REALISING THE GROWTH POTENTIAL

The Oxfordshire Innovation Engine Update

May 2016

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OxLEP driving economic growth

FRONT COVER IMAGES:

1. **Diamond Light Source**. *Courtesy of ©Andrew Brookes 2012.*
2. **Williams Jerez Team 2015**. *Courtesy of ©LAT Photographic 2015.*
3. **Harwell Campus Aerial**. *Courtesy of ©UKAEA 2006.*
4. **OrganOx**. *Courtesy of ©Nick White 2012.*

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SQW *This report was prepared by SQW in consultation with representatives of the business, financial, government and research communities of Oxfordshire:* **www.sqw.co.uk**

The Oxfordshire Innovation Engine Update

Preface

The Oxfordshire Innovation Engine was launched in October 2013. It assessed the characteristics of the cluster of 1,500 high tech firms in Oxfordshire, and of the research and business infrastructure that both generates much of the technology and supports its commercialisation. The report also identified a number of constraints to growth, and made recommendations about how they could be overcome in order to realise the economic potential of the outstanding range and depth of scientific research undertaken in Oxfordshire.

This Update reports on progress made over the 2.5 years since the original study. It uses a variety of data sources and some case studies of firms to identify changes. These include impressive growth of Oxfordshire's economy and of the high tech cluster, including some firms with outstanding potential for beneficial impact on society as well as continued expansion; a further strengthening of the research infrastructure; and some significant improvements in the services and facilities to support high tech firms in Oxfordshire – notably in relation to the availability of risk capital and new business premises.

However, there remain some problem areas, including the capacity and quality of transport infrastructure and the slow (although improved) rate of new housebuilding. Oxfordshire's economy is growing faster than its labour force, a mismatch which will increase long distance commuting and resulting congestion, and will eventually constrain growth. There are some bold solutions being proposed, including the application of some of the technologies developed in Oxfordshire to reduce congestion and environmental impact. There is certainly more commitment in both public and private sectors to managing growth positively, and I look forward to seeing the benefits of this commitment in future.

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REALISING THE GROWTH POTENTIAL

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Executive summary

1. The Oxfordshire Innovation Engine, launched in October 2013, examined the county's outstanding science and technology assets, their potential to generate economic growth, and factors which were constraining that growth. This Update report considers recent changes, in particular whether the constraints that were identified in the Innovation Engine report are being addressed and the area's growth potential realised.

2. **The overall conclusion from this review is that real progress has been made over the last few years, particularly:**
   - strong economic growth in Oxfordshire and an extraordinary scale of new investment in high tech firms
   - more productive relationships between research and business communities
   - much improved access to risk capital and more specialist business space for high tech firms
   - greater collaboration between local public sector organisations, and stronger engagement with the Government to support and positively manage growth.

3. There are still significant issues to address, notably the cost and supply of housing, road congestion, the need for a stronger business voice and better, more consistent articulation of the 'Oxfordshire growth story' across private and public sectors. However, the direction of travel is strongly positive.

The research infrastructure

4. Oxfordshire's research infrastructure is steadily strengthening, at a time when financial pressures on much of the UK's research activity are intensifying. **The University of Oxford** was rated as the top research university in the UK in the 2014 Research Excellence Framework, and it consistently ranks among the top few universities in the world. There has been continued sustained growth in the University's total external research income, which in 2014/15 reached £523m.[1]

5. **Oxford Brookes University** received £4.84m in Quality-related Research Funding from the Higher Education Funding Council for England in 2015-16, an increase of 41% on the previous year. Oxford Brookes consistently ranks within the top 10 universities in the UK for intellectual property, reflecting the strong impact of its research, from which the University draws in the region of £1.8 million annually.[3]

6. Investments of around £400m have been made in the research infrastructure in Oxfordshire – mainly in **Oxford University** and at **Culham** and **Harwell** – since the Innovation Engine report was produced. This includes a £110 million investment in a new Precision Cancer Medicine Institute, £20m for the Chan-Soon-Shiong Oxford Centre for Molecular Medicine, £60m for the Oxford Big Data Centre and £15.6m for the Robotics and Remote Handling Centre. The University has also funded new buildings for Physics and Maths, reflecting its growing strengths in the physical sciences. The larger investments align well with the Government's priorities for research and technology development, and also with foresight work on the key technologies for the next 20 years.

7. In parallel with increased research funding are measures to increase the local economic impact of research. For example, during 2015, Oxford University produced an Innovation Strategy, restructured Isis Innovation (which has aided the establishment of over 100 spin-out companies since 2000), and established a £320m fund, Oxford Sciences Innovation, to invest in science and technology based spin outs.

[1] https://www.ox.ac.uk/about/organisation/finance-and-funding?wssl=1
[2] https://www.brookes.ac.uk/about-brookes/news/research-funding-increases-by-over-40-per-cent-to-%C2%A34-84m/
[3] http://www.internationalinnovation.com/build/wp-content/uploads/2015/02/Oxford_Brookes_Intl_Innovation_173_Research_Media.pdf

The dynamics of the high tech business ecosystem

8. Oxfordshire's economy as a whole is performing strongly, and the scale of recent investment bodes well for future growth. Total employment in Oxfordshire grew by 7.8% 2011-14, to 400,000. This compares to growth of 6.2% nationally. GVA[4] growth 2011-14 was also above the national average (15.6%, compared to 12.1% for the UK).

9. The Innovation Engine report estimated that, based on 2011 data, there were approximately 43,000 employees in 1,500 high tech firms in Oxfordshire. By 2014 there were 46,100 high tech employees in Oxfordshire, a growth of 7.2% since 2011, virtually all of which was in high tech services, and most of it in the south of Oxfordshire. GVA growth in key high tech sectors was also well above the national average (e.g. GVA in 'information and communication' grew by 29.3% in Oxfordshire 2011-14, compared with 8.4% in the UK).

10. Based on recent investment, the rate of growth of the high tech sector appears likely to increase. In the 12 months to July 2015, Oxford's technology firms received a reported £1.4bn in investments – more than five times the previous year's total of £250 million[5]. There are now five high tech companies in Oxfordshire worth over US$1bn[6], and over 20 new Oxford technologies and ventures received a record £2.6m in proof-of-concept funding in 2014 alone.[7]

11. **There are major growth opportunities in all main areas of the Oxfordshire high tech cluster:**

    - the **bioscience** cluster has continued to grow strongly over the last few years. In 2015, letscellit.com in association with Bidwells identified 233 bioscience firms in the area, compared with 163 identified by OBN in its 2011 Biocluster Report. Since December 2014, ten Oxfordshire bioscience firms have attracted between them over £1bn in investment. The cluster includes some 'star performers' such as Adaptimmune and Immunocore. Employment in these two firms combined has increased from 75 to 380 in the last two years, based on major investment and partnership agreements with big pharma. Both firms have the potential to make a global impact on cancer therapies over the next 10 years, and both are committed to continued growth in Oxfordshire.
    - the major Oxfordshire firms in the **telecoms and computing** sectors have experienced mixed fortunes over the last few years. Sophos has continued to go from strength to strength, based on the quality of its technology and the booming cyber security market. Natural Motion, founded as an Oxford University spin out in 2001, also continues to succeed in the highly competitive but also fast growing gaming industry. In January 2014 it was acquired by social network gaming company Zynga for over US$500m. RM Group, which employs 1,600 people, mainly at its Milton Park headquarters, specialises in providing IT services to educational organisations and establishments. It has had mixed fortunes in recent years: in 2013 it closed its PC business and made around 300 staff redundant, largely as a result of the closure of the Government's 'Schools for the Future' programme.
    - **Physics** related firms have been a distinctive part of the Oxfordshire high tech cluster ever since the formation of Oxford Instruments in 1959. Oxford University, together with UKAEA facilities at Harwell and Culham, have created a unique skills base and a range of facilities which continue to grow: for example, with the location at Harwell of the Satellite Applications Catapult Centre and the European Centre for Space Applications and Telecommunications. These facilities and related expertise have attracted firms to grow in the area, including through inward investments such as Element Six (R&D into synthetic diamonds), acquisitions such as Siemens Magnet Technology

[4] GVA is Gross Value Added, which is a measure of the value of goods and services produced in an area or sector of the economy. In general terms it is the difference between the value of goods and services produced and the costs associated with their production
[5] http://www.oxfordtimes.co.uk/business/13378021.Tech_firms_reap_the_benefits_of_massive_ investment_surge/
[6] Adaptimmune, Circassia, Immunocore, Oxford Nanopore and Sophos
[7] http://www.cambridgenetwork.co.uk/news/record-investment-in-oxford-ventures-in-2014/

(formed through Siemens' acquisition of Oxford Magnet Technology), and new starts such as Tokamak Energy and Oxis Energy. Tokamak Energy is developing compact spherical tokamak devices in combination with new magnet technologies, intended to overcome long running obstacles to making fusion energy commercially viable. Oxis Energy Ltd, a spin out from Oxford University Materials Department, is developing a Lithium-Sulphide battery technology that has the potential to revolutionize the rechargeable battery market.

- **Engineering and electronics** – interviews with firms indicated steady growth in these areas and significant innovation. The University of Oxford's Engineering Department has generated 26 spin outs since 2001, and in November 2015 the Institute of Biomedical Engineering was awarded the Queen's Anniversary Prize for achieving 10 substantial spin outs in the last eight years. Examples of recent progress by firms include: Oxford Photovoltaics, which secured substantial funding in 2015 to develop further its solar cell technology; Williams Advanced Engineering, which has made major progress in diversification into new markets, based on technologies developed in Formula 1; Reaction Engines, which secured £20m investment from British Aerospace in November 2015 and a commitment to £60m of Government funding to further develop and test its new aerospace engine that combines both jet and rocket technologies; and Oxbotica, which originated from Oxford University's Mobile Robotics Group and was identified by The Wall Street Journal as one of the 'Top 10 Tech Companies to watch in 2015'.

12. Despite the excellent growth prospects for many Oxfordshire high tech firms, there are also some risks. Firms interviewed were strongly positive about the quality of the Oxfordshire labour market and the research infrastructure, but they expressed concerns about the cost of housing and congestion on strategic roads. Some have been affected by downturns in global markets and public spending cuts in the UK. Most operate internationally and have choices about where to expand. There is considerable acquisition activity, particularly in bioscience, and this also leads to uncertainty about future growth in Oxfordshire.

Physical infrastructure

13. The pipeline of development of **specialist property** for high tech firms has improved over the last two years. A Framework Master Plan has been produced for Harwell Campus by the new joint venture partners proposing 400,000 sqm of new commercial, academic and technical space, plus new homes, supporting infrastructure and amenities. New buildings for the European Space Agency and the Rutherford Appleton Laboratories have been completed, and a 4,000 sqm innovation centre and a 3,000 sqm High Tech "Making" Building are under construction.

14. Milton Park secured a Local Development Order which enables development in the Enterprise Zone[8] to be fast tracked. In 2014 MEPC developed 5,100 sqm speculatively, which at the time was a significant risk due to the fragility of the economic recovery. However, both buildings are now fully let, primarily to fast growing high tech firms such as Ipsen, a global pharma company, and Adaptimmune and Immunocore.

15. Significant progress has also been made in relation to the Oxford Northern Gateway and Oxford Technology Park. Proposals for the development of 90,000 sqm of high tech business space, 500 homes and ancillary services at the Northern Gateway were included in an Area Action Plan which was adopted by the City Council in July 2015. Planning permission has been granted for Oxford Technology Park, near Oxford Airport, to provide 40,000 sqm. At UKAEA Culham there are also plans for a substantial increase in business use of the site, with outline planning permission having been obtained for 9,000 sqm of office/light industrial space.

[8] The Science Vale Enterprise Zone comprises two sites: 28ha on Milton Park, and 93ha on Harwell Campus. EZ designation provides firms with certain benefits, including exemption from business rates for five years and simplified planning processes - see http://enterprisezones.communities.gov.uk/about-enterprise-zones/

16. In addition, match funding for new business incubation and accelerator facilities was announced as part of the Oxford & Oxfordshire City Deal by the Government in early 2014. This includes an Innovation Accelerator at Begbroke; a Bioescalator in Oxford; the Harwell Innovation Hub; and the Culham Advanced Manufacturing Hub.

17. However, the availability of flexible business space for early stage companies in Oxford is still very constrained. The Oxford Trust is the only third sector developer of such spaces and has recently announced the acquisition of a site in Headington to build a second innovation centre that supplements its full-to-capacity Oxford Centre for Innovation in the city centre.

18. Progress on **housing delivery** has, by comparison, been relatively slow, and affordability issues have worsened. House prices in the county are between 9 and 10 times average incomes, well above the national average of 6.6. The number of housing completions in Oxfordshire has increased by 38% over the last five years, and some large scale developments are now beginning to deliver new homes, including NW Bicester Eco Development and various sites at Didcot. However, the 2014 Strategic Housing Market Assessment (SHMA) for Oxfordshire concluded that there is a big gap between housing need (around 5,000 new homes per year up to 2031) and current supply (2,672 completions in 2014/15). The findings of the SHMA have been largely incorporated into draft Local Plans, although there are still significant issues of deliverability to be addressed, and the formal local plan approval process is very protracted.[9]

19. The number of housing completions in Oxfordshire has increased by 74% over the last five years, and some large scale developments are now beginning to deliver new homes, including NW Bicester Eco Development and various sites at Didcot. However, the 2014 Strategic Housing Market Assessment (SHMA)[10] for Oxfordshire concluded that there is a big gap between housing need (around 5,000 new homes per year up to 2031) and current supply (2,672 completions in 2014/15). The findings of the SHMA have been largely incorporated into draft Local Plans, although there are still significant delivery issues to be addressed, and the formal local plan approval process is very protracted.

20. In relation to **transport investment**, the Oxford & Oxfordshire City Deal secured Government funding to enable new transport schemes to support developments at the Science Vale Enterprise Zone, Oxford Northern Gateway and the first phase of the "Science Transit" public transport scheme. There have also been improvements to the strategic road network, for example to A34 junctions. However these have not prevented a steady increase in congestion in Oxford city and across the county. The capacity of the main strategic roads in Oxfordshire remains a key concern of businesses.

21. There have also been significant improvements to broadband and rail. Nearly 95% of the county now has access to high speed broadband. In relation to rail, the new Oxford Parkway station at Water Eaton has opened, providing fast direct access to London Marylebone via Bicester. A potential new passenger rail route has been proposed between Oxford station and Oxford Science Park and Business Park, via an existing freight branch line, and plans for the East West rail route to Cambridge have continued to progress. The March 2016 Budget included an announcement that the National Infrastructure Commission will investigate options for improving transport links between Oxford and Cambridge. Station improvements at Oxford, Didcot and Culham are also proposed, though timing is likely to be an issue.

[9] Data taken from the Guardian, 26th March 2016, referencing Lloyds Bank and the ONS as sources
[10] https://www.oxford.gov.uk/info/20201/oxford_growth_strategy/762/strategic_housing_market_assessment

The innovation ecosystem

22. In the last few years the landscape for **risk capital** in Oxfordshire has greatly improved. Two major new funds were launched in 2015, both with a long term investment perspective: Oxford Sciences Innovation, formed through a partnership between Oxford University and ISIS, which has £320m to invest in science and technology based spin outs; and the £890m Woodford Patient Capital fund, run by one of the most successful fund managers in the UK and based in Oxfordshire. Recent research undertaken by Nesta indicates that the number of deals in Oxfordshire by both angel and institutional investors has increased since 2006, signifying a growing and maturing VC ecosystem. The variety of funding sources available is important to ensure that firms with high growth potential but not directly connected with the research infrastructure, as well as those that are, have access to investment.

23. Some progress has also been made in relation to **business networks and lobby groups**. There are various networks relating to the high tech business community in Oxfordshire, including OBN, which continues to serve the bioscience community in Oxfordshire and beyond. Venturefest has had two more successful annual events, and has also launched 'Pitchfest' with four standalone funding rounds in the past 18 months. Connected Oxford continues to run regular networking events for entrepreneurs, and Oxford Investment Opportunities Network has increased its capacity to facilitate business angel investment in new and small firms. Significant additions include the Network Navigators initiative, which is designed to help firms negotiate the variety of business support available in various key sectors, and the Academic Health Science Network for the Oxford region, which has further strengthened the networking opportunities for the bioscience community.

24. However, the general view among consultees is that networks within the Oxfordshire high tech community are still under-developed, particularly when compared with Cambridge, which has a strong and enduring group of serial entrepreneurs and investors who clearly consider it their mission to promote the high tech cluster there. In turn, this has been very effective in securing both public and private sector investment in the area.

25. In relation to **governance and leadership**, two different proposals for devolution of responsibility and funding have been submitted to central government. There is broad agreement locally on what should be devolved, including greater responsibilities for skills, infrastructure planning and delivery, and health and social care. There is also agreement on the need for a major investment programme to support the construction of 100,000 homes and the creation of over 85,000 jobs by 2031, and to work jointly with surrounding areas to promote and bid for strategic infrastructure such as improved rail and road links between Oxford and Cambridge. However, there is disagreement over the appropriate governance arrangements for implementation, which may take some while to resolve.

26. Oxfordshire has not been good at **'telling the story'** of growth and opportunity in a consistent way, compared particularly with Cambridge. Yet it has a unique set of attributes which make for an extremely powerful marketing message, both in isolation and within the context of the Golden Triangle of Oxford/Cambridge/London, which has the greatest concentration of world class scientific research and high tech business anywhere. This means Oxfordshire struggles to get the investment in infrastructure it needs to achieve its potential contribution to national economic growth. Such investment is crucial to convince firms with the brightest prospects, and the most choice, to grow in Oxfordshire rather than elsewhere.

1. Introduction

1.1 **Oxfordshire has outstanding science and technology based assets and credentials:**

- a global brand, conveying an image of academic excellence, historical significance and of a beautiful place in which to live
- the University of Oxford, which is among the top few in the world, with outstanding research and teaching, and Oxford Brookes University, one of the best performing new UK universities
- a unique grouping of 'big science' and other research facilities, including the Culham Centre for Fusion Energy, and at Harwell: the Science and Technology Facilities Council (STFC) Rutherford Appleton Laboratory; Diamond Light Source, the national synchrotron facility; the Medical Research Council; the Satellite Applications Catapult Centre; and the European Centre for Space Applications and Telecommunications (part of the European Space Agency)
- a highly skilled labour force, with a higher proportion of graduates than any other English county
- over 1,500 high tech firms, many with a strong focus on R&D across a range of technologies and employing over 46,000 people
- a highly innovative environment: Oxfordshire was ranked 1st in a recent exercise which benchmarked local innovation in the UK
- a superb strategic location, 40 miles from Heathrow, one of the largest hub airports in the world, and 50 miles from London.

1.2 The Oxfordshire Innovation Engine, which was launched in October 2013, examined these assets, their potential to generate economic growth, and factors which were constraining that growth. This update assesses progress since then in relation to the main areas of investigation. It covers:

- the research and commercialisation infrastructure
- the high tech business community
- the physical infrastructure for growth
- the innovation ecosystem – including access to finance, business networks, governance and leadership, and promoting Oxfordshire's high tech cluster.

2. Research and its commercialisation

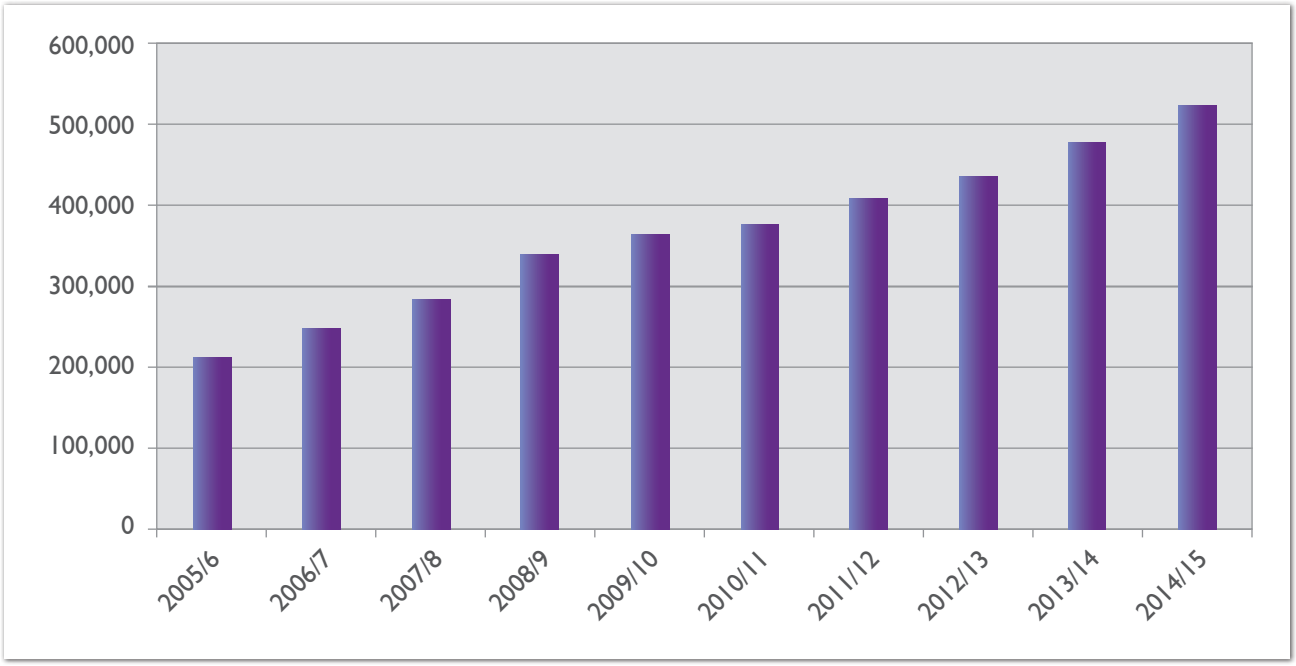
The research infrastructure

2.1 Oxfordshire has an outstanding research infrastructure which is steadily strengthening, at a time when financial pressures on much of the UK's research activity are intensifying.

2.2 The 2014 Research Excellence Framework (REF) concluded that the **University of Oxford** has the country's largest volume of world-leading research, and the University was also rated top in the REF power rankings published by Research Fortnight. It consistently ranks among the top few universities in the world (e.g. 2nd overall in the 2015/16 Times Higher Education World University Ranking, and 6th in the QS Ranking). Almost half of the research produced by the University's 2,400 academic staff was rated in the 2014 REF as four-star,[11] meaning "quality that is world-leading in terms of originality, significance and rigour".[12] The University ranked first in 12 subjects for their volume of world-leading research, and eight other subjects were ranked first on other measures. The rankings meant Oxford was the top-ranked UK university in both the physical and life sciences.

2.3 *Figure 2-1* shows the sustained growth in the University's total external research income in recent years, to £523m in 2014/15. All sources of research funding – government, charitable and private sector – have increased. In addition, the European Investment Bank (EIB) has agreed to provide £200 million for Oxford University's programme of improvement and expansion of research and teaching facilities, the largest loan ever committed by the EIB to a university indicating a high level of confidence in the institution.[13]

FIGURE 2-1: *Oxford University External Research Income (£000s)*



Source: https://www.admin.ox.ac.uk/researchsupport/reports/income/1415/

[11] http://www.theguardian.cm/education/2014/dec/18/oxford-cambridge-britain-top-research-university
[12] http://www.ref.ac.uk/panels/assessmentcriteriaandleveldefinitions/
[13] http://www.eib.org/infocentre/press/releases/all/2015/2015-198-oxford-university-to-benefit-from-largest-ever-european-investment-bank-university-loan.htm

2.4 There is increasing pressure on Government funding which could slow the future growth of research funding from this source. However, Oxford University has been very effective at securing other sources of funding in recent years. Future growth will have implications for the number of researchers and for facilities. A simple extrapolation of past trends suggests that the University may need around 10,000 additional researchers (faculty, post doctoral and post graduate research students) by 2025, together with additional accommodation. If this scale of growth is achieved in practice, planned redevelopment of the Science Area and University land at Osney Mead will meet some of the requirements, but further expansion plans are still to be agreed.

2.5 **Oxford Brookes University** received £4.84m in Quality-related Research Funding from the Higher Education Funding Council for England in 2015-16,[14] an increase of 41% on the previous year. Oxford Brookes consistently ranks within the top 10 universities in the UK for income from intellectual property, reflecting the strong impact of its research, from which the University draws in the region of £1.8 million annually.[15]

2.6 **Oxford Brookes University** has maintained its largely complementary role to the University of Oxford, focusing more on high level training and applied research, and with excellence in distinctive subject areas such as automotive engineering, the built environment and nursing – all of which have strong relevance to the current and future needs and characteristics of the Oxfordshire economy.

2.7 In addition to the two universities in Oxford, **Science Vale** in southern Oxfordshire claims the largest concentration of research and development activity in Western Europe, accounting for 4% of total R&D employment in England, and 13% of that in SE England.[16] This includes a unique grouping of 'big science' and other research facilities, including the Culham Centre for Fusion Energy, and at Harwell: the Science and Technology Facilities Council (STFC) Rutherford Appleton Laboratory; Diamond Light Source, the national synchrotron facility; the ISIS Pulsed Neutron Source; the Central Laser facility; the UK Space Gateway, including the Satellite Applications Catapult Centre; the European Centre for Space Applications and Telecommunications (part of the European Space Agency); and the Medical Research Council's facilities.

2.8 **Approaching £500m of investment has been made over the last few years in new or expanded research facilities in Oxfordshire. Examples include:**

- in Oxford: new physics and maths buildings for the University of Oxford (demonstrating its growing strength in physical sciences); and at Headington, the Oxford Big Data Centre, the Precision Cancer Medicine Institute, the Chan-Soon-Shiong Centre for Molecular Medicine and the Centre for Clinical Magnetic Resonance Research
- at Culham, the Robotics and Remote Handling Centre
- at Harwell, the Rosalind Franklin Institute, the new Rutherford Appleton Laboratory and the European Centre for Space Applications and Telecommunications.

2.9 These investments align well with the Government's current priorities for research and technology development, and also with foresight work on the key technologies for the next 20 years. The MedTech2014 report, for example, highlights the following key emerging technology trends:

- increased use of ICT, mobile technology and software
- personalized medicine, diagnostics and testing
- drug delivery systems
- changes in drug development
- issues around biomedicine.[17]

[14] https://www.brookes.ac.uk/about-brookes/news/research-funding-increases-by-over-40-per-cent-to-%C2%A34-84m/
[15] http://www.internationalinnovation.com/build/wp-content/uploads/2015/02/Oxford_Brookes_Intl_Innovation_173_Research_Media.pdf
[16] http://www.sciencevale.com/
[17] http://www.oxint.com/InNewsdetails.cfm?id=110&title=Tomorrow%27s%20Innovation%20Roadmap%3A%20The%20MedTech%20Report%202014

2.10 The £110 million investment in a new Precision Cancer Medicine Institute at the University of Oxford is a good example of this alignment. The new centre will carry out research into a wide range of personalized cancer therapies, advanced cancer diagnostic and therapeutic techniques, including advanced cancer imaging, trials of new drugs, minimally invasive surgery and proton beam therapy.[18]

Support for innovation and commercialisation

2.11 In parallel with increased research funding have been measures to increase local engagement and the economic impact of research. During 2015, Oxford University was engaged in a scenario planning exercise and preparation of an Innovation Strategy. The former was undertaken in collaboration with other stakeholders in Oxfordshire and resulted in the launch of a 'Green Paper' in May 2016 which provides a high level vision for Oxfordshire in 2035, combining greater prosperity and an improved quality of life. The University's Innovation Strategy is focused on four main areas: developing a culture within the University where innovation and knowledge transfer are more embedded in all activities; increasing opportunities to learn about enterprise; better communications about innovation and commercialisation; and improving support mechanisms. The last includes in particular strengthening of Isis Innovation, the University's technology transfer and commercialisation organisation, and establishing a £320m fund, Oxford Sciences Innovation, to invest in science and technology based spin outs.[19]

2.12 The strong focus on innovation by the University mirrors the characteristics of the Oxfordshire economy. A recent report by the Enterprise Research Centre[20] and the Enterprise Europe Network, which benchmarked local innovation across the UK, ranked Oxfordshire 1st on a combined index of six survey based measures relating to firms' engagement in: product or service innovation; new to the market innovation; process innovation; strategic or marketing innovation; R&D; and collaborating in relation to innovation.

2.13 ISIS has aided the formation of over 100 spin-out companies from Oxford University since 2000, across all science disciplines. For example, engineering has generated 26 spin outs since 2001, and in November 2015, the Institute of Biomedical Engineering was awarded the Queen's Anniversary Prize for achieving 10 substantial spin outs in the last eight years. In information engineering, the Mobile Robotics Group is among the top three organisations in the world developing autonomous vehicles, and major corporate partners include Dyson and Jaguar Land Rover. And in energy, an Energy and Mobility Centre at Begbroke is proposed, involving industry partners, the City Council and the University Engineering Department in developing technologies for low carbon vehicles and to optimise the logistics for intra-city mobility.

[18] http://www.ox.ac.uk/news/2014-10-23-giant-%C2%A3132m-investment-cancer-research-oxford-university

[19] There are six cornerstone investors: Invesco Asset Management Limited, IP Group plc, Lansdowne Partners (UK) LLP, Oxford University Endowment Fund, the Wellcome Trust and Woodford Investment Management LLP. Credit Suisse is acting as the sole placement agent.

[20] The Enterprise Research Centre is a partnership between the business schools at Aston, Birmingham, Imperial, Strathclyde and Warwick and has various funders, led by ERSRC, BIS and Innovate UK.

2.14 New measures to support the effective application of research include the Begbroke Accelerator and the Oxford Bioescalator, both of which have attracted government funding through the Oxford and Oxfordshire City Deal;[21] the Oxford Centre for Applied Superconductivity, a joint public-private sector £6.5m project to be launched in 2016; and a test environment for robots and autonomous vehicles at Culham.

2.15 In addition, the Oxford Academic Health Science Centre (AHSC) and related Network (AHSN) were both formed in 2013 to help translate research into positive patient outcomes. The Oxford AHSC is a collaborative partnership of Oxford-based organisations (the two universities and the two health trusts) covering health and social care; commissioning and service delivery; and research, education and training. The AHSN plays a complementary role, linking 80 member organisations in the NHS, research and business across an area with a population of 3 million, including Berkshire, Buckinghamshire, Oxfordshire, Milton Keynes and parts of Bedfordshire. It is focused on four main areas: improving care through developing stronger clinical networks (e.g. for maternity care, child anxiety and depression); improving commercial R&D collaboration; speeding up clinical innovation (which often requires service reconfiguration); and wealth creation through improving NHS/university/NHS links.

[21] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/276205/Oxford-Oxfordshire-City-Deal.pdf

3. The dynamics of the high tech business ecosystem

Growth of the high tech cluster

3.1 Oxfordshire's economy as a whole is performing strongly, and the scale of recent investment bodes well for future growth. Between 2011 and 2014, the number of jobs in Oxfordshire – including employees and the self employed – grew by 7.8% to 400,000. This compares to growth of 6.2% nationally. Within this total, employee numbers grew by 6.3% to 341,500 (compared to 5.3% nationally), and self employment slightly faster. Growth of GVA 2011-14 was also above the national average (15.6%, compared to 12.1% for the UK).[22]

3.2 The Innovation Engine report estimated that, based on 2011 data, there were approximately 43,000 employees in 1,500 high tech firms in Oxfordshire. Of these, 13,100 were in manufacturing and 29,900 were in services. On a narrower definition (which excludes some important sectors in Oxfordshire such as publishing and some engineering) there were 20,000 employees.[23]

3.3 *Table 3-1* shows the changes over the three years to 2014, the latest for which data are available.[24] By 2014 there were 46,100 employees in high tech sectors in Oxfordshire, 13.5% of total employee jobs in Oxfordshire (20,500 on the narrower definition). This is an increase of 7.2% since 2011, slightly above the rate of growth for all employees. Virtually all of this growth was in high tech services, which now account for nearly 10% of total jobs, and most of it in the south of Oxfordshire. GVA growth in key high tech sectors was also well above the national average (e.g. GVA in 'information and communication' grew by 29.3% in Oxfordshire 2011-14, compared with 8.4% in UK).

3.4 Based on the scale of recent investment the rate of growth of the high tech sector – both in employment and GVA – appears likely to increase. In the 12 months to July 2015 Oxford's technology firms received a reported £1.4bn in investments – more than five times the previous year's total of £250m. There are now five high tech companies in Oxfordshire worth over US$1bn (Adaptimmune, Circassia, Immunocore, Oxford Nanopore and Sophos), and over 20 new Oxford technologies and ventures received a record £2.6m in proof-of-concept funding in 2014 alone. The scale and breadth of this investment seems likely to stimulate growth in high tech manufacturing as well as services in future, which would provide greater balance to the high tech cluster which has been driven in recent years by services growth.

[22] Source: http://www.ons.gov.uk/ons/rel/regional-accounts/regional-gross-value-added--income-approach-/december-2015/index.html

[23] Eurostat definitions. Source: ONS, Business Register & Employment Survey (NOMIS). Narrow Definition – High-tech manufacturing: 2007 SIC 21, 26, 30.3. High-tech knowledge intensive services: 2007 SIC 59-63, 72. Broader Definition – High-tech & medium high-tech manufacturing: 2007 SIC 20-21, 25.4, 26-29, 30 (except 30.1), 32.5. High-tech & selected other knowledge intensive services: 2007 SIC 58-63, 71-72, 74.1, 74.9.

[24] The source of all the employment data is the Business Register & Employment Survey (NOMIS), undertaken annually by ONS. This is a sample survey and the 2014 results are provisional. Hence the figures may be subject to sampling errors and future adjustment, but they are the most recent and best available.

TABLE 3-1: *Employees in high-tech sectors (Eurostat Definition), Oxfordshire 2011 and 2014*

	2011	2014
Total employment (All sectors, including employees and self employed)	371,500	400,600
Total Employees (All Sectors)	320,600	341,500
Number of Employees (narrow Eurostat definition of high tech)		
High-Tech Manufacturing	4,000	3,800
High-Tech KI Services	16,000	16,800
Total: Eurostat High-Tech Sectors	**20,000**	**20,500**
As % of Total Employees (narrow Eurostat definition of high tech)		
High-Tech Manufacturing	1.2%	1.1%
High-Tech KI Services	5.0%	4.9%
Total: Eurostat High-Tech Sectors	**6.2%**	**6.0%**
Number of Employees (broader Eurostat Plus definition including 'medium tech')		
High and Medium Tech Manufacturing	13,100	12,400
High-Tech and selected other KI Services	29,900	33,700
Total: Wider High-Tech Sectors	**43,000**	**46,100**
As % of Total Employees (narrow Eurostat definition of high tech)		
High and Medium Tech Manufacturing	4.1%	3.6%
High-Tech and selected other KI Services	9.3%	9.9%
Total: Wider High-Tech Sectors	**13.4%**	**13.5%**

Source: ONS, Business Register & Employment Survey (NOMIS). Total employment figures provided by Cambridge Econometrics, who compile the figures from three sources: data on employees in employment are taken from BRES; agricultural employment data include agricultural labour force data from DEFRA; and estimates of self-employment are taken from the Annual Population Survey (APS).

High tech employees: Narrow Definition – High-tech manufacturing: 2007 SIC 21, 26, 30.3. High-tech knowledge intensive services: 2007 SIC 59-63, 72. Broader Definition – High-tech & medium high-tech manufacturing: 2007 SIC 20-21, 25.4, 26-29, 30 (except 30.1), 32.5. High-tech & selected other knowledge intensive services: 2007 SIC 58-63, 71-72, 74.1, 74.9. Figures for total employees exclude farm-based agriculture (2007 SIC 01000).

All figures are rounded to the nearest hundred employees, therefore figures in the table may not sum exactly to totals.

The specialist areas

3.5 Four main specialist areas were identified in the Oxfordshire Innovation Engine report, as illustrated in ***Figure 3-1***. These categories are imperfect – there are considerable overlaps between them and some firms could be categorised into two or three areas. However, the categorisation does illustrate distinct technology strengths in Oxfordshire (which in many cases extend into surrounding areas – for example, the concentration of telecoms and computer related firms extends across the Thames Valley as a whole, and the motorsport and broader high performance engineering cluster extends north and east into Northamptonshire, Buckinghamshire and Milton Keynes). Therefore the original categorisation has been used in this Update to present information on the recent performance of a variety of high tech firms. The following paragraphs illustrate, primarily through case studies based on in-depth interviews, recent progress across all of these areas, but also refer to some setbacks.

FIGURE 3-1: *Understanding high tech Oxfordshire: core overlapping technologies*

Bioscience, medical technologies and pharmaceuticals

3.6 The bioscience cluster in Oxfordshire has continued to grow, and to attract increased investment. The 2011 Biocluster Report by OBN identified 163 bioscience firms in Oxfordshire, an increase of 14% since 2008. In 2015, Bidwells in association with letscellit.com, identified 233 bioscience firms within 20 miles of Oxford, and the Oxford Academic Health Science Network has identified some 700 companies involved in pharmaceuticals, digital healthcare, diagnostics and medical technologies in the AHSN area, which extends across Berkshire, Buckinghamshire, and part of Bedfordshire as well as Oxfordshire. These recent surveys suggest rapid and sustained growth over the last seven years, although different area definitions mean it is not possible to be precise about growth rates.

3.7 Direct evidence from our research and interviews with firms undertaken for this update confirmed that the bioscience cluster is growing rapidly, and includes some firms with huge potential. Since December 2014, ten Oxfordshire bioscience firms have attracted between them around £1bn in investment *(Table 3-2)*.

TABLE 3-2: *Recent investments in bioscience firms in Oxfordshire*

FIRM	SIZE OF INVESTMENT	DATE OF INVESTMENT
Midatech	£49m	December 2014
Summit Therapeutics	£22m	March 2015
Adaptimmune	£127m	May 2015
Oxford Biomedica	£16m	May 2015
PsiOxus	£15.5m	May 2015
Circassia	£281m	June 2015
Oxford Nanopore	£70m	July 2015
Immunocore	£320m	July 2015
Blue Earth Dx	£18m	July 2015
Replimune	£20m	September 2015

Source: Data compiled by Jon Rees

3.8 Four bioscience companies in Oxfordshire (Adaptimmune, Circassia, Immunocore and Oxford Nanopore) have valuations of over US$1bn and all are growing fast. Adaptimmune and Immunocore both featured in the Innovation Engine report but are now substantially bigger – *see **Box 3-1***. Both have the potential to make a global impact on cancer therapies over the next 10 years, and both are committed to continued growth in Oxfordshire.

3.9 Adaptimmune, Immunocore and Evotec (***Box 3-2***) all illustrate the global nature of bioscience, particularly as firms scale up. For Adaptimmune and Immunocore, this has involved establishing a presence in the USA, whilst retaining the HQ functions and continuing to build research activity in Oxfordshire. For Evotec, a German company which acquired Oxford Asymmetry in 2000, this has involved mainly growth elsewhere, driven by continued acquisitions and a major collaboration with Sanofi.

3.10 Oxfordshire continues to provide an attractive environment for bioscience firms, as evidenced by continuing inward investment: for example, French pharma company Ipsen is due to open a 2,500 sqm facility at Milton Park in early 2016, and BerGenBio, a Norwegian clinical stage biopharmaceutical company has recently established a presence on the Oxford Science Park.

3.11 However, firms do express concerns about constraints to growth (for example, see the Evotec case study), and the attractions of North America are considerable. For many successful bioscience firms in Oxfordshire, a route to growth will be either to acquire other firms, or to be acquired. The consequences for growth locally then become more unpredictable.

BOX 3-1: Adaptimmune and Immunocore

Adaptimmune and Immunocore are developing, in different ways, novel therapies for cancer using engineered T cell receptors (TCRs). The technology, which originated in Oxford University, is genuinely ground breaking.

In 2013, the two companies employed 75 staff between them. It had taken 20 years of research, including 14 years since the spin out of the original technology from Oxford University, and approximately £75 million, to develop the TCR technology, but in the summer of 2013, Immunocore signed partnership agreements with two leading pharmaceutical firms (Genentech and GlaxoSmithKline (GSK)). These agreements provided financial security to Immunocore and offered substantial returns – up to around £400m in development and commercial milestone payments, plus royalties. However, Adaptimmune was still at the pre-revenue stage.

Recent changes

The two firms have continued to exploit the same basic technology platform, which is focused on using the body's own T cell system to fight cancer, but in different ways. This has led them to use different routes to grow their business, although there remain similarities: notably generation of revenue and scientific credibility through strategic licensing deals with major pharma firms, a strong focus on R&D to develop new product lines, and a continuing commitment to maintaining R&D facilities in Oxfordshire.

Adaptimmune has made dramatic progress since 2013. In March 2014, James Noble became full-time CEO of Adaptimmune, having been CEO of both companies since their formation in 2008. He has over 20 years' experience in the biotech industry and has served on numerous public and private company boards in the UK and USA. This move was designed to support a growth strategy for Adaptimmune, which was generating promising early results from clinical trials in the USA of its NY-ESO TCR therapeutic candidate. In June 2014, the company announced a collaboration and license agreement with GlaxoSmithKline (GSK), potentially worth over $350m in the first seven years, for the development and commercialisation of the NY-ESO clinical programme. This was followed in September by a private placement which saw Adaptimmune secure $104m from blue chip US funds and Oxford University, and in May 2015 the company completed an Initial Public Offering on NASDAQ raising $176m in net proceeds. The scale of this investment is enabling Adaptimmune to progress clinical trials in a range of cancers while also accelerating the development of its proprietary pipeline. To support further planned expansion, a new 67,000 sq ft laboratory and office building is under construction at Milton Park, Oxfordshire, to accommodate around 200 R&D specialists, while a pilot manufacturing and laboratory facility is being built in Philadelphia to support clinical and manufacturing operations. Both buildings are scheduled for delivery in late 2016.

In July 2013, Adaptimmune had 22 employees and by November 2015 it had 200 (three quarters at Milton Park, the rest in Philadelphia).

Immunocore has continued to develop through the partnership model and has signed two more agreements, with Medimmune (part of Astra Zeneca) and Eli Lilly. Further clinical trials have all yielded positive results.

In parallel with advances in its R&D and trials programmes, Immunocore has strengthened its management (including bringing in an experienced CEO, Eliot Forster, in early 2015) and Board, and has raised £320m of private equity funding to enable rapid growth. This will allow it to maximise the value of the existing agreements while also expanding R&D in order to build the product pipeline. The firm has also taken on new office and laboratory premises at Milton Park, as well as opening a small office near Philadelphia, within the main concentration of pharma companies and related research in the USA.

In July 2013, Immunocore had 50 employees and by November 2015 it had 180 at Milton Park. It is planning to employ around 400 by 2018.

Links within Oxfordshire

Both companies are committed to long term growth in Oxfordshire. They both intend to retain their HQ and R&D functions at Milton Park, while also growing facilities in the USA to manage the interface with US pharma companies, regulators and to operate clinical trials and, in Adaptimmune's case, to establish a pilot manufacturing facility.

The Milton Park location suits both firms – there is a strong specialist labour market in the area, and both firms find it relatively easy to attract people to live and work in southern Oxfordshire, partly because of the global brand of Oxford, and partly because the two firms are exploiting leading edge technology in the field of immune-oncology with huge potential health benefits.

Both firms are very international, with employees from over 20 countries. Many are recruited following doctoral work at a UK university, but increasingly people are being recruited direct from overseas as well as in the UK.

In addition, MEPC has done an excellent job in facilitating their growth by providing new office and lab space as required (including building speculatively during the recession, which was almost unique in the UK). Both firms continue to maintain their links with Oxford University, which is an investor in both companies and Professor Sir John Bell, the University's Regius Professor of Medicine, is a Non-Executive Director of Immunocore. The CEOs of both companies have served as non-executive directors of local biotech start-ups and both firms are members of OBN, the main biotech network for Oxfordshire and surrounding areas – in October 2015, Adaptimmune won the UK Biotech Fundraiser of the Year Award at OBN's annual awards.

Constraints on growth

The funding constraints on growth, which were evident in 2013, have been overcome by both companies. However, without the previous long term financial support by local business angels, neither company would have survived. The success of the two firms, and the outstanding quality of their R&D and proprietary pipelines, means they have both been able to recruit excellent people quickly. The cost of housing is a concern, but one which people seem to accept: there is at least a range of housing available near Milton Park, including substantial new and relatively affordable development at Didcot. Congestion on the A34 is an on-going concern, although rail accessibility and reliability is good.

BOX 3-2: Evotec

Growth to 2013

Oxford Asymmetry, formed in 1991, was a classic spin-out from the University of Oxford. It was acquired in 2000 by the German company, Evotec, and – after a difficult period immediately post-acquisition – the new company grew by developing collaborative innovation/ research-based alliances with big pharma and through a series of acquisitions. At the time of the original Oxfordshire Innovation Engine study (in 2013), Evotec had a worldwide workforce of 610 staff, of whom around 200 were based on Milton Park near Abingdon. It was a genuinely global business with 50% of its sales in North America. It reported limited links into local networks and institutions within Oxfordshire.

The story from 2013-2015

After the publication of the *Oxfordshire Innovation Engine*, Evotec completed a number of further acquisitions. Examples included German-based Bionamics GmbH and Euprotec, a small Manchester-based contract research organisation. At the same time, some of its major collaborations developed further; for example, various milestones were achieved with Roche and Bayer. New international collaborations were also announced, both with companies (e.g. Debiopharm, Eternygen) and institutions (e.g. Fraunhofer Institute for Molecular Biology and Applied Ecology and Ohio State University).

However, the most significant development between 2013 and 2015 was a major multi component strategic collaboration with Sanofi. This was announced late in 2014 and the process was completed in 2015. One part of the collaboration involved the transfer of more than 200 scientists – based in Toulouse – to Evotec, allowing Evotec to expand its capacity very significantly and quickly. A pipeline of five pre-clinical oncology discovery projects was also licensed from Sanofi to Evotec. In addition, Sanofi's global screening library was made available to Evotec's pharma, biotech and academic partners; this will be of substantial intellectual value in relation to Evotec's core business over the years ahead.

The collaboration with Sanofi was – and continues to be – a very major undertaking. As part of a major restructuring process, Sanofi had been looking for a partner to take on the Toulouse site at zero nominal cost. Over five years, the Sanofi operation will be transferred to Evotec. Integration into Evotec will require major cultural changes. The Sanofi staff were research scientists who were used to working as a cost (rather than profit) centre and in a unionised environment. They had little experience of working for customers or operating on a commercial basis. Notwithstanding the clear synergies, the merger process was itself therefore ambitious.

However, after the first few months, it is progressing well. For Evotec, it represents a step change in terms of overall scale, and it constitutes a major platform for further growth.

The collaboration with Sanofi underlines Evotec's international character. Looking ahead, it is probable that the Sanofi site will account for the majority of future growth; in part, this is simply because the site at Toulouse is substantial. Already, some forty additional staff have been recruited to Toulouse.

This pattern of growth is reflected in Evotec's headcount: as of autumn 2015, Evotec employed around 950 staff (up from 610 in 2013) of whom 240 were based in Oxfordshire (up from about 200). Had the opportunity linked to Sanofi not arisen, it is probable that some further growth would have occurred at Milton Park (particularly in chemistry-based activities).

Oxfordshire continues to be a good place for Evotec to do business and the Milton Park site is important for the business – although as Evotec grows, the Oxfordshire-based activities will account for a lower proportion of the whole business. Oxfordshire brings with it both pros and cons. The area's main strengths relate to the labour market and the fact that it is possible to recruit high calibre chemists. The biggest problem surrounds the availability and affordability of housing. This has become increasingly challenging over the last two years for both new graduates and for more experienced staff seeking to relocate. Links with the academic community in Oxfordshire continue to be relatively limited – although the "depth" of bioscience in Oxfordshire compares well to Evotec's other major European sites (e.g. Hamburg and Goettingen).

3.12 Medical devices and digital health are also areas of strength in Oxfordshire. Owen Mumford and Becton Dickinson are both global businesses with substantial facilities in Oxfordshire, and Accentus Medical – which has its origins in UKAEA at Harwell – won the Best New UK Medtech Development Programme category at the OBN Awards in 2015. In relation to digital health, Oxehealth was the first joint spin-out (in 2012) from the University of Oxford (Engineering) and Oxford University Hospitals NHS Trust. The firm operates at the interface between engineering and healthcare, using expertise in computer vision and signal processing to extract patients' vital sign data from a live video feed output by a standard digital video camera.

Telecoms and computing

3.13 The major Oxfordshire firms in the telecoms and computing sector have experienced mixed fortunes over the last few years. Sophos has continued to go from strength to strength, based on the quality of its technology and the booming cyber security market *(see Box 3-3)*. Natural Motion, founded as an Oxford University spin out in 2001, also continues to succeed in the highly competitive but also fast growing gaming industry. In January 2014 it was acquired by social network gaming company Zynga for over US$500m.

3.14 In contrast RM Group has had mixed fortunes in recent years. The Group employs 1,600 people, mainly at its Milton Park headquarters, and specialises in providing IT services to educational organisations and establishments. In 2013 it closed its PC business and made around 300 staff redundant, largely as a result of the closure of the Government's 'Schools for the Future' programme.

3.15 The Sophos and Natural Motion growth stories mirror that of some of the other larger Oxfordshire high tech firms: increasing internationalisation, successful fund raising (in the case of Sophos, through flotation), growth through acquisition (either as acquirer or seller) as well as recruitment, and faster expansion overseas than in Oxfordshire. These changes benefit Oxfordshire, but they also bring the risk that overseas locations become more attractive. This increasing exposure to international competition is the context within which the Oxfordshire high tech cluster needs to be seen.

BOX 3-3: Sophos

Growth to 2013

Sophos was founded in 1985 by two post-doctoral students from the Department of Engineering at the University of Oxford. Subsequently, it grew through a mix of organic growth and a series of acquisitions. By the time of the original *Oxfordshire Innovation Engine* study, it had a global workforce of about 1,600 people of whom around 480 were based in Oxfordshire.

The story from 2013-2015

Kris Hagerman joined Sophos in 2012 as CEO. Under his leadership, the company has focused on small and medium-sized business customers, recognising the particular challenges facing mid-market enterprises and the channel that serves them. This means that Sophos designs its products to be used by companies that do not have highly skilled security staff, and typically have less monetary resource. Sophos billings are equally split between endpoint security software (anti-virus, mobile management, encryption) and network security (firewalls, web, email, wireless). Most competitors tend to focus on one or the other but Sophos is leading the industry in bringing the two together to provide enhanced protection and dramatically reduce the time and resources required to investigate and address security incidents. In the context of a rapidly-growing US$500bn cybercrime industry, the approach adopted by Sophos has been very successful.

Since the *Oxfordshire Innovation Engine* was completed, the company has continued to grow, both organically and through acquisition. By December 2015, it employed nearly 2,900 people globally (of whom about 500 were based in Oxfordshire). Hence – in terms of headcount – Sophos has grown globally by over 80% in two years. It has grown in Oxfordshire, but much more slowly.

In summary, Sophos' recent acquisitions have allowed it to extend its security offering to reflect the rapidly changing ways in which small companies use IT and the consequential challenges in terms of protection. Recent acquisitions have included: India-based Cyberoam (with Unified Threat Management (UTM), next-generation firewall and network security expertise) in February 2014; California-based cloud security firm Mojave Networks (October 2014); Massachusetts-based Reflexion Networks Inc (in June 2015); and Dutch firm, SurfRight, with expertise in signature-less next-generation endpoint threat detection and response (ETDR) and advanced threat prevention (in December 2015).

Flotation – and the consequences

However the major "event" over the period from 2013-2015 was the flotation of Sophos on the London Stock Exchange in July 2015. This was Sophos' third attempt to float the business. Whereas the first attempt in 2007 was thwarted by the financial crisis, the July 2015 flotation coincided with heightened public interest in cyber security. The flotation was a major success and through it, Sophos was valued at over £1bn. It provided some liquidity for shareholders and also access to capital which will be important for continuing growth.

One consequence of flotation has been that Sophos is now more *"visible"* within the UK. This is proving to be very important, particularly in terms of recruitment; far more people simply *"know about Sophos"*. In parallel, within Oxfordshire, Sophos has benefited from processes of "churn" in the (broadly defined) IT sector. Some local restructuring – notably RM Education (based on Milton Park) – and ownership changes relating to direct competitors (e.g. the acquisition of McAfee (in Aylesbury) by Intel) have meant that there has been more access to appropriately skilled people.

Links to the University of Oxford

Sophos reports that over the last couple of years, its dialogue with the University of Oxford has become stronger and that it is now recruiting more graduates from the university. A wide range of factors seems to have been at play. First, there is a "general sense" that the university is becoming more "open". Second, and in addition, there are some personal links between senior academics in the Department of Computer Science and some of Sophos' senior managers (which can be traced back to undergraduate days). Third, as a result of significant government funding, specialist research is now being conducted in cyber security within the University of Oxford; this is seen as *"the best in the UK"*, meaning that the University is an obvious partner for reasons of expertise, not just location. Fourth, Sophos itself has grown to a point where it is regarded as a serious player globally (and again, flotation was important in these terms). These four different factors have been mutually reinforcing. The consequence is that the relationship has evolved; and the expectation is that links will deepen in the future. However, in relation to enterprise and entrepreneurship, there is still a sense that more could be done around the University of Oxford.

International dimensions

The cyber security sector is a global industry – albeit one that is constantly adapting and changing. It is notable that all of Sophos' recent acquisitions have been international ones – emphasising further the global nature of Sophos' business. Within this context, India should be seen as an important centre, even though the cost advantages are perhaps less significant than they were a few years ago. Silicon Valley however continues to have a *"very deep labour market"* and that makes it very competitive. Oxfordshire's role – and potential – needs to be understood in these terms.

Internationally, the University of Oxford is one of a number of centres of specialist research linked to cyber security; and Sophos has links across these. Other leading institutions (with which Sophos has links) are the Johannes Kepler University of Linz (Austria) and Karlsruhe Institute of Technology (Germany).

Physics related

3.16 Physics related firms have been a distinctive part of the Oxfordshire high tech cluster since the formation of Oxford Instruments in 1959 as a spin out from Oxford University's Physics Department. In addition, the UKAEA facilities at Harwell and Culham have created a skills base and range of facilities which have continued to grow: for example, with the location at Harwell of the Satellite Applications Catapult Centre and the European Centre for Space Applications and Telecommunications. These facilities and related expertise have attracted firms to grow in the area, including through inward investments such as Element Six (which undertakes R&D into synthetic diamonds), acquisitions such as Siemens Magnet Technology (which was formed through Siemens' investment in, and then full acquisition of, Oxford Magnet Technology), and new starts such as Tokamak Energy and Oxis Energy.

3.17 ***Box 3-4*** demonstrates the innovative nature of the technology being developed by Tokamak Energy, as well as its potential impact. The view of Tokamak's management is that this work could not be undertaken anywhere else in the world, due to the unique combination in southern Oxfordshire of expertise in fusion technology, high field magnets and highly complex engineering processes. A study commissioned by Tokomak Energy indicates a growing cluster of fusion energy research and commercial activity in Oxfordshire, with potentially very significant beneficial economic and societal impacts.

3.18 Oxis Energy Ltd, a spin out from Oxford University Materials Department, is developing a Lithium-Sulphide battery technology that has the potential to revolutionize the rechargeable battery market. By offering high capacity and battery stability over the cycle life and across a broad temperature range, the technology has potential applications in electric vehicles, energy storage and defence. The firm is based at Culham Innovation Centre.

3.19 The location of national and international space and satellite technology facilities at Harwell has made the area the centre of the UK space industry, which has tremendous growth potential over the next 15 years.[25] However, there have also been some setbacks. Employment in the JET project at Culham is reducing as the focus for publicly funded fusion research shifts to the International Thermonuclear Experimental Reactor being built in France. In addition, the Industrial Products division of Oxford Instruments has lost some staff over the last year due to adverse trading conditions overseas, though other parts of the business have grown, including through acquisitions, and there are also some promising developments in the pipeline ***(Box 3-5)***.

[25] See, for example, "UK space industry set to rocket with £240 million of investment": press release from the Department for Business Innovation and Skills, 9 November 2012

BOX 3-4: Tokamak Energy Ltd

Tokamak Energy was established at Culham in 2010. It is developing compact spherical tokamak devices in combination with new magnet technologies (using high temperature superconductors), and developing engineering innovations to overcome long running obstacles to making fusion energy commercially viable. Its business model is based on agility and open innovation – working collaboratively with universities, research laboratories and other businesses whilst ensuring that the ownership of crucial intellectual property is protected.

The technology and expertise for spherical tokamaks was originally developed at Culham Laboratory, but government funding is now focused on huge fusion devices built through international collaboration. The highly successful JET (Joint European Torus) device at Culham will, in due course, be superseded by the huge ITER tokamak presently under construction in France. Tokamak Energy and its backers (a group of high net worth individuals, plus Rainbow Seed Fund and the Institution of Mechanical Engineers) are convinced that progress can be made much more quickly through innovative engineering of small scale devices.

Recent changes

Tokamak Energy now employs 20 scientists and engineers, plus 10 contractors and several part time consultants. To accommodate this expansion, Tokamak Energy expanded into new premises at Milton Park in 2013 with further expansion in 2015. The firm has won various awards over the last year, including being recognised as a Technology Pioneer by the World Economic Forum. It has secured £10m of private investment and has an ambitious timetable for building a succession of new tokamaks, each of which take the technology closer to commercial viability. However, this will require substantial additional tranches of funding over the next 5 to 10 years.

Links within Oxfordshire

The mix of expertise available within southern Oxfordshire – in particular the combination of deep expertise in nuclear fusion, high field superconducting magnets, and advanced engineering processes is unique to this area and crucial to the establishment and growth of Tokamak Energy. The recent reduction in employment at Culham Laboratory has also helped the firm to recruit very experienced and technically excellent staff. Informal collaboration has continued with Oxford Instruments, Siemens Magnet Technology, the Rutherford Laboratory as well as Culham. In addition, the initial funding was provided partly by local business angels with a real understanding of the science and engineering challenges and opportunities.

Constraints on growth

The key to future growth will be Tokamak Energy's ability to demonstrate significant progress towards commercial viability with each new Tokamak it builds and tests, and whether additional investment can be secured based on this progress. At a later stage (assuming it continues to make significant progress) the firm will have to deal with regulatory and licensing issues, which are likely to be onerous. Other factors such as specialist expertise and the availability of suitable property are unlikely to be constraints.

BOX 3-5: Oxford Instruments plc

Growth to 2013

Oxford Instruments was founded in 1959 by Sir Martin and Lady Audrey Wood. By the early 1980s, its turnover exceeded £100m. In 2011, it entered the FTSE 250 Index and it was voted PLC of the year. By 2012, its revenues were in excess of £330m globally and it employed just over 1,800 people worldwide; of these, about 220 people were based at Oxford Instruments' Tubney Woods site, to the south of Oxford.

The story from 2013-2015

The global picture…

Since the publication of the Oxfordshire Innovation Engine, Oxford Instruments has grown overall, although there has been some movement within this. Across the three main operating sectors – and comparing the latest situation (as set out in the press release accompanying the Announcement of Preliminary Results for the year

to 31 March 2015) to that reported in the Oxfordshire Innovation Engine – the headlines might be summed up as follows:

- NanoTechnology Tools (high performance technology products for research and industry) generated sales of £153m in 2012. In the year to March 2015, overall revenue was over £210m. The increase was partly as a result of several acquisitions
- Industrial Products (analytical systems and components for research and industry) generated sales of £129m in 2012. In the year to March 2015, the equivalent figure was £107m, due in part to the successful completion in 2014 of a non-recurring contract to supply superconducting wire to ITER
- Service (worldwide network of service) generated sales of £56m in 2012. In the year to March 2015, this had risen to £69m.

Whilst the performance of NanoTechnology Tools and Service is reported in very positive terms, the challenges facing Industrial Products in particular have been apparent in the comments published alongside the different financial reports. The press release accompanying the Announcement of Preliminary Results for the year to 31 March 2015 referred, for example, to the consequences of macro-economic uncertainty, particularly in Russia and Japan, and its effects. Oxford Instruments' response involved a wide-reaching cost reduction programme which resulted in "structural changes which have been embedded in the cost base of our businesses".

However, as in the earlier period, acquisition has continued to be an important strand of Oxford Instruments' activities. Although there have also been some disposals, since the publication of the Oxfordshire Innovation Engine report, the following acquisitions have taken place:

- May 2015: Medical Imaging Resources, Inc. (MIR), a Michigan-based company specialising in the build, lease and service of mobile medical imaging labs
- January 2014: Andor Technology plc, a Belfast-based market leading supplier of high performance optical cameras, microscopy systems and software
- December 2013: Roentgenanalytik Systeme GmbH, a company which specialises in designing and supplying instruments for coating thickness measurement and material analysis, using X-ray fluorescence
- November 2013: RMG Technology Limited, a specialist in Laser Induced Breakdown Spectroscopy which was based in West Sussex (although the business was subsequently relocated to Oxfordshire).

Oxford Instruments in Oxfordshire…

Oxford Instruments' activities within Oxfordshire need to be understood within the wider corporate context outlined above. Overall, employment at the firm's Tubney Woods site has been stable over the last two years – it fell slightly and then rose again, bolstered by the relocation of RMG Technology Limited.

Oxfordshire continues to provide an important "home" for Oxford Instruments, whilst recognising also that the firm is genuinely global.

Reflecting on the last couple of years, there have been some developments which are (and/or will be) important for the company. In particular, the creation of a Hub for Networked Quantum Information Technologies (NQIT) – led by the University of Oxford – could be very significant. This will look to combine state of the art systems for controlling particles of light (photons) together with devices that control matter at the atomic level to develop technologies for the future of communications and computing.

Whilst it is important not to overstate the significance of Oxfordshire to Oxford Instruments today – noting, for example, that in August 2015, Oxford Instruments entered into a strategic relationship with the School of Physics at the University of Bristol – the links that do exist are strongly embedded: Harwell and Culham continue to be seen as an important part of the overall landscape; Oxford Instruments continues to work closely with Isis Innovation; and the firm continues to be an investor in a few Oxfordshire-based companies, notably Tokamak Energy. Moreover, within Oxfordshire, Oxford Instruments continues to run a well-regarded apprenticeship scheme.

Engineering and electronics

3.20 There is a wide variety of engineering and electronics firms in Oxfordshire, ranging from large established businesses through to small start-ups, and including technologies such as autonomous vehicles, solar energy and electronic control systems. *Boxes 3-6* and *3-7* provide examples of two firms in different areas of activity which have made rapid progress over the last two years in different ways. Oxford Photovoltaics secured substantial funding in 2015 to develop further its solar cell technology, whilst Williams Advanced Engineering has made major progress in diversification into new markets, based on technologies developed in Formula 1. Williams Advanced Engineering has also established a Technology Ventures division to support the development of innovative ideas into new businesses *(Box 3-7)*.

BOX 3-6: Oxford Photovoltaics Ltd

Oxford Photovoltaics develops Perovskite solar cells. Perovskite is the fastest improving solar cell technology ever seen and Oxford Photovoltaics is leading the global development and commercialization. The company believes that its perovskite-based technology will improve the performance of traditional silicon solar panels by at least 20%, and will facilitate new market opportunities for the generation of solar power. These include BIPV (building integrated PV) where the company's technology can be coated onto glass to allow large office blocks to generate their own electricity.

Oxford Photovoltaics has raised over £12.6m during 2015 from existing and new investors to enable the technology to be taken to the next stage of development towards commercial deployment. The firm is a spin-out from the University of Oxford, based at Begbroke Science Park. It employs 30 PV and advanced materials scientists.

BOX 3-7: Williams Advanced Engineering Ltd

Williams was founded in 1977 by Frank Williams and Patrick Head as Williams Grand Prix Engineering Ltd. The company was initially based in an empty carpet warehouse in Didcot, Oxfordshire, and immediately entered a car in Formula 1. By 1981, Williams had won both the F1 Drivers and Constructors championships, and more racing successes followed. In 1996 Williams moved to its current site at Grove, and by 2013 it had 630 employees, 150 of whom had been recruited over the previous 2 years. The firm was beginning to diversify, building on the expertise and technologies developed in F1 to enter new markets.

In 2010, Williams Advanced Engineering was established as a separate company within the Williams Group, and moved into a new building on Williams' Grove campus in 2014. Williams Advanced Engineering provides engineering solutions for other firms, with a focus on energy efficient performance. Its markets are in automotive (50%), motorsport (30%), defence (the largest of the others), aerospace, renewable energy and sports science.

By 2015 the Group employed 700, including 550 in Williams' Formula One operation, Williams Martini Racing, and 150 in Williams Advanced Engineering. Williams Advanced Engineering is set to expand over the next few years, but F1 is likely to remain the largest part of the Group for the foreseeable future.

Williams Martini Racing and Williams Advanced Engineering are entirely complementary. Williams Advanced Engineering's link with the Formula 1 team is critical to its success in two main ways:

- Williams' F1 brand is important for market entry and credibility
- Williams Martini Racing has specialist expertise and facilities (e.g. wind tunnel, machine shop) which Williams Advanced Engineering uses in providing services to customers.

Equally, Williams Advanced Engineering is important to Williams' F1 operations:

- It makes more efficient use of the Group's resources by using specialist facilities and expertise which are only needed by the F1 team for part of the year
- It helps attract and retain sponsors by demonstrating the value in other sectors of the technology, expertise and processes (including rapid response) developed in F1.

Expertise and market focus

Williams Advanced Engineering's main areas of expertise include aerodynamics, vehicle dynamics, lightweight structures, hybrid and electric vehicles. Williams Advanced Engineering was the battery supplier for Formula E last year, it is again this season, and is continuing to work on upgrades for the future.

The company also specialises in high performance engineering, prototyping and low volume production. For example:

- Communications, optical, electric and power transmission systems for 600 tanks for General Dynamics
- Development of light, compact drive systems for the Pedelec cycle for Brompton
- It built six C-X75 Jaguars for the latest Bond film in 12 weeks.

Labour market

The workforce is recruited nationally. Many commute from lower cost areas further north, which are also closer to the heart of the biggest labour market for advanced engineering in the Midlands. To support continued growth, Williams Advanced Engineering is planning to expand its graduate intake, and it operates some apprenticeships.

Customers and suppliers

Williams Advanced Engineering's customers are widely spread across the UK and, increasingly, internationally (e.g. Nissan in Japan). However, the main focus is on growing the UK market: as a relatively small business, it is easier to service UK markets.

The Williams Group is quite vertically integrated, therefore a lot of products and services are sourced internally. Externally, Williams Advanced Engineering's suppliers tend to be the same as for Williams Martini Racing, for historical reasons. Many are relatively local, but Williams Advanced Engineering also sources specialist inputs from anywhere in the UK.

Networks

The main networks tend to be industry/sector focused: Formula 1 and Formula E provide informal networking opportunities. The Motorsport Industry Association has been active in promoting the expertise of motorsport firms in other sectors, and the Automotive Council has established various consortia of which Williams Advanced Engineering are members, for example on autonomous vehicles and reuse of old batteries. Innovate UK is also an important organisation for networking and access to funding.

More locally, Williams Advanced Engineering is active in the Oxfordshire LEP and through its new 'Technology Ventures' team it has two small projects with Oxford University: one on power generation from waste (with Engineering), and the other on nanomaterials (with Materials Science). The company is also developing links with both Harwell (e.g. the Satellite Communications Catapult) and Culham, particularly in the areas of energy, lightweight materials and robotics.

Technology Ventures

The Technology Ventures team in Williams Advanced Engineering was established in early 2015 to identify opportunities to build more IP and revenue streams which are not solely dependent on consultancy. This is likely to include:

- partnering with research organisations such as Oxford University, the Satellite Applications Catapult at Harwell and Culham Science Centre on projects with potential for commercial application and licencing
- partnering corporates to accelerate and commercialise technology
- working with some new starts and small businesses to provide technical support and 'accelerator' facilities, including potentially short term use of some facilities at Williams.

3.21 Another example of an Oxfordshire engineering firm developing novel technologies is Reaction Engines, which was founded in 1989 and is developing new synergetic air-breathing rocket engines suitable for powering modified aircraft directly into Earth orbit and at cruise speeds of up to five times the speed of sound. Reaction Engines secured £20m investment from British Aerospace in November 2015 and a commitment to £60m of Government funding to further develop and test its engine technology, which has the potential to revolutionise the speed of air travel.

3.22 Other examples of successful firms in this area include Zeta Group, Oxford Technical Solutions and Neptec. Zeta Group includes Zeta Automotive and Zeta Specialist Lighting, and was formed in 1989 as a spin out from Oxford Brookes University. Oxford Technical Solutions was founded in 1998 to develop and manufacture high accuracy inertial navigation systems. Both firms have developed specialist products for fast growing markets (respectively, LED and solar lighting systems, and intelligent vehicle control), both continue to invest heavily in R&D, and both are funding steady growth through retained earnings. Neptec, a Canadian owned company which develops and produces intelligent spaceflight sensors and equipment, recently located its European headquarters at Harwell Campus.

3.23 Recent spin outs include Oxbotica, which originated from Oxford University's Mobile Robotics Group. The firm specialises in mobile autonomy, navigation and perception. Its technology allows robots, vehicles, machinery and people to precisely map, navigate and actively interact with their surroundings, and has a wide range of applications, including autonomous vehicles, building 3D simulation environments, site surveys and inspection of hazardous environments. Oxbotica is providing the control and sensor systems for the UK Autodrive project which is trialling the use of driverless cars in central Milton Keynes. The Wall Street Journal identified Oxbotica as one of the 'Top 10 Tech Companies to watch in 2015' and claimed it "may be one of the few companies in the world to rival Google in driverless cars".[26]

[26] http://www.wsj.com/articles/europes-2015-tech-startup-landscape-1424300739

4. Physical infrastructure

Property for high tech firms

4.1 Progress has been made over the last two years in increasing provision of specialist property for high tech firms in Oxfordshire, both for early stage and larger, more established companies. As identified in the Oxfordshire Innovation Engine report, the main concentration of specialist property is in Science Vale, but the prospects for increased provision around Oxford and Bicester, in the northern part of the Oxfordshire's 'Knowledge Economy Spine', are also now improving. There remains a shortage of purpose built laboratory space, although this is a national problem linked to viability issues.

4.2 **Milton Park** continues to be the largest and most successful property scheme in Oxfordshire catering for the high tech cluster. It is home to 7,500 employees in 250 organisations in over 90 buildings. 28ha of the 101ha at Milton Park is in the Science Vale Enterprise Zone (the remaining 93ha within the EZ is on the Harwell Campus – see below). The Park also has an award winning Local Development Order which allows planning permission for a wide range of new development to be obtained in just 10 days and is considered by MEPC, the owner/operator, to have been instrumental in accelerating development of the Park.

4.3 Milton Park has attracted and retained fast growing high tech firms, and MEPC has been willing to take risks to be able to offer property at short notice on flexible terms. For example, in 2014 MEPC developed 5,100 sqm speculatively (101 and 102 Park Drive), the first development in the Enterprise Zone since its designation. At the time there was almost no speculative development of business space anywhere in the UK due to the fragility of the economic recovery. However, both buildings are now fully let, primarily to Ipsen, Adaptimmune and Immunocore (see paragraphs 3.9 to 3.10). MEPC is currently developing a further 12,000 sqm of additional new space for Adaptimmune and two other firms.

4.4 **Harwell Campus** already accommodates around 200 organisations and companies, employing over 5,000 people in total. There are also many major corporates and research organisations which regularly use facilities on the campus but which have no permanent base there. A Framework Master Plan has been produced by the new joint venture partners proposing 400,000 sqm of new commercial, academic and technical space, plus new homes, supporting infrastructure and amenities. Recently completed developments include new facilities for the European Space Agency, an 8,000 sqm RAL Space Test Facility, the Copernicus satellite dish and Element Six (De Beers) Phase II. In addition, a 3,000 sqm High Tech "Making" Building is under construction, along with "The Quad", which includes a 4,000 sqm innovation centre and additional technical, office and amenity space. In the pipeline is a 20,000 sqm 'university quarter' for existing and new research activities, further development of the 'space cluster', and new homes for rent and sale.

4.5 Significant progress has also been made in relation to the **Oxford Northern Gateway**, the development of which is now being promoted by the land owners, St John's College. The Oxfordshire Innovation Engine report noted that the "greatest potential for sustainable growth is to the north of the city around Begbroke, the new Northern Gateway (Peartree) and the planned new rail station at Water Eaton" (which has now opened). After many years when development of the Northern Gateway was prevented by transport and Green Belt constraints, proposals to develop a technology park of around 90,000 sqm, 500 homes and ancillary services were included in an Area Action Plan which was adopted by the City Council in July 2015.

4.6 At **Oxford Science Park**, on the southern edge of the city, around 50,000 sqm of office and laboratory space has been completed to date, with further development planned on a pre-let or pre-sale arrangement. And planning permission was secured in December 2015 for around 40,000 sqm of office and R&D space at **Oxford Technology Park**, close to Oxford Airport to the north of the city.

4.7 At **Culham** there are also plans for a substantial increase in business use of the site. This includes re-use of existing buildings as the activity related to JET is gradually run down, and also development of new commercial buildings on over 6ha of what is currently

open space. Outline planning permission has already been granted for three office/light industrial buildings totalling 9,000 sqm on part of this land. Together with proposed development of housing on the land adjacent to Culham (which prospectively may be allocated in the South Oxfordshire Local Plan), these initiatives could significantly enhance Culham's role in the Oxfordshire high tech cluster, well beyond its traditional role as a Government funded research centre.

4.8 In addition, progress has been made in increasing the provision for new business start up, particularly through research commercialisation. Match funding for ***new business incubation and accelerator facilities*** was announced as part of the Oxford & Oxfordshire City Deal by the Government in early 2014. This includes a 5,400 sqm Innovation Accelerator for advanced engineering businesses at Begbroke; a Bioescalator on the Old Road site in Oxford, adjacent to existing research facilities and the Churchill Hospital; the Harwell Innovation Hub, focused on open innovation; and the UKAEA Culham Advanced Manufacturing Hub, focused on remote handling technologies.

4.9 The Oxford Trust has also been actively promoting additional capacity for start ups within Oxford, partly in response to the recommendation in the Innovation Engine report to increase business incubator provision in Oxford ***(see Box 4-1)***. It is important that provision for start ups not directly related to research commercialisation improves in parallel with that for spin outs.

BOX 4-1: Support for Start-Ups - The Oxford Trust

The Oxford Trust was started in 1985 by Sir Martin and Audrey (Lady) Wood who founded Oxford University's first major spin out company Oxford Instruments ***(see Box 3-5)***. The Trust is a strategic organisation with programmes running across three key objectives:

Enterprise: to support economic growth by encouraging innovation

Education: to inspire young people about science, technology, engineering and maths

Engagement: to encourage people of all ages to engage with how scientific research impacts their lives.

The Trust created and opened the UK's first science innovation centre in 1986 and created a model that many others across the country have since copied. Today the Trust directly supports the county's innovation ecosystem through its Oxford Centre for Innovation (OCFI) in the city centre (30,000 sq ft) which is home to many small companies, a community-run makerspace and support organisations. In addition, it supports Venturefest Oxford (paragraph 5.6) as a co-founder and strategic partner and also co-invests in research to improve understanding of the innovation ecosystem and inform policy-making.

In 2012 the Trust co-funded the original Oxford Innovation Engine report. One of the report's findings identified the lack of flexible start-up space in the city centre for companies wishing to remain within walking distance of the University of Oxford and the city transport network. The fact that the OCFI facility operates at capacity, with a waiting list of start-up businesses wanting to move in, is indicative of the problem.

The Trust's board of trustees responded to this challenge by addressing it head on – where were the new opportunities to support innovation within the city? In 2016 it acquired a large parcel of land in Headington, close to the growing health and data sciences quarter on the Old Road campus and Oxford Brookes University. Building on the success of the OCFI, the Trust now plans to build a second similar sized independent innovation centre and a science education centre on the site that will further its mission and objectives and help create a pipeline of future scientists and entrepreneurs.

Constraints on growth

The Trust has always sought partnerships wherever possible and, while it has been successful in delivering real impact across its areas of activity, it also appreciates the value of working with others to fund long term investments. It is becoming harder for smaller organisations to access matched funding, particularly with capital projects, and without this it will be increasingly difficult to provide much valued philanthropic support for young companies, schools and the wider community. In addition, housing and transportation remain challenging across the wider cityscape making attracting and retaining staff difficult, particularly at junior levels.

Progress on housing delivery

4.10 In comparison with specialist property for the high tech cluster, progress to increase the availability and affordability of housing has been disappointing. The average price of a home sold in Oxfordshire in 2014 was £253,000: 50% above the national average and 13% above average for the South East region. House prices in the county were on average 9 times higher than incomes (in both cases measured for the lower quartile, to avoid distortion by the top end of incomes and house prices), indicating that many young households are not able to afford to buy a home. In Oxford and South Oxfordshire, lower quartile house prices were on average over 10 times higher than annual lower quartile incomes. These ratios were significantly worse than the national average of 6.6.[27] In March 2016, Lloyds Bank reported that Oxford is the least affordable city in the UK, with average house prices 10.68 times the average earnings of residents.[28]

4.11 Increasing supply is part of the solution, and in this respect some progress has been made over the last few years. The number of housing completions in Oxfordshire has increased by 74% over the last five years, compared with an average national increase over the same period of 15%.[29] The greatest increases in completions have been in Cherwell, South Oxfordshire and Vale of White Horse districts, which is consistent with the fact that some large scale developments are now beginning to deliver new homes, including NW Bicester Eco Development (the first phase of nearly 500 new homes is under construction, as part of the eventual development of 6,000 homes) and various sites at Didcot.

4.12 However, the absolute number of new homes completed each year is still well below the requirement. The 2014 Strategic Housing Market Assessment (SHMA) for Oxfordshire took into account the growth potential of the economy and concluded that up to 2031, Oxfordshire needs between 4,678 and 5,328 new homes per year. This compares with a total of 2,672 completed in 2014/15 (source: local authority annual monitoring reports).[30] The key issues to be resolved concern increasing the rate of implementation of outstanding planning permissions, and speeding up the local plan processes currently on-going in the county *(see below)*.

Progress with Local Plans

4.13 Local Plans provide the framework within which physical development in the county is facilitated and managed. They are important to give developers confidence to invest, and residents reassurance that any negative impacts of development will be managed as effectively as possible. Investment programmes to provide much needed infrastructure provide some confidence that the public sector is able to manage sustainable growth.

4.14 *Table 4-1* provides a summary of progress on Local Plans over the last few years. The Plans have been influenced by the evidence base, including the SHMA, which was based on forecasts of higher levels of economic growth than in the past, largely due to the strengths and increased momentum of the high tech cluster. Different districts have responded in different ways. Cherwell reissued its draft Local Plan with increased housing allocations in line with the SHMA figures; Vale of White Horse has also accepted the SHMA figures in full and their robustness is currently being tested at Examination in Public (EiP). In contrast, West Oxfordshire has argued that it should provide less housing than indicated by the SHMA on the grounds of both environmental constraints and that economic growth is unlikely to be as fast as assumed in the SHMA. These arguments were rejected by the Inspector appointed to chair the EiP, and further sessions have been postponed until December 2016 to allow the Council the opportunity to undertake further work on meeting housing needs. South Oxfordshire has an adopted Core Strategy to 2027, and is currently

[27] Data taken from the Oxfordshire Strategic Housing Market Assessment, 2014
[28] Guardian, 26th March 2016, referencing data from Lloyds Bank and ONS
[29] Sources: Oxfordshire local authorities Annual Monitoring Reports, and DCLG for national data
[30] https://www.gov.uk/government/statistical-data-sets/live-tables-on-house-building – Table 255 Housebuilding: permanent dwellings started and completed, by tenure and LEP, 2014-15

working on a more detailed plan for an extended period to 2031. Oxford also has an adopted Core Strategy which runs to 2026, and since 2011, the Council has focused on developing action area plans for key development areas within the city.

4.15 The five local planning authorities (LPAs) have also been working together and are near agreement on how to accommodate the 15,000 new homes that Oxford City has not been able to make provision for due mainly to a combination of City boundary and Green Belt constraints. Once agreed, there will be a need for appropriate adjustments to the existing housing provision in approved Local Plans and those in progress. In addition, a review of the Oxford Green Belt, commissioned by the Oxfordshire Growth Board[31] and published in November 2015, assessed the existing Green Belt in relation to the five purposes of Green Belt that are set out in legislation. This is intended to inform consideration of whether any Green Belt land could in future be used to accommodate sustainable forms, patterns and types of new development.[32]

TABLE 4-1: *Recent progress on local plans in Oxfordshire*

DISTRICT	CURRENT SITUATION WITH LOCAL PLANS AND AREA ACTION PLANS
Cherwell	Local Plan Part 1 (strategic sites and policies) was formally adopted in July 2015. The plan is intended to deliver sustainable economic growth and a boost to housing supply, with a particular focus on the expansion of Bicester
Oxford	The Oxford Core Strategy to 2026 was adopted by the Council in March 2011. Area Action Plans have been prepared and adopted for Barton, Northern Gateway and West End. The latest AAP to be adopted, in July 2015, was the Northern Gateway, which will provide 90,000 sqm of high tech employment space and 500 homes on 46ha of land, the development of which has been constrained for many years, mainly by transport issues
South Oxfordshire	The South Oxfordshire Core Strategy 2027 Development Plan Document was formally adopted by the Council in December 2012. Work to extend the plan period to 2031 and provide more detail is currently underway. As part of this, a Refined Options report was published in February 2015. Beyond this there is no firm timetable for the updated plan to be submitted for Examination and approval
Vale of White Horse	The Examination in Public into the Local Plan Part 1: Strategic Sites and Policies (to 2031) was completed in early 2016 and the Inspectors report is now awaited. An Action Area Plan for Science Vale is in the early stages of development
West Oxfordshire	The initial hearing of Examination in Public into the draft Local Plan, dealing with strategic matters, including the duty to co-operate and housing and employment requirements, was held in late November 2015. However, the Inspector concluded from this preliminary session that the provision for housing supply over the plan period was not in accordance with national guidance. This Inspector suspended further sessions until December 2016, to allow the Council to undertake further work on housing numbers and sites and to address the issue of 'unmet' housing need arising from Oxford City.

Source: Review of relevant local authority websites

[31] A partnership of the five district councils, Oxfordshire County Council, Oxfordshire Local Enterprise Partnership, Oxfordshire Skills Board and the Oxford universities, and charged with delivering the Oxfordshire Strategic Economic Plan

[32] Oxford Green Belt Study, Final Report, Prepared by LUC for Oxfordshire Growth Board, October 2015, paragraph 1.5

Progress on transport improvements

4.16 Many of the organisations interviewed for this Update expressed concern about road congestion in Oxfordshire, particularly on key strategic routes (M40, A34, A40, A420) and within Oxford city. *Table 4-2* (extracted from Oxfordshire County Council Congestion Report 2014/15) shows a steady increase in average journey times across the city, as well as an increase in the number of motor vehicles entering central Oxford in the morning peak. The table also shows a gradual increase in congestion across the County, although these averages do not reflect the higher level of congestion on key routes.

TABLE 4-2: *Congestion Indicators*

INDICATOR	2010	2011	2012	2013	2014
Average journey time per mile during the morning peak (Oxford City)	05.58	06.12	06.00	06.11	06.22
Percentage of journey times within 15% of the average – term time only (Oxford City)	76.3%	77.3%	78.1%	77.0%	77.14%
Number of motor vehicles into central Oxford in the morning peak	8,900	9,000	9,000	9,200	9,300
Percentage of base network with congestion during the morning peak (County)	8.8%	9.0%	11.9%	9.8%	11.0%
Total County wide road mileage (million miles)	11.23	11.29	11.26	11.17	11.47

Source: Oxfordshire County Council Congestion Report 2014/15

4.17 There has been progress over the last few years, particularly securing investment commitments from Government through the Local Growth Fund and the Oxford & Oxfordshire City Deal. The latter secured Government funding to enable three new transport schemes to support developments at the Science Vale Enterprise Zone, Oxford Northern Gateway and the first phase of the "Science Transit" public transport scheme. Most recently, in the March 2016 Budget, the Chancellor announced that the National Infrastructure Commission will investigate options for improving transport links between Oxford and Cambridge.

4.18 There have also been improvements to the strategic road network, for example to A34 junctions (with the M40, at Milton Park and to give direct access to Harwell). However these are unlikely to satisfy business expectations for reduced congestion on this and other key strategic routes. The problems are exacerbated by the fact that the M40, A34 and A40 all function as both key strategic routes on the national road network, and as bypasses for, and access routes to, Oxford city. Even a minor incident on any part of the road network around the city tends to cause a widespread major increase in congestion.

4.19 More progress has been made in relation to rail infrastructure. The new Oxford Parkway station at Water Eaton has now opened, providing a direct service taking under one hour to London Marylebone via Bicester. A potential new passenger rail route has been proposed between Oxford station and Oxford Science Park and Business Park, via an existing freight branch line, and plans for the East West rail route to Cambridge have continued to progress. There are also plans to improve the stations at Culham and Didcot to increase capacity and access. However, there is frustration that little progress has been made in relation to the redevelopment of Oxford station, which in turn is key to unlocking the Oxpens development proposals for the surrounding area as well as improved rail links north and south from Oxford.

4.20 Prospects for infrastructure improvements in future should be enhanced by the Infrastructure Strategy, currently being produced for the Oxfordshire Growth Board. This seeks to identify priorities for investment across all types of infrastructure (including transport, utilities and telecommunications) to enable the development of the new homes and jobs required to 2031.

5. The innovation ecosystem

5.1 This section considers recent improvements in the innovation ecosystem – the soft infrastructure which supports growth of the high tech cluster in Oxfordshire. The section is selective, focusing on four areas: access to finance, business networks, governance and leadership, and promoting and marketing Oxfordshire ('telling the story'). It is intended to illustrate recent progress rather than provide a comprehensive overview of change.

Access to finance

5.2 The biggest change over the last two years in relation to finance and professional services is the greatly improved landscape for funding S&T based ventures in Oxfordshire. A wide range of investors are active in and around Oxford, including Oxford Capital, IP Group, Woodford Investment Management, Parkwalk, Mercia, and OSEM. Improvements over the last few years are partly the result of the national economy moving from post-recession sluggishness into a growth phase, but it is also because of two major initiatives based in Oxfordshire:

- the launch of Oxford Sciences Innovation in May 2015, formed through a partnership between Oxford University and ISIS, to invest £320m in science and technology based spin outs. The fund is managed by Oxford Sciences Innovation (OSI), which is providing capital and scaling expertise to businesses driven by intellectual property. It is the largest single university venturing fund yet recorded by Global University Venturing.[33] Investments by the fund will be targeted specifically at spinouts from the Mathematical, Physical, Life Sciences and Medical Sciences Divisions, as well as the Harwell and Culham laboratories
- a new Woodford Patient Capital fund, launched in April 2015, providing long term funding for start-up companies. The fund raised £890m at launch, and is being run by one of the country's most successful fund managers, Neil Woodford. It is a global fund, not exclusive to Oxfordshire companies, but is based in Oxford and is likely to use its local networks to identify good investment prospects.

5.3 These funds not only bring a substantial amount of risk capital to the high tech cluster, but they are also committed to a different model of investment. They are attempting to provide much longer term ('patient') capital for small firms with high growth potential. A criticism of previous models is that they were driven by the need for short term returns, which forced the sale of mid-sized companies before they had the chance to realise their full growth potential, to the detriment of the local economy. This is a wider problem for tech companies in the UK, and the opportunity for Oxfordshire companies to benefit from long term investment is a distinctive advantage.

5.4 These new funds complement on-going support for access to finance through, for example, Oxford Innovation's Investment Networks, which over the last three years have held over 60 investment meetings, enabling over 50 companies to raise around £40m in total. Recent research undertaken by Nesta indicates that the number of deals in Oxfordshire by both angel and institutional investors has increased since 2006, signifying a growing and maturing VC ecosystem. The variety of funding sources available is important to ensure that firms with high growth potential but not directly connected with the research infrastructure, as well as those that are, have access to investment.[34]

Networks and lobby groups

5.5 The Innovation Engine report commented that "there are various networks relating to the high tech business community in Oxfordshire, including the business angel networks and sector specific networks such as OBN. However, our research suggests that the high tech community is less well networked within Oxfordshire than, say, its equivalent in the Cambridge area" (Oxfordshire Innovation Engine, paragraph 7.21).

5.6 There has been some progress since this was written. OBN continues to be a strong networking organisation for the bioscience community, although

[33] http://www.globaluniversityventuring.com/article.php/4611/oxford-launches-worlds-largest-university-venturing-fund
[34] Based on a conversation with Nesta regarding on-going research to be published in Spring 2016

it is increasingly regional and national in focus rather than Oxfordshire specific. Venturefest has had two more successful annual events, and since 2013 the concept – which started in Oxford – has been extended, with the support of Innovate UK, to a further eight locations in the UK. In addition, Venturefest has launched 'Pitchfest' with four standalone funding rounds in the past 18 months. Connected Oxford continues to run monthly networking events for entrepreneurs. Significant additions include the 'Network Navigators' initiative run by the Oxfordshire LEP, which helps firms navigate through the resources and networks which support business sectors in Oxfordshire, and the Academic Health Science Network for the Oxford region, which has further strengthened the networking opportunities for the bioscience community.

5.7 However, the general view among consultees is that networks within the Oxfordshire high tech community are still under-developed, particularly so when compared with Cambridge *(see Box 5-1)*. The Oxfordshire Innovation Engine report attributed this to the increasing international, rather than local, focus of high tech firms in Oxfordshire, and the increasing draw of London on entrepreneurs and business angels, who previously may have had a more local focus.

5.8 However, these factors do not fully explain the difference with Cambridge, which is subject to similar trends. It has a strong and enduring group of serial entrepreneurs and investors who clearly consider it their mission to promote the Cambridge high tech cluster. Their leadership galvanises support within the business and research community for a wide range of networking and promotional initiatives which enhance the functioning of the cluster and raise the profile of Cambridge nationally and internationally. This in turn has been very effective in securing a commitment to positively managing growth, and attracting both public and private sector investment in the area – ranging from the longest guided busway in Europe to a £1.5bn upgrade of the A14 between Cambridge and the A1 at Huntingdon[35] and inward investment by major corporates such as Astra Zeneca and Microsoft.

BOX 5-1: Business networks – examples from Cambridge

Cambridge Futures

This was a private sector led organisation created in 1996 by Marcial Echenique, the then Professor of Architecture at the University, to stimulate thinking about the future development of Cambridge. It involved a wide range of senior people in private, public and third sectors, and provided an excellent forum in which to discuss controversial issues about the future scale and pattern of development in a non-political environment. Marcial Echenique also ran a transport consultancy, which undertook a range of modelling exercises for Cambridge Futures to demonstrate the impacts of different future settlement patterns on sustainability and congestion. These provided a focus for a consultation exercise, the outcome of which suggested that the public were more positive about growth than had previously been assumed. Cambridge Futures influenced the change in strategic policy in the 2003 Cambridgeshire and Peterborough Structure Plan to a more concentrated and intensive form of development within and on the edge of Cambridge, which replaced previous policies which focused on restraint and dispersal.

Cambridge Network

Cambridge Network was established in 1998 by an influential group comprising the then Vice-Chancellor of the University of Cambridge, now Lord Broers, with businessmen and entrepreneurs Hermann Hauser, David Cleevely (both still on the Board), Nigel Brown, Fred Hallsworth, and Anthony Ross

[35] the A14 serves a very similar set of multiple roles to the A43, including as a major trunk road between one of the largest ports in the country (Felixstowe) and the Midlands, a local commuter route, and a bypass to Cambridge

(then head of 3i in Cambridge). It is a membership organisation which is intended to bring people together – from business and academia – for events, peer learning groups, training and resource sharing. It runs a news section and a popular recruitment gateway through its website, and provides a members' directory.

The set up was funded by the founders, but it quickly became self-financing. It has over 1,000 corporate members as well as individual members. Annual subscription ranges from £50 to £1,000, depending on company size. Cambridge Network has 11 staff, including an experienced CEO seconded from PA Consulting Group in Cambridge, a CFO, and nine others responsible for the recruitment gateway, the website, events, training programmes, marketing, etc.

Cambridge Ahead

Cambridge Ahead was set up in late 2013 as a business and academic member group dedicated to the successful growth of Cambridge and its region in the long term. The group's vision is ambitious: for Cambridge to be the pre-eminent small city in the world. It aims to represent the business community and partners in the Cambridge city region by offering soundly-based opinion and being an advocate for Cambridge to local and national governments about the opportunities and needs of the region. It is politically non-aligned. Currently it has 36 member organisations and a number of individual members.

At any one time the group may have up to 10 specific initiatives with defined objectives and measurable outcomes. Two projects have already been completed ('Promoting Cambridge' and 'Improving the Quality of Life'), and five are underway:

- *Growth & Commercial Space* – developing a 20-40 year vision for the city which can transcend short-term political differences, together with a set of future requirements for infrastructure and planning
- *Connecting Cambridge* – to provide a compelling, long-term vision for Cambridge as the best hyper-connected city (in the world), with a strategy and framework for system-wide success
- *Education & Skills* – to improve the quality of education, redress funding imbalances, increase the number of school leavers with STEM qualifications, and help develop skills that businesses want
- *Housing* – to address shortages of supply, including blockages in planning, site availability and labour and materials supply; and understand the demographics of demand and new models of finance
- *Transport* – to work towards a road, rail and cycle transport solution that meets the needs of Cambridge's inhabitants, commuters and businesses, and focusing on congestion in the city region.

In addition, Cambridge Ahead is involved in work which is more reactive and short-term: for example, support for the Greater Cambridge City Deal and lobbying of the Treasury to move Papworth Hospital to the Cambridge Biomedical Campus rather than to Peterborough.

Project leaders are selected for each priority and each in turn assembles a team of individuals from across Cambridge in order to tackle these priorities. The project members are drawn from a wide range of bodies – the Universities, the Councils, the LEP, the BID, Cambridge Network, Cambridge Enterprise, businesses and other Cambridge stakeholder organisations. All involvement is voluntary. Project Groups are supported by a small executive team comprising a chief executive and an office manager.

Governance and leadership

5.9 Oxfordshire has a fragmented local government structure which makes it difficult to agree and then implement the kind of ambitious strategy for growth advocated in the Oxfordshire Innovation Engine report and the Strategic Economic Plan for Oxfordshire produced by the Local Enterprise Partnership. Some progress has been made on cross boundary cooperation. The Oxfordshire Growth Board was established in 2014 as a Joint Statutory Committee of the six councils of Oxfordshire, and involving other organisation such as the Local Enterprise Partnership and the universities. The Growth Board oversees all the projects agreed in the Oxfordshire City Deal and Local Growth Deals that fall to the councils, working collaboratively, to deliver. The local authorities are also working together on issues such as the allocation of Oxford's unmet housing need, and the role of the Oxford Green Belt. However, there are continuing significant differences of opinion and policy regarding where

development should occur around Oxford and in the case of West Oxfordshire, the amount of housing that should be provided.

5.10 Two different sets of proposals have been put to the Government for greater devolution and cooperation to deliver some local government and NHS functions. The first proposal – an "Expression of Interest for Devolution to Oxfordshire" – was submitted to central government in September 2015.[36] This proposed greater devolution of powers and funding to Oxfordshire in five main areas: infrastructure; skills and employment; planning and housing delivery; business support; and health and social care. The proposal was supported by all six local authorities, the Local Enterprise Partnership and the Clinical Commissioning Group, and included a commitment to undertake a 'governance review' with the prospect of establishing a combined authority to take responsibility for integrated infrastructure planning and oversee delivery of a major investment programme to support the construction of 100,000 homes and the creation of over 85,000 jobs by 2031.

5.11 The second proposal, made public in February 2016, involves devolution of a similar range of functions, but the proposed governance arrangements are different. They involve the creation of three or four unitary authorities, some of which would extend beyond the county boundary, and the abolition of the County Council.[37] The District Councils and County Council have now separately commissioned consultants to examine options and recommend on the best future structure. It remains to be seen what the outcome of these studies will be, and whether and when there will be agreement on a devolution deal.

5.12 In parallel, a strategic partnership of local authorities and local enterprise partnerships, known as England's Economic Heartland, has been developed, extending well beyond Oxfordshire, to promote and bid for large scale infrastructure projects such as East-West Rail, a Cambridge to Oxford expressway and western rail access to Heathrow.

5.13 There has also been significant recent progress in the health and social care sector, where the Oxford Health Trusts, the Clinical Commissioning Group and the County Council agreed measures in November 2015 to reduce the delays in discharge of elderly patients from hospital, thereby freeing up hospital beds for acute care. The developing devolution proposals for health and social care intend to build on this model of integrated working and would result in the devolution of some budgets currently managed by NHS England (although this has not yet been agreed).

5.14 The movement towards greater cooperation and devolution is therefore positive, although the fact that two different devolution proposals have been submitted to the Government is an indication of the continued tensions and difficulties of all parties working together in Oxfordshire. Further progress will also depend on the extent to which the Government, and related organisations such as Highways England, Network Rail and the Homes and Communities Agency, are prepared to commit funding as well as devolved responsibilities to deliver infrastructure improvements. These commitments could greatly improve the delivery of infrastructure and housing, which are the key constraints to growth identified in this report.

"Telling the story"

5.15 Oxfordshire has been poor at promoting its successes, both internally to its citizens and businesses, and externally to the rest of UK and internationally. The brand is extraordinarily strong, as are the research and high tech business communities. Yet in the UK, it is usually Cambridge, and occasionally other places, that get the publicity for research commercialisation and high tech growth. Oxfordshire is rarely mentioned, despite its outstanding resources and commercialisation successes, and the consequent potential to contribute to national economic growth.

[36] https://mycouncil.oxfordshire.gov.uk/documents/s31474/Oxfordshire%20Expression%20of%20Interest%20Devolution%20-%20final%20submission%209_15.pdf
[37] http://www.oxfordshire.vision/

5.16 Inconsistent messaging and very limited marketing and PR are major issues. Compared to Oxfordshire, Cambridge has been very good at these things for some time, led largely by the business community but supported by public sector and research communities. The latest manifestation is "The Case for Cambridge", a short video and document which sets out the importance of Cambridge to the UK's economy, the risks to its success, and government actions that are needed to address these risks *(see Table 5-1)*. In parallel another version of the 'Cambridge Phenomenon' is being produced, this one telling the story of the ways in which Cambridge technologies, companies and entrepreneurs have improved the lives of people around the world.[38]

TABLE 5-1: *The Case for Cambridge: the five asks of Government*

1.	A tax increment financing deal underpinned by increased tax revenues that will provide capital for infrastructure and potentially lever the private capital for infrastructure investment that we see evidence of. We estimate a three to one return on GVA to investment.
2.	More imaginative funding approaches for local and other public authorities to engage with private sector investors and allow more joint investments in housing and infrastructure, including through the Housing Revenue debt-cap relaxation and private sector infrastructure bonds. We believe there is a huge amount of commercial funding that could be unlocked for the region if Government can help us to release it.
3.	Development of a Cambridge regional transport plan with the key infrastructure agencies – Highways England and Network Rail – that reflects local priorities.
4.	A devolved model of skills funding to ensure that the training and apprenticeships provided meet the needs of the local business growth.
5.	An update to the 30-year-old schools' funding model for fairer funding in local schools.

Source: http://www.cambridgeahead.co.uk/the-case-for-cambridge/

5.17 There is a perception that Oxfordshire has fared less well than Cambridge in securing both public and private sector investment as a result of a failure sufficiently to articulate its strengths and opportunities. However, in recent years Oxfordshire has received very substantial funding – particularly in the research and commercialisation infrastructure – and the work of the Oxfordshire Growth Board and the proposals for devolution of powers and funding from central government (similar in extent – though different in detail – to Cambridge's 'five asks of Government' summarised in *Table 5-1*) demonstrate a shared commitment to supporting growth. Nevertheless, some mixed messages about growth, and evident disagreements over the proposals for devolution in Oxfordshire, demonstrate that there are continuing difficulties. In addition, Cambridge has a level of positive PR and marketing which Oxfordshire has yet to match. In some cases, this marketing should be undertaken jointly with Cambridge and London, in the context of the Golden Triangle – the greatest concentration of world class scientific research and high tech business anywhere – and in others separately, simply to promote the outstanding strengths and opportunities of Oxfordshire.

[38] http://www.cambridgephenomenon.com/initiatives/book-2016/

6. Conclusions

6.1 Oxford is a powerful global brand, the research community is exceptionally strong, diverse and growing, and many high tech firms have exciting growth potential. Over the last few years, there have been significant improvements in the supporting environment for the high tech cluster, particularly in relation to the availability of risk capital. The University of Oxford has also increased its focus on commercialisation and local economic development. And the evidence from firms is that Oxfordshire is an attractive place to recruit to, despite having median house prices 10 times median salaries.

6.2 But the area continues to struggle to get the attention its high tech cluster merits internationally, and the investment needed to support growth.

6.3 The Oxfordshire Innovation Engine report made 13 recommendations and identified four main indicators of success in realising the growth potential of the high tech cluster. ***Table 6-1*** provides a summary of progress in relation to the recommendations: in general, the findings are strongly positive, but with a few notable exceptions.

6.4 The four indicators of success were:

- an additional contribution to the national economy of at least £1 billion in GVA (at constant prices) within 10 years, representing a 30% uplift on current projections
- stronger and more productive relationships between Oxfordshire's high tech companies, the universities and research institutes
- substantially higher levels of private and public investment in Oxfordshire
- a perception of Oxfordshire, both internally and externally, as a place which is committed to sustainable growth, and which reflects the scale and success of the high tech community, and its potential to generate greater local and national benefits whilst also achieving global impact.

6.5 This update has shown that considerable progress has been made in relation to at least three of these indicators:

- The number of employees in high tech sectors in Oxfordshire grew by 7.2% 2011-14, slightly above the growth rate for all employees in the county. In addition, total employment in the county over this period grew at a rate which is well above that implied by the 'planned economic growth scenario' used in the Strategic Housing Market Assessment – a scenario which essentially factored in the additional growth expected as a result of the recent investments made to support the high tech cluster. There has also been strong GVA growth in Oxfordshire: between 2011 and 2014, GVA grew in the county by 15.6%, compared to the national average of 12.1%. In addition, the generally positive feedback from firms interviewed for this update, and the scale of recent investment in high tech firms, bode well for future employment and GVA growth.
- there is evidence of strengthening relationships between Oxfordshire's high tech companies, the universities and research institutes. This is illustrated by, for example, preparation of Oxford University's Innovation Strategy and the Oxfordshire Green Paper, the increasing number of spin outs, the progress being made at Harwell after a long hiatus, and the fact that funding has been secured for four new specialist incubator facilities in the county. We also received positive comments from firms about more engagement by the University of Oxford (e.g. ***see Box 3-3***, the Sophos case study)
- there is also clear evidence of increased private and public sector investment, including: the continued increase in funding for research and related facilities; the five-fold increase in investment in Oxfordshire's technology firms in 2014-15 compared with the previous year; the launch last year of the £320m Oxford Sciences Innovation fund and the new Woodford Patient Capital fund, which raised £890m at launch; and the successful negotiation of a City Deal for Oxfordshire and the consequent funding allocations. All these are very positive indicators of future growth.

6.6 The most problematic area in relation to the indicators of success is the perception of Oxfordshire, both internally and externally, and some remaining ambiguities about growth. There has been progress in identifying the scale of investment required (e.g. in housing and infrastructure) to achieve sustainable and sustained growth and, to a lesser extent, in securing that investment. But perceptions take a long time to change, and there continue to be disagreements aired in public. Many technology firms have grown rapidly over the last few years, but collectively the private sector has not stepped up to drive the growth agenda, except through the LEP (with very limited resources). Given the scale of investment by both private and public sectors in Oxfordshire's high tech cluster and its supporting infrastructure, the marketing and PR budgets used to promote them is small.

6.7 Oxfordshire has the opportunity to contribute hugely to national economic growth, based on outstanding science and technology resources and talent, creating great opportunities for the county's young people and providing a high quality of life for all.

6.8 In the public sector there is positive movement towards greater coordination on strategic infrastructure and planning, health and social care, and economic development. There is clearly local support for devolution of more powers, responsibilities and funding from central government, though disagreement on the enabling governance arrangements. The outcome is unclear currently, but the fact that these matters are even being discussed seriously represents a considerable step forward over the last two years.

6.9 In the private sector, there is a need for a strong, cross sectoral organisation dedicated to promoting Oxfordshire and its long term growth. There are various approaches to achieve this. One would be to build on one of the existing structures, but all of these are constrained in different ways. The experience of Cambridge is that a separate business organisation with an exclusive focus on enabling the long term growth of Oxfordshire may be the answer. It would work closely with existing organisations, including in particular the LEP, but would be independent.

6.10 Whether it is an adaptation of an existing organisation or a new one, there needs to be a small but dedicated and widely respected group of business leaders, from different sectors, willing and able to take the lead and to stay involved and committed to supporting a sustainable growth agenda for Oxfordshire in the long term.

TABLE 6-1: *Progress in relation to the main recommendations in the Oxfordshire Innovation Engine*

RECOMMENDATION	PROGRESS
Research infrastructure	
Continue to improve visibility to external organisations of inter-disciplinary research at the University of Oxford and the processes for signposting firms to relevant research and staff.	The University has taken significant steps to improve its engagement with firms – e.g. through developing an innovation strategy, restructuring ISIS and establishing a large fund to support spin outs.
Increase the involvement of the University of Oxford with the public and private sector research facilities at Harwell. This should go beyond the existing joint appointments to establishing academic activities there, such as joint research teams.	The University's involvement with Harwell has increased at individual and departmental levels.
Develop proposals for a major long term expansion of university and corporate research and other related facilities in the Begbroke area, involving the University, its Colleges, other landowners, local government and transport operators.	The University is considering its longer term needs, but has not reached a decision on what they are. However, there has been some progress: for example, in relation to the Northern Gateway, development at Begbroke and plans for Osney Mead.
Soft infrastructure	
Lobby Government to develop measures to encourage institutional investors with a long term perspective, such as pension funds, to invest in high tech firms.	There has been no indication that Government is likely to do anything further to encourage institutional investors to invest in high tech firms. However, the situation in Oxfordshire has improved markedly with the establishment of two new investment funds.
Develop proposals to increase the supply of early stage investment capital by matching local business angel investment networks funds with national sources of funding.	The two new investment funds should significantly increase access to risk capital in Oxfordshire. In addition, the OION business angel network secured significant additional funding through a SEIS scheme last year. Research by Nesta shows an increase in both angel and institutional investment in Oxfordshire over the last 10 years.
Encourage the most experienced angel investors in Oxfordshire to pass on their know-how on to the next generation of investors, using the existing networks as a vehicle and strengthening those networks in the process.	The most experienced investors tend not to use the formal networks. There is no indication this has changed. The need to encourage the next generation of investors is increasingly urgent as some of the most prolific long term business angel investors in Oxfordshire retire.
Lobby Government to improve, and in particular dramatically speed up, the processing of work permit applications for foreign nationals. As part of this lobbying process, seek Government agreement to decentralise the approval process for work permit applications made by Oxfordshire high tech firms.	No change.
Maintain better information on the high tech community in Oxfordshire. Specifically, this should include a database of high tech firms, and more comprehensive information on interactions between the University of Oxford and high tech businesses.	No change.

RECOMMENDATION	PROGRESS
Soft infrastructure *continued*	
Increase networking events and activities in Oxfordshire, to support improved linkages across all areas of the high tech community and with the government, research, financial and professional services communities, and to promote strong and consistent messaging regarding priorities.	There are numerous networking events, but few that are cross sectoral and involving all the different communities within the high tech cluster.
Physical infrastructure	
Implement proposals for a 'Knowledge Economy Spine' for Oxfordshire, by supporting housing and high tech employment growth in the three main foci: Bicester, Oxford and Science Vale. In particular, additional provision for growth to accommodate high tech businesses and employment needs to be made in and around Oxford, including to the north of the city (Begbroke, Water Eaton and the Northern Gateway/Peartree) and to the south (Oxford Science Park and Grenoble Road).	The Knowledge Spine is an integral part of the Oxfordshire Strategic Economic Plan and draft Local Plans. Progress on implementation has been made, particularly in Bicester, Science Vale and on the northern side of Oxford. On the southern side of Oxford there is a proposal to open an existing freight rail line to passenger traffic, which would improve access to both the Oxford Science Park and Business Park.
Support additional office space (including business incubator provision) in Oxford city centre, particularly the proposals for a bioescalator incubator on the Churchill Hospital campus, and for the Magnet science discovery centre and expanded Oxford Centre for Innovation.	The bioescalator has secured the commitment of government and University funding. The Magnet project has been dropped due to opposition to the design. There has been some expansion of business incubator provision in the city centre, with Oxford Innovation (which runs OCFI on behalf of The Oxford Trust) converting surplus space in the Town Hall to incubator use. However, demand continues to exceed supply. In addition, The Oxford Trust plans to open a new innovation centre in Headington.
Improve the capacity and connectivity of strategic and local transport infrastructure within the Knowledge Economy Spine, particularly the A34, the main north south rail links, and fast bus services between the rail stations and main employment centres. Implement superfast broadband proposals.	Rail links have improved with the opening of the new Oxford Parkway station at Water Eaton and a direct service from there to Marylebone via Bicester. Some improvements have been made to A34 junctions, though congestion on the county's roads has continued to increase. There have been improvements in access to broadband.
Strategic direction and leadership	
Provide strong public and private sector leadership and consistent messaging to realise the growth potential of Oxfordshire's 'innovation engine'.	There are indications of stronger leadership, for example through the Oxfordshire Growth Board, in securing funding through a City Deal, in the scenario planning exercise undertaken by the University with other local stakeholders, and in current discussions about stronger collaboration between local authorities and devolved funding. However, there is still inconsistent messaging about how growth is to be managed, and insufficient promotion of the strengths and opportunities of Oxfordshire's high tech economy.

Source: SQW

Annex A: Consultees

ORGANISATION	PERSON	POSITION
Adaptimmune	James Noble	CEO
Drayson Racing	Lord Paul Drayson	CEO
Evotec	Dr Mario Polywka	Chief Operating Officer
Harwell Campus	Angus Horner	Partner & Director
Immunocore	Eliot Forster	CEO
	Ian Laing	Investor
MEPC	Philip Campbell	Commercial Director
Oxford Academic Health Science Network	Dr Nick Scott-Ram	Director of Commercial Development
Oxford Brookes University	Professor Alistair Fitt	Vice Chancellor
Oxford City Council	David Edwards	Executive Director for Housing & Regeneration
Oxfordshire County Council	Sue Scane Maggie Scott	Director for Environment & Economy Chief Policy Officer, Corporate Services
Oxford Instruments	Andy Sowerby	Group Business Development Manager
Oxfordshire LEP	Nigel Tipple	CEO
Oxford Technical Solutions	Tony Hurley	Technical Director
Prodrive	Dominic Cartwright	Managing Director, Automotive Technology & Composites
Sophos	John Shaw Sarah Leatherbarrow	VP Product Management Public Relations Manager
STFC	Dr Tim Bestwick	Executive Director of Business and Innovation
The Oxford Trust	Steve Burgess	CEO
Tokamak Solutions	Dr David Kingham	CEO
UKAEA Culham	Steve Moss	Head of Property Strategy
University of Oxford	Professor Ian Walmsley Professor Sir John Bell Professor Lionel Tarassenko Stuart Wilkinson	Pro-Vice-Chancellor for Research Regius Professor of Medicine Head of Engineering Head, Knowledge Exchange and Impact Team
Williams Advanced Engineering	Paul MacNamara Steve Newbury	Technical Director Technology Ventures
Zeta Controls	Adrian Dennis	Managing Director

About the authors:

Chris Green, *Director, SQW*

Chris Green is a Director with SQW, with 35 years professional experience of economic development and planning work in public and private sectors in the UK and internationally. He was Chief Executive of SQW Group between 2006 and 2015, and was previously managing director of SQW Ltd. He negotiated a merger with Oxford Innovation (OI) in 2006, which brought OI into the SQW Group.

Chris has directed a range of projects throughout the UK and internationally on economic and spatial development, including economic development strategies, assessments of high technology clusters and innovation districts, proposals for the re-use of major employment sites, economic impact assessments, action plans for small business development, finance initiatives for small firms, and feasibility plans for incubators and science parks.

Clients include public and private sector organisations operating within the UK and internationally, in Africa, Asia, Europe, Latin America and the Middle East.

Prior to joining SQW in 1987, Chris worked for 10 years in local government planning and economic development.

Dr Christine Doel, *Director, SQW*

Christine Doel is a Director of SQW and Head of Markets. She joined SQW after completing a PhD in economic geography at the University of Cambridge.

Christine has worked as project director on a wide range of local, sub-national and national economic development projects across the UK - from research-based exercises, through strategy development and action planning, to delivery (often through partnerships and including financing issues), and evaluation.

She has developed three broad specialisms: area-based strategy, partnership, delivery and governance; spatial development policy, focusing particularly on the interface between economic development/regeneration and spatial planning, including with regard to natural resources, flood risk and employment land provision; and rural development within national and local policy frameworks.

Clients include local authorities, local enterprise partnerships, universities, property developers, sub-regional partnerships, regional agencies and central government.

SQW

SQW is a leading provider of research, analysis and advice on sustainable economic and social development for public and private sector organisations. Founded in Cambridge in 1983 by Nick Segal, Roger Quince and Bill Wicksteed, the firm now operates from offices across the UK.

SQW offers services in a diverse range of fields, from innovation and spatial development to the personalisation of public services. In all of its work, the firm employs the principles of rigorous analysis, collaborative working, commitment to quality and independence of thought.

SQW's staff bring extensive experience to their assignments, with backgrounds in academia, national and local government, and industry. Clients include government departments and agencies in the United Kingdom and overseas, devolved administrations, local authorities and partnerships, higher education institutions, charities, infrastructure providers, investors and developers, and service providers.

SQW is part of SQW Group. Its sister firm is Oxford Innovation, which provides flexible business space and coaching services to innovative start-up and high growth companies, and manages three business angel networks.

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The Oxfordshire Innovation Engine Update

REALISING THE GROWTH POTENTIAL

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