supremely creative"* do not extend currently across the two cities in their entirety. Parts of the area (notably south Bristol and inner east Bristol) are excluded from much of this narrative.

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[64]*see http://www.bbc.co.uk/news/uk-england-39320118 Accessed 19th March 2017*
[65]*See https://www.roughguides.com/article/why-bristol-is-the-coolest-city-in-britain/ Accessed 21st December 2017*

THE EVOLUTION OF "INNOVATION SPACES"

8.6. **North Bristol** and the two **city centres** have been the major spatial focus for the growth of the innovation cluster over recent decades.

8.7. Development in **north Bristol** reflected land availability and infrastructure provision, coupled with a locally-permissive planning regime set against landscape and policy constraints elsewhere around the two cities. This growth reflected – and then reinforced – the concentration of major technology and knowledge-based employers in this area – including BAE Systems, (the relocation of) Inmos, Rolls Royce, and HP Research Labs; and both financial services businesses and the Ministry of Defence.

8.8. North Bristol also benefitted from the strengthening of the strategic transport infrastructure which took place between the mid-1960s and mid-1970s (including the M4/M5 interchange at Almondsbury; the first Severn crossing in 1966; Bristol Parkway station in 1972; and the M32 in 1975). Investment has continued in the immediate area through key institutions (e.g. UWE Bristol, National Composites Centre (University of Bristol)), and major businesses (e.g. Rolls Royce, Airbus, GKN). Over time, this process has involved regeneration and re-investment; for example, the new innovation centre at UWE Bristol is located in buildings originally built for use by HP, and now accommodating Future Space, the Bristol Robotics Laboratory and the Health Technology Hub. Both Rolls Royce and Airbus have invested in new facilities whilst shrinking in size overall in employment terms. Although the National Composites Centre and Bristol and Bath Science Park are wholly new facilities, by re-using physical assets, the innovation cluster is effectively re-inventing itself.

8.9. In parallel, however, the **city centres** have played an increasingly central role. At least in part, this has followed industrial restructuring and urban regeneration. As the docks closed, development sites and empty warehouses became available. This helped to provide cheap, flexible workspace and amenities such as *Spike Island* (see Box 8-1) and *Watershed* (with a focus on film, culture, media and digital technologies). These in turn helped to support the growth of the creative and cultural industries in Bristol. Subsequently, space in (mainly ageing) office blocks has been converted to flexible business space with supporting business services. City centre examples include the *Future Economy Centre* and *Desklodge* in Temple Way; *Temple Studios*; the *Emmaus Business Incubator in Backfields House* in central Bristol and Paintworks (to the east of Bristol City Centre); and the *University of Bath Innovation Centre* in Carpenter House, an office building in the centre of Bath.

Box 8-1: Case Study – Spike Island

Situated on the Bristol inner city harbour area from which it took its name, *Spike Island* provides working space for artists, designers and creative businesses, including affordable co-working space and incubator provision *(Spike Design)*. It has the reputation among the national art and design community of being one of the most inclusive and dynamic organisations in Europe dedicated to the production and exhibition of contemporary art and design.

Originally built in 1956 for blending and packing Brooke Bond tea, the building that is now home to Spike Island closed in 1990 and fell into disrepair. A group of local painters, sculptors and printmakers going by the name of *Artspace* (founded in 1976) had already converted and occupied the nearby McArthur's Warehouse on the Harbourside, and were active in seeking out and administering affordable artist studio space in the area. When their occupation of the McArthur's Warehouse was placed under threat, by increased rents and a proposed re-development of the site in 1998, *Artspace* moved to the nearby former Brooke Bond tea packing factory. This was leased to them on a peppercorn rent by Bristol City Council (which owned the building). The Council had recognised that the building's large, well-lit open-plan spaces had potential as an arts venue and flexible work space. The building was renamed Spike Island.

Redevelopment of *Spike Island* was funded by the Royal Society of Arts 'Art for Architecture' scheme and funding was also secured from the newly-formed National Lottery. It was led by, among others, artists Louise Barber and John O'Connor (both linked with *Artspace*) working with *Niall Phillips Architects*. Spike Island's growing reputation for supporting contemporary art practice has since attracted additional funding. Today, its status as an Arts Council England National Portfolio organisation accounts for about 22% of funding, a further 3% comes from Bristol City Council and 75% is from Spike Island's various business activities, such as renting affordable art

space and creative facilities and running cultural events. The building is still owned by Bristol City Council, but is on a 125-year lease to Spike Island.

'Spike' today includes a gallery and café, 56 flexible studio spaces which are available to artists and a variety of co-working spaces and offices. One such space is the Associate Space, a shared space used by over 100 members of the Associates' network, providing computer access and video editing, a resource library and archive. According to the 'Spike' website, together the spaces provide *"a vibrant hub for production, presentation and debate…"* and offer *"opportunities for audiences to engage directly with creative practices through participation and discussion"* through a programme of public exhibitions, talks, activities and events. The goal of 'Spike' is to create a challenging and dynamic community of artists and designers, and collaborate with local and regional partners), international institutions, museums and universities. Parts of the building are now given over to students and staff from the UWE Bristol Fine Art BA programme, together with a wide range of creative companies in fields including: graphics, web, product and interactive design, fine art fabrication; typography; film and video production; illustration and animation.

8.10.   The consequence of these different processes is that the innovation cluster now occupies different places across Bristol-Bath – and it must be recognised as having played a formative role in the evolution of all these. In outline:

- Major employers in the **aerospace and advanced engineering sector** remain focused in north Bristol, particularly around Filton. This has sustained a large specialist labour market and has attracted companies in the supply chain to locate nearby.

- The early growth of the **microelectronics and digital** businesses cluster was also in north Bristol, where Inmos (which moved from the city centre) and HP Labs were located. However, more recent growth has also focused in and around the city centres in both Bristol (e.g. Oracle, XMOS) and Bath (see, for example, Box 5-2).

- The **MoD** at Abbey Wood has attracted defence-related activity to business parks and other locations in the immediate vicinity.

- **Creative and cultural businesses and organisations** are strongly focused in central and inner Bristol and central Bath. In Bristol, the early growth was around the docks, including conversion of redundant warehouses to low cost studio space (e.g. Spike Island), and Clifton (BBC). As these areas became more expensive and the cluster grew, areas such as Bedminster and Stokes Croft became more popular. Bristol Games Hub, for example, developed in Stokes Croft. Bottle Yard Studios in South Bristol is an interesting exception – a relatively isolated outpost attracted by the availability of suitable premises.

- **Professional and business services** are concentrated mainly in the city centres and, increasingly, the Temple Quarter Enterprise Zone between Bristol city centre and Bristol Temple Meads railway station. The 70ha Temple Quarter Enterprise Zone was established in 2012. By 2015, it accommodated 2,000 jobs in 300 businesses, including major accountants, banks and law firms; many of these had moved from outdated office stock close to the traditional city centre (some of which has been redeveloped for housing and student accommodation). The Enterprise Zone aims to attract 4,000 jobs by 2017 and around 17,000 over the 25-year lifespan of the project.

8.11.   This process is ongoing. Alongside established geographical concentrations, the distribution of innovative companies is widening across the city-region and new spatial concentrations are emerging. Recent regeneration initiatives such as **Paintworks** in Arnos Vale – which brands itself as *"a place not a scheme"* (and had formative links to ITV) – and **Filwood Green Business Park** in Knowle West are starting to provide new spatial hubs that may well grow in importance. **Knowle West Media Centre** is now a well-established focal point in south Bristol, and **Bottle Yard Studios** is starting to generate linked activities in its immediate locality.

8.12.   It is evident that there are many examples of existing employment provision being – *effectively* – *"recycled"* as the innovation cluster evolves. For example, the conversion of old industrial space in the St Philips area of Bristol for use as a new science incubator (Unit DX) was announced in November 2016 and completed in May 2017. The incubator provides 10,000 sq. ft. of laboratory space certified to Biosafety

Level 2, fume cupboards, 5,000 sq. ft. of office facilities and access to instrumentation equipment through a link with the University of Bristol. The scheme is privately funded and is supported by SETsquared as well as the University of Bristol, which has a partnership agreement with the centre to support its graduates in the commercialisation of research[66]. Two companies founded at the University became the first tenants: Ziylo, formed in 2014 in the Davis Research Group, and NuNano, formed in 2011 by Dr James Vicary and Professors Heinrich Hoerber and Mervyn Miles.

8.13. Creating *new build space*, particularly for growing innovative companies, has been more problematic. Filwood Green Business Park in Knowle West (mentioned above) is an exception, funded by the City Council and the then-Homes and Communities Agency as part of a more general regeneration programme. To the north, Bristol and Bath Science Park also benefitted from investment in a large innovation centre, and the large premises for the National Composites Centre. No other buildings on the 60-acre Science Park have yet been completed, despite it having been operational since 2011. This may have reflected its relative isolation, and the availability of a substantial amount of new office space in central Bristol, particularly in the Temple Quarter Enterprise Zone. Recently, however, South Gloucestershire Council has taken over as ground landlord. Planned investment includes the University of Bath's automotive centre (referred to earlier).

8.14. In Bath, new space for innovative firms is planned in the **Riverside Enterprise Area,** comprising 98ha of land which follows the line of the river through the city. This includes a new innovation centre to relieve pressure on the existing centre in Carpenter House. In addition, new Grade A office space in the Riverside area is expected to both attract new inward investment as well as enable some firms to move from outdated office space in the existing city centre, some of which can then be converted as grow on space for creative and digital businesses. Bath Spa University has also recently taken over a former manufacturing building adjacent to the river.

Figure 8-1: Innovation spaces – and major innovation assets – in the West of England
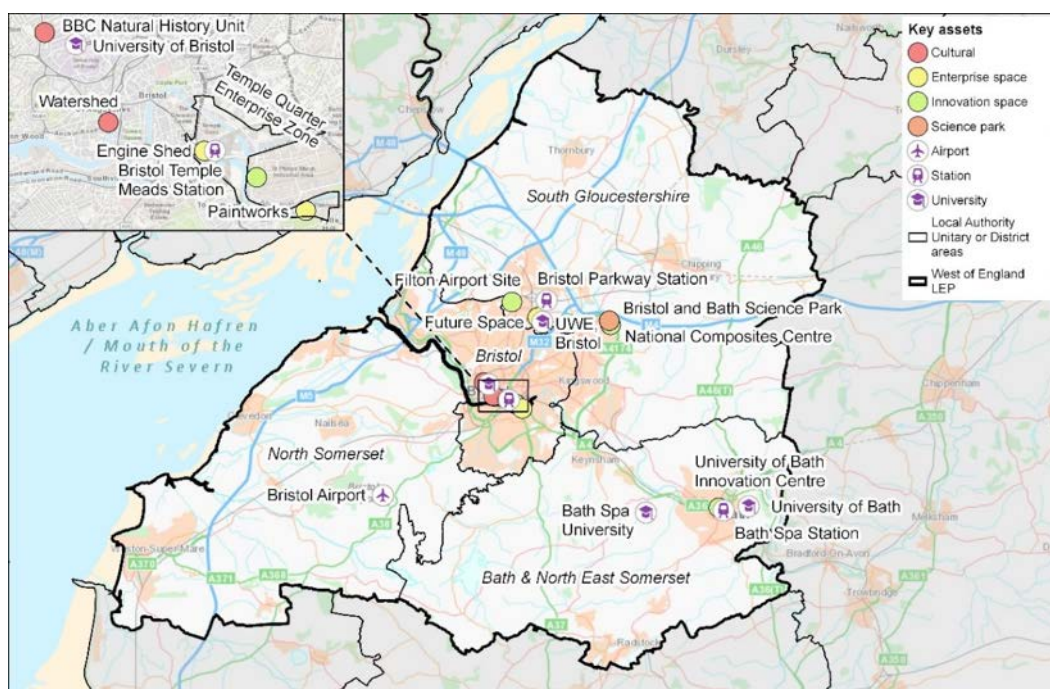
Source: Produced by SQW 2018. Licence 100030994 Contains OS data © Crown copyright [and database right] [2018]

[66]See http://unitdx.com/ and http://www.bristol-business.net/green-light-for-science-incubator-to-give-bristol-chance-to-compete-against-oxford-and-cambridge/

THE ROLE OF "INNOVATION SPACES" IN ANIMATING THE CLUSTER

8.15.   Many of the "innovation spaces" referenced above have been (and continue to be) very important in enabling entrepreneurs and firms to access networks, specialist expertise and funding, as well as premises. For example, both Engine Shed and Watershed have played central roles in supporting Bristol's development as a highly networked centre for innovative and creative firms; and Future Space and Bristol and Bath Science Park are starting to do likewise. Engine Shed was a collaboration between Bristol City Council and the University of Bristol. For a time, it also accommodated the West of England LEP and Invest Bristol and Bath. It is home as well to SETsquared and various networking organisations (e.g. TechSPARK), the new Oracle Cloud Start-up Accelerator programme (see case study below), as well as new and small firms in its incubation space. It is a genuine meeting and event-space for innovative firms and organisations. Recently-approved plans for Engine Shed 2 in adjacent property will allow for a significant expansion of business accommodation and other activities. Bristol Games Hub (home, *inter alia*, to Opposable Games) has also played an important role in putting Bristol on the national map for games development and is an important focal point for the sector.

Box 8-2: Case Study – The Oracle Cloud Start-up Accelerator Programme

Oracle announced in February 2017 that Bristol will be one of seven hubs globally (the others are Delhi, Mumbai, Paris, Sao Paulo, Singapore and Tel Aviv) for its Cloud Start-up Accelerator programme. The programme will provide six months of mentoring from technical and business experts, a co-working space, cloud services and support to start-ups' access to Oracle customers, partners and investors, and free Oracle Cloud credits. The partnership with Oracle will also potentially give firms a distinctive advantage in accessing funding.

The co-working space (which may not be needed by all programme participants) will be based in the Engine Shed and will be run by members of the Oracle research and development team. Ten new and early stage companies will be supported each year.

At the launch, Dermot O'Kelly, senior vice president, Oracle UK and Ireland, said that *"Bristol has one of the most vibrant and exciting start-up ecosystems around today. We will be working as part of this buoyant community to support local start-ups and nurture new waves of development and talent here in the UK, and ensure we continue to build upon the heritage we have in leading global innovation."* Oracle has already been working with several firms, including Yellow Dog, which will continue to benefit from technical support – in this case, technical and commercial scale up of access to computer power.

Oracle's choice of Bristol rather than London (the location for most accelerator programmes run by technology corporates in the UK) is significant. According to Phil Bates, Oracle Cloud Architect based in Bristol, the reason for choosing the city is the strength of its 'tech ecosystem', the presence in Bristol of Oracle's product development team, and the distinctiveness of being in Bristol rather than London. The latter is also a risk, because of the city's relatively small size and low profile internationally with big technology firms and funders. The strength of the ecosystem is reflected in its rapid growth and diversity, ranging from aerospace to digital media and encompassing high performance and cloud computing. Sue Daly of TechUK also referred to Bristol's *"openness to collaboration and working together".*

Box 8-3: Case study – Future Space

Future Space is one of four University Enterprise Zones in the UK, funded by UWE Bristol, BEIS and the West of England LEP.

Future Space provides space, business and innovation support for small, high growth companies, with a variety of space from co-working desks to self-contained small units available on flexible terms to new and small firms. Future Space offers a mix of office, workshop and fully serviced wet laboratory facilities, and operates a gateway policy to ensure firms are undertaking innovative technology-based activities. The facility was over 70% full after little more than a year of operation and well ahead of ahead of plan. It is run by Oxford Innovation, a national operator of innovation centres.

There is a wide range of firms signing up from the broadly-defined tech sector including:

- Entrepreneurs attracted by co-location with Bristol Robotics Laboratory and other university expertise, including Reach Robotics and Open Bionics, two early tenants.

- Life and health sciences – including for example Pertinax Pharma, a spin-out from the University of Bristol Dental School, which has a well-formed management team; another company already operating in Trowbridge with a need for additional lab space; and a third which looked for lab space throughout the South, including London, Oxford and Exeter, but opted for Future Space.

- Big data – including Esoterix Systems, a company specialising in intelligent transport solutions ("a kind of Uber for minibuses"), and DesAcc, a firm from Seattle developing analytical software for the medical sector. DesAcc moved to the UK to recruit technical skills without the Seattle prices, and it wanted a link to UWE Bristol. Others have come from firms in engineering, product development and environmental solutions for the aerospace sector and systems engineering.

Alongside extensive office-based accommodation, Future Space has several distinctive attractions:

- the availability of fully serviced lab space, ready to be fitted out by the tenant. The servicing includes full fume extraction, a bottled gas ring main, three phase power, water and drainage, etc. The availability of these services into the lab provides a huge cost saving on fit out for most lab-based businesses.

- shared lab space with shared equipment

- the availability of workshop space

- links with UWE Bristol including research collaboration, use of equipment with technical support, intern and student recruitment, and a presence on a lively campus – important for most of the firms enquiring about space

- business and innovation support through the on-site team, which is responsive to requirements and provides good links with the local ecosystem, the eclectic mix of companies and the community vibe – and can signpost businesses to a wider range of services and facilities.

Strategic accessibility is also important – particularly access to Bristol Parkway and the motorway network. Also, many clients and employees live in north Bristol (and beyond) and they find it is easier to get to work at UWE Bristol than travelling into the city centre.

THE DIGITAL DIMENSION

8.16.   The creation of "place" has been closely and iteratively related to both the development of social networks and the provision of workspace (of different forms for businesses of varying character). Increasingly, there is evidence to suggest that these processes are being supported by digital connectivity. This is not a substitute for social interaction enabled by physical provision and proximity; but it is, arguably a further catalyst and enabler. Moreover, there is some evidence to suggest that – at least in part – this digital infrastructure is itself a product of the innovation cluster.

Box 8-4: Connecting the innovation cluster – telecoms and smart city infrastructure

An early initiative to maximise use of Bristol's telecommunications infrastructure was the shared use of the city's 'dark' fibre internet connection owned by BT/Telewest. This project, B-MEX (Broadband Media Exchange), was led by, among others, David May (University of Bristol) and Dick Penny (Watershed). This has had benefits across all innovative sectors, including high tech, digital and aerospace.

The B-MEX network project was a major step forward in developing 'digital Bristol' and 'Bristol is Open', a joint venture project with University of Bristol to build an *"open programmable city"*. The project has created its own high bandwidth fibre network around the city, created open wireless, and installed data sensors around the city to drive internet of things innovation and provide real time, open information to issues like congestion, waste

management, entertainment events, e-democracy, and energy supply. These initiatives were considered by one consultee to be *"a very useful beacon",* but progress in developing the user interface for Bristol is Open is slow and has been hampered by cuts in local government budgets.

Bristol City Council also administers schemes to get fibre to premises for businesses, and two autonomous vehicles projects are based at the Bristol Robotics Laboratory: Ventura, with Innovate UK, and Flourish, with BAE Systems and Axa Insurance. The purpose is to provide a practical demonstration of the use of sensing technologies.

CONCLUSION

8.17.   This chapter has again demonstrated the indivisibility of "the social" and "the spatial" in relation to the evolution of the innovation cluster and the quality of life that is as at the core of Bristol-Bath as talented, tolerant and technology-rich creative cities. In many respects, Chapter 8 (with a focus on innovation spaces) has been the "mirror image" of Chapter 4 (networking).

8.18.   Overall, Bristol-Bath is generally well endowed with business space for innovative firms ranging from co-working incubator facilities through to large scale science and business parks. Ensuring that this situation continues into the future will be an important role for local planning authorities through their Local Plans, and for the Combined Authority/Local Enterprise Partnership more generally. In responding to the consultation on the Joint Spatial Plan, business organisations argued that there is under-provision of appropriate employment land. Others have noted that scale-up space is in short supply, forcing growing businesses to move to sites which are less than ideal. These issues are considered in more detail in subsequent chapters.

9. Infrastructure issues – and emerging spatial policy

Chapter Summary

Bristol-Bath is under some pressure in relation to infrastructure. This is apparent with regard to both housing and transport. In response, a Joint Transport Study and Joint Spatial Plan are being prepared. It will be important that these are advanced in a manner that addresses the need for more housing, more investment in transport and a real focus on placemaking consistent with the ambitions and potential of the wider innovation cluster.

9.1.   Alongside the cluster-specific narrative, it is important to take some account of wider infrastructure issues: these certainly have a bearing on the functionality of Bristol-Bath as places and they are also a material factor in relation to the overall quality of life on which the vibrancy of the innovation cluster depends.

TRANSPORT

9.2.   In this context, transport congestion was raised as a persistent concern among consultees. From our 22 business survey responses, *"the level of congestion on local roads/issues linked to parking"* was the issue most frequently identified as a major concern looking forward.

9.3.   This is not uncommon: in both Oxfordshire and Cambridge, congestion has been identified as a major constraint in relation to the growth of the knowledge economy[67]. It is notable though that across Bristol-Bath – as indeed in Oxfordshire and around Cambridge – the issues are gaining a very high political profile.

9.4.   On 21st February 2017, the *Bristol Post* reported that *"It's official: Congestion is now worse in Bristol than EVER before"*. Quoting headline statistics from TomTom's historic database for 2016, the local newspaper reported that *"drivers in Bristol can expect a 34 per cent increase in congestion levels on average, increasing to 62 per cent during morning peak times and 67 per cent in evening peak times"*. TomTom had identified Bristol as the 9th most congested UK city – less congested than London or Manchester, but more congested than Reading, Leeds-Bradford and Birmingham-Wolverhampton. Moreover, it had recorded a 3% increase in congestion in Bristol as compared to the previous year; in relative terms, this increment was higher than for London[68].

9.5.   Travel by road between Bristol and Bath is particularly problematic due to congestion over large parts of the day impacting on both car and bus movement. A high-speed train link takes around ten minutes – but on a half-hourly basis – with additional, but slower, local services between Bristol Temple Meads station and Bath.

9.6.   Historically, Bristol largely escaped the urban road-building seen in comparable UK cities – local proposals were strongly opposed by civic and environmental groups and plans for major urban road schemes were largely abandoned (with the exception of the M32, linking the city centre to the M4). Compared to other "core cities", Bristol was, however, very slow to invest in effective public transport and is alone in not having some form of tram or light-rail-based provision. Early proposals for investment in light rail foundered on political differences between the City of Bristol and the forerunner of South Gloucestershire Council. The soon-to-be-completed MetroBus (Bus Rapid Transit) is generally seen as a welcome, but modest, improvement.

9.7.   Within this overall context, a **Joint Transport Study** is being prepared in parallel with the development of the Joint Spatial Plan (JSP). This has identified a requirement to invest around £7.5bn in transport improvements[69]. Of this, £6bn is required to tackle existing needs (including the development of land allocated in approved Local Plans) and £1.5bn is for additional requirements in the JSP. Most of the funding for this requirement is to be identified, but in the light of comments in the JSP about the viability

[67]*See, for example, the discussion relating to the transport infrastructure within Oxfordshire in Oxfordshire Innovation Engine, SQW 2013 (updated 2016) for University of Oxford, Science Oxford and partners*

[68]*TomTom Traffic Index: Measuring Congestion Worldwide (www.tomtom.com/en_gb/trafficindex/)*

[69]*West of England Joint Transport Study: Transport Vision Summary Document, November 2016 (published for consultation by the four Unitary Authorities*

of the affordable housing requirement, funding from development is unlikely to contribute much to transport infrastructure.

HOUSING

9.8.   Over centuries, both Bristol and Bath have been relatively wealthy cities (reflecting the mercantile history of the former and the historic role and architectural heritage of the latter). This has created important legacies, including a stock of high quality and attractive housing (certainly as compared to elsewhere) – which is another element of the overall quality of life that the area offers. However, concerns relating to the availability and affordability of housing were aired frequently during our consultations; and for some at least, housing issues – coupled with, and exacerbated by, congestion – were in some danger of undermining the future potential of the innovation cluster[70].

9.9.   Evidence suggests that housing has become less affordable in both Bristol and Bath. Drawing on data on median house prices (from the Ministry of Housing, Communities and Local Government) and on residence-based earnings for employees (from the Annual Survey of Hours and Earnings), it is apparent that the affordability ratio has worsened over the last decade. However, the rate of decline has been much less rapid than in either Cambridge or Oxford, and – on these data at least – the current affordability ratios in both Bath and Bristol (on local authority boundaries) remain more favourable. This finding might reflect statistical issues – one of which is that residence-based earnings have risen relatively quickly in Bristol and Bath, thereby dampening the affordability ratios (even though it may well confirm the tightening of the labour market as was noted in paragraph 5.15).

9.10.   Over the decade from 2006 to 2016, DCLG data suggest that the overall housing stock increased by 11% in Bristol and 6% in Bath (and North East Somerset). The comparable figures for Cambridge and Oxford were 14% and 6% respectively (signalling different approaches to growth), while for England as a whole, housing stock grew by 8%. In all cases, administrative boundaries provide a poor proxy for functional urban areas (i.e. Bristol is bigger than the area administered by Bristol City Council, whilst Bath accounts for only a part of Bath and North East Somerset). Nevertheless, the overall shape of this growth narrative rings true.

CURRENT AND FUTURE SPATIAL POLICY

Current planning policy

9.11.   All four unitary authorities across the Bristol-Bath city-region (Bristol, Bath and North East Somerset, South Gloucestershire and North Somerset) have adopted core strategies for spatial development (for the period to between 2026 and 2029). All four make provision for accommodating significant population and employment growth.

9.12.   Within this context, the outward expansion of Bristol has been accompanied by large scale and effective regeneration within the city, driven by housing growth, new development for commercial uses (in Temple Quarter and Harbourside in particular) and leisure and retail investment. The existing Bristol Core Strategy states that: *"We want to embrace the opportunities for change and regeneration which exist in all parts of the city – with a focus on South Bristol, Inner East Bristol, the Northern Arc and at Avonmouth – to improve people's lives in those areas and to foster the progress of the whole city. In our city centre, we wish to promote the potential for new homes and commercial, creative and leisure space"* (Spatial Vision and Objectives)

9.13.   For Bath, the spatial strategy (Core Strategy 2011-29) is *"for the expansion of knowledge intensive and creative employment sectors by enabling the stock of office premises to increase from about 173,000m^2 in 2011 to about 213,000m^2 in 2029"*. Of the 7,000 new homes planned for the city, 3,300 are expected to be provided within the central area and along the river – much of it on former industrial land – and a further 2,100 on former MOD land on the northern edge of the urban area.

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[70]*In this context, it is notable that alongside Cambridge, Oxford, Warwick and York, Bristol was identified as one of the areas that has seen the biggest increase in sales of "£1m-plus homes" in the ten years since 2007 (see https://www.bbc.co.uk/news/business-44237967)*

The development of future spatial policy

9.14. Looking ahead, the spatial planning context will be one of continued rapid growth in the city-region: the West of England LEP area is expected to see population growth of 8.7% over the next 10 years, which will bring with it great opportunities for economic growth but also challenges for planning, place making, transport and affordable housing. As noted above, concerns about escalating house prices and increasing transport congestion were frequently expressed in consultations, eroding some of the differentiating factors of the two cities (although both are still cheaper and less congested than London).

9.15. Currently the four local authorities are producing a **Joint Spatial Plan (JSP)**. The JSP will provide strategic policies for the growth of the Bristol-Bath city-region to 2036. Public Consultation on the latest version ("Publication Document") closed in January 2018, prior to its submission to government and its expected consideration later in 2018 through an Examination in Public. The final JSP will be a statutory Development Plan Document and will form the strategic policy context for the next iteration of individual Local Plans prepared by the four unitary authorities (including in relation to levels of growth).

9.16. The JSP is seeking to provide for up to 105,000 new homes (including one third in the affordable category[71]) and 82,500 additional jobs within the city-region over the period 2016-36. The four authorities' existing Core Strategies make provision for some 66,000 dwellings, so the JSP will add substantially to existing commitments, albeit over an extended time period. It is envisaged that the additional housing will be developed primarily within Bristol, through intensification of use, and in strategic development locations within the city-region. Stakeholders including the Initiative and Business West (representing business interests) have argued that the plan under-provides for future housing need and that it risks constraining future economic growth.

9.17. In relation to employment growth, the JSP focusses on the existing Enterprise Zones and Areas, and on south Bristol (the latter to assist in addressing the inequality gap). The Enterprise Zones and Areas have capacity to support the provision of up to 78,400 jobs depending on end uses. Existing allocations elsewhere in the city-region (particularly on Severnside and in north Bristol) are considered to be sufficient to accommodate the remaining jobs growth, although the JSP acknowledges some mismatch between the location of demand for and supply of employment space. Following consultation on the Emerging Spatial Plan, further consideration is currently being given to the role of the port at Avonmouth and Bristol Airport as employment locations with growth potential. Again, the Initiative and Business West have argued that there is insufficient land allocated for employment uses of the right quality and in appropriate locations to support future employment growth, particularly in relation to the innovation cluster.

CONCLUSION

9.18. Looking ahead, there are major social-spatial challenges and dilemmas in seeking both to support the growth of the innovation cluster *and* to conserve the quality of life on which that growth depends. Some of these are being addressed through the development of the JSP, but key spatial issues include, in outline:

- the need to deliver more affordable housing at sub-market rents and prices, despite viability problems. The JSP estimates that only around 11,000 of the 35,000 affordable homes that are needed will be deliverable through market mechanisms

- the impact of affordability in more general terms (relative to other urban areas in the UK or continental Europe), particularly house prices and rents relative to incomes for those employed or mobile professional and knowledge workers seeking employment in the innovation cluster

- the imperative for substantial transport investment to address issues of congestion and to enable delivery of the housing growth

- the criticality of a genuine focus on placemaking to ensure new development creates attractive, well serviced places. Scale of settlement is critical to this, and there are currently issues with some of the recent peripheral development, which well-planned further growth could help address

- the imperative to manage the intensification of uses in Bristol in particular to retain and enhance the attractions of the city and avoid squeezing out employment uses, recognising the importance of these in relation to the vibrancy of the innovation cluster.

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[71]*Housing provided at below current market rates, to accommodate people who cannot afford to pay market rates to buy or rent in the area*

10. Structures and processes of local governance

Chapter Summary

Over decades, the history of Bristol-Bath in relation to governance and leadership has been rather mixed. Over the last few years, there has been greater collaboration between the four local authorities. More recently, a devolution deal has been agreed, a Combined Authority has been formed and a mayor has been elected. The development of a Local Industrial Strategy – alongside the Joint Transport Study and Joint Spatial Plan – ought to provide the basis for an effective strategic framework. This needs to support the growth of the innovation cluster across the city-region.

10.1.   The evolution of local governance arrangements across Bristol-Bath (and the wider West of England) has been part of the two cities' growth processes and their progressive emergence as *"talented, tolerant and technology-rich"* places. It has seen many twists and turns – some determined locally, others driven by central Government. It has also had an important role in the development of the innovation cluster.

EVOLUTION SINCE THE 1990s...

10.2.   Since the abolition of Avon County Council in 1996, formal governance across the West of England as a whole has been structured around four unitary local councils. As Sunley's study (of the Bristol TTWA) notes, historically the functional economic city region has been politically fragmented, its area split across multiple local authorities[72]. Like many others, it is also "under-bounded" – the functional economic area (and continuous built-up area) extends beyond the city of Bristol, particularly to the north.

10.3.   The study observes further that, at least historically, the city-region has lacked clear strategic leadership – a view shared by many of those consulted for this study. The 1990s and first decade of the 21st century saw a succession of overlapping area-based initiatives driven by central government along with regional scale economic and regeneration strategies driven by the Government Office and Regional Development Agency. At the time, a lack of coordination and political differences between the four unitary authorities tended to frustrate effective policy implementation on the ground.

10.4.   More recently, there has been greater collaboration between the four local councils – including more focused leadership, joint frameworks for planning and transportation, and new governance structures. The West of England Local Enterprise Partnership (LEP) was formed in 2011, following the abolition of regional development agencies and regional assemblies (which had responsibility for regional spatial strategies, which were also abolished). Business–led according to the government but locally providing a strong platform for the four local councils, the new West of England LEP developed a Strategic Economic Plan for the West of England as a whole (published in 2014). This focused on economic development and skills, and the infrastructure needed to support both. It established the Enterprise Zone (focused around Bristol Temple Meads station) and a range of other Enterprise Areas across the city-region. Importantly in the context of this study, it also funded a succession of specific growth initiatives (drawing on both EU and UK funding streams). These supported (and continue to support) transport, infrastructure and skills capital investment, as well as schemes with a more immediate focus on innovation[73]. It has also supported a coherent inward investment function, Invest Bristol and Bath, and sector groups and networks (including high technology, advanced engineering and aerospace, creative industries, and health and life sciences).

10.5.   As described in Chapter 9, this period saw the four unitary authorities come together to start preparing the **Joint Spatial Plan** for the West of England. They also collaborated around the roll-forwards of the **Joint Transport Study.**

[72]*Sunley, P., "Case Study Report – Bristol" (Draft dated July 2017) – part of the ESRC research programme entitled "Structural Transformation, Adaptability and City Economic Evolutions"*
[73]*Examples include Bristol Robotics Lab and Future Space at UWE Bristol; University of Bath's Institute for Advanced Automotive Propulsion Systems at the Bristol and Bath Science Park; and the University of Bristol's planned Quantum Technologies Innovation Centre at its new Temple Quarter Enterprise Campus*

...AND DEVOLUTION

10.6.   Most recently, the city region was offered the opportunity by central government to agree a "devolution deal" providing them with additional powers and financial resources. This, as elsewhere in the country, involved the creation of a Combined Authority, the **West of England Combined Authority (WECA)**, and the requirement for an **elected mayor** for the area as a whole. Three of the four West of England unitary authorities came together to form the Combined Authority[74]. The West of England Mayor, elected in May 2017, chairs the Combined Authority (whose members include the leaders of the three unitary authorities). WECA has devolved powers relating to transport, housing and skills. Staff attached to the LEP transferred to the WECA. The LEP, with increased representation from business, will have an advisory role on business interests and economic strategy. A "Joint Committee" (which includes North Somerset Council) continues to have formal powers over the investment of EU and Local Growth Funds. It also oversees joint planning and transport matters.

10.7.   The **Devolution Deal** agreed with the Government (which resulted in the establishment of WECA) provides for various devolved powers and responsibilities:

- •   £1 billion of investment to deliver infrastructure to boost economic growth in the region. Government will provide £30m a year over a 30-year period, with additional funding expected from other sources

- •   full responsibility for the Adult Education Budget from 2019/20, helping ensure that adult skills provision meets the needs of West of England businesses and learners

- •   enhanced powers to speed up delivery of new housing in line with the Joint Spatial Plan and resist unsustainable developments that are not in line with jointly agreed planning policies

- •   a Business Rates retention pilot, which allows the three unitary authorities to retain 100% of business rates (up from 50%).

10.8.   The Devolution Deal is an important development because it potentially enables strategic decisions to be made about infrastructure, housing and skills at the level of the city-region, (although WECA does not yet have formal strategic planning powers). Given the concerns expressed by firms about congestion, rising housing costs and the recruitment and retention of staff, increased local control over priorities for investment in these areas ought to be helpful. However, it is also important that there is sufficient funding for the WECA to address them effectively.

10.9.   WECA published a West of England Strategy Discussion Paper in Spring 2017. Following consultation, it then produced what is effectively an Interim Operating Framework as the basis for its 2018/19 Business Plan. This sets out its programme for infrastructure provision, skills and business support.

10.10.   Nationally, the Industrial Strategy was published in November 2017. It is a wide-ranging document, but it includes proposals for the development of local industrial strategies (to be led by Combined Authorities or LEPs across England). These will be *"long term, based on clear evidence and aligned to the national Industrial Strategy".* They will *"identify local strengths and challenges, future opportunities and the action needed to boost productivity, earning power and competitiveness"*[75]. WECA is leading on the production of the West of England's Local Industrial Strategy (LIS) in collaboration with the Department for Business, Energy and Industrial Strategy (BEIS) with input from the LEP and other stakeholders. This will be completed in 2019. Once finished, the LIS – together with the Joint Spatial Plan and Joint Transport Study (see Chapter 9) – will frame the use of devolved investment funds linked to the Devolution Deal and other national and local resources.

10.11.   Alongside WECA and West of England LEP, the four Unitary Authorities in the city-region continue to have important powers and responsibilities which affect the growth of the innovation cluster. In particular, they are the planning and education authorities, and support economic development in a variety of ways, including through the provision of premises for new and small businesses (for example, in the Waterside Enterprise Area in Bath and the Future Economy Centre in Bristol). The local authorities have also supported the innovation and growth of creative, cultural, digital and green businesses in other ways – often in partnership with others[76] – although their scope for doing so has been severely limited in recent years by funding challenges.

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[74]*The fourth local council, North Somerset, was unwilling to sign up to the Combined Authority – but committed to cooperating with it and remained party to the JSP and Joint Transport Study. It is party to the West of England Joint Committee which includes the elected West of England Mayor and the leaders of all four unitary authorities.*
[75]*Industrial Strategy: Building a Britain fit for the future Department for Business, Energy and Industrial Strategy, November 2017 – page 221*

CONCLUSION

10.12. Over the last 20 years, the West of England has had a mixed track record in relation to local governance – and arguably, other UK city-regions have made more headway. Since 2011, however, the West of England LEP has provided some level of coherence, and through the local authorities, significant progress has been made in relation to the Joint Spatial Plan and the Joint Transport Study. Along with the establishment of the West of England Combined Authority, the agreement of a wide-ranging devolution deal and the election of a mayor across the West of England, and the creation of a Local Industrial Strategy, this provides the context for a potentially more coherent and effective strategic framework for the city-region. This represents a substantial opportunity for the future development of the innovation cluster. Key priorities that ought to feature are considered in Chapter 11.

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[76]*For example, 'Bristol is Open' was established as a joint venture project between Bristol City Council and University of Bristol with the aim of building an open programmable city. The project has created its own high bandwidth fibre network around the city, created open wireless, and installed data sensors around the city to provide real time, open information to issues like congestion, waste management, entertainment events, e-democracy, and energy supply. It was considered by one consultee to be "a very useful beacon", but progress in developing the user interface has faltered.*

11. Conclusion: future challenges and priorities for the Bristol-Bath innovation cluster

11.1. This chapter draws together the main findings from earlier parts of this document to summarise both the current strengths and weaknesses of the Bristol-Bath innovation cluster, and the main opportunities and threats looking ahead. It then considers what might need to be done to sustain the dynamism of the innovation cluster within two creative cities.

Current strengths and weaknesses

11.2. Drawing on the preceding analysis, Table 11-1 provides a summary statement of the current strengths and weaknesses of the Bristol-Bath innovation cluster.

Table 11-1: Bristol-Bath innovation cluster: summarising its strengths and weaknesses

Strengths

- **Networks:** Very strong networks and sense of community, particularly across the digital and high tech, and creative and cultural sectors

- **Technological spread:** Diversity of innovation and technology strengths

- **Scale:** Real critical mass in aerospace, advanced engineering, creative, high tech and digital such that Bristol-Bath is of national significance

- **Major companies:** Growing cadre of major corporates with a significant knowledge-intensive presence in the area

- **Universities:** Genuine strength, scale and complementarity of four universities which increasingly are core players within the innovation cluster

- **Access:** Good access to London – coupled with the relative isolation of Bristol and Bath from cities of similar scale

- **People:** A well-qualified workforce with distinctive strengths – e.g. computer engineers, aerospace engineers, coders – and a high level of "stickiness" and commitment to place

- **Quality of life:** High quality of life – in small liveable cities with "edginess", culture and lifestyle attractions, and easy access to the countryside

- **City profile:** Both Bristol and Bath are known around the world as historically significant English cities

- **Governance:** Commitment to WECA and operating at the West of England scale signal a step forward (as evidenced through the commitment to a Joint Spatial Plan)

- **Culture:** collaborative networks and distributed cross-sectoral leadership, with elements of shared vision and ambition

- **Forward momentum:** The West of England is growing quickly (in terms of population and employment), generating confidence in relation to future prospects (although also some pressures)

Weaknesses

- **Science and innovation profile:** Bristol-Bath has a relatively low profile in the UK and internationally given the depth, strength and potential of the innovation cluster

- **Isolation:** Bristol-Bath is rather "invisible" from Westminster in relation to the broad spatial constructs that seem to be shaping policy (i.e. it is not part of the Golden Triangle / Cambridge – Milton Keynes – Oxford Growth Corridor, Northern Powerhouse or Midlands Engine)

- **Success stories:** Relatively few firms from within the innovation cluster have grown from start-up/ spin-out to beyond medium size

- **Network resilience:** The strength of existing hubs and networks is dependent on a relatively small number of key people

- **Congestion:** The transport network is under considerable pressure

- **Housing:** The cost, availability and affordability of housing are all increasingly flagged as concerns; and there may be tensions in relation to the use of sites for development purposes

- **Labour and skills shortages:** Employers report labour and skills shortages, and a labour market which is under some pressure

- **Balance between sectors:** Whilst the area has high productivity sectors, much recent growth has been in low wage, low value sectors

- **Access to finance:** There has been a lack of risk capital – although the situation is improving

- **Diversity and opportunity:** Key networks within the innovation cluster lack diversity, particularly in relation to their ethnic profile and gender balance, and there is limited connectivity to more deprived areas

- **Spatial inequality:** There are increasing pressures reflecting intra-urban inequality; and both cities are expensive for people in low paid jobs

OPPORTUNITIES, THREATS – AND "WICKED ISSUES" FACING THE INNOVATION CLUSTER

11.3.   Looking towards the next decade and beyond, it is apparent that the strengths and weaknesses listed in Table 11-1 present explicit and implicit opportunities and threats. These are put into particularly stark relief when considered relative to competing city-regions (elsewhere in the UK, in mainland Europe and beyond) and in the light of broader trends and drivers linked to technology, Brexit and the global economy. They might, genuinely, be considered as "wicked issues" in relation to the future vibrancy and growth of the innovation cluster. Six appear to be especially important.

11.4.   First, it is apparent that **some of the networks – and more particularly the networkers – need to find *"the next generation"*.** We have observed at several points that a few key individuals appear to be at the heart of networking processes. Some of these are now in the later stages of their careers and it will be important that their successors continue to emerge. This process needs to be on-going. The innovation cluster didn't "start" in the 1980s, but that decade (which in some respects was a low point, particularly in Bristol) appears to have been especially formative. The individuals who were central to that journey across the cultural and creative, and high tech and digital sectors, need to see similar levels of commitment and enthusiasm vested in others. There are examples of that process working through. New generations of creative and tech leaders are driving networks and collaboration, and the further growth and evolution of the cluster – but this needs to continue and accelerate.

11.5.   Second, and related, **it is important that the innovation cluster reinvents itself**. Over past decades, the (re-)invention process has at times benefitted from a level of public sector investment that is unlikely to be repeated looking ahead.   Moreover, particularly in the context of Brexit, it is at least possible that major international corporates will be more wary about investing in UK cities. Given both vulnerabilities, it will be even more important that an internal (re-)investment cycle is properly functioning. We have noted that the innovation cluster is in effect creating businesses with clever technologies and growth potential – but this potential must be realised and the returns from it (financial and in terms of accumulated knowledge and experience) ought to be driving the cluster as a whole forward.

11.6. Third – and as hinted – **the process of Brexit poses risks, particularly in relation to the aerospace sector, and these risks ought to be mitigated**. Alarmism would, of course, be folly. Equally though, simply ignoring the risks would be unwise: consideration really ought to be given to the ownership structures of some major employers and the knowledge and competencies ensconced within them. The process of Brexit will not – of itself – change the skills endowment that has developed in north Bristol, and it is this that defines the area as a world class location for firms in the sector. Nevertheless, in relation to future investment decisions from companies that are headquartered outside of the UK, the weighting attached to different factors may well shift – and the political nature of decision-making may also come more explicitly to the fore.

11.7. Fourth, **it is going to be crucial that the interconnectedness between "talent" and "tolerance" – to use Richard Florida's terminology – are fully recognised**. Currently, employers within the innovation cluster are flagging issues relating to skills and labour shortages. At the same time, parts of the city-region barely feature in the growth narrative and the communities within them are missing out. The networks that have emerged are compelling, but they are not fully inclusive, particularly in relation to ethnicity and gender. Business leaders from major companies have themselves noted the need for *"greater diversity and inclusion (gender, ethnic) of local communities in the opportunities created by a fast-growing tech ecosystem"*. Richard Florida's latest book is entitled *"The new urban crisis: gentrification, housing bubbles, growing inequality, and what we can do about it"*. Although focused mainly on much larger cities (London, New York), the themes within it – captured by the title – are relevant in terms of Bristol-Bath and the role of networks within the innovation cluster ought to be acknowledged in this context.

11.8. Fifth, **there is a need to recognise that the growth process is likely to "get harder" in spatial terms**. Over the last three decades, the innovation cluster has benefited from vacant, derelict and cheap city centre space which has been colonised by freelancers and small businesses, particularly in the cultural and creative, and high tech and digital sectors.   This space is no longer "vacant, derelict or cheap"; indeed, quite the opposite. In addition, housing supply is under a good deal of pressure; and the transport infrastructure is highly congested. All of this suggests – and the JSP largely anticipates – that new spatial solutions will be needed. These must sustain the growth dynamic of the innovation cluster, and the quality of life that many within it cherish, whilst also finding "new spaces" for the cluster to occupy.

11.9. Finally, **housing and infrastructure including transport and future mobility** represent a threat to continued levels of economic performance and investment in the innovation cluster. The city-region is playing "catch up" compared with many of its competitors. Private sector rents, in particular, could affect the area's ability to attract and retain early career, mobile professional and knowledge workers; but house prices too are an increasingly serious issue. Even with some increasing levels of investment, congestion threatens to become a deterrent, both to growth and investment, and to connectivity across the city-region.

PRIORITIES FOR THE INNOVATION CLUSTER

11.10. In the light of the six "wicked issues" outlined above, we set out eight priorities for the innovation cluster looking ahead. These are not detailed actions which are earmarked for particular organisations/ individuals or specific strategic or investment processes. Instead, they are set out here to inform discussion and debate, recognising the implicit potential.

1: Achieving "scale-up" businesses

11.11. There is a mismatch between the statistics on employment growth across most priority sectors since the recession, and the evidence of activity on the ground, including the strengths of the innovation cluster, the engagement of the area's universities and relevance of their distinctive expertise, and the excitement around some of the small innovative businesses. It may also be true – though very difficult to measure – that Bristol is at the forefront of a new economic model in which a high proportion of people are freelance, work highly flexibly between firms and sectors, and are not picked up by traditional measures of employment or productivity.

11.12. However, the area needs to see more start-up and spin-out businesses from within the innovation cluster

grow to medium size and beyond. Some of these ought to emerge as "home grown" unicorns (a privately held start-up company with a current valuation of US$1 billion or more). Cambridge claims to have over 10, and there are five in Oxfordshire. They attract attention from Government, the venture capital sector and technology corporates interested in having a presence in the most innovative locations. A group focused on identifying and supporting potential unicorns, Silicon Valley Comes to the UK (SVC2UK), has offices in London, Cambridge and Manchester, reflecting its perspective on where the main opportunities are.

11.13. To achieve more "scale-ups", there is a need for better access to risk capital. It is improving, and the interest from London-based VCs is growing, but it remains limited. Our consultations suggested considerable excitement about investment prospects in Bristol, but also a lack of competition from other VCs. This needs to change.

11.14. The universities may also have a role to play. In 2015, the University of Oxford launched Oxford Sciences Innovation, the largest university-focused venturing fund in the world. OSI holds £580m in capital provided by a variety of co-investors (UK and overseas funds, companies, charities and the university). It invested £4.5m in 2015, and £30m in 2016 (alongside similar amounts from other co-investors), from which 25 Oxford-originated spin-out companies have arisen.

11.15. Individually, none of the local universities has the same status and networks as Oxford (or Cambridge, which also has substantial venture funds), but collectively they would have considerable power to attract funds to invest in spin-outs and new ventures (note that OSI is not restricted to investing in spin-outs from the university), and a substantial potential deal flow.

2: Attracting more investment

11.16. Can the corporates which have already been attracted to Bristol and Bath be persuaded to play a role in attracting more investment by tech companies? Their experience can be a powerful attraction and profile raiser (e.g. how many people outside Bristol know that Oracle is re-engineering its cloud architecture in Bristol; or that Cray is focused on high speed networking; or that IBM is focused on IoT applications; or that Toshiba has its European Telecommunications Research Laboratory in Bristol?).

3: Specialist property

11.17. The availability of incubator space for firms in Bristol and, to a lesser extent Bath, has been good. There have been opportunities since the early 1970s, when the docks in Bristol closed to commercial uses, through to the designation of the Enterprise Zones and Enterprise Areas, for the conversion of old industrial and storage buildings and derelict land for reuse as incubator and modern office space for new and small creative, digital and high-tech businesses. However, property conversion opportunities in most of Bristol's inner-city areas have now been exhausted, and the relaxation of planning regulations on conversion to residential uses, combined with increased house prices, make it unlikely that many more opportunities will come forward.

11.18. This is at a time when there is strong momentum in the innovation cluster, and the public sector has fewer resources available to invest in creating new space. More creative solutions will be needed to maintain the flow of affordable incubator and grow on space. For example, the retail sector is under pressure. This will lead to some retail property becoming vacant and owners or retailers with long leases looking for alternative uses. This is not straightforward because of the way the property sector works (which means it may be better to keep a property empty and maintain its book value than let it as multi-tenanted space on short leases), but may result in some opportunities.

4: Place making – particularly in north Bristol

11.19. The quality of the urban environment of both Bristol and Bath is outstanding in places and generally good. They are both attractive, liveable cities. Much of the new development over the next 15 years will take place through intensification of use in Bristol. The emerging Joint Spatial Plan makes the point that it will be extremely difficult to deliver enough affordable housing given the need for improved infrastructure. Equally important will be the need to create new, equally liveable places: to the visitor,

north Bristol (sometimes referred to as the "northern fringe") is difficult to understand or admire as "a place". It seems to be a collection of non-descript parts linked by dual carriageways. This may seem unreasonable or controversial, but it appears to be a common perception. Yet the area has a whole series of major assets. Critical to this will be the development of the former Filton Airfield by the Malaysian company, YTL, with the opportunity to create a whole new community with the quality, facilities and connectivity to support the further development of the innovation cluster.

11.20. Also at Filton, aerospace has been of crucial importance to the West of England. However, it has long been functionally separate from other parts of the innovation cluster and we have found little evidence to suggest that this has changed. The establishment of the National Composites Centre and the investment in Bristol and Bath Science Park both ought to be significant in relation to its long-term prospects, but the process of Brexit has clearly introduced a level of uncertainty that would not previously have been anticipated. Aerospace has not, to date, really operated through open innovation models – unlike many other knowledge-based sectors. There are some signs that this might be changing – in which case the NCC and Bristol-Bath Science Park ought to be assets equipping the West of England for further growth. To encourage this process – and to mitigate some of the risks linked to Brexit – the uses to which Filton Airport is put will become critically important.

5: Building specialist skills

11.21. The delegation of the adult education budget to the new West of England Combined Authority gives greater freedom to tailor adult skills provision more specifically to the needs of the innovation cluster and link provision better to education and training for young people, including changes underway in the offer of the four universities. The area is already well endowed with both generic and specialist skills, but to continue to attract investment by major technology corporates and enable rapid growth by local firms, the supply of specialist skills will need to improve. One comment from consultations with firms in particular stands out – *"democratise skills training – you don't need a degree to write code"*. Equally, the extent to which relatively small digital firms are developing their own responses is noteworthy. There is a real need to recognise and support processes of this nature – and the devolution process ought to enable a wider response.

6: Recognising the imperative for more inclusive networks

11.22. Informed by this comment – and also the challenges and opportunities linked to sustaining creative cities more generally – a sixth priority surrounds the need to broaden out networks and networking across the innovation cluster, and to build more inclusive networks. The cluster needs more talented people; but there are areas across both cities that have been excluded from this growth process. Steps need to be taken to link these in more effectively.

11.23. In this context – as noted in both Chapter 4 and Chapter 8 – ventures like Knowle West Media Centre and Bottle Yard Studios are extending the spatial footprint of the innovation cluster into south Bristol. Initiatives of this type need to be encouraged.

11.24. Specific initiatives – and ideally a more deep-seated cultural change – are needed to address the relative exclusion of women and those from black and minority ethnic groups from the networks and opportunities offered by the innovation cluster. Effectively connecting with neglected potential and talent will further boost the creativity and productivity of these sectors locally.

11.25. More generally, greater inclusivity will be achieved when more people – particularly younger ones – can afford to live within Bristol-Bath. A radical approach to housing provision and delivery ought therefore to be seen as a policy initiative to encourage further growth of the innovation cluster.

7: Maintaining and replenishing the collaborative culture

11.26. The area – and Bristol in particular – is renowned for its highly networked, collaborative, open, and (at times) "edgy" and alternative culture. This is a real competitive advantage: it is as good as Cambridge (which is much smaller), and better than London and Oxford (which are more fragmented). Maintaining this advantage is really important, as is ensuring a new generation of 'nodes' (people and places) develops

to supplement (and in some cases replace) the current generation. In particular, the cross-sector networking (such as First Friday at Watershed) is particularly valuable because so many new opportunities develop at the interface between different technology and creative areas.

8: Acknowledging that Bristol and Bath are quite different

11.27. Although they are very close, Bristol and Bath are quite different places, with different strengths and opportunities. Strategic planning for the whole area is important because of the scale of growth expected and the constraints on new development and infrastructure, but there are distinct differences between the business cultures of the two places, and in the range of the people attracted to live and work in each.

11.28. These observations are not new and their consequences have been a matter for much discussion for decades. Almost fifty years ago, the Royal Commission on Local Government in England clearly grappled with precisely the same question. In seeking to carve up the South West province, it commented that: *The main problem was whether to propose one unit or two.*

Bristol, with its suburbs, is a city of over half a million people, the main regional capital... and Bath looks to Bristol for the range and quality of urban facilities (if not for the cultural amenities) which only a very big city can provide. But Bath, with its magnificent architecture, is a historical city, conscious of a strong feeling of independence from Bristol...

In shopping, education, cultural activities and professional services, Bristol and Bath are not only individually strong centres; they are complementary to each other...

We would not propose putting Bath and Bristol together if we thought it would lead to their physical coalescence and to uniformity throughout the area. On the contrary, it should be a main advantage of combining them in the same Unit that a single authority will have the resources and room for manoeuvre to plan the growth of the whole area in the best interests of its different parts"[77] .

11.29. These differences should be celebrated: they provide people with more choice of where to live and work at different stages in their lives. Whilst there are opportunities to grow the innovation cluster across both cities, the scale of opportunity in Bristol is what stands out, and this ought to be recognised locally.

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[77]*Royal Commission on Local Government in England, 1966-1969 (chaired by the Rt Hon Lord Redcliffe-Maud) Volume 1 Report – presented to Parliament by Command of Her Majesty, June 1969 – page 265*

ANNEX A: LIST OF CONTRIBUTORS

A.1.   Many different people have contributed to this study, whether as Steering Group members and/or as consultees. The study was completed between 2016 and 2018, and we would like to acknowledge all the many contributions that have been made. Organisational affiliations (shown below) relate to the time of the consultation; some may have changed subsequently.

Table A-1: List of contributors

Name	Organisation
Silas Adekunle	Reach Robotics
Paul Appleby	VID Communications
Mike Bartley	LEP High Technology Sector Group
Phil Bates	Oracle Bristol
Alan Bayley	Low Carbon South West
Tom Beasley	Bristol and Bath Science Park
Tim Bleszynski	Arnolfini
Prof Martin Boddy	UWE Bristol
Simon Bond	SETsquared Partnership & University of Bath
John Bradford	High Tech Bristol & Bath – Cloud SIG
Dr Neil Bradshaw	University of Bristol
Max Brown	GKN
Dr Philip Brown	University of Bath & Ceryx Medical Limited
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Antony Corfield	West of England Local Enterprise Partnership
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John Durrant	BDH, ex BBC
Alex Earl	ICU
Sarah Edwards	Bristol Crew
Scott Fletcher	Play Nicely
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Gina Fucci	Films@59
Neal Harris	SHOP (Spike Island)
Nic Hemley	Scott Logic
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Mark Howard	Airbus
Prof Jon Hunt	University of Bath
Elaine Jackson	Icon Films
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Prof Jonathan Knight	University of Bath
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Jim Morrison	Deep Blue Sky
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Nick Sturge	Engine Shed
Nigel Toon	Graphcore
Ben Trewhella	Opposable Games
Charlotte Wadsworth	ArthurCox Ltd (Spike Island)
Barry Warburton	IBB
Simon Young	West of England Aerospace Forum

Afterword

This study was led by Chris Green. Sadly, Chris passed away before it was completed. Chris worked at SQW for many years. He was Managing Director of SQW and Chief Executive of SQW Group until 2016, but he also worked as a consultant throughout, specialising in knowledge-based economic growth and links to spatial planning.

Chris was an undergraduate at the University of Bristol, he met his wife there, and he told us of how he spent an undergraduate summer "building the M5". He retained a great affection for, and interest in, the place. In this context, he also said that this study was the project that he had "always wanted to do".

We have had to finish this study without Chris, and we are very grateful for the help and support that we have received, particularly from Professor Martin Boddy who chaired our Steering Group. But we hope the final report is one that would have pleased Chris. Very shortly before he was taken ill, he took part in an SQW away day during which everyone was asked to write down one insight from recent projects that others ought to know about. Chris's "post-it" note simply said: "Bristol/Bath: How important a few individuals are in making clusters work". This report hopefully bears this out.

David Crichton-Miller

CEO, SQW Group