The Cambridge Phenomenon;
An Innovation System Built on Public Private Partnership

Giorgio Caselli, Andy Cosh, Peter Tyler

Abstract: Last year marked what some see to be the 60th anniversary of the ‘Cambridge Phenomenon’, a term that was first coined in a Financial Times article to describe the explosion of knowledge-intensive (KI) businesses in and around Cambridge city since 1960. During this period, Cambridge has grown to become one of the leading technology clusters in the world and is now home to over 30 science parks, including the Cambridge Biomedical Campus – Europe’s largest healthcare and medical research centre. Research by SQW and Kate Kirk and Charles Cotton are but a few examples of the excellent work that is available to date on the Cambridge Phenomenon. However somewhat less research has been published on the business base that makes up the cluster and how it has evolved over time. There has also been relatively less attention given in recent years to how the innovation system has developed, particularly in relation to the way in which the public and private sectors work together. This paper seeks to address these issues. Section one introduces the topic of the paper by positioning the Cambridge phenomenon and the core features of an innovation system. The second section provides a detailed picture of the Cambridge cluster by examining its companies during the last decade. The third section considers how the Cambridge innovation system has evolved in recent years to increase and enhance the benefits from private and public sector collaboration. Finally, the future prospects are drawn in the light of long-term trends together with recent challenges brought by the pandemic around the world.

Keywords: Ecosystem, Cambridge, Cambridge Phenomenon, Cambridge Biomedical Campus, Babraham Research Campus, Centre for Business Research, Innovation, Public Private Sector Collaboration
1. Introduction

Last year marked the 60th anniversary of the ‘Cambridge Phenomenon’, a term that first appeared in an article published by the Financial Times in 1980 to describe the explosion of knowledge-intensive (KI) businesses in and around the city of Cambridge since 1960\(^1\). Once a medieval town with a major academic institution at its heart, over the last 60 years Cambridge has grown to become one of the leading technology clusters in the world. Today it is home to more than 20 science parks, including the Cambridge Biomedical Campus – Europe’s largest healthcare and medical research centre – and is a hotspot for bioscience and computer technology companies. Cambridge also usually ranks amongst the fastest growing cities in the world, partly reflecting the benefits of its location. In addition to being part of the ‘golden triangle’ with London and Oxford, Cambridge represents the Eastern point of the Cambridge-Milton Keynes-Oxford Growth Arc – one of the most productive and prosperous parts of Europe [1].

This article begins in the next section by providing a detailed picture of the Cambridge cluster by examining its companies over the last decade. It draws on the unique methodology developed by Cosh and Caselli at the Centre for Business Research (CBR) to analyse the scale, make-up and growth rate of economic activity in the wider Cambridge region. The article then focuses on how the Cambridge innovation system has evolved in recent years to increase and enhance the benefits from private and public sector collaboration. It focuses specifically on the Life Sciences sector drawing on research undertaken by the authors to assess the economic impact of two important parts of the rapidly developing Cambridge Life Science landscape; namely the Cambridge Bioscience Campus [2] and the Babraham Research Campus [3]. The emphasis is on showing how successful public-private collaboration has enhanced the growth of the business base illustrating the main pathways relating to the provision of finance (direct and indirect), labour market contributions from universities and others, and property market impacts. The evidence points to a substantial economic pay-back from this collaboration. The article concludes by considering future prospects for the Cambridge high technology cluster.

2. The Cambridge Cluster

2.1 The Cambridge Cluster in the making: how did it all come about?

The growth of a world-leading technology cluster in the middle of what is still predominantly an agricultural region is without a doubt a success story. To borrow an expression used in a July

\(^1\) We are grateful to Matthew Bullock for sharing with us the following anecdote on the origin of the term ‘Cambridge Phenomenon’:

*It was coined at the first ever networking meeting which I called in The Eagle in July 1979 which had 19 attendees. After everyone met, we asked how many other tech firms we knew of in the city and tallied up a grand total of 36. This was such a surprising number that we agreed that it was an unexplained phenomenon, a phrase Jack Lang then used in briefing Peta Levi, his cousin, who wrote that article in the FT.*
2016 article by The Guardian, the Cambridge Cluster is “the crown jewel of Britain’s technology sector”. ‘Silicon Fen’, as the area is also dubbed due to its location on the Southern tip of the Fens, is viewed by many as Britain’s answer to Silicon Valley in the US. It is often cited as an exemplar of successful innovation ecosystem, from which to draw lessons about entrepreneurship, business growth and regional development. Therefore, it comes with no surprise that the Cambridge Phenomenon has been able to attract increasing attention over time.

One of the first contributions to explain what was happening in the city where Charles Darwin, Alan Turing and Stephen Hawking completed their studies was a report by Segal Quince Wicksteed (SQW) in 1985 [4]. It traced the genealogy of virtually all of the high-tech businesses in Cambridge back then, identifying in most cases a direct or indirect link with the University of Cambridge and its Colleges. The report was overseen by a committee chaired by Matthew Bullock, an influential figure in the Cambridge Phenomenon who at that time was a local branch manager at Barclays. Interestingly, the SQW report did not project long-term survival for the Cambridge Phenomenon, which became clearer only with the evolution of Life Science companies in the second half of the 1980s alongside the continued growth of high-tech companies. The 1985 report was followed by another study by SQW in 2000 that provided an updated assessment of the Cambridge Phenomenon, revealing a larger and more diverse cluster of businesses with strong international networks [5]. A third SQW report, commissioned by the East of England Development Agency (EEDA) and published in 2011, examined the performance of the Cambridge Cluster and the main constraints to its growth after 50 years since the Cluster came into existence [6].

More recently, the work by Kate Kirk and Charles Cotton has been instrumental in advancing knowledge and understanding of the Cambridge technology cluster. They published two books, The Cambridge Phenomenon – 50 Years of Innovation and Enterprise in 2012 [7] and The Cambridge Phenomenon – Global Impact in 2016 [8], which succeeded in the mammoth task of portraying a comprehensive yet succinct picture of the Cambridge Phenomenon. These books unveil, through a wealth of illustrations and anecdotes, the inside story of the companies and people behind the Cambridge Phenomenon and the contribution that their innovations have made to humanity. A more detailed review of these studies is provided by David Gill, Managing Director of the St John’s Innovation Centre in Cambridge, in the first issue of Innovation & Impact [9].

These and other studies on the history of the Cambridge Cluster tend to concur that it did not originate from an ordered and planned process, but instead developed organically out of ‘creative chaos’. The Cambridge ecosystem has been decades in the making and, although a full account of the different factors that have contributed to its evolution is beyond the scope of this paper, it is possible to identify a number of key elements that have determined its success.

---

2 We would like to thank Charles Cotton and David Cleevely for drawing our attention to this point.
A first element is a series of scientific breakthroughs that established Cambridge as a leader in information technology and computing. A notable example is when Sir Maurice Wilkes and his colleagues at the University of Cambridge’s Mathematical Laboratory (now the Department of Computer Science and Technology) designed and built the Electronic Delay Storage Automatic Calculator (EDSAC), the world’s first fully functional stored-program computer. Although the EDSAC was slower than other computers being developed at the time, Sir Maurice Wilkes opted for a simple design to enable his computer to have the widest possible practical applications. After performing its first calculations on 6th May 1949, the EDSAC was quickly adopted by the wider University and supported the work of researchers in a range of disciplines – including Nobel Prize winners Sir John Kendrew and Dr Max Perutz (Chemistry, 1962), Sir Andrew Huxley (Medicine, 1963) and Sir Martin Ryle (Physics, 1974). These achievements have been continuing through the leadership of Professor Andy Hopper, former Head of the Department of Computer Science and Technology who also co-founded over a dozen spin-offs and start-ups, including Acorn Computers, Olivetti Research Laboratory and Real VNC.

Along with these scientific breakthroughs, at the heart of the Cambridge Phenomenon is the founding of several technology consultancies such as Cambridge Consultants, Sagentia (formerly known as Scientific Generics), The Technology Partnership (TTP) and PA Consulting. Cambridge Consultants, one of the UK’s first technology-transfer companies, was founded in 1960 in then Ram Yard, a narrow alley next to the Round Church. It was set up by three Cambridge University graduates to “put the brains of Cambridge University at the disposal of the problems of British industry”. A number of today’s successful companies in the Cambridge information technology ecosystem have links stretching back to Cambridge Consultants, for example Domino Printing Sciences and Xaar.

A third element was a change in the local authorities and University of Cambridge’s attitude towards industrial development in the city. Whilst IBM’s request to come to Cambridge was declined by the County Council in 1965, the city local authorities’ opposition to industrial development in and around the historic city of Cambridge ceased in the late 1960s. Local planners revisited their policies after a commission led by Sir Nevill Mott, then head of the Cavendish Laboratory, published a report (known as the Mott Report) in 1969 calling for a radical shift in the attitude towards industrial development [10]. All this was happening only a couple of years after the Ministry of Technology decided to establish the CADCentre in Cambridge, which led to a cluster of computer-aided design (CAD) companies in the city including Shape Data, Cambridge Interactive Systems and Applied Research of Cambridge. The Mott Report paved the way for a new era of collaboration between the private sector and academia, for example through the creation of the Cambridge Science Park by Trinity College in 1970 under the guidance of Dr John Bradfield, Senior Bursar. The foundation of the Cambridge Science Park, based on a concept developed in the US during the 1950s and the oldest science park in the UK, is often credited with kicking off the Cambridge Phenomenon. The St John’s Innovation Centre followed in 1987 to provide accommodation for young entrepreneurial companies. Some 10 years later, the then vice-chancellor of the University, Lord Alec Broers, encouraged greater cross-fertilisation of ideas between academia and industry. He persuaded international tech giants such as Microsoft to take premises alongside
start-ups and research institutions based in the city, laying the foundations for what may be viewed as the second start of the Cambridge Phenomenon.3

Over the years, the University of Cambridge has been playing a major role in the Cambridge Phenomenon. With over 100 affiliates having been awarded the Nobel Prize since 1904, the University has been the place where a number of scientific discoveries that have revolutionised our world and made Cambridge famous globally first happened. Perhaps the most celebrated of all is the discovery of the structure of DNA by Dr James Watson, Dr Rosalind Franklin and Dr Francis Crick in 1953, followed by the development of a new approach to DNA sequencing in 1997 through the pioneering work of Professor Shankar Balasubramanian and Professor David Klenerman. Professor Balasubramanian subsequently co-founded Solexa, later acquired by Illumina in 2006 for $650m, to provide fast, low-cost gene sequencing.

Besides contributing some of the greatest inventions of all time, there are numerous examples of start-ups that spun out of the University of Cambridge in order to commercialise an idea that was initially developed as part of academic research. Among these companies are Kalium Health, PharmEnable, PolyProx Therapeutics, Qkine and Sano Genetics.4 Financial and other support has been provided to start-ups via Cambridge Enterprise, the commercialisation arm of the University of Cambridge, and Cambridge Innovation Capital, a venture capital firm established with the support of the University that invests in intellectual property-rich companies. The University has also been supplying a continuous pool of talent for these start-ups and other businesses in the Cambridge Cluster to draw upon. A recent report by research consultancy and software company Beauhurst with the Royal Academy of Engineering [11] revealed that the ‘golden triangle’ of Cambridge, London and Oxford dominates the UK’s start-up scene, with four institutions (i.e. Oxford, Cambridge, Imperial and UCL) contributing one-third of all academic spin-outs in the country – mostly in the pharmaceutical sector.

Another element that has made it possible for a high-tech cluster to develop in what still remains primarily a university town has been the availability of capital for companies to grow. Among the main investors that have contributed to the establishment of the Cambridge Cluster as we know it today is Cambridge Angels [12], a leading Cambridge-based business angel network of more than 60 high-net-worth investors made up mostly by successful entrepreneurs. Cambridge Angels, which was founded by Robert Sansom and David Cleeevely in 2001, has been investing in start-up and scale-up businesses dealing primarily with technology, internet, software and hardware. Its members, who act as the ‘Lead Angels’ for all Cambridge Angels that have decided to invest in a particular company, are behind many of the success stories that we have heard about the Cambridge Phenomenon in recent years. Another investor that has been particularly active in the Cambridge landscape over the last couple of decades is Amadeus Capital Partners [13], a venture capital firm investing in high-technology companies across a variety of sectors. Founded by Anne Glover and Hermann Hauser in 1997, it has backed

---

3 We are grateful to David Gill for pointing this out.

4 Stories of Kalium Health, PharmEnable, Qkine and Sano Genetics stories are presented in this issue of the Innovation & Impact.
over 130 companies and raised more than $1bn investment since then. Similarly, IQ Capital Partners was established by Nigel Brown, Ed Stacey, Max Bautin and Kerry Baldwin in 2006 with the aim of investing in early stage technology businesses. Its investments, many of which have a close link to innovation originating in Cambridge, resulted in exits including trade sales to Oracle, Google and Apple. Other examples of venture capital firms that have invested in Cambridge companies are New Enterprise Associates (NEA) [14], Oak Investment Partners [15] and 3i Group [16].

Cambridge-based companies have also been able to attract funding from a wide range of other world-leading life science and technology investors. Key examples include IP Group [17], Atlas Venture [18], M Ventures [19], SV Health Investors [20] and Index Ventures [21]. According to Tech Nation [22], Cambridge is 2nd in the UK after London and 9th in Europe for venture capital investment into tech companies throughout the 2014-2019 period. Data from Beauhurst [23] also show that high-growth start-ups in Cambridge have received £4.6bn through over 1,300 fundraisings since 2011. The figure that is perhaps most revealing is the number of $1bn companies that have been created in Cambridge since the start of the Phenomenon. The recent acquisition of pharmaceutical company Kymab, initially spun out of the Wellcome Sanger Institute, by Sanofi for $1.45bn brought the number of Cambridge-based companies reaching a $1bn valuation to a total of 20.5

Equally important for the success of the Cambridge Phenomenon has been the high degree of entrepreneurialism distinguishing many of the central figures in the Cluster, together with a culture strongly anchored on collaboration and sharing of ideas. It is often said about Cambridge that its “people go out of their way to be helpful”. This culture of mutual support has been nurtured by a number of membership organisations established in Cambridge over the years. Among the first was Cambridge Network [24], which brings together people from business and academia to exchange ideas and encourage collaboration within the technology sector. It was co-founded by an influential group comprising David Cleevely, one of the most active entrepreneurs in the Cambridge scene, and Nigel Brown, former chairman of financial services company NW Brown and recipient of the Queen’s Award for Enterprise Promotion in 2007 for his central role in supporting the growth of the Cambridge Cluster. Other prominent examples include One Nucleus [25], a not-for-profit organisation supporting companies, institutions and individuals in life sciences and healthcare, and Cambridge Wireless [26], an active community of over 1,000 Information and Communication Technologies (ICT) companies also co-founded by David Cleevely.

5 The 20 Cambridge-based companies that reached the $1bn threshold are the following (in alphabetical order): Abcam, Arm, Autonomy, AVEVA, Blinkx, Cambridge Antibody Technology, Cambridge Silicon Radio, Chiroscience, CMR Surgical, Darktrace, Domino Printing Sciences, Frontier Developments, Improbable, Ionica, Kymab, Marshall of Cambridge, ProMetic, Solexa, Virata and Xaar. The list also includes companies that are no longer in operation since they were acquired by another company. Along with these 20 companies, there may be others that do not qualify because they have not yet floated or been acquired.
2.2 The Cambridge Cluster today: making sense of ‘creative chaos’

Starting with the seminal study by SQW in 1985 [4], there has been a continued interest by researchers and other commentators in quantifying the scale of the Cambridge Cluster and understanding its key parts. The work of Cosh and Caselli at the Centre for Business Research of the University of Cambridge makes us well positioned to provide a detailed picture of the Cambridge Cluster 60 years after the first technology consultancies were formed [27-29].

Since the project group’s formation in late 2014, the Centre for Business Research has been concerned with establishing an accurate and accessible source of information on the scale, make-up and growth rate of economic activity in the Cambridge region. The Centre was initially commissioned by Cambridge Ahead [30], a business and academic member organisation dedicated to the sustainable growth of the city region, to create a dashboard to monitor business growth in and around Cambridge. Taking the original Cluster Map developed by Sherry Coutu and Trampoline Systems as the point of departure, the Centre extended the coverage to companies of any sector and size and devised a unique growth measurement methodology to keep the dashboard up to date. The Cluster Map (now part of Cambridge Cluster Insights), which is refreshed on a regular basis and is updated with wholly new data annually, currently covers ten years of data for over 26,000 businesses in the Cambridge city region and the wider Cambridgeshire and Peterborough area. CBR data and analyses have also been informing local economic development and planning, including the Cambridgeshire and Peterborough Independent Economic Review (CPIER), the Local Industrial Strategy and the Greater Cambridge Local Plan.

The CBR latest annual draw, which covers the period up to the start of the March 2020 Covid lockdown, portrays a picture of a vibrant and expanding KI community in the city region. The Cambridge Cluster is home to some of the UK’s most innovative businesses, with many employment concentrations in fast-growing sectors such as life sciences, ICT, advanced manufacturing and agri-tech. These sectors have been identified in local strategic documents, including the CPIER and the Local Industrial Strategy, as strategic sectors for further development. Figure 1 provides a breakdown of total employment and total turnover by sector for Cambridge-based companies in 2019-20. The number of companies, together with their total employment and turnover, in each sector at the start and end of the decade is reported in Appendix A.

6 Cambridge Cluster Insights can be accessed at the following link: https://www.cambridgeahead.co.uk/cambridge-cluster-insights/.

7 The underlying core corporate database has been maintained with the ongoing support of Cambridge Ahead, and is currently sponsored by Arm, Marshall of Cambridge and the Cambridgeshire and Peterborough Combined Authority.

8 Cambridge-based companies are incorporated companies and limited liability partnerships (LLPs) that have either their primary trading address or registered office (unless their primary trading address is identified as elsewhere) within a 20-mile radius of the centre of Cambridge (i.e. Great St Mary’s). A detailed list of narrow sectors included in each broad sector is available from the authors on request.
Figure 1. Total employment and total turnover of Cambridge-based companies by sector in 2019-20. Source: Cosh & Caselli, CBR.

Figure 1 shows that knowledge intensity in Cambridge has remained high over time, increasing from 33.3% to 37.5% during the last decade when measured in terms of turnover. ‘Information
technology and telecoms’, with almost 22,000 employees and £4.8bn turnover, and ‘Life science and healthcare’, with more than 20,500 employees and £6.5bn turnover, are the largest KI sectors in Cambridge. These two sectors have a long and illustrious history of creating some of the most successful companies in the UK.

Sir Greg Winter, former Master of Trinity College who was awarded the Nobel Prize in Chemistry in 2018, invented the first humanised monoclonal antibody in 1986. He then co-founded Cambridge Antibody Technology (CAT) in 1989, which developed the first fully human monoclonal antibody blockbuster drug, Humira, in 2006. CAT was acquired by AstraZeneca for $1.3bn in that same year. Over the years, the ‘Life science and healthcare’ sector in Cambridge has seen a series of other innovative companies contributing to its fortunes. Key examples include: Abcam, a global supplier of biological research tools to life scientists and one of the best examples of the ‘creative chaos’ that has been shaping the Cambridge Phenomenon, since it was founded as a result of a chance meeting; CMR Surgical, a leading medical technology company that produces a next-generation robotic surgery system, Versius, used by a number of NHS hospitals across the country; Illumina (formerly Solexa), a global leader in DNA sequencing and array-based technologies; Kymab, a clinical-stage biopharmaceutical company, that develops novel human antibody-based therapeutics.

The expansion of the Cambridge Life Science cluster also received a boost when AstraZeneca, one of the largest pharmaceutical companies in the world already employing over 3,600 employees in Cambridge, decided to move its corporate headquarters and global R&D Centre to the Cambridge Biomedical Campus. AstraZeneca is due to begin moving into its new $500m-plus headquarters in 2021, following a 2020 that has been in many ways an exceptional year for the company. Despite the challenges posed by the Covid-19 pandemic, AstraZeneca has posted strong full-year results while producing its Covid-19 vaccine together with Oxford University.

In turn, the ‘Information technology and telecoms’ sector in Cambridge comprises some of the UK’s best-known ICT companies. These include: Arm, a spin-out of Acorn Computers and the world’s leading semiconductor intellectual property supplier, which saw a record 6.7bn chips being shipped by its silicon partners in the final quarter of 2020; Aveva, a leading engineering and industrial software provider whose origins trace back to the CADCentre; Raspberry Pi, a charitable foundation and an award-winning developer of a cheap, credit-card sized computer that is one of the best-selling computers in the world; Darktrace, a world-leader in cyber security that, after being founded in 2013 by mathematicians from the University of Cambridge, is targeting a London IPO during the first half of 2021 expected to value the business at £4bn. The city is also home to famous game studios such as Frontier Developments, a video game

---

9 We wish to thank David Cleevely for making this point.

10 Abcam story was covered in the first issue of the Innovation & Impact. Current issue includes the story of Illumina.

11 As noted to us by David Cleevely, AstraZeneca have also striven to embed themselves in the networks that exist in the city, probably more than any other company.
developer that has produced several games in the Elite series, and Jagex, a multi-award winning games developer of tens of online titles (including RuneScape).

Alongside these homegrown companies, a number of international tech giants have opened offices in Cambridge. Just outside the railway station, Amazon staff have been designing flying drones at Amazon Cambridge Development Centre, while some meters away Microsoft Research Cambridge has been developing computer chips for Artificial Intelligence (AI). In close proximity to Amazon and Microsoft, next to the Cambridge University Botanic Garden, Apple has been advancing Siri, the talking digital assistant included in Apple’s smartphones. These tech giants have also been actively looking for innovative start-ups originated in Cambridge to acquire. In many cases, these tech giants have subsequently grown that acquisition and used it as a major base for expansion and investment. For example, Amazon acquired Cambridge-based EVI Technology in 2012 as part of its effort to build the Alexa digital assistant. In a similar vein, VocalIQ, a voice recognition technology start-up founded by Professor Steve Young, was acquired by Apple in 2015 to further improve its Siri technology.

The successes achieved by Life Science and ICT companies in Cambridge meant that they have often been the target of notable acquisitions. Some examples include Domino Printing Sciences, which was founded in 1978, floated in 1985 and sold to Brother Industries for £1bn in 2015; Autonomy, which was founded in 1996, listed in 1998 and sold to HP for $11bn in 2011; Cambridge Silicon Radio (CSR), which was founded in 1998, floated in 2004 and sold to Qualcomm for $2.4bn in 2015. The recent acquisitions of Kymab by Sanofi for $1.45bn and of Arm by NVIDIA for $40bn, which is a special case given the strategic importance of Arm for the local and national economy, are but the latest examples of a long list of acquisitions. Although concerns have been raised by some – including leading entrepreneur and Arm co-founder Hermann Hauser – that this practice of ‘selling the crown jewels’ may not do any good to the Cambridge and UK’s technology industry, these acquisitions testify to the appetite that exists for Cambridge-based companies.

The dynamic nature of the Cambridge Cluster is apparent if one compares the 2019-20 figures with earlier assessments of the KI business base in and around the city. The first report on the Cambridge Phenomenon published by SQW in 1985 identified about 300 high-tech businesses in Cambridge [4]. The data for 2019-20 reveal that the Cluster is now home to over 5,000 KI businesses – a sizeable increase. Over time there has also been a change in the employment structure of the Cluster. While a limited number of large companies tended to dominate employment until the 1990s, the last 20 years have witnessed a rise in the number of small and medium-sized businesses – accompanied by a constant flow of businesses that started up during this period. ‘Education, arts, charities, social care’ and ‘Construction and utilities’ are among the largest non-KI sectors in the area and have both benefited from the expansion of

---

12 As observed by David Cleevely, this practice might be seen as ‘inward investment’ but it is different from the kind of inward investment that one would see in other parts of the UK. It is also critically dependent on networks rather than just a search for interesting companies, in that these acquisitions are the product of networking and the exchange of information.

13 At the time of writing, Arm’s acquisition by NVIDIA is under review by antitrust regulators.
the Cambridge KI economy over time. A striking feature of the Cambridge city region is also the large size of its manufacturing sector, which counts over 37,000 employees if high-tech and non-high-tech manufacturing are considered together.

Contributing to the vibrancy of Silicon Fen is a multitude of non-corporate KI research organisations operating alongside the corporate sector. At the last count, over 37,000 staff were employed at universities and other KI research organisations in the area, making the Cambridge Cluster one of the largest and most dynamic concentrations of KI organisations in Europe. Among these organisations are some institutions that are at the forefront of biomedical research, including the MRC Laboratory of Molecular Biology (biological processes at the molecular level), the Wellcome Sanger Institute (genomic research), the Babraham Institute (immunology) and Addenbrooke’s Hospital (medical education and research).

The speed at which the Cambridge Cluster has evolved in recent years is best understood by examining the growth of its business base over time. Figure 2 compares sectors according to their employment and turnover growth throughout the last decade. The chart shows faster growth the further away from the origin a bubble is located.

**Figure 2.** Employment and turnover growth of Cambridge-based companies by sector between 2010-11 and 2019-20. Note: The size of each bubble is proportionate to the number of employees in 2019-20 on a continuous scale. Bubbles with an outline identify KI sectors. Source: Cosh & Caselli, CBR.

The two largest KI sectors making up the Cambridge Cluster, ‘Life science and healthcare’ (orange bubble with an outline) and ‘Information technology and telecoms’ (blue bubble with
Innovation & Impact 2021

12

an outline), have been among the fastest growing sectors over the last decade. The number of staff employed in these sectors has grown by 8.4% pa compared with a rate of 6.3% pa across the whole Cambridge economy. In turn, total turnover of Life Science and ICT companies almost trebled during the period, increasing from £3.8bn in 2010-11 to £11.3bn in 2019-20. These results indicate that the KI economy in Cambridge has performed well over recent years, growing faster than the national economy. Among non-KI sectors, growth has been remarkable in ‘Education, arts, charities, social care’ (light blue bubble without an outline) and ‘Other services’ (green bubble between the ‘Life science and healthcare’ and ‘Information technology and telecoms’ bubbles – e.g. hospitals). However, a caveat must be made with regard to the considerable increase in size of ‘Education, arts, charities, social care’, since it partly reflects transfers of employees in state schools to newly incorporated academies (and the subsequent consolidation of those academies) rather than new employment.

There is also evidence that the Cambridge Cluster provides a fertile ground for high-growth businesses. A recent study conducted by the authors in collaboration with Metro Dynamics identified a total of 210 scale-up and other high-growth businesses in the Cambridgeshire and Peterborough Combined Authority area [28]. It revealed that these businesses tend to be more prevalent among KI sectors, particularly in ‘Life science and healthcare’ (where approximately 63 out of 1,000 companies are high-growth businesses). In the words of Dr Andy Richards, founder of Chiroscience, founding member of Cambridge Angels and Chairman of Babraham Bioscience Technologies and other companies, Cambridge is “a safe place to do risky things”. This is reflected in the myriad of start-ups that have emerged in the Cluster over the years, including the instructive case studies that are presented later in this issue.

2.3 The geography of the Cambridge Cluster: location matters

It emerges from our analysis of the evolution of the Cambridge Cluster that, despite the challenges associated with limited transport infrastructure and spiralling house prices, a growing number of KI companies have regarded the city region as an attractive location to do business. The geography of Silicon Fen is best captured through a series of maps showing how the location of companies differs across sectors and over time. These maps allow for an up-to-date analysis of the nature of the individual clusters that have been contributing to the success of the Cambridge Phenomenon and their pattern of growth in recent years. This sub-section focuses on Life Sciences and ICT as two of the sectors that drive innovation in the ecosystem and that tend to benefit more from companies being co-located with one another.

Figure 3 depicts the location of Cambridge-based companies operating in ‘Life science and healthcare’. The maps plot the location of companies at the start and end of the observation period, allowing for any changes in location due to companies relocating their operations, starting up or being discontinued during the period to be captured. Each bubble identifies a company and is sized by the number of employees in 2019-20. The callout boxes provide the

---

14 The location of each company for mapping purposes was taken to be the postcode of its primary trading address.

15 The maps were created using some of the Power BI tools underpinning Cambridge Cluster Insights. 2014-15 is the first year for which we hold information on companies’ location.
names of some of the main business and science parks in the Cambridge Cluster with a strong concentration of Life Science companies.

Figure 3. Location of Life Science companies based in the Cambridge Cluster. Note: The size of each bubble is proportionate to the number of employees in 2014-15 and 2019-20. Source: Cosh & Caselli, CBR.

It is evident from Figure 3 that Cambridge-based companies operating in ‘Life science and healthcare’ tend to co-locate with other similar companies in a process known as ‘agglomeration’. Being located in close proximity to fellow Life Science companies and other research organisations opens up a number of opportunities for these companies, including
access to a rich pool of talent, availability of specialised biotech investors and transfer of tacit knowledge. There is evidence that Life Science companies are concentrated near the city centre and around some of the main business and science parks in the area. A prominent example is the Cambridge Biomedical Campus, which is home to AstraZeneca, the MRC Laboratory of Molecular Biology and a number of state-of-the-art hospitals, including Addenbrooke’s Hospital and the new Royal Papworth Hospital. Other parks with noticeable concentrations of Life Science companies are the Babraham Research Campus, Cambridge Science Park, Granta Park and Wellcome Genome Campus.

Figure 3 reveals that the Cambridge Life Science cluster has grown over time in at least two important ways. First, through the considerable growth of companies that have been based in the area since the start of the period, as indicated by the larger size of many of the bubbles in 2019-20 relative to 2014-15. Second, through the companies that either started up or relocated to the area in any of the following years, which is captured by the higher number of bubbles in 2019-20 compared with 2014-15. This evidence suggests that the Cambridge Life Science cluster has been able to attract new and growing companies over time. This trend has resulted in the rapid expansion of several of the Life Science parks in the area, including Chesterford Research Park south-east of Cambridge near Saffron Walden – now home to Charles River Discovery, Cambridge Epigenetix and Axol Bioscience.

The location of Cambridge-based companies operating in ‘Information technology and telecoms’ is shown in Figure 4. The callout boxes give the names of some of the main business and science parks in the Cluster with a high concentration of ICT companies.

A first agglomeration of ICT companies is found on the North West edge of Cambridge city around Castle Park, Huntingdon Road and Madingley Road. This agglomeration includes some fast-growing and innovative companies such as Aveva and Amazon’s EVI Technologies. Two of the business and science parks with a long history of attracting ICT companies, namely Cambridge Science Park and the St John’s Innovation Centre, still emerge as prominent locations for companies operating in this sector. Cambridge Business Park, comprising 12 modern office and technology buildings amounting to 325,000 sq. ft, is another of the parks located in close proximity to these two centres that also shows a strong concentration of ICT companies.

Besides these concentrations, our results suggest that the number of Life Science and ICT companies taking business units along the North-West Cambridge corridor – the triangle stretching from North West Cambridge to the A1, delimited by the new A14 and the old Huntingdon road/A1307 in the North and the A428 in the South – has increased over time [29]. It is possible that these companies are seeking to extend their relationship with Cambridge outwards, maintaining reasonable connections with the city while benefitting from shorter travel times and lower costs, along with preparing for potential opportunities associated with the Arc. A case in point is Cambourne Business Park off the A428, which after several years of low take-up has now become a prominent location for Life Science and ICT companies. There is evidence that the number of companies located near Cambourne, and particularly on Cambourne Business Park, has increased considerably over recent times, following an upgrading of the A428. For example, Carl Zeiss moved out of Cherry Hinton and took up new
premises on Cambourne Business Park in 2019 due to fast business growth. The park is also host to a rich group of ICT companies comprising Amino Communications, Global Graphics Software and Netcracker.

Figure 4. Location of ICT companies based in the Cambridge Cluster. Note: The size of each bubble is proportionate to the number of employees in 2014-15 and 2019-20. Source: Cosh & Caselli, CBR.

In turn, the CBR data tends to show that, despite some noticeable concentrations around the major centres within the local region, the location of non-KI companies is generally somewhat more scattered relative to companies operating in KI sectors [29]. There are also signs that non-KI businesses are finding conditions in Cambridge less attractive. Over the years, the impact on employment of companies moving out of the city region has exceeded that of those moving in – making employment growth 1% less on average over the last four years. This evidence
suggests that some non-KI companies might be responding to the rising cost of premises and labour in Cambridge, along with the relatively limited agglomeration benefits that typically exist among non-KI sectors. A parallel trend has been the rapid expansion of the East Cambridgeshire economy (+6.8% employment growth for non-KI sectors in the last year), partly reflecting the expanding economic impact of the Cambridge economy.

While being home to two vibrant Life Science and ICT clusters, Cambridge features FinTech companies and is becoming, together with London, a hotspot for AI companies. Alongside Darktrace, the first company to develop an AI system for cyber security, key examples include: Five AI, a leading developer of software for driverless vehicles; Secondmind (formerly ProwlerIO), founded in 2016 with the aim of applying practical machine-learning research to help people make decisions; Fetch.ai, which is building a machine learning network for tomorrow’s digital economy; Cambridge Quantum Computing, a global leader in quantum software and computing with a focus on quantum chemistry, quantum machine learning and quantum cybersecurity. Following the advantages that AI brings to drug discovery and development, an increasing number of companies are working at the intersection of AI and pharmaceutical research. A major example is BenevolentAI, a global leader in the application of AI for drug discovery and development, which has research facilities on the Babraham Research Campus. Contributing to the explosion of the AI sector in Cambridge is Samsung’s decision to open a new AI research centre in the city. Headed by Professor Andrew Blake and based near other international tech giants such as Amazon and Microsoft, the centre employs some 150 researchers, engineers and other staff. In recent years, AI has also been gaining increasing attention as a subject of study and research by the two universities that are based in the city, the University of Cambridge and Anglia Ruskin University. For example, the University of Cambridge has recently announced the appointment of the first DeepMind Professor of Machine Learning and the launch of the UK’s first Master’s degree in the responsible use of AI, which is led by the Leverhulme Centre for the Future of Intelligence – an interdisciplinary research centre based at the University of Cambridge. At the same time, Anglia Ruskin University was among the first universities in the UK to offer a number of courses aimed at closing the AI skills gap, including a BSc in Artificial Intelligence and an MSc in Intelligent Systems and Machine Learning.

2.4 The role of business and science parks: clusters within the Cluster

A healthy degree of competition exists not only among Cambridge-based companies to attract top talent, but also among the business and science parks located in the Cluster to draw in companies. While offering an attractive working environment and a range of support services, the parks tend to facilitate interactions among the companies and other research institutions that are located on them. Since the creation of Cambridge Science Park in 1970, business and science parks have increased in number and have become one of the distinguishing features of the Cambridge Cluster. The remainder of this section provides an overview of the main business and science parks in the Cluster, building on some unique data on parks that are held by the authors at the CBR.

As part of a piece of research commissioned by Cambridge Ahead and Huntingdonshire District Council in 2020 [29], we identified over 80 business and science parks located in the North-
West Cambridge corridor across Huntingdonshire. We then established which companies were based on these parks and recorded key information including their size, sector, age and financing. For our main analysis, we selected 19 of these parks based on their quantitative significance, the proportion of KI companies on the park and a location of interest for our study.

Table 1. Comparison of companies on business and science parks in and around Cambridge [29].

<table>
<thead>
<tr>
<th>BUSINESS &amp; SCIENCE PARKS</th>
<th>Number of companies in 2020</th>
<th>% of companies in KI sectors</th>
<th>Average age in Years</th>
<th>Average number of employees</th>
<th>Total number of employees</th>
<th>% Employment Latest Year</th>
<th>Life Science</th>
<th>ICT</th>
<th>Employee growth %pa in last 3 years</th>
<th>Total R&amp;D spend in last 3 years</th>
<th>Total R&amp;D spend in last 3 years</th>
<th>In last 3 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Babraham Research Campus</td>
<td>54</td>
<td>94%</td>
<td>7.2</td>
<td>29.2</td>
<td>1,575</td>
<td>90%</td>
<td>0%</td>
<td>9%</td>
<td>314,486</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cambourne Business Park</td>
<td>30</td>
<td>63%</td>
<td>15.7</td>
<td>69.3</td>
<td>2,079</td>
<td>14%</td>
<td>40%</td>
<td>2%</td>
<td>147,969</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cambridge Biomedical Campus</td>
<td>2</td>
<td>100%</td>
<td>24.0</td>
<td>2,227.5</td>
<td>4,455</td>
<td>100%</td>
<td>0%</td>
<td>20%</td>
<td>235,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cambridge Research Park</td>
<td>10</td>
<td>80%</td>
<td>14.5</td>
<td>93.8</td>
<td>938</td>
<td>60%</td>
<td>5%</td>
<td>20%</td>
<td>54,076</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cambridge Science Park</td>
<td>77</td>
<td>84%</td>
<td>15.7</td>
<td>95.9</td>
<td>7,385</td>
<td>35%</td>
<td>28%</td>
<td>3%</td>
<td>1,092,373</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chesterford Research Park</td>
<td>18</td>
<td>89%</td>
<td>12.5</td>
<td>127.3</td>
<td>2,291</td>
<td>99%</td>
<td>0%</td>
<td>20%</td>
<td>104,559</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Granta Park</td>
<td>16</td>
<td>94%</td>
<td>25.1</td>
<td>249.9</td>
<td>3,999</td>
<td>74%</td>
<td>6%</td>
<td>6%</td>
<td>1,286,539</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harston Mill</td>
<td>9</td>
<td>89%</td>
<td>16.8</td>
<td>73.6</td>
<td>662</td>
<td>1%</td>
<td>31%</td>
<td>3%</td>
<td>171,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>St John’s Innovation Centre / Park</td>
<td>156</td>
<td>56%</td>
<td>10.4</td>
<td>16.5</td>
<td>2,569</td>
<td>4%</td>
<td>60%</td>
<td>23%</td>
<td>176,978</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wellcome Genome Campus</td>
<td>6</td>
<td>100%</td>
<td>10.0</td>
<td>197.5</td>
<td>1,185</td>
<td>100%</td>
<td>0%</td>
<td>3%</td>
<td>109,471</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buckingway Business Park</td>
<td>26</td>
<td>62%</td>
<td>21.8</td>
<td>47.3</td>
<td>1,230</td>
<td>3%</td>
<td>12%</td>
<td>6%</td>
<td>17,850</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cambridge Business Park</td>
<td>63</td>
<td>29%</td>
<td>11.9</td>
<td>40.0</td>
<td>2,519</td>
<td>0%</td>
<td>54%</td>
<td>0%</td>
<td>1,042,960</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cambridge Commercial Park</td>
<td>20</td>
<td>35%</td>
<td>21.0</td>
<td>128.9</td>
<td>2,578</td>
<td>0%</td>
<td>2%</td>
<td>2%</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cambridge Innovation Park</td>
<td>194</td>
<td>78%</td>
<td>4.1</td>
<td>9.4</td>
<td>1,821</td>
<td>1%</td>
<td>2%</td>
<td>4%</td>
<td>1,036</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ermine Business Park</td>
<td>39</td>
<td>26%</td>
<td>13.5</td>
<td>196.6</td>
<td>7,667</td>
<td>0%</td>
<td>9%</td>
<td>4%</td>
<td>46,335</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lancaster Way Business Park</td>
<td>48</td>
<td>21%</td>
<td>17.1</td>
<td>43.4</td>
<td>2,083</td>
<td>2%</td>
<td>3%</td>
<td>6%</td>
<td>4,957</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minerva Business Park</td>
<td>115</td>
<td>12%</td>
<td>12.7</td>
<td>12.3</td>
<td>1,419</td>
<td>0%</td>
<td>11%</td>
<td>6%</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vision Park, Histon</td>
<td>113</td>
<td>24%</td>
<td>8.4</td>
<td>31.8</td>
<td>3,591</td>
<td>24%</td>
<td>4%</td>
<td>8%</td>
<td>332,967</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Westbrook Centre</td>
<td>8</td>
<td>75%</td>
<td>15.9</td>
<td>226.3</td>
<td>1,810</td>
<td>0%</td>
<td>11%</td>
<td>16%</td>
<td>26,383</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1,004</td>
<td>54%</td>
<td>11.1</td>
<td>51.6</td>
<td>51,856</td>
<td>33%</td>
<td>15%</td>
<td>7%</td>
<td>5,164,940</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Cosh & Caselli, CBR.

Table 1 summarises the main business and science parks that are situated in and around Cambridge. The table includes indicators of size (e.g. number of companies and total employment) and specialisation (e.g. % of companies in KI sectors and % of employment in the Life Science sector). The upper half of the table shows parks with a high degree of knowledge intensity, particularly in ‘Life science and healthcare’, whilst the lower half of the table includes parks that tend to host primarily non-KI companies.
The 19 parks selected for further study include more than 1,000 companies, over half of which are operating in KI sectors. On average, these companies have 11 years of age and a little over 50 employees. Taken together, companies located on these parks employ almost 52,000 people, accounting for over a fifth of all staff employed by Cambridge-based companies. Importantly, these parks have contributed over £5bn R&D expenditure and more than £6bn fundraising during the past three years.

The parks listed in Table 1 have been separated into two groups; the first ten, which are characterised by a high proportion of KI companies and/or significant R&D expenditure, and the other nine. Employment growth among the first group of parks has been high in general, with total employment of these 378 companies reaching 27,138 in 2019-20. The parks in the lower half of the table have 626 companies that employ 24,718 people. The number of people employed by these companies grew by 6.0% pa over the past three years in comparison with 9.5% pa for those in the upper half of the table. The two groups of parks also differ in terms of R&D spending. The parks in the upper half of the table show considerably higher levels of R&D spending and much higher proportions of companies on the park carrying out R&D over the last three years. The expenditure on R&D by companies on these parks has been £3.7bn during that same period, substantially higher than the £1.5bn spent by companies located on parks in the lower half of the table.

Significant differences also exist across parks in the upper half of the table. The Life Science parks are: Babraham Research Campus, Cambridge Biomedical Campus, Chesterford Research Park, Granta Park and the Wellcome Genome Campus. The benefits of clustering are felt most strongly in this important sector, which tends to dominate in terms of R&D spending and fundraising. Over the last three years, the Life Science companies on these parks spent £3.1bn on R&D (61% of the R&D across all sectors) and raised £5.0bn (83% of the fundraising across all sectors). This was achieved despite representing only 15% of companies and 33% of employment across all the business and science parks. In turn, the parks with 30% or more of their companies and employment in the ICT sector are: Cambourne Business Park, Harston Mill and St John’s Innovation Centre. Cambridge Research Park and Cambridge Science Park have a more balanced portfolio of companies across KI sectors.

A number of the Life Science parks are characterised by the co-location of private-sector companies with research organisations. One of the best examples is the Wellcome Genome Campus, situated in the village of Hinxton approximately 9 miles south of Cambridge. At its heart sits the Wellcome Sanger Institute, named after the British scientist who, like only a handful of other scientists, won the Nobel Prize twice. The Wellcome Sanger Institute, which was established in 1993, is the place where Sir John Sulston and his colleagues made an instrumental contribution to sequencing the human genome as part of the Human Genome Project. In close proximity to the Wellcome Sanger Institute is the European Molecular Biology Laboratory’s European Bioinformatics Institute (EMBL-EBI). Founded in 1994, EMBL-EBI is an international governmental organisation providing data services and training to help scientists realise the potential of ‘big data’ in the biological sciences. Next to these world-leading research
institutions is the BioData Innovation Centre, an incubator for genomics and biodata businesses including Congenica, Eagle Genomics and SciBite.

Another major example of a park where Life Science companies co-exist alongside established research institutions is the Babraham Research Campus. Located on over 430 acres in a parkland environment 6 miles south-east of Cambridge, the Campus is home to the Babraham Institute, a world-class research institution with an emphasis on healthy ageing through the human lifecycle. Operating alongside the Babraham Institute are over 60 bioscience companies, some of which have already successfully floated such as Abzena, Bicycle Therapeutics and Mission Therapeutics. The co-location of a dynamic community of start-up and scale-up businesses with world-leading academic research from the Babraham Institute, along with the opportunity for these businesses to access state-of-the-art scientific facilities made available by the Institute, are unique features that differentiate the Babraham Research Campus from other Life Science campuses in the UK. These and other related features of the Babraham Research Campus, which were the subject of a recent study commissioned to the authors by Babraham Bioscience Technologies and its Campus partners [3], are discussed in more detail in the next section.

3. Building the Local Bioscience Innovation Eco-system Through Public and Private Partnership

The previous section showed the extensive base of knowledge based companies that now comprise the Cambridge cluster and how quickly the number has grown in recent years. This section considers how the Cambridge innovation ecosystem has developed, focusing specifically on the bioscience sector, highlighting key features that have been contributing to its continued success.

As section 2 discussed, underpinning the success of the Cambridge Phenomenon is a powerful innovation system that has evolved considerably since the early 1960s. There have been many studies into the key elements of successful innovation systems with a core focus on the triple helix model that considers the relevant interactions between knowledge based institutions (universities, research centres), industry and government [31]. There are various adaptations of this basic model [32].

For our present purposes we adopt the framework shown in Figure 1. This framework was originally developed by Baxter et al. [33] and it distinguishes four key systems which contain the people, companies and institutions that have to come together in a particular place to translate knowledge and ideas into outcomes that enhance societal well-being and generate commercial success.

---

16 Congenica story is covered in this issue of Innovation & Impact, while Eagle Genomics was presented in the first issue.

17 First issue of the Innovation & Impact includes the story about the Babraham Research Campus.
The Knowledge System comprises the institutions, networks, and agents through which ideas (that can form the basis for new inventions and sustained development), develop and traverse, and through which workers gain access to technological expertise. The Finance System comprises those institutions and agents that provide the capital for investment in business operations, facilities, and community infrastructure. The Business System contains the companies and other economic agents, institutions, and formal and informal networks that facilitate the commercialisation of ideas and the development of globally competitive businesses, including business decision-makers, skilled labour, as well as accountants and lawyers. The framework adds one further system; namely the Place System; which embraces those agents of change that enhance the attractiveness of the place for the production of knowledge and entrepreneurial activity and thus provide the land and property (Research Campuses), infrastructure, health care, education, training, housing, schools, shops, parks, cultural facilities and the Regulatory Environment.

Figure 5. A Simple Framework with which to consider relevant interaction in the Cambridge High-Technology Innovation Eco-system [33].

Research shows that relative success requires attention across all the systems shown in Figure 5 and includes building the capacity of the knowledge base, the quality of the physical place and infrastructure including the provision of premises, the financing of enterprise, provision of training in entrepreneurship and the fostering of business and industry networks [33]. Attention to branding, marketing and promotion is also important. Successful innovation requires interaction and collaboration between the systems shown in Figure 5 but the formal mechanisms by which this occurs are often quite weak. Each of the systems shown requires entrepreneurial and innovative activity and the gains to innovation are often greatest at the boundaries of the interaction. Bringing the systems together successfully takes effort and ‘spanning the boundaries’ is facilitated by strategic partnerships or ‘intermediaries’. As Baxter et al. show successful enterprising places built on technology based activity are characterised by academic excellence, flexible local institutions, adjustable infrastructure and civic leadership (Baxter et al, 2007). Bringing these factors together takes time and effort and assets have to be
developed through a strategic approach built on effective partnerships and incentives that enable entrepreneurship and the required resources to be mobilized.

3.1. Building the required interactions; the role of place based assets

A key role for the Cambridge research campuses described in section 2.4 has been to provide the ‘neutral space’ that has been shown to be important to enable the required key interactions in the Cambridge High-Technology Systems [34]. They also accommodate many of the businesses that employ the skilled labour that is so essential to the growth of the cluster. A particularly noticeable feature of some of the most significant Research Campuses is that the investment required to develop them has been secured from extensive public (state) and increasingly charitable funding over a number of years. The Wellcome Trust (Genome Campus), the Cambridge Biomedical Campus, centred on Addenbrookes Hospital, and the Babraham Research Campus, are of particular note in this respect. Their development represents a robust partnership between the public (state) and the private sector. We can illustrate this by considering the evidence provided by the findings from recent research on the economic impact of the Cambridge Biomedical Campus [2] and also the Babraham Research Campus [3].

**Cambridge Biomedical Campus**

Figure 6 shows the main components of the Cambridge Biomedical Campus and how they come together to deliver the interactions required. The close links between research staff in medical and related Departments in the University and local bioscience companies, occur either through direct collaboration, funding, as an employment route for University graduates, or as vehicles for the commercialization of University-based research. Much research in University departments is funded by public bodies such as the Medical Research Council. The contribution of the major charitable bodies, such as the Wellcome Trust, cannot be overstated. Indeed, it is to be argued that the conventional triple helix model based as it is on the interaction of government, academic and business should incorporate the charitable sector and thus the importance of a ‘quadruple helix’.

The Economic Impact Assessment of the Bioscience Campus summarised the overall position well; namely;

- The University and other knowledge based institutions are a source of basic and applied research, which can be commercialized with the help of the University’s Enterprise Unit.
- The universities supplies highly qualified graduates and scientists that make up a large skilled local labour pool available to local bioscience, medical science and pharmaceutical companies.
- Externally originating public funds support the primary health care sector in the city-region (mainly Addenbrooke’s hospital, which in it turn has strong links to and interactions with the University).
- External funding also supports relevant research within the University and other knowledge institutions.
• Local companies both compete and collaborate in bioscience, drug development and related medical fields, in some cases via strategic alliances with similar firms elsewhere (including overseas).

• A significant venture and private equity market has developed locally, to provide finance for new and expanding companies. In some cases, venture finance also originates outside the region, in London or even overseas.

As the Economic Impact Assessment made clear ‘the synergies between these different components that together make up the Cambridge bioscience cluster are not only mutually reinforcing, but act to stimulate innovation, enterprise and growth. In this sense the cluster is a prime example of place-based circular and cumulative causation. Indeed, the cluster is essentially a knowledge-intensive and knowledge-driven network of both core and applied medical-related science’ [2].

The Babraham Research Campus

The Babraham Research Campus is a 430-acre in a parkland environment approximately 10 km south-east of Cambridge. The site was initially bought by the Agricultural Research Council in 1948 who developed the campus’s first research and laboratory facilities at the Babraham Institute. In 1993 the Babraham Institute phased out agriculture related research and began focusing increasingly on its current biological research specialisation of epigenetics, signalling and lymphocyte signalling. The freehold owner of the site is now the Biotechnology and Biological Sciences Research Council (BBSRC)-part of UK Research and Innovation (a non-departmental public body (NDPB)) and which is the largest UK public funder of non-medical bioscience. At the present time there are around 60 biomedical organisations co-located with the Babraham Institute (BI). The Campus is managed and developed by Babraham Bioscience Technologies (BBT); on behalf of its shareholders, the British Government through the BBSRC research council and the Babraham Institute.

Figure 6. Main Components of the Cambridge Bioscience Cluster [2].
The Campus is an interesting part of the overall innovation system in that it supports UK bioscience through advancing discovery research and also providing laboratory space and facilities for early-stage and growing commercial life-science organisations. It seeks to meet the needs of life science companies that are typically under-serviced by the commercial property market UK wide. The uncertain viability, and therefore higher risk profile, of these companies may make them less attractive as tenants to more commercially orientated science parks. In turn, the companies themselves may find it difficult in their early stages of development to accept the long-leases and terms offered by the standard commercial science park offering. The outcome is that this segment of the market tends to be characterised by a classic market failure that impedes the growth of the sector.

Through its involvement, the public sector is able to help overcome this market failure. Thus, in the case of the Babraham Research Campus, its leasehold ownership of the site dating from the 1940s, and the financial support it has provided, has enabled it to work with its partners to provide space for start-up companies, supporting early stage life-science ventures with laboratory and office space units of 600 sq.ft and above on short-term flexible lease terms. The evidence from a recent study into the economic impact of the Campus identifies the critical role that such public (state) investment has played in offering a stable and supported community within which these companies have been able to flourish [3]. This, in turn, has helped the overall growth of the life science sector in Cambridge. New ventures are thus able to start-up and develop rapidly with access to science, technology, talent and capital with fewer barriers that might prevent them getting to the all-important scale-up phase. The support offered helps with scientific progress and increased economic activity, both locally and for the UK as a whole.

The Campus both runs and supports accelerator and soft-landing programmes that shape business development and it also assists businesses to obtain funding from a wide variety of sources. Venture finance from outside the Cambridge sub-region has become of increasing importance in recent years. Co-location of a vibrant community of start-up and scale-up companies with world-leading academic research from BI, as well as the opportunity for these companies to access a range of state-of-the-art scientific facilities made available by BI, are thus important features of the Babraham Research Campus. These facilities embrace, amongst others, Biological Support Unit, Chemistry, Gene Targeting, Antibody Sales, Bioinformatics, Flow Cytometry, Imaging, Lab Services, Lipidomics, Mass Spectroscopy and Sequencing [3].

3.2 The key role of the Babraham Research Campus in attracting commercial investment and deal flow for Campus companies

Babraham Research Campus tenant companies have attracted a significant amount of commercial investment over the last decade; raising over £1.2bn to date, of which more than £300m was received in 2018. Companies estimated that being located on the Campus accelerated their fundraising by three months and increased the amount of funds raised by 10%. The total market value of the largest fourteen companies on the Campus was £4.1bn which represented a 7.2 times return for investors, who put in £636m. These values represent significant potential returns to the investors. Companies on the Campus have been able to attract funding from a wide range of international and leading life-science and technology
investors including the IP Group, SV Health Investors, Morningside and Medixci Ventures and many global corporate investors such as Merck Ventures, SROne (GSK), Novartis Ventures and Pfizer Ventures. These investors have supported Campus companies at different stages of their growth, from seed financing to Series B and C rounds and on to IPO.

The evidence thus suggests that well-targeted campus based public sector support over a sustained period of time can add real value by enhancing the creation of knowledge, helping to drive innovation and enabling entrepreneur driven life science businesses to flourish. Thus contributing to the momentum behind the Cambridge Phenomenon. Besides the wider medical and health benefits the research indicates that every £1 of public investment is associated with a £3 of economic gain—demonstrating the benefits of public-private partnership in bioscience research [3].

4. Future Prospects

This article has provided some insight into how Cambridge has been able to become one of the world’s leading clusters of high technology companies. The scale of business activity, and the vitality of the innovation eco-system that underpins it, is unrecognisable from the position in the early 1960s. The prospects for future growth look very encouraging. A core strength of the high technology cluster is its strength in ICT, Life science and Nanotechnology. The convergence of these technologies offer virtually unlimited opportunities to improve human well-being, as well as create substantial commercial opportunity and economic growth.

Looking ahead, the constraints on the growth of the cluster will not be a shortage of new ideas, or entrepreneurial activity and the finance to drive things forward, but more to do with the fragility of the core infrastructure that provides the connectivity between its parts and, crucially, the housing to accommodate its ever expanding workforce. In recent years the rising cost of living associated with the success of the Cambridge Phenomenon has affected the relative affordability of Cambridge housing.

Although Silicon Fen continues to attract both established businesses and entrepreneurs, there is some evidence to suggest that employment changes due to business start-ups are no longer exceeding the losses due to company closures. The CBR latest annual draw indicates that the impact of net entrants (i.e. companies born or moved in less those died or moved out) has shifted over time from being a strong positive influence on growth at the start of the decade to exerting a negative influence in 2019-20. These data speak to some of the warnings made in the Cambridgeshire Peterborough Independent Economic Review [35], which concluded that greater investment in transport infrastructure (e.g. rail and road links) should be made and more houses should be built if Cambridge is to keep up to speed with rival tech centres such as San Francisco and Boston while coping with increasing competition from Asia, particularly from the Far East. However, more research needs to be carried out in order to establish what lies behind the slowdown in the number of business start-ups that we have observed in recent years.

The traffic congestion due to inadequate transport infrastructure and soaring house prices are two of Cambridge’s long-standing problems. Travelling across Cambridge has become
increasingly difficult, particularly at rush hours, while buying a house in the city is now a dream for many. Cambridge often ranks as one of the least affordable and most unequal cities in the UK, second only to London, and is witnessing many of the issues that Silicon Valley has now been facing for some time. To address these problems, which may ultimately translate into a falling rate of growth in the city region, local authorities in Cambridge signed a City Deal with central government in 2014 to unlock major investment in infrastructure, housing and jobs. The agreement, worth up to £500m over a 15-year period and the largest of several City Deal programmes taking place in the UK, will play a fundamental role in ensuring that infrastructure in Cambridge can keep pace with expansion.

At the same time, it has been stressed by some that expansion should not come at the cost of a sense of place – indeed one of the distinguishing features of the Cambridge Cluster. This view is captured well by Sir Geoff Mulgan, Professor of Collective Intelligence, Public Policy and Social Innovation at UCL knighted in 2020 for his services to the creative economy [36]:

*Innovation districts depend on a sense of place, often working best in 19th century buildings, with streets not towers, bricks more than concrete, flexible spaces rather than overdetermined ones, character rather than conformity. But buildings are not enough, and I argue that the planners and developers of clusters of this kind prioritise physical development too much and need to also understand them as a kind of collective intelligence, and one that is highly dependent on relationships.*

Research by the authors suggests that Cambridge-based companies tend to regard transport- and housing-related pressures in the city as major constraints to their future growth (e.g. [3]). This issue is usually framed as one of either Cambridge or overseas; companies view the city region as a unique location within the UK and might have to relocate overseas to be able to find a similar ecosystem. The ‘Cambridge or overseas’ debate has gained momentum in the aftermath of the Brexit referendum in June 2016, as concerns have been raised that the UK’s departure from the EU might exacerbate problems for an area that has been built on attracting the best brains from around the world. The potential consequence could be a significant loss of jobs in the UK in favour of other countries, pointing to the additional benefits brought by the Cambridge Cluster to the national economy. This issue was already noted by SQW nine years before Brexit became a reality, when it called for “an effective migration policy that does not place restrictions on highly skilled or talented people from outside the European Economic Area seeking to work or study within the Cambridge area” [6]. At the same time, recent findings provide some reasons to be optimistic. Last year saw biotech companies raising a record £2.8bn in equity finance [37], while the demand for laboratory space in Cambridge reached the highest level for five years despite the disruptions caused by Covid [38].

The outbreak of the Covid-19 pandemic has also brought a number of additional challenges for an economy that hinges on close-knit interactions among its actors. In the first of a series of updates commissioned by the Greater Cambridge Partnership and Cambridge Ahead [27], the authors provided a snapshot of the impact of events in 2020 by considering a small sample of companies with accounts covering on average the year ended in May 2020 – showing the impact of the first few months of the Covid-19 pandemic. Although we cannot be sure about the true picture until the next updates in 2021, we found a significant reduction in the
performance of these companies compared with the previous year. Moreover, the impact of the pandemic is not even across companies. It would appear that certain Life Science and software companies have performed well, whereas business services and hospitality companies have been severely affected. Our results also indicated that the impact on turnover is greater than the impact on employment, perhaps reflecting the benefits of the furlough and other Covid-related schemes. At the time of writing it is impossible to predict how the pandemic will unfold, but the resilience shown by the Life Science and ICT sectors over the past year suggests that – provided the various challenges discussed in this paper are addressed – there will be much more to come for the Cambridge Phenomenon.

References


[28] Cosh, Andy and Caselli, Giorgio, SME Observatory Insight into scale-up and high-growth businesses, report to the Cambridgeshire and Peterborough Combined Authority, Nov. 2020.


[34] Kitson, Michael et al., The Connected University: Driving Recovery and Growth in the UK Economy, Nesta, Apr. 2009.


Giorgio Caselli completed his PhD in Financial Economics and received an MSc (Distinction) in Finance and Management both from Cranfield University, UK. He also completed an MSc (Distinction) in Business Economics and a BSc (Hons) in Economics and Management from the University of Ferrara, Italy.

Giorgio is a Research Fellow at the Centre for Business Research and a Postdoctoral Research Associate at St Edmund’s College, University of Cambridge, where he is currently examining the link between corporate growth and regional development as part of the Cambridge Ahead project. Prior to joining the Centre, Giorgio worked as an analyst at Deloitte’s Global Financial Services Industry and completed his PhD in Financial Economics at Cranfield University. His doctoral research investigated how ownership structure affects monetary policy transmission via the risk decisions of financial firms. His PhD thesis was awarded the Director’s Prize for Best Doctoral Thesis of the Year. Giorgio regularly presents his research at leading international conferences and his work received a Young Researcher Award by the European Association of Cooperative Banks.
**Andy Cosh** was until recently Programme Director for Enterprise and Innovation and Assistant Director of the Centre for Business Research at the University of Cambridge; and now holds the position of Senior Research Associate. He was one of the founder members of the Judge Business School at Cambridge University. In his early career Dr Cosh worked at HM Treasury and as a Research Officer at the Department of Applied Economics, Cambridge University. Prior to becoming a self-employed consultant in 2012, he was a Reader in Management Economics, Accounting and Finance. From 1995-2007 he combined his academic role with the professional office of Senior Bursar at Queens’ College Cambridge. He has also acted as a business consultant to several firms and has carried out research for the ESRC, EPSRC, European Commission, the British Bankers Association and various UK government departments.

**Peter Tyler** is Professor in Urban and Regional economics in the Department of Land Economy, University of Cambridge, Fellow, Director of Studies and President at St. Catharine’s College. He has been a Project Director for over seventy major research projects for Government. Besides his work in the United Kingdom for HM Government. He has been an Expert Advisor to the OECD, European Commission and HM Government, including serving on the National Evaluation Panel for Sure Start. He was a Programme Leader for the Cambridge MIT initiative and is a Policy Fellow at the Cambridge Centre for Science and Policy. During 2016 he was an Expert Advisor to UN Habitat III. Peter was made a Master of the Royal Town Planning on the basis of his contribution to urban and regional spatial planning and a Fellow of the Royal Institute of Chartered Surveyors in the light of his considerable knowledge and experience in the spheres of land, property or construction. He is an Academician of the Learned Society for Social Sciences.
Appendix A. Number of companies, total employment and total turnover by sector in the Cambridge city region

<table>
<thead>
<tr>
<th>KNOWLEDGE INTENSIVE SECTORS</th>
<th>2019-20</th>
<th>2010-11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of companies</td>
<td>Total number of employees</td>
<td>Total turnover £,000</td>
</tr>
<tr>
<td>Information technology and telecoms</td>
<td>3,107</td>
<td>21,980</td>
</tr>
<tr>
<td>Life science and healthcare</td>
<td>631</td>
<td>20,737</td>
</tr>
<tr>
<td>High-tech manufacturing</td>
<td>834</td>
<td>17,082</td>
</tr>
<tr>
<td>Knowledge intensive services</td>
<td>800</td>
<td>8,090</td>
</tr>
<tr>
<td>TOTAL KI SECTORS</td>
<td>5,372</td>
<td>67,889</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OTHER SECTORS</th>
<th>2019-20</th>
<th>2010-11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of companies</td>
<td>Total number of employees</td>
<td>Total turnover £,000</td>
</tr>
<tr>
<td>Primary</td>
<td>760</td>
<td>11,889</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>1,198</td>
<td>20,086</td>
</tr>
<tr>
<td>Wholesale and retail distribution</td>
<td>2,238</td>
<td>23,948</td>
</tr>
<tr>
<td>Construction and utilities</td>
<td>3,197</td>
<td>21,829</td>
</tr>
<tr>
<td>Transport and travel</td>
<td>686</td>
<td>8,710</td>
</tr>
<tr>
<td>Property and finance</td>
<td>3,333</td>
<td>11,673</td>
</tr>
<tr>
<td>Other business services</td>
<td>5,070</td>
<td>26,428</td>
</tr>
<tr>
<td>Other services</td>
<td>2,917</td>
<td>19,660</td>
</tr>
<tr>
<td>Education, arts, charities, social care</td>
<td>1,236</td>
<td>26,472</td>
</tr>
<tr>
<td>TOTAL NON-KI SECTORS</td>
<td>20,635</td>
<td>170,695</td>
</tr>
</tbody>
</table>

| TOTAL ALL SECTORS | 26,007 | 238,584 | 48,397,333 | 18,525 | 137,181 | 23,517,175 |
| % Knowledge Intensive | 20.7% | 28.5% | 37.5% | 19.7% | 28.8% | 33.3% |

Source: Cosh & Caselli, CBR.