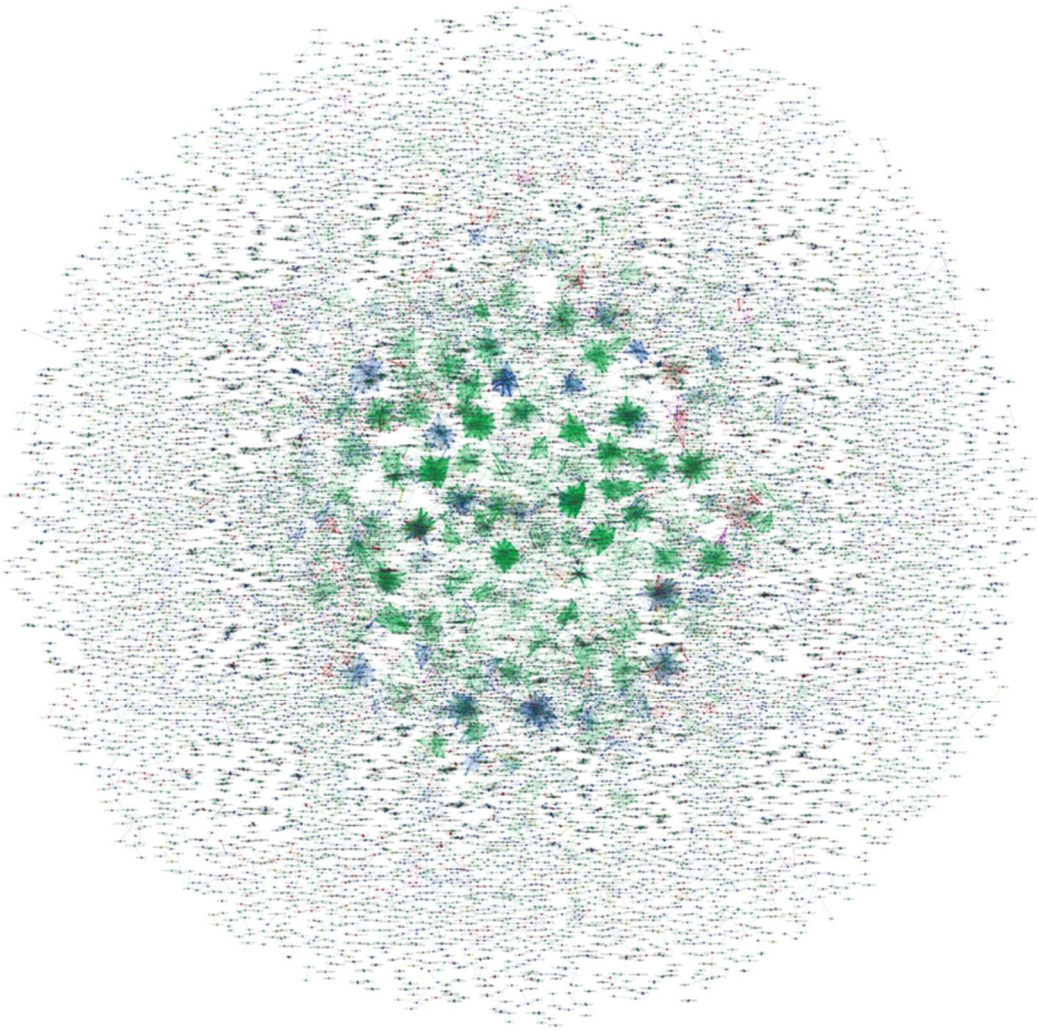
Mapping London's Science and Technology Sectors

Final Report to the Greater London Authority

October 2015



trampoline systems

SQW

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Cover page image: London company directors – network map produced by Trampoline Systems using Companies House data.

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Executive Summary

1. In summer 2014, the Greater London Authority (GLA) commissioned a team from SQW and Trampoline Systems "*to provide an evidence-based understanding of the size, make-up and dynamics of London's science and technology sectors"*.

2. The scope of the study was extremely broad. It demanded a range of methodologies – some conventional, some exploratory. These included: a review of literature; an analysis of data from the Inter-Departmental Business Register (IDBR) and Business Register and Employment Survey (BRES); an interrogation of the Companies House database; a web-based questionnaire (the "London Tech Census") based on the Companies House platform; an analysis of Twitter feeds and shared company directorships; and bilateral consultations with a range of science and technology businesses and institutions/organisations.

3. The report focused on the substantive findings from these different strands of work. However it is worth noting the methodological lessons that were learned. These included the power of in-depth case studies in the sense of "theory testing"; the potential of social media as a research tool for network analysis; and – on a more cautionary note – the limitations of conventional data sources and the challenges of gathering information through crowd-based approaches.

The importance of clustering and agglomeration

4. The study observed that **London's fundamental strengths in relation to science and technology sectors derive from processes of clustering and agglomeration working in concert together**. Cluster-based assets include:

   - over 50 incubators, accelerators and innovation centres of varying – and quickly evolving – forms; some (but not all) have links to London's universities and research institutions and/or major corporates
   - an enormous range of more-or-less formalised networks and a high "density" of informal networking
   - a range of sources of specialist early stage finance.

5. The competitive advantages deriving from these cluster-based assets are magnified by London's more general attributes as a world city, including:

   - its exceptional complement of world class universities, notably (in the context of science and technology), Imperial College, University College London (UCL) and King's College London
   - its strengths in relation to healthcare, particularly the presence of major teaching hospitals and academic health science centres and networks
   - the depth and scale of its assets in relation to financial and professional services

- its concentration of corporate headquarters (and hence a large population of potential corporate buyers for innovations linked to science and technology)
- its large – and diverse – resident population, and the market that this represents
- its concentration of major national institutions
- its role as a national centre of government
- the scale of its workforce – and its ability to attract highly specialised labour from around the world
- its outstanding international connectivity.

The scale of the science and technology sectors

6. With synergies linked to both clustering and agglomeration, London has a very dynamic and fluid science and technology ecosystem, and one that is evolving very quickly. For this reason, it is very difficult indeed to measure. Conventional approaches – based on the standard industrial classification – are wanting while web-based big data techniques are still, in truth, in their infancy, and there are many questions in relation to their robustness. Nevertheless, looking across a range of sources – and using a relatively cautious definition – this study estimated that **the number of science and technology businesses in London is 90-95,000 and that the total number of employee jobs is around 700,000 – just over 15% of the London economy as a whole**. However there is "churn" within this: the rate of growth in the number of employee jobs is about three times faster in Inner London than Outer London. Equally, while most science and technology sectors have seen employment growth, those with a manufacturing focus have actually shed jobs. Hence **the sector as a whole is evolving quickly: it is changing rapidly in both its spatial distribution and composition**.

Key sectoral strengths: digital and life sciences

7. Within this context, the **pace of change across London's digital sectors has been relentless**. The growth and character of Shoreditch, in particular, has been well documented: it is informal, fluid, fast-changing, overwhelmingly young and intrinsically connected globally. Yet the Shoreditch narrative needs to be kept in perspective: London is some way behind the West Coast USA, particularly in producing global tech companies, although it has a growing number of medium and large tech firms that could have global impact if given the right support. It would also be wrong to reduce London's digital sectors to Shoreditch alone: their footprint is broader and there is a need to recognise the wider role of incubators and accelerators in fuelling the process of enterprise. That said, the attraction of Inner London is very strong, costs notwithstanding. Some constraints were identified – notably, continuing issues with regard to access to finance; the risk averse nature of some customers (particularly in the domain of fintech); difficulty securing appropriately flexible broadband provision; continuing challenges in relation to property provision/costs; and the limited read-across to London's research base. However London was consistently identified as "*the best place in Europe*" for digital start-ups and there was considerable evidence of would-be entrepreneurs moving to London from elsewhere in the UK and internationally to start their business.

8. Although there are important overlaps through digital health, in the main, **London's life sciences sectors** are quite different. Here, links with London's research institutions, universities and hospitals are central to the process of growth. In this context, the opening of the Crick Institute is likely to be a major catalyst while looking ahead, Imperial College's plans at Imperial West and those of UCL in Stratford are also important. Currently identified constraints include the lack of grow-on space, particularly for those firms requiring laboratory facilities; the cost pressures and skills shortages for firms engaged in manufacturing; and the shortage of risk capital. There are also concerns about regulation, including in digital health, but regulation is having a stimulating effect on some areas, notably **cleantech**, where there are also strong market opportunities in London (e.g. in relation to waste, clean transport and energy efficiency).

The challenge ahead: *Growing* science and technology businesses in London

9. Overall, London provides an outstanding ecosystem for the formation of science and technology businesses and it offers – and generates – substantial clustering and agglomeration benefits. It is certainly the best place in Europe to *start* a science and technology business, and it is a global magnet for technology entrepreneurs. Moreover, this process should accelerate further: many of the supporting institutions and initiatives are either new (e.g. MedCity, Tech City UK, the Catapult Centres) or still "*in development*" (notably the Crick Institute, Imperial West and UCL East). Hence there is considerable emerging potential – and this will need to be exploited and harnessed to the full.

10. However *growing* a business locally is more difficult. Some of the concerns expressed in the course of this study are – effectively – the costs of agglomeration. London is a victim of its own success: housing costs, transport congestion and the high costs of some expertise (e.g. development engineers) are ultimately constraints to growth. That all said, so far at least, none of this has prevented firms from starting in London or both firms and individuals seeking to move to London to be part of the wider ecosystem.

11. There are, however, some challenges for GLA (and its partners) as it looks to support the science and technology sector in the future. Four issues – some of which are genuine dilemmas for the London institutions – stand out in this context:

- *First, whilst some of the challenges identified in relation to science and technology sectors are capable of being addressed at a London scale, many simply are not*. Decisions taken by UK government (and indeed at an EU level) will have a major bearing on the future growth of London's science and technology sectors (most immediately with regard to international migration).

- *Second, there are substantial differences within London*. All the evidence points to rapid growth in Inner London but much slower growth (and in some cases decline) in Outer London. For the London authorities, there are real tensions across London's economic geography and appropriate solutions need to be found for Outer London. In general terms, the evidence suggests that London's science and technology firms simply do not want to locate there, whatever the upside *vis-à-vis* the cost of premises.

- *Third, particularly for life science, there is an urgent need to think creatively beyond London's boundaries*. There are natural synergies to be exploited across the Golden Triangle, with links to Cambridge and Oxford, and indeed the area in between. The *digital technologies sectors* also need to grow in a way that is consistent with their own evolving functional economic footprints; these are likely to be more networked and international, with clear links to other cities globally as well as in UK.

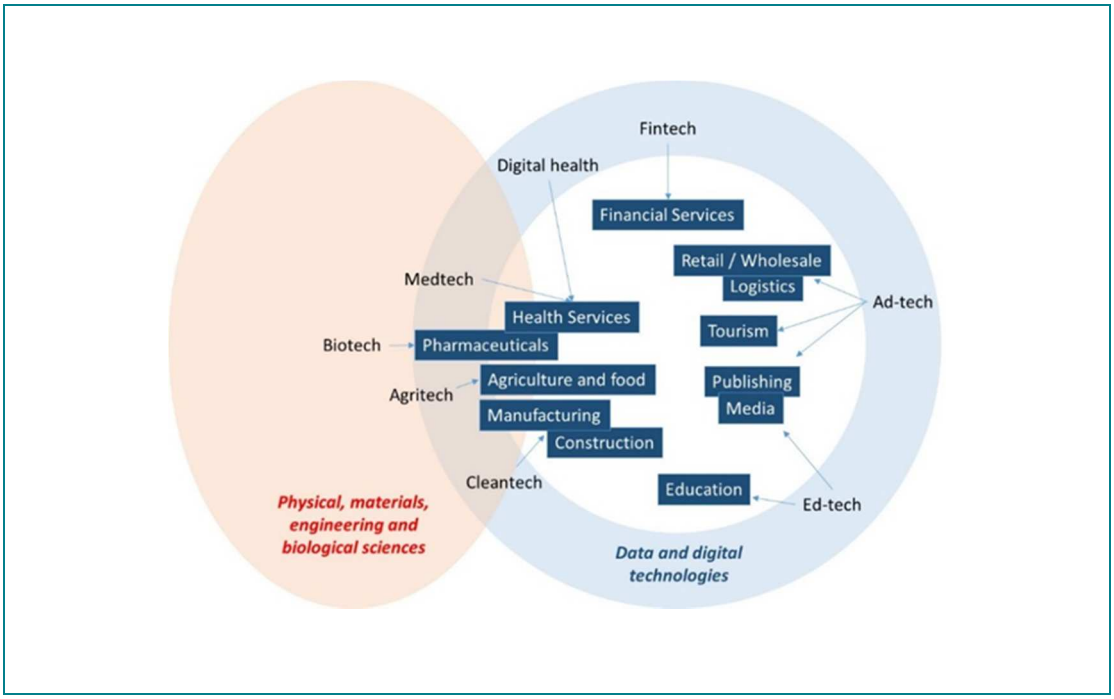
- *Finally, while noting that London comprises multiple clusters – all of which benefit from wider processes of agglomeration – there is a need to try and cross-fertilise ideas and opportunities*: the "*Shoreditch bubble*" (as one consultee described it) should not be institutionalised into a "*Shoreditch fortress*" and instead, its intrinsic "messiness" should be encouraged – even if it does make accurate measurement impossible. The scale, diversity and dynamism of tech sectors in London provides an extremely rich environment for exploiting market opportunities at convergence areas between technologies – an obvious example being digital health. However, organisational structures (including networks) tend to be sectorally focused, and there is a need to ensure that opportunities for cross-fertilisation are not overlooked.

1. Introduction

1.1 In summer 2014, the Greater London Authority (GLA) commissioned a team from SQW and Trampoline Systems "*to provide an evidence-based understanding of the size, make-up and dynamics of London's science and technology sectors".*

1.2 The scope of the assignment was extremely broad and the context for it was/is a series of sectors that are very difficult to define and "measure". Sectors such as biotech, medtech, digital health, clean tech, fintech, adtech and edtech exist at boundaries and they are transformative in their potential. While the associated terminology is being widely used, it defies easy definition. As demonstrated in the graphic below, some of these sectors have a strong science component; most involve digital technologies and potentials (in some shape or form); many are defined around the sectors/markets they serve; and all are evolving very quickly indeed.

Figure 1-1: Defining the new science and technology sectors



Source: SQW

1.3 London's science and technology sectors – as of 2015 – involve huge numbers of very small firms, a good proportion of which are "pre-revenue" and actually "pre-company", comprising instead loose affiliations of interested (and interesting) individuals, often of many nationalities; but at the same time, major corporates are also very active in this space, not least Google, GSK, and BSkyB. Equally, London's universities and other well-established institutions (such as the major hospitals and the BBC) are playing a key role in some science and technology sectors, but by no means all. And London – as an agglomeration and a cluster – has an immensely complicated relationship with the businesses born within it: birth is relatively easy, but while London offers the potential for very rapid growth, the constraints are substantial and – at times – overwhelming.

1.4 Against this backdrop, the methodology we adopted for this piece of work was wide ranging. Elements of it were quite exploratory. It included, *inter alia:*

- an initial review of literature and scoping consultations with intermediary bodies who might have an insight into parts of London's science and technology sectors
- an analysis of data sourced by ONS – on behalf of GLA Economics – from the Inter-Departmental Business Register (IDBR); and then an analysis of data from the Business Register and Employment Survey (BRES)
- an interrogation of the Companies House database – initially using the SIC-code based definitions developed by ONS – to provide a live, on-line, geocoded resource which is capable of identifying individual science and technology-based businesses from a live and publicly-available dataset (with no issues of confidentiality, unlike both IDBR and BRES)
- the launch of the London Tech Census – based on the Companies House platform and allowing science and technology-based businesses the opportunity both to amend their own records, to add to them and to classify themselves as operating in one or more of the emerging science and technology sectors (adtech, fintech, etc.)
- a sizeable number of business consultations and case studies, exploring processes of growth in all parts of London's science and technology-based communities
- an analysis of company directorships (from Companies House data) and Twitter feeds (from the London Tech Census) in order to interrogate two dimensions of networking within and beyond London.

1.5 On reflection, some of these elements worked better than others, but all contributed to a developing narrative with regard to the common and distinctive opportunities and constraints facing different science and technology sectors in London; their intrinsically connected (and indeed international) character; and their future growth potential.

1.6 Given the enormous scope of this piece of work, our Steering Group played an important role in terms of providing overall direction; and the consultancy team also met with London Enterprise Panel's Digital, Creative, Science and Technology (DCST) Working Group on three separate occasions. At the mid-point of the study, we collectively sought to identify some key research questions of particular importance to policy makers. These provided an important focus as the study progressed. Both the questions – and the early observations which led to them – are summarised in the table below.

Table 1-1: Research questions defined at the study's mid-point

Early observations in relation to London's S&T Sectors	Research questions
There are a number of different growth models across London's science and technology sectors: • growth driven out of London's science • growth linked to London's market (and relating, fundamentally, to its size) • growth linked to London's own very established specialisms	⇨ *Q1: What is the balance between these three, and are the growth opportunities and constraints very different?*

Early observations in relation to London's S&T Sectors	Research questions
Given the tightness of the central London property market, the potential of the Golden Triangle seems to be extremely important for the S&T sectors which are driven out of London's science, but much less so when other growth processes are at play.	⇨ *Q2: Is this distinction a valid one, and if so, what are the implications for the spatial footprint of future growth?*
Across the piece – as borne out by the IDBR data from ONS – Inner London seems to be benefitting disproportionately from the growth of the tech sectors	⇨ *Q3: Is this correct, and what are the implications in terms of planning for the growth of these activities, and planning for economic growth in Outer London?*
Internationalisation is a feature across the board, although it takes very different forms.	⇨ *Q4: What are the associated risks and opportunities in this context?*
Regulatory change is likely to impact significantly on a number of tech sectors over the next few years	⇨ *Q5: On balance, what does this mean for London?*
Despite their potential, many small tech businesses struggle to make money, and London can be very expensive	⇨ *Q6: What evidence is there of tech-based activity being priced out of London?*
Major corporates appear both to be intrigued by tech-based sectors and concerned by them	⇨ *Q7: What does this mean for London and its mega-city economy as it looks to the future?*
The relationship between the science and technology sectors and London's universities is patchy	⇨ *Q8: Should positive steps be taken to strengthen the depth of those relationships, particularly outside of life science?*
In some tech sectors, there is the suggestion that concepts are too complicated to attract early stage funding	⇨ *Q9: To what extent is London's early stage financing community adapting to the opportunities arising from the tech sector, and can anything be done to de-risk the process?*
There is evidence of some level of networking, but much of it is informal – and also the suggestion that relationships are difficult to sustain because of London's scale and the amount of churn within it	⇨ *Q10: Is London too big to sustain a strong innovation ecosystem or is it, simply, very different from those characterising Oxford and Cambridge?*
Many have commented that London has advantages over North America – partly because of time zones and partly because the "centre of tech" and the "centre of finance" are in the same place	⇨ *Q11: Is London doing all that it should to exploit these geographical advantages, and what do they mean for different parts of the S&T sector?*

1.7 The report that follows has been structured to examine these (and related) themes/questions from a number of different perspectives. It is divided into six substantive chapters:

- in *Chapter 2,* we examine London's principal assets of relevance to the growth of science and technology sectors and we comment specifically on the importance of these in relation to processes of both agglomeration and clustering
- in *Chapter 3,* we use the available evidence to consider the scale and location of science and technology firms and jobs within different parts of London
- *Chapter 4* focuses on the digital components of London's science and technology sectors; it describes the nature of these tech sectors and the principal constraints relating to their growth
- *Chapter 5* considers the growth dynamics and prospects of life sciences and cleantech – sectors with a stronger link to London's science base

- *Chapter 6* reflects on the scale and significance of science and technology sectors in London in an international context
- finally – and drawing on all the different strands of evidence – *Chapter 7* reflects on the overarching questions relating to London's science and technology sectors which were discussed and agreed at the mid-point stage (summarised in the table above). In so doing, it considers the principal constraints to, and opportunities for, growth, and the issues on which GLA and its partners may wish to focus and reflect.

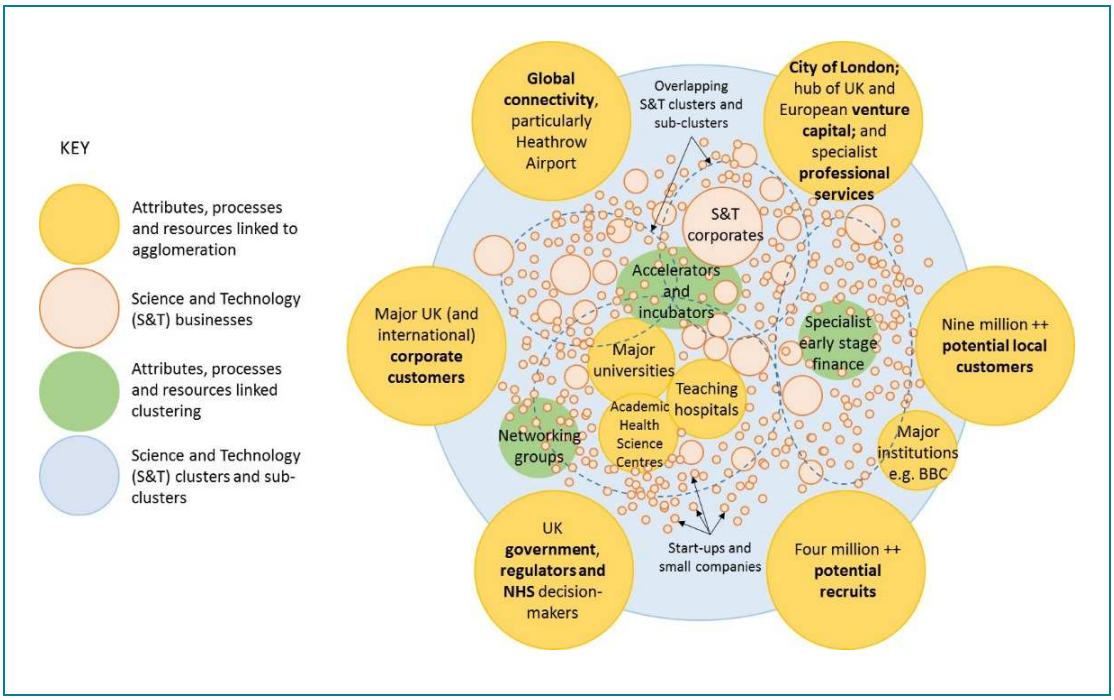
1.8 In completing this piece of work, we have undertaken a large number of consultations with individuals from within London's science and technology sectors. We are extremely grateful to all of our interviewees for the time they have made available to contribute to this piece of work. We are also grateful to the 150 businesses that completed an entry in the London Tech Census.

2. London's assets for science and technology

2.1 Compared to other locations in the UK and internationally, London has all of the ingredients of a *dynamic ecosystem* through which science and technology sectors should thrive and prosper. Although the distinction is not absolute, these assets derive from two distinct processes, and – crucially – the relationships between them. One element reflects the process of *clustering* and the iterative development of a specialist hard and soft "infrastructure" to stimulate and support science and technology-based business endeavour; in this respect, London has parallels to knowledge-based economies elsewhere, notably in and around Oxford and Cambridge in a UK context and – from different perspectives – Basel and Silicon Valley internationally. The second is the product of the substantial advantages conferred on London through *agglomeration processes* and the consequential benefits of scale. In this respect, London is fundamentally different from Oxford and Cambridge: London is a global city with very distinctive economic attributes and potentials and the better comparators are, arguably, New York and San Francisco.

2.2 *As a focus for science and technology sectors, the fundamental strengths of London derive from processes of clustering and agglomeration working in concert.* Different elements are summarised graphically in Figure 2-1 below. They are described in outline in the paragraphs that follow.

Figure 2-1: London's science and technology sectors – and the influence of clustering and agglomeration



Source: SQW

London's cluster-based assets

2.3 At the core of London's science and technology clusters are, undoubtedly, its **businesses**. These are the fundamental focus of this report and the processes through which they are forming and growing are explored in considerably more depth in subsequent chapters. For now, it is sufficient to recognise that they are numerous; and that they range in scale from major global corporates through to micro-businesses, many of which are pre-revenue and "below the radar" in terms of company counts.

i: Incubators, accelerators, work-space and innovation centres

2.4 The fact that London is such an effective place to start a S&T business is, in part, a consequence of the network of well over 50 **incubators, accelerators and innovation centres** that has developed over recent years. These take many different forms:

- **First, within London, there are examples of innovation centres linked to a university or research institution**. One example is *London BioScience Innovation Centre (LBIC)* which is linked to the Royal Veterinary College and was completed in 2001 with a strong focus on life sciences; the expectation is that businesses will occupy the centre for about three years before moving to grow-on space elsewhere. Another example is the *Imperial Incubator*, based on the Imperial College campus, and providing a mix of laboratory and office space for new and growing businesses in sectors ranging from medical devices to software to mechanical engineering. The incubator is part of Imperial Innovations, the technology transfer company of Imperial College which is now listed on AIM. A third example is the QMB innovation centre in Whitechapel, owned by the technology transfer arm of Queen Mary College and large enough at 39,000 sq ft to provide a mix of incubation and grow on laboratory and office space

- **A second model is premised on the concept of – genuinely and proactively – *accelerating* the process of business growth through competitions**. For example, *The Bakery* is an accelerator with a particular focus on adtech. Launched in 2013, it is supported by a number of major brands (e.g. Heinz, Panasonic, BMW) and advertising agencies (e.g. Vizeum, Havas Worldwide London, Karmarama). Adtech businesses compete for ten places on the accelerator programme. Successful applicants receive free office space in Shoreditch, some financial support and mentoring for a period of six months; and in return, The Bakery usually takes an equity stake. Similarly, *Level 39* describes itself as "*Europe's largest technology accelerator space for finance, cyber-securities, retail and future cities technology companies*"; it was opened in 2013 and is based in Canary Wharf. Also in Docklands, the Canary Wharf Group has set up *Cognicity*, which aims to identify and accelerate the development of smart city technology products and services. Participants will create and pilot the technologies and services that will help build the "the integrated city of the future" and Canary Wharf Group's development pipeline, with the six winning start-ups each receiving a £50,000 prize and a high-profile piloting opportunity[1]. Another example is *Healthbox*, which was founded by US venture capital firm Sandbox Industries in 2012. It provides

[1] http://www.cognicity.london/

short term accommodation, seed capital and connections to organisations and individuals from across the healthcare spectrum. The accelerator concept originates in north America and – although relatively new and involving relatively small numbers of companies – ventures like Level 39, The Bakery and Healthbox are attracting a great deal of attention. However, although they include workspace provision, it would be wrong to regard them fundamentally as a property solution.

- **A third group has very close – and strongly commercial – links to some major corporates**. The disruptive potential of many of the associated technologies is such that the major corporates need to stay close to it – hence their interest in technology start-ups. For example, launched in 2012, Google Campus is providing free event spaces, fast wifi, subsidised desk space and a home for start-ups. Google estimates that some 2,000 start-ups attended the Campus in 2013 and that half of these benefitted from mentoring sessions with "Googlers". According to Google's own research, "*the two most important attributes of Campus valued by start-ups are that it is a place for learning and mentoring, and to network with similar start-ups*"[2]. Other examples include Cisco (see case study below) and Telefonica, whose Wayra incubator is located in Bloomsbury. In both cases the London incubators are part of a growing international network of facilities which Cisco and Telefonica are sponsoring.

- **A fourth group – and perhaps one that is relatively "*under the radar*" – reflects a wide range of local solutions, which are more widely located across London**. The importance of these emerged through our consultations with smaller S&T businesses. Many are clustered around the centre. For example, in Camden – and with a package of financial support, some from the Mayor of London's Regeneration Fund – the *Camden Collective* makes workspace available free of charge to very early stage creative businesses; for some, this has been extremely important during their financially precarious early months. South of the river – and near the other end of the spectrum in terms of cost – we also found enthusiasm for *WeWork South Bank* which provides co-working office space (which again has American roots as a business model). As one digital health business explained in the course of our consultations, "*staff love it, clients love it, it is absolutely in the centre and everyone is energised by it, even though it is very expensive…. It is a brilliant and exciting place to be, and it has transformed our business*". Other examples elsewhere in London include the UGLI campus (ex BBC studios) at White City, which has become a centre for new and small creative and media businesses; Croydon Tech City, providing specialist tech co-working and incubator space; the Digital Greenwich Innovation Centre; incubator space for fashion designers at 639 Enterprise Centre in Tottenham; and Londoneast-UK, involving re-use of the former Sanofi manufacturing plant at Dagenham for small life science firms.

2.5 Across these four, there are – of course – **hybrids and newly emerging models.** IDEALondon – described in one of the case studies below – is a hybrid venture of particular relevance to digital technologies. Another example is the European Institute of Innovation and technology

[2] See *London Campus: At the heart of a thriving and diverse start-up scene – results of our second Campus survey* Wiesner Vos, Google, December 2013 – page 26

(EIT) ICT Labs, which established a London Node in 2014 with Imperial College, UCL, Intel and BT as core partners[3]. The London Node has a strong focus on cyber-physical systems, smart energy, future Cloud, health and wellbeing, urban life and mobility. The Labs will be based at the London Co-Location Centre, located at Imperial West. The overall landscape of property provision for early stage S&T businesses is itself evolving quickly, consistent with the growth of S&T activity across London. The growth of The Trampery – described in a second case study below – provides an illustration.

Case Study: IDEALondon - digital technology incubator

IDEALondon (Innovation Digital Enterprise Alliance London) is an incubator centre in Wilson Street (Shoreditch) that provides business and technical support, mentoring and 'strategic acceleration programmes' to digital enterprises. It is a joint initiative between Cisco, DC Thomson and UCL. Some 22 companies in total have been sponsored by one of the three partners to occupy space in IDEALondon since it was opened at the end of 2013.

The proposal to co-sponsor IDEALondon was first discussed at the time of the Olympics in London, in order to create a longer term legacy, and a commitment was made at a meeting at 10 Downing Street in 2011 concerning support for Tech City.

The three partners participate equally, though UCL provides the administrative support to run the incubator. None of the partners has set rules about who to sponsor (e.g. UCL does not restrict its sponsorship to UCL spin-outs or graduates). Entrepreneurs apply on-line to IDEALondon. The partners review applications and any one of them may opt to engage in dialogue with the applicant and then to provide sponsorship. In general, the decision is based on the quality of the application and the extent to which each of the sponsors believes they can help the firm. For example, Cisco is likely to sponsor where it believes it can best provide technical or market assistance to the entrepreneur, whereas UCL may sponsor if it believes access to academic expertise is particularly important.

All of the partners provide desk space, support and mentoring, and assistance to raise funding. Cisco and DC Thomson may also choose to invest in the business. Firms are expected to move on to other accommodation within a year, or when they reach 8 people, though so far the rules have not been strictly applied.

UCL runs the facility, and each has sponsored companies there. Cisco has supported 16 start-ups in IDEALondon to date.

In all cases, the partners' sponsorship of IDEALondon is part of a wider programme to support tech entrepreneurs.

- ***Cisco*** - IDEALondon is one of various incubators that Cisco is establishing worldwide, each with a distinct technology focus. In London it is the Internet of Things, in which UK is perceived to be taking some leadership. There are two others being established in Europe, in Berlin (focusing on manufacturing technologies) and Barcelona (focusing on smart cities). Others are located in the US and Asia. The incubators programme is one of three main components of the Business Innovation Gateway (BIG). The other two are BIG awards – a 6 monthly competition which provides innovative new businesses with funding, mentoring and access to expertise from Cisco and its partners – and the National Virtual Incubator (NVI) Alliance - a network of affiliated incubation/innovation centres around England, supported by either local authorities or universities and generally linked to science parks or similar facilities. Cisco has installed video collaboration technology enabling firms in these incubators to interact with mentors, Cisco staff, etc.

- ***UCL*** - for UCL, the incubator is part of its commitment to support tech firms in London, and forms part of the Centre for Entrepreneurship (UCL Advances). UCL is likely to co-sponsor another incubator in the King's Cross area during 2015, focused on the creative sector and linked to St Martin's College.

- ***DC Thomson*** has established a corporate venturing arm to identify entrepreneurial teams at the leading edge of digital innovation with the potential to scale to a global market. IDEALondon is part of this venture and is seen as an opportunity to back seed-stage businesses that align with DC Thomson.

[3] See http://www.eitictlabs.eu/

Case Study: The Growth of The Trampery to provide physical provision for small science and technology businesses

The Trampery was established in 2011, and now runs 45,000 sq ft of shared workspace in five facilities which provide space for 200 businesses:

- Bevenden Street, Shoreditch - 4,000 sq ft, for digital tech businesses
- Old Street, Shoreditch - 10,000 sq ft, also for digital tech businesses
- Fish Island Labs, Hackney Wick - 8,000 sq ft for arts and media businesses
- Mare Street, Hackney – 20,000 sq ft for fashion businesses
- Travel Tech Labs – 3,000 sq ft in London Bridge (part of an 18,000 sq ft facility).

The Trampery is a social enterprise which aims, through layout, furnishing and operating processes, to create communities of firms which interact and benefit from each other's presence. Unlike many tech incubators and accelerators in London, The Trampery does not have rules about how long firms stay, and how big they can grow – as long as they don't grow to dominate the workspace. It is opening new workspaces partly to enable firms already in their existing facilities to expand, thereby retaining the involvement and income from the growing firms and freeing up space for new entrants.

The Trampery has 12 staff, nine of whom are permanent employees. It either takes relatively short leases on the buildings it converts to workspace, or enters into partnership with existing leaseholders. Firms have to be financially stable before they are accepted into the Trampery facilities, which means they have either secured investment or have a proven product or service. They pay a licence fee to occupy defined space (not hot desks), which may vary from self-contained studios in the fashion tech facility in Mare Street to desk spaces for digital businesses. Terms are very flexible, but the length of commitment is increased as firms grow bigger. The Trampery does not take equity in the firms.

The social interaction – which is regarded as being as important to business development as the time spent at the work desks – is now being encouraged further by The Trampery creating members clubs, which are in the tradition of the old London clubs of the 18th and 19th Centuries, rather than contemporary clubs. They provide separate social space for a limited number of member entrepreneurs who have a common interest in innovation and are encouraged to use the facility frequently. There is a small Members Club within the Old Street Trampery, and two new Members Clubs being established in Clerkenwell and Pall Mall.

The Trampery is also developing a mixed residential and workspace scheme, in collaboration with the Peabody Trust, in Hackney Wick. The scheme will provide 500 apartments and 60,000 sq ft of workspace. It is intended to address a key constraint on tech firms in London – the cost of residential accommodation. All applicants for the residential space will be means tested on entry, and will benefit from subsidised accommodation, catering and mentoring.

The Trampery business model is successful and is clearly meeting demand. The latest workspace is a Travel Tech facility at London Bridge. This was 1,000 times oversubscribed, so clearly addressed a pressing market need. It has Gatwick as a corporate sponsor, and provides 50 desks for travel tech firms.

ii: Networks and networking

2.6 Within London, there is increasing convergence between physical provision and the process of networking and this is one of the most distinctive and powerful aspects of cluster growth: as the provision of workspace has become less proprietorial, informal networking has grown. One digital health business that we consulted during the study noted that *"we are surrounded by entrepreneurs who are mostly working in the consumer world of tech and increasingly, we are picking up all sorts of insights*". The route to networking in this instance is simply using shared facilities, attending events that are held locally (of which there are many) and, literally, informal conversations.

Networks

2.7 Outside of physical provision, there are dozens of more-or-less formal and more-or-less permanent networks, some of which are cloned across different geographical clusters internationally. Some of these are well established but a good proportion appear to have emerged very recently. Examples of networks of vastly different types include:

- *Mobile Monday* – the London branch of a wider networking movement, focused originally on mobile technologies, which originated in Finland
- *TechMeetUps* – a London-based network for web-based start-ups which now has local branches elsewhere in the UK and internationally
- *NewFinance*, which is a global network of professionals actively involved in financial innovation through technology with meetup groups in London, Montreal, New York, San Francisco, Warsaw and Paris
- The *Digital Health Professionals Network*, which was formed by two founders of digital health businesses as a peer support network, in order navigate the health service landscape, build up industry knowledge and contacts and share the start-up experience with others in similar situations
- *Internet of Things Meet Up*, which is a network developing new smart city products in the Internet of Things arena[4].

2.8 There are, in addition, some larger scale and more formally based networks, including:

- *One Nucleus*, which was formed from the merger of the London Biotechnology Network (LBN) and the Eastern Region Bioscience Initiative (ERBI), has 470 members and offers a range of services including training, a purchasing scheme, networking events, specialist seminars and conferences, and information (e.g. on laboratory space availability)
- *Tech City* and *MedCity,* which are formal network organisations which have been sponsored by the public sector to promote, coordinate and communicate within and beyond their respective tech communities:
  - *Tech City* was established in 2010 to support the emerging tech cluster in Shoreditch, but its remit has since been expanded to deliver programmes to accelerate the growth of digital businesses throughout UK, at all stages of their development. It also acts as an advocate for digital entrepreneurs
  - *MedCity* was formed in 2014, and aims to provide a "go to" point for life sciences businesses and investors across London and the Greater South East, foster collaboration and a commercial mind-set in the research and clinical community, and act as an advocate and an ambassador for life sciences in the region.

[4] http://iot.london/

The process of networking

2.9 In addition to the plethora of network organisations in London, there is a great deal of informal networking. This tends to be quite localised within particular parts of London, and focused on particular tech clusters – for example, digital in Shoreditch, media and broadcasting in White City and Chiswick, life sciences in the Knowledge Quarter (around St Pancras).

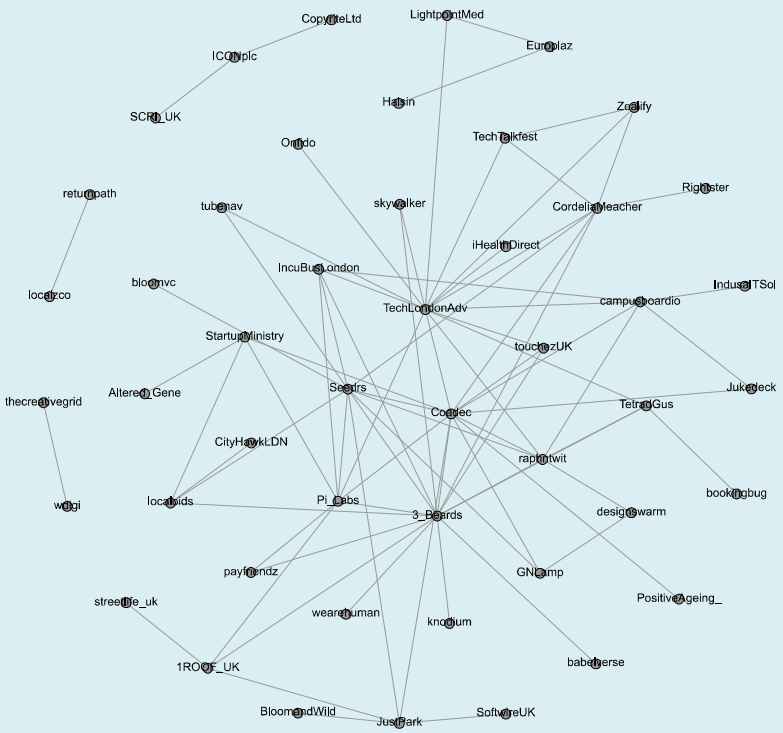
2.10 Through the study, we sought to explore some of this informal networking in two ways: by analysing Companies House data to identify people who are directors of multiple tech companies in London, and also in Cambridge and Oxford; and through analysis of relationships on Twitter using information provided by firms responding to the London Tech Census. The Evidence Box below highlights some of our findings.

Evidence Box: Identifying informal processes of networking

The director analysis enabled us to identify a number of serial entrepreneurs and business angels, some of whom we interviewed to gain greater insights into the process of tech company formation and growth in London. Many of these individuals operate across a wider geography than London – typically London and Cambridge, or London and Oxford/Thames Valley. Some have spent many years supporting tech businesses, and have proved a valuable source of patient capital and advice. In addition, we also mapped London company directors and the network map we produced is presented in Annex B.

The analysis of Twitter relationships is shown in the graphic below. It illustrates the strong personal links between senior employees in many London tech companies. Those which have the most links are located at the centre of the diagram, and comprise a mix of companies and network organisations.

Figure 2-2: "Following relationships" on Twitter between those that completed the London Tech Census



(Source: Trampoline Systems)

iii: Specialist early stage finance

2.11 A third – and still emerging – element of London's cluster-based credentials surrounds the specialist soft infrastructure relating to early stage finance. Of course – through crowdfunding – innovative approaches to early stage finance are themselves an "output" from London's S&T sectors. These are growing fast, though still small in scale relative to overall supply and demand. Some specialist networks of early stage investors with a focus on both S&T and London have been established for a long time, others are emerging in response to demand. For example:

- *London Business Angels*, operating since 1982, is one of the longest established angel networks in Europe. Since 2000, LBA has helped over 200 companies raise over £50 million. Its focus is on innovative companies, but not specifically on tech sectors. In addition, London firms attract funding from other well established angel networks such as Cambridge Angels and Oxford Investment Opportunities Network.

- A much more recent example of a specialist network is *Fintech Circle.* It was launched at Level 39 (the fintech accelerator) in the latter part of 2014 as the first angel network in Europe focused exclusively on fintech. In essence, it invites high net worth individuals to become a member of Fintech Circle with the aim of making investments in fintech start-ups. The scale of these investments is £100k-£500k. The intention is that they should take advantage of tax relief through the Enterprise Investment Scheme (EIS) and Seed Enterprise Investment Scheme (SEIS); and hence there is a strong UK (and *de facto* London) focus. The first Fintech Circle Funding Round closed in January 2015.

- Specialist seed capital funds have also emerged, mainly focused on the digital technologies sectors, and located within the main tech business clusters. Examples include: *Passion Capital*, based in Shoreditch, which funded 34 early stage tech companies in its first two years of operation; *No1 Seed*, based in Soho and funding 5-10 seed investments a year; *Sussex Place Ventures*, which invests in early stage businesses in the Golden Triangle (London-Cambridge-Oxford) in software, digital economy and IP rich businesses, including medtech and new materials; and *Syncona Partners*, established by the Wellcome Trust to provide long term investment in IP rich healthcare businesses.

London's agglomeration advantages

2.12 Alongside – and thoroughly intertwined with – London's growing cluster credentials are its substantial assets and resources deriving from processes of agglomeration. London is superbly well endowed as a place for disruptive and innovative business activity. In Figure 2-1, we identified ten different "*attributes, processes and resources*" linked broadly to agglomeration and the status of London as a world city and national seat of government. All ten are having a formative role in relation to the growth of London's science and technology sectors.

i: London's universities

2.13 London has a great depth of resource linked to its universities. One website – www.studylondon.ac.uk – identifies no fewer than 47 different institutions at which it is possible to study for a first or higher degree. Among these institutions are some of the world's best universities in relation to science and technology teaching and research; and both the students that are taught and the research that is generated are closely related to the strength and depth of London's science and technology sectors.

2.14 Measuring the extent of this resource is fraught. The recently-published Research Excellence Framework (REF, 2014) provides evidence on the quality/impact/environment of research conducted through different institutions and some measure as to its scale (in terms of staff numbers included in the submissions). Illustratively, for four of the 36 Units of Assessment (UoAs) considered in the REF and for three of London's universities (and also for Oxford and Cambridge), the table below shows the number of full time equivalent (FTE) staff and the quality of research, judged here in terms of the "*percentage of the submissions of world-leading (4*) quality*". The data suggest, for example, that in terms of submissions relating to computer science and informatics, UCL is similar in scale to the University of Cambridge but that 61% of its work is of "world leading quality". In terms of clinical medicine, 48% of the submissions from both Imperial College and King's College London were judged to be of "world-leading quality". Although it is not easy to absorb quickly, the table points to both the scale and quality of research excellence ensconced within London's leading universities.

Table 2-1: Data extracts from the Research Excellence Framework, 2014 for three London universities, and for Oxford and Cambridge

REF Unit of Assessment	**Computer Science and informatics**		**Clinical Medicine**		**Electrical and Electronic Engineering, Metallurgy and Materials**		**Mathematics**	
Measure	*Scale:*	*Quality:*	*Scale:*	*Quality:*	*Scale:*	*Quality:*	*Scale:*	*Quality:*
Imperial College	49.45	56%	334.18	48%	44.2 / 37.0	49% / 44%	100.31	44%
King's College London	46.00	32%	136.42	48%	0	0	43.20	22%
University College London (UCL)	70.70	61%	449.74	43%	38.00	40%	62.95	27%
University of Cambridge	73.50	53%	238.51	53%	34.12	60%	148.60	59%
University of Oxford	54.60	48%	192.05	58%	33.56	69%	143.77	45%

Note that "Scale" is measured in terms of Full Time Equivalent (FTE) staff included in the REF submissions; "Quality" relates to the percentage of the submissions of world-leading (4) quality*

Source: Research Excellence Framework, 2014

2.15 Looking globally, the international standing of London's universities may be evidenced through sources such as the Times Higher Education World University Rankings for 2014/15. The table below shows the global rank of the same institutions listed above for selected individual (and science and technology-related) disciplines, and overall. It is worth noting further that although it does not feature among the science and technology-related specialisms, London School of Economics and Political Science (LSE) ranks 34th overall. Hence

London has four separate institutions within the top 40 globally; and three of these have scientific specialisms that score more highly again. The depth and excellence of the resources is, genuinely, world class.

Table 2-2: Rank on the World University rankings in 2014/15 for selected London universities and Cambridge and Oxford

Subject / Institution	Clinical, pre-clinical and health	Engineering and technology	Life sciences	Physical sciences	Overall (incl. arts & humanities)
Imperial College	4	6	10	12	9
King's College London	11	n/a	37	n/a	40
University College London (UCL)	8	53	17	38	22
University of Cambridge	3	5	3	6	5
University of Oxford	1	7	4	7	3

Source: Times Higher Education World University Rankings, 2014-15

2.16 Within this overall context, particular reference should also be made to *inter-disciplinary research* which is often intrinsically "applied" and collaborative in character. Important examples within London include:

- The *Digital Economy Lab* at Imperial College, which aims to support the integration of massive, real-time data across sectors in order to provide benefits at the systems of systems level, and enable 'smart' decision making, in areas such as: monitoring and controlling infrastructure to reduce CO_2 emissions and waste; improving health and well-being; improving public service productivity and quality as well as increased citizen satisfaction; and the creation of new business and more jobs
- The *Interdisciplinary Research Centre in Biomedical Materials* at Queen Mary University of London, which aims to develop new materials for biomedical implants
- The *Centre for the Humanities and Health* at King's College, University of London, which is undertaking research on "the boundaries of illness". It engages scholars from arts, humanities and health disciplines including from Literature, Philosophy, History, the Visual Arts, Film Studies, Clinical Psychology and Psychiatry, Medicine and Nursing
- The *new biomedical engineering centre* to be built at Imperial West with a £40m donation from an alumnus. It will comprise laboratory and office space for interdisciplinary, translational research initiatives at the interface of biomedical sciences and engineering. It will include a clinical facility providing patients with direct access to innovations in healthcare
- The *City Collaborative Transport Hub*, a network of interdisciplinary activity at City University London centred on transport challenges, particularly decarbonising transport globally.

2.17 Finally, looking ahead, it is important to note that two of the major research based universities – *Imperial College and University College London (UCL)* – are currently planning or undertaking major expansions in order to maintain their growth and particularly to create more opportunities for research collaborations between academic and corporate partners, and for

commercialisation. Imperial West at White City is a 25 acre site which will eventually provide space for 3,000 researchers, commercialisation and business incubation. Phase 1 will include student accommodation (completed), a 50,000 sq m research and translation hub (under construction), the biomedical engineering hub referenced above, and incubator space for start-ups. UCL is planning to develop a similar range of facilities on the Olympic Park site at Stratford.

ii: London's major teaching hospitals – and iii: Academic Health Science Centres

2.18 Alongside the universities are some world class teaching hospitals, several of which are now part of Academic Health Science Centres. Indeed, London accounts for three of the seven AHSCs that have been created in the UK. These are:

- *Imperial College Healthcare*, which was formed in 2007 following the merger of Imperial College's Faculty of Medicine with Hammersmith Hospital and St Mary's NHS Trust
- *King's Health Partners*, which includes King's College London, Guy's and St Thomas' NHS Foundation Trust, King's College Hospital NHS Foundation Trust, and South London and Maudsley NHS Foundation Trust
- *UCL Partners*, which includes Barts Health NHS Trust, Great Ormond Street Hospital for Children NHS Trust, Moorfields Eye Hospital NHS Foundation Trust, Queen Mary, University of London, Royal Free London NHS Foundation Trust, UCL and University College London Hospitals NHS Foundation Trust.

2.19 The three AHSCs are substantial organisations. The largest – UCL Partners – treats more than 1.5 million patients each year (with a spatial footprint that extends beyond London and into Essex and Hertfordshire), has a combined annual turnover of around £2 billion and includes around 3,500 scientists, senior researchers and consultants. This scale of resource is significant in relation to London's science and technology assets.

2.20 Other hospitals in London with major research activities include the Royal Marsden and its associated Institute of Cancer Research in Sutton; St Mark's Hospital and Academic Institute (including the Wolfson Unit for Endoscopy) in Harrow; and Harefield Hospital (part of the Royal Brompton and Harefield NHS Foundation Trust), the largest specialist heart and lung centre in the UK.

iv: London's financial and professional services

2.21 London's role as the hub of UK financial and professional services[5] has been a critical factor in the growth of the science and technology sectors from two different – but mutually reinforcing – perspectives:

[5] It is worth noting the pace at which businesses in this sector appear to be growing currently. The recent London Business Survey found that financial and insurance activities was the industry sector with the largest proportion of business units reporting an increase in employee numbers in the 12 months to mid-2014 (21%). See http://www.london.gov.uk/sites/default/files/london-business-survey-main-findings_0.pdf

- Firstly, London is home to highly specialist financial and professional services, and nowhere else in the UK (or, in most cases, the rest of Europe) has the same depth of expertise. London can claim specialist patent lawyers, venture capitalists and intellectual property experts, and this provision itself gives London-based science and technology firms' distinct locational advantages and attracts more firms to London.

- At the same time though, London's highly specialist financial and professional service providers have been key clients for many of the tech sectors that have blossomed over recent years. In a UK (and indeed European) setting, London is the obvious home for fintech because London is where most of the financial expertise (in the form of banks, brokers, asset managers, pension funds, hedge funds, private equity firms, insurance companies, etc.) already exists. Equally, the growth of adtech in London owes much to the presence of the main advertising agencies within the capital and also the headquarters of the principal "marketers" (i.e. the likes of Procter and Gamble, Unilever, etc.).

2.22 The symbiotic nature of this relationship has been widely recognised. In its analysis of the growth of fintech, Ernst and Young for instance comments that:

> *We describe Traditional fintech as 'facilitators' (larger incumbent technology firms supporting the financial services sector) and Emergent fintech as 'disruptors' (small, innovative firms disintermediating incumbent financial services firms with new technology). The UK is poorly represented in Traditional fintech (four out of the top 100 globally), but is strong in Emergent fintech (one half of all promising start-ups in Europe)[6].*

v: London's corporates: B2B

2.23 Over half of the companies on the FTSE 100 are headquartered in central London. Although the link to science and technology is indirect, the fact that London is home to major corporates more generally is important in relation to the growth of science and technology-based activities.

2.24 A number of our consultees commented that the reason they have to be in London relates more to the high concentration of buyers than any (more usually cited) supply side factor. Indeed, one company (which works in science-related big data) explained that *"if we were not in London, we would spend all of our time here in any case, because it is where our consumers are".* The importance of this market-related perspective should not be overlooked in explaining the growth of science and technology sectors within the capital. As illustrated in Figure 1-1 (in Chapter 1), many of the emerging S&T sectors are defined at the boundary between a conventional sector (with conventional corporate "buyers") and either digital technologies or science.

vi: London's consumers: B2C

2.25 In similar vein, London is a very attractive business location simply because – for those science and technology firms that rely on "business-to-consumer" (B2C) channels – the scale of the London market is invaluable. From among our own consultations, one firm (which is

[6] *Landscaping UK fintech* – Report commissioned by UKTI and completed by Ernst and Young, 2014

developing diagnostics for preventative and personalised healthcare) explained its presence in London in terms of the large number of relatively affluent potential customers that could be found through the network of private hospitals. With a growing and diverse population that is fast-approaching nine million in number – and with many tourists that also visit the capital – London is an ideal place for B2C firms to find a significant consumer base.

vii: Institutions/institutes in London

2.26 As the capital city, London has historically attracted many key institutions. Although there has been a conscious effort to relocate some away from the capital (either in whole or in part), London continues to attract a significant share of the total.

2.27 One well established institution that has had a huge impact on parts of the science and technology sector is the BBC – and a case study which examines its influence and roles within the ecosystem (and some of the pressures it is facing) – is provided below. Another which is still being built is the Francis Crick Institute; this is likely to have a very significant impact over the years ahead and we consider it further in Chapter 5. Other examples include the Open Data Institute (based in Shoreditch), the Turing Institute (to be located on the British Library site in the Knowledge Quarter), and the Wellcome Trust (also in the Knowledge Quarter).

Case Study: The role of one well-established institution in the development of science and technology sectors in London: BBC Future Media

Future Media is a division with the BBC's Central Operations. It is concerned with media for digital services and the development and application of technologies to deliver BBC online, including through websites, mobile services and connected services. These services have a global market. The division employs 1,300 people, mainly engineers, designers and product managers.

Around 60% of the division's staff are still based in London (Portland Place and White City), but an increasing proportion are in Salford. This partly reflects the BBC's strategy of expanding outside London, but it is also partly because recruitment and retention of engineers and designers at affordable salaries is easier in the north. In London, it is becoming exorbitantly expensive for the BBC, which cannot offer share ownership or top salaries. The BBC also tends to recruit British people: it rarely applies for visas for non EU nationals, whereas many tech companies recruit a high proportion of their technical staff from overseas where salary expectations are lower.

The BBC's Connected Studio is an open innovation project, and forms part of the Future Media Division. It is based in Media City Salford, but also has facilities in Euston Square, which it cohabits with UCL researchers. It also works collaboratively with the Digital Catapult and the British Library, both close by. The Connected Studio operates across the country, inviting small creative companies and entrepreneurs to work closely with them on content innovation to address challenges faced by BBC online. So far over 2,500 people have participated in Connected Studio sessions, and 120 companies have received grant support ranging from £5k to £75k to develop their ideas. Locations which have been used in London include Shoreditch Village Hall, and the Guardian building and Facebook office, both in the Knowledge Quarter (Kings Cross/St Pancras/Euston area).

London as a business location

London has a great culture and ecosystem for digital companies. It has lots of talented people, many of whom choose to work on a freelance contract basis rather than as employees. The BBC has a global market, and needs to be in London at the heart of the global cluster of media companies. However, most employment growth in new services is likely to be in Salford due to cost pressures in London.

viii: UK Government in London – and the regulators and the NHS

2.28 Through Westminster and Whitehall, London is the hub of UK government. It is also home to three of the national Catapult Centres (Cell Therapy, Digital and Future Cities) and most of the national regulators (Ofcom, Ofgem, Financial Services Authority, etc.). Some science and

technology sectors are strongly influenced by UK (or increasingly EU) regulatory frameworks and there are perceived to be some imminent threats – not least those relating to the proposed European General Data Protection Regulation (which relates to the use of personal data and could be challenging for many digital businesses). In this context, some of our consultees commented on the value of being physically "*close to the centre*" and the ability, as a result, to "*gain the ear of government*".

ix: London's workers – and those that are willing to come to London

2.29 Across the science and technology sectors, the nature, depth and scale of London's labour market is a major asset. London's workplace population – i.e. the number of people with jobs in London – is over 4.5 million. London attracts nearly 800,000 in-commuters from surrounding areas and has a strong centripetal effect. With this scale, and the strong demand from London firms for specialist skills, the specialist labour market that firms can draw on is very substantial.

> *"The most impressive thing is that more graduates are applying for jobs in the tech sector, which means the message is getting through that this is a great place to work. The least impressive thing is the number and size of exits in the London tech sector, which is lagging way behind Silicon Valley"*
>
> Extract from a media tech company's response to the London Tech Census, 2015

2.30 Moreover, London continues to be highly attractive to people from around the world with specialist skills of relevance to the growth of science and technology businesses. Through our consultations, we were told repeatedly of the international nature of London's science and technology workforce. We frequently found that between half and three quarters of the employees of firms we interviewed were not British nationals. Moreover, McKinsey's report for London First and the London Enterprise Panel noted that 44% of the companies identified as "high potential" through Tech City's 'Future Fifty' group have at least one founder from overseas. In its first Campus survey, Google counted 22 nationalities amongst Campus residents; six months later, this had grown to 33 nationalities[7]. The intrinsically international nature of the London's science and technology sector is very striking indeed.

x: London's global connectivity

2.31 Its international character relates – fundamentally – to London's global connectivity. London Heathrow Airport is a hub airport and the second busiest in the world in terms of international passenger traffic. In addition, Gatwick is 12th busiest[8]. Moreover London has the substantial benefit of being in the central time zone – which means that it can act as a bridge between American and Asian markets. For increasingly internationally-focused science and technology businesses, London's assets in relation to connectivity are invaluable.

How the benefits of clustering and agglomeration work together

2.32 For the average science and technology business, the difference between clustering and agglomeration benefits is entirely artificial: the two processes work together and often they are equally important. To illustrate the point, the case study below reflects on the experience of Mendeley, a business which has grown in London through the development of genuinely

[7] *London Campus: At the heart of a thriving and diverse start-up scene – results of our second Campus survey* Wiesner Vos, Google, December 2013 – page 5
[8] Airport Council International, 2014 ranking of airports on volume of international passenger traffic

disruptive technology. Its growth narrative embraces elements of clustering (notably the importance of networks, the importance of proximity and a site in Shoreditch) and agglomeration (e.g. its international founders choosing to set up their business in London; the importance of links to major publishing houses; and the importance of connectivity).

Case Study: The importance of both clustering and agglomeration in explaining London's assets for science and technology businesses – Mendeley

Mendeley is a web based reference manager and a social network for researchers. It is used for managing and sharing research papers, discovering research data and collaborating online.

It is used by many major research and education institutions worldwide (including MIT, Stanford and Cambridge), and over 3 million students, ranging from undergraduates to professionals, use Mendeley for organizing, writing, collaborating and promoting their research.

Mendeley has developed genuinely disruptive technology, in this case affecting the research sector and publishing industry:

- *"What [Mendeley] are up to is boldly innovative. The Mendeley team is attempting nothing less than changing the way scientists conduct and share their research." Wired Magazine, June 2010*
- *"Mendeley Throws Open the Doors to Academic Data" New York Times*
- *"The Guardian is correct in quoting me; I strongly believe that Mendeley can change the face of science." Dr. Werner Vogels, CTO Amazon.com & former research scientist at Cornell University.*

Overview of Mendeley's development

Mendeley was founded in November 2007 by three German post graduate students of computer science and management. The idea for Mendeley was based on their own frustrations in accessing and managing large numbers of research documents. They located the business in London for three main reasons:

- access to finance
- the strength of the high tech ecosystem in London, including the availability of talented people with the right mind-set
- London's international significance and connectivity.

Additional factors included the strength of UK's universities and research base, and the presence in London of the world's major publishers (Mendeley's markets and competitors)

Funding was raised in London in four main phases. The first phase was business angel investment of approximately £200,000. Subsequent phases, raised from a mix of UK and US business angels and funds, amounted to £1.5m, £6m and £4m. Investors included the former executive chairman of Last.fm, the former founding engineers of Skype, and the former Head of Digital Strategy at Warner Music Group, as well as academics from Cambridge and Johns Hopkins University. Mendeley has won several awards: for example, Plugg.eu "European Start-up of the Year 2009", TechCrunch Europas "Best Social Innovation Which Benefits Society 2009", the Guardian Activate 'Start-up Most Likely to Change the World for the Better' in 2010, and an Innovation Excellence award in 2014 from the Stationers Company.

Mendeley is located in White Bear Yard, a co-working space in Farringdon. The team now comprises 100 staff, mainly researchers and developers. In 2015 it will move to 19,000 sq ft offices in the new Alphabeta development in Finsbury Square, Shoreditch.

The sale to Elsevier

Mendeley was purchased by the Elsevier publishing company in 2013. The sale was controversial, leading to debate on scientific networks and in the media interested in open access, because Elsevier was seen as operating restrictive publishing practices which are antithetical to the open sharing model of Mendeley.

However, the sale made strong business sense for both the sellers and the purchaser. For the founders of Mendeley and their investors, the sale provided an opportunity to realise a substantial capital gain whilst enabling further growth of the business through the global market access and the financial strength of Elsevier. The intentions of Elsevier were thoroughly tested and it was felt that Mendeley would be encouraged and supported to continue to grow, while

remaining as a separate operation: "We are committing to implementing Mendeley's existing product development roadmap, and giving the company the space to 'let Mendeley be Mendeley'. Mendeley is a great company with a thriving, innovative culture and a lot of talented people. It's open, social and collaborative, and it is important to us that it retains all of those traits" (Olivier Dumon, Managing Director of Academic and Government Markets for Elsevier).

In addition, the timing was right. There are three main windows of opportunity for selling a technology business:

- At a very early stage, when the purchaser is essentially acquiring the intellectual property and energy of the start-up team – revenues and profitability are likely to be low or zero, and the product may need substantial further development
- Once the product is proven and generating revenues. In this case the purchaser is likely to be acquiring a new product or service which complements and adds value to their established business activities. They see profit potential, rather than a substantial existing profit stream
- When the firm is well established, generating substantial profits for its shareholders and staff. In this case, the purchaser is buying additional turnover and profit growth.

For Elsevier, Mendeley was in the second of these categories. Its acquisition gave Elsevier a strong presence in the rapidly developing digital information market, and specifically in a specialist niche which was entirely consistent with, and complementary to, Elsevier's distinctive strengths in publishing (i.e. markets relating to the scientific and research communities).

Since the acquisition Mendeley has doubled in size from 50 to 100 employees. Mendeley continues to work from separate offices: Elsevier's London offices are in Camden and the Strand, and its headquarters are in the Netherlands.

In 2010 Mendeley established an office in New York, encouraged by its US investors, to make faster progress in penetrating the North American market. However, it had mixed results: it probably enabled faster growth in North America, but it distracted senior management at a time when their attention really needed to be focused on growing the core business is London. Following the acquisition by Elsevier, the separate Mendeley office in New York was closed.

Mendeley considers itself an edtech firm, since its main market is educational and research institutions and individuals. However, as it is now owned by Elsevier, one of the world's leading publishers, it could also be categorised as adtech, and it also falls within the digital technologies categorisation.

London as a business location

Mendeley's founders consider London's main advantages to tech-based businesses to be:

- Its established business ecosystem, including formal and informal networks, a large specialist labour market and large number of early stage firms operating is a diversity of technology areas
- Access to risk finance, including early and later stage funding, which is regarded as the best in Europe
- The scale, prominence and global connectivity of London, which make it a good place to do business, to attract staff to, and to find all the supporting infrastructure that is needed
- Supportive, pragmatic and simple fiscal incentives for investing in tech businesses. These encourage successful entrepreneurs to re-invest in new ventures, which increases their chances of success (through the transfer of knowhow) and strengthens the business ecosystem as a whole.

For some tech firms, the strength of higher education and research in London, and more generally in the UK (which 'punches above its weight internationally'), is important. For Mendeley it is important primarily because HE is a major market, but for some the research base in London is the source of the firms' main technology or expertise.

Mendeley is located in Farringdon because it is at the heart of the tech cluster. London is so large that it is inevitable there will be particular concentrations of tech businesses in particular locations. Being in close proximity to other tech firms and the supporting infrastructure is really important to access networks and information, and to recruitment and retention of staff. The Farringdon/Old Street/Tech City area is where firms are, and where employees want to be.

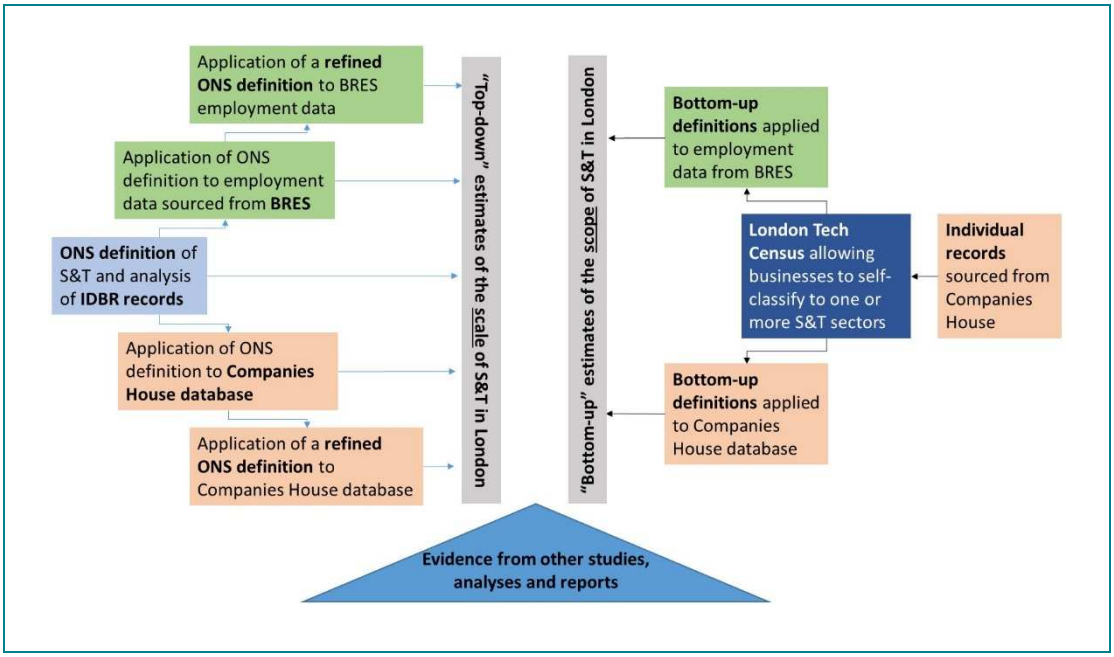
3. The scale and location of science and technology sectors in London

Overall scale of science and technology sectors in London

3.1 Measuring the scale of science and technology sectors is immensely challenging. S&T sectors simply defy straightforward definition. They often exist across the boundaries which are demarcated through the system of standard industrial classification (SIC) and on which all official data are structured[9]. Whilst attempts have been made to measure the sector through web-based big data techniques[10], there is little to suggest that these approaches are in fact any more robust; and they have tended to result in multiple estimates of the scale of activity. The challenges of measurement are not the preserve of this study. In seeking to understand the geography, nature and scale of the UK's digital industry – one element of our brief in a London context – Tech City UK recently reflected on the challenges of measurement, observing that *"the digital economy is, quite simply, evolving too rapidly. Indeed, we came across a number of challenges from the complex to the very basic, such as defining a technology company, to analysing government data[11]".*

3.2 Within this study, we have sought to use a range of alternative approaches, recognising that none of them is perfect but that the use of multiple sources allows for a process of "triangulation". Our overall approach is illustrated in the diagram below and then explained in the paragraphs that follow.

Figure 3-1: Defining the scale of London's S&T sectors: Triangulating different approaches



Source: SQW

[9] Officially known as the UK Standard Industrial Classification (UK SIC), the latest version of which is the UK Standard Industrial Classification 2007 (UK SIC 2007).
[10] See, for example, *Measuring the UK's Digital Economy with big data* Report prepared by NIESR and Growth Intelligence for Google, 2014
[11] *Tech Nation: Powering the Digital Economy, 2015* Report prepared and published by Tech City. Page 6

"Top-down" estimates of the scale of London's science and technology sectors

3.3 Our starting point with regard to measuring the scale of London's science and technology sectors was a piece of work completed by ONS on behalf of GLA Economics. We made use of preliminary data extractions published by ONS and we completed further analysis of them (and this analysis is reported here); ONS subsequently published a methodology report explaining how those estimates were generated[12].

3.4 The source used by ONS was the Inter-Departmental Business Register (IDBR) which is a comprehensive list of UK businesses that is used by government for statistical purposes. The IDBR is continuously updated, and contains confidential information[13]. ONS derived a definition of science and technology sectors on the basis of the 2007 Standard Industrial Classification (SIC 2007). It concluded that in 2013, across London, there were 93,000 S&T workplaces[14] and just over 900,000 S&T employees. It derived these numbers by considering five sub-categories: digital technologies, life sciences and healthcare, publishing and broadcasting, other S&T manufacture, and other S&T services. Its detailed breakdown is shown in the table below.

Table 3-1: Numbers of workplaces and employees in Science and Technology categories in London, 2013

Science and Technology category	Number of workplaces	Percentage of total S&T workplaces	Number of employees	Percentage of total S&T employees	Average size of workplace
• Digital Technologies	34,400	37%	155,600	17%	4.5
• Life Sciences & Healthcare	10,780	12%	259,200	29%	24.0
• Publishing & Broadcasting	32,275	35%	268,900	30%	8.3
• Other scientific/ technological manufacture	2,180	2%	20,200	2%	9.3
• Other scientific/ technological services	13,330	14%	198,100	22%	14.9
Total Science and Technology sectors	*92,965*	*100%*	*901,900*	*100%*	*9.7*
All sectors	426,880		4,371,000		10.2
Total S&T as % of all sectors	22%		21%		

Source: IDBR/ONS[15]

[12] See http://www.ons.gov.uk/ons/rel/regional-trends/london-analysis/identifying-science-and-technology-businesses-in-official-statistics/art-identifying-science-and-technology-businesses.html?format=print – published on 15th February 2015

[13] For a more detailed explanation, see http://discover.ukdataservice.ac.uk/catalogue?sn=6697

[14] Note that an individual business may be associated with more than one workplace or "local unit" (which includes branches, etc.) and hence the terms are not synonymous. That said, in simple numerical terms, the vast majority of businesses are single site operations and therefore associated with only one workplace. However, large businesses, which are more often multi-site, employ a high proportion of the workforce.

[15] See www.ons.gov.uk/ons/about-ons/business-transparency/freedom-of-information/what-can-i-request/published-ad-hoc-data/business-and-energy/february-2014/index.html

3.5 Using "like for like" definitions, SQW re-ran the ONS analysis of IDBR on three years of data from the Business Register and Employment Survey (BRES). BRES does not provide information on the number of workplaces/firms, but it does provide estimates of the number of employee jobs. As the table below shows, the estimates of employee jobs are broadly similar from the two sources. From BRES, the estimate of employee jobs is a little higher than from IDBR – around 980,000 employee jobs were recorded in 2013 in S&T sectors (as defined by ONS).

Table 3-2: Analysis of employee jobs in Science and Technology sectors (as defined by ONS) based on BRES

Science and Technology category	Number of employees 2013	% of total S&T employees	*Number of employees 2012*	*% of total S&T employees*	*Number of employees 2011*	*% of total S&T employees*
Digital Technologies	168,500	17%	*150,000*	*16%*	*167,100*	*18%*
Life Sciences & Healthcare	275,400	28%	*272,400*	*30%*	*260,600*	*29%*
Publishing & Broadcasting	298,600	31%	*264,400*	*29%*	*253,100*	*28%*
Other scientific/ technological manufacture	20,600	2%	*25,900*	*3%*	*21,500*	*2%*
Other scientific/ technological services	215,700	22%	*207,900*	*23%*	*210,800*	*23%*
Total S&T	978,800	100%	920,600	*100%*	913,100	*100%*
All sectors	4,581,700		4,446,100		4,303,300	
Total S&T as % of all sectors	21%		21%		21%	

Source: BRES

3.6 However, the data in the two tables above are significantly influenced by the inclusion of "healthcare" – which includes hospitals and primary care – within "life sciences and healthcare". In terms of the core S&T sectors we are more interested in life sciences excluding most healthcare. Inspection of the "life sciences only" data (from BRES) suggests very much smaller numbers – so small in fact that the data cannot be reported for reasons of confidentiality.

3.7 A third source available to us is the Companies House database. Although this contains information relating to individual businesses, it is – in statistical terms – a less robust source than either BRES or IDBR, particularly in relation to employment. There are three main issues in this context: the geographic reference point is a registered address which may not match the location from which staff are employed; employment information derives from company accounts (and is therefore patchy in coverage and dated); and for larger businesses, there are major complications (and inconsistencies) in relation to how group-subsidiary structures are handled. However the great advantage of Companies House data is that unlike both IDBR and BRES, data are wholly in the public domain there are no confidentiality restrictions on their use, even at the level of individual companies. Whilst not a "silver bullet", the Companies House records are therefore worth treating seriously.

3.8 As an input into this study, Trampoline Systems completed a thorough analysis of the Companies House database, and – based on known examples – it developed algorithms to correct for the inconsistent treatment of group-subsidiary relationships (and the consequential allocation of employee jobs to SIC codes)[16]. Trampoline Systems sought to (a) replicate the analysis completed by ONS on the basis of its initial definition of S&T (which included healthcare) and (b) consider a refined definition with healthcare-related activities stripped out[17]. The results of Trampoline Systems' analysis are summarised in the table below.

Table 3-3: Analysis of employee jobs in Science and Technology sectors (as defined by ONS) linked to registered addresses in London and based on Companies House records

	Companies	Revenue (£bn)	Employees
• Digital Tech (ONS definition)	44,970	£30	170k
• Life science and healthcare (ONS definition)	15,970	£16	200k
• Publishing and broadcasting (ONS definition)	35,530	£74	280k
• Other science and tech manufacturing (ONS definition)	3,210	£16	66k
• Other science and tech services (ONS definition)	9,860	£27	160k
Science and Technology sectors (ONS definition)	**109,540**	**£163**	**880k**
• Life science (i.e. ONS definition less healthcare & related)	720	£5	22k
Science and Technology sectors (Narrower definition)	**94,280**	**£153**	**700k**
All (total economy)[18]	*790,090*	*£2,295*	*10,020k*
Science and Technology sectors (ONS definition) as a % of the total economy	*13.9%*	*7.1%*	*8.7%*
Science and Technology sectors (Narrower definition) as a % of the whole economy	*11.9%*	*6.6%*	*7.0%*

Source: Companies House / Trampoline Systems. Numbers may not sum due to rounding.

3.9 All three "Top-Down" data sources are imperfect; and the first two are also subject to significant confidentiality restrictions. *However they appear to be converging around an estimate of about 90-95,000 science and technology sector workplaces, and around 900,000*

[16] Where companies have a group structure, the registered addresses of the subsidiaries may be the same as for the HQ (which is often in London). This can (but does not necessarily) result in all employment in the group being recorded as in London, despite the fact that the group's subsidiaries may be in various locations around the UK. We addressed this problem by separating out the holding company from its subsidiaries. Where the summed output and employment of all the subsidiaries was smaller than the holding company's output and employment, we subtracted the summed output and employment of all the subsidiaries from that of the holding company, leaving only the excess for the holding company. However, this did not eliminate the problem that some jobs recorded as being in companies based in London may actually be located elsewhere in the country.

[17] Note that using data from IDBR, ONS completed a separate analysis which distinguishes between public and private sector employee jobs and workplaces in (a) life sciences and healthcare and (b) other S&T sectors. It found that in 2013, the private sector accounted for 92% of London's life sciences and healthcare work places and 32% of its jobs. While private sector jobs/workplaces provide a better proxy for the core S&T sectors, they remain an imperfect one (as, for example, private sector hospitals will still be included in this narrower definition). ONS's analysis is available at www.ons.gov.uk/ons/about-ons/business-transparency/freedom-of-information/what-can-i-request/published-ad-hoc-data/business-and-energy/april-2014/index.html

[18] Note that the Companies House data result in a far higher estimate of both total employee jobs and total companies than the other sources; there are a number of different reasons for this (and our view is that the IDBR-based estimates of the total economy are more robust and hence provide a better basis for estimating S&T sectors' share of the total economy)

employees on a broad definition, but around 700,000 on a narrower one (which we think is the more plausible).

"Bottom-up" estimates of the scale of London's science and technology sectors

3.10 In approaching the top-down exercise, we were well aware of the limitations of SIC codes in relation to S&T sectors in general, and especially with regard to the emerging "techs". Indeed, the critique developed by NIESR and Growth Intelligence was/is one with which we largely concur[19]. In order to try and find a way around this, our intention was to launch – and then use the findings from – a "London Tech Census" to allow firms to classify themselves in relation to science and technology sectors, as recognised "on the ground" (fintech, adtech, medtech, biotech, etc., as depicted earlier in Figure 1-1), through a genuinely crowdsourced approach (which at least created the possibility of every S&T firm in London taking part – hence the term, "London Tech Census").

3.11 In practice, the London Tech Census generated just under 150 responses. Around half of these identified themselves as being from within one or two distinctive science and technology sectors. However about a fifth identified themselves as being in more than five (and some recognised more than 10). *So even working bottom-up, it was apparent that sector definitions are very fuzzy indeed. At one level, this was frustrating. But it is also the reality of the S&T economy: individual businesses frequently defy straightforward classification even when asked to describe themselves in terms they should recognise (and without the burden of the SIC code straightjacket.)*

3.12 Simply because of the need to use a comprehensive dataset, our intention then had been to map the crowdsourced, "bottom-up", definitions of individual S&T sectors back onto SIC codes, but at a very disaggregated level (as we had the read-across to the company-level data from Companies House). After some "cleaning" – to deal with the problem of major generic SIC code categories being included in relatively niche science and technology sector definitions, and also to draw on research through other studies – we applied our "bottom-up" definitions to the BRES dataset.

3.13 The "answer" – in terms of the number of employee jobs in each S&T sector – was an overstatement (as even at the disaggregated SIC level, the analysis picked up whole SIC codes). Moreover, given that the London Tech Census allowed respondents to associate themselves with more than one sector, the "bottom-up" estimates could not be aggregated (for there was very significant double counting). Nevertheless, the results provide another perspective on employee jobs in science and technology sectors in London. They suggest that:

- Most individual S&T sectors have somewhere between 100,000-300,000 employee jobs in London
- As with the ONS definitions and analysis, estimates of employee jobs in biotech and medtech are especially fraught. The numbers generated through the bottom-up approach are too big to be plausible because of the SIC code structure onto which

[19] See *Measuring the UK's Digital Economy with big data* Report prepared by NIESR and Growth Intelligence for Google, 2014

Census responses had to be mapped (although this also should be seen as indicative of the huge range of activities that are actually implicated in drug discovery, diagnostics, etc.)

- Typically, Inner London accounts for about 70% of London's jobs in S&T sectors (compared to around 60% of the whole economy), suggesting a concentration in central areas

- Intuitively, the pattern of employment in London's S&T sectors looks "about right" when compared to a parallel analysis for Greater Cambridge and Oxfordshire: for example, compared to London, Oxfordshire has relatively few employee jobs in fintech and adtech while Cambridge has relatively more in biotech and medtech.

Evidence from other sources

3.14 There have been other attempts to assess the scale of London's science and technology sectors and – as part of a process of calibration – it is helpful to consider the findings from these. However there is also a need for considerable care as definitions vary substantially.

3.15 Several recent reports have focused on the size of the digital technology sectors in London:

- The first Tech Nation report found that 251,590 people worked for (digital) technology businesses in (Inner) London[20]. Compared to the findings from IDBR and BRES (see above), this estimate appears to be high – although the definition of digital technology is broader and hence there may well be overall consistency

- A study published by Nesta estimated that the number of employees in high tech industries in London over the period 2011-2013 is about 290,000. This estimate is low compared to the findings from IDBR and BRES. We think the reason for it surrounds Nesta's methodology – which relied particularly on the Annual Population Survey and considered the number of London residents working in high tech industries (i.e. a residence-based measure), rather than the number of high tech jobs in London (a workplace-based assessment)[21]

- A report sponsored by Bloomberg Philanthropies[22] on London's digital economy concluded that there are 382,000 employed in the 'tech/info sector' (which includes parts of the ONS defined digital tech and publishing and broadcasting sectors). Using a different approach based on analysis of job advertisements, it also concluded that there are 44,000 employed in fintech occupations, and 54,000 in 'big data' occupations, within a 25 mile radius of central London

- The analysis of the UK's digital economy by Growth Intelligence and the National Institute of Economic and Social Research[23] , using a definition of the digital economy based mainly on firms' product type, sales process and client type, concluded that

[20] *Tech Nation – Powering the Digital Economy, 2015* Tech City
[21] *The geography of the UK's creative and high-tech economies*, Nesta, January 2015 – data taken from Table 7.3.
[22] *London: Digital City on the Rise*. Dr Michael Mandell, South Mountain Economics, and Dr Jonathan Liebenau, London School of Economics, sponsored by Bloomberg Philanthropies, June 2014
[23] *Measuring the UK's Digital Economy with big data*, Growth Intelligence and NIESR, 2014

there are 64,600 digital economy companies in London. A comparative assessment using a SIC-based definition (but one which differed again from ONS and other approaches) identified 51,500 companies.

3.16 In relation to Life Sciences, BIS has developed a database of life sciences firms in the UK based on successive annual surveys, which can be analysed by region and sub sector[24]. The database indicates that there are approximately 415 life sciences firms in London[25], employing around 17,840 people. The definition of the sector is not based on SIC codes, but is reasonably close to the revised ONS based definition above which excludes healthcare. The London Health Board has also provided employment estimates based on work undertaken by McKinsey, which estimates that there are 995 life sciences firms in London employing nearly 29,000 people[26]. We consider different estimates of the size, composition and location of the life sciences sectors in more detail in Chapter 5.

Spatial distribution of science and technology sectors in London, and growth over time

3.17 From the different sources – and notwithstanding their limitations – it is possible to build up a picture of the granularity of employment in London, and how this is changing. We use two sources in this context (IDBR and Companies House) to provide alternative perspectives.

Insights from IDBR

3.18 The two tables which follow provide data on employee jobs and business units in 2013, and they show change over the preceding decade. They are therefore important in charting overall growth. In terms of **employee jobs**, they indicate that:

- Over the decade, the total number of jobs in London increased by 16% while the total number of S&T jobs grew by 15%
- However there were significant differences in performance across different S&T sectors: whereas the number of jobs in "digital technologies" increased by 29%, the number in "other scientific/technological manufacture" decreased by 45%
- There was also a distinctive spatial dimension: the overall number of S&T jobs increased by 29% in Inner London but it decreased by 6% in the Outer London Boroughs. The differences were especially stark in "digital technologies" – which saw the number of jobs increase by 53% in Inner London and fall by 4% in Outer London
- At a more granular scale, central London and east London have seen the fastest growth: in both cases, employee jobs in digital technologies have grown by 50% or more.

[24] *Strength and Opportunity 2014: The landscape of the medical technology, medical biotechnology, industrial biotechnology and pharmaceutical sectors in the UK*. BIS Annual Update.
[25] In Chapter 5, we map these data
[26] *Promoting Growth and Jobs in Life Sciences*, London Health Board, 17th March 2014. Figures based on data taken from *Life Sciences Strategy for London*, McKinsey & Company, February 2012

Table 3-4: Employee jobs overall, in science and technology as a whole, and its sub-sectors, in 2013 and change from 2003 (based on ONS definitions, using IDBR)

	Whole economy		Science and Technology (Total)		Digital Technologies		Life Sciences & Healthcare		Publishing & Broadcasting		Other Scientific/ Technological Manufacture		Other Scientific/ Technological Services	
	2013	% change 2003-2013	2013	% change 2003-2013	2013	% change 2003-2013	2013	% change 2003-2013	2013	% change 2003-2013	2013	% change 2003-2013	2013	% change 2003-2013
Inner/Outer London														
Inner London[27]	2,690,700	22%	598,900	29%	106,000	53%	147,000	42%	216,200	21%	4,700	-45%	125,000	21%
Outer London[28]	1,680,300	7%	303,100	-6%	49,600	-4%	112,200	11%	52,600	-10%	11,000	-49%	72,400	-12%
Sub-regional geographies[29]														
Central	1,915,700	19%	438,900	33%	77,200	50%	92,200	46%	168,000	28%	2,600	-24%	98,900	23%
North	267,000	11%	38,300	-2%	6,200	2%	20,300	25%	5,900	-28%	1,100	-68%	4,800	-2%
South	596,200	5%	107,500	-9%	19,900	-4%	45,400	2%	16,900	-26%	3,000	-58%	22,100	-3%
East	853,900	23%	141,000	18%	26,600	64%	59,200	26%	28,400	10%	3,600	-53%	17,900	20%
West	738,200	12%	176,300	-2%	25,700	-3%	42,100	27%	49,600	1%	5,400	-38%	53,700	-14%
Region														
London[30]	**4,371,000**	**16%**	**901,900**	**15%**	**155,600**	**29%**	**259,200**	**27%**	**268,900**	**13%**	**20,000**	**-45%**	**198,100**	**6%**

Source: SQW, Using 2003 & 2013 IDBR Data

[27] Defined here as the London boroughs of: City of London, Camden, Greenwich, Hackney, Hammersmith and Fulham, Islington, Kensington and Chelsea, Lambeth, Lewisham, Newham, Southwark, Tower Hamlets, Wandsworth, and Westminster

[28] Defined here as the London boroughs of: Barking and Dagenham, Barnet, Bexley, Brent, Bromley, Croydon, Ealing, Enfield, Haringey, Harrow, Havering, Hillingdon, Hounslow, Kingston upon Thames, Merton, Redbridge, Richmond upon Thames, Sutton and Waltham Forest

[29] See Table 3-5 for definitions of the sub-regional geographies

[30] Note that sub regional figures do not in all cases sum to London totals due to rounding adjustments and missing data for two districts for two S&T categories

Table 3-5: Business units overall, in science and technology as a whole, and its sub-sectors, in 2013 and change from 2003 (based on ONS definitions, using IDBR)

	Total business units		Science and Technology (Total)		Digital Technologies		Life Sciences & Healthcare		Publishing & Broadcasting		Other Science/ Technology Manufacture		Other Science/ Technology Services	
	2013	% change 2003-2013	2013	% change 2003-2013	2013	% change 2003-2013	2013	% change 2003-2013	2013	% change 2003-2013	2013	% change 2003-2013	2013	% change 2003-2013
Inner/Outer London[31]														
Inner London	223,245	17%	49,645	39%	15,750	30%	4,845	74%	21,355	44%	900	-16%	6,795	36%
Outer London	203,630	19%	43,320	35%	18,650	23%	5,935	75%	10,930	52%	1,275	-15%	6,545	37%
Sub-regional geographies														
Central[32]	146,165	13%	30,545	28%	8,645	22%	2,925	68%	13,970	31%	575	-17%	4,445	23%
North[33]	39,595	19%	7,690	34%	2,935	9%	1,185	71%	2,400	64%	200	-18%	965	45%
South[34]	78,690	16%	18,610	30%	7,580	14%	2,195	71%	5,255	47%	410	-21%	3,165	36%
East[35]	88,425	29%	19,230	71%	8,045	64%	2,495	88%	5,705	95%	565	-10%	2,430	64%
West[36]	74,000	18%	16,890	34%	7,195	21%	1,980	74%	4,955	46%	425	-13%	2,335	38%
Regions														
London	**426,880**	**18%**	**92,965**	**37%**	**34,400**	**26%**	**10,780**	**74%**	**32,275**	**47%**	**2,180**	**-16%**	**13,330**	**37%**

Source: SQW, Using 2003 & 2013 IDBR Data

[31] See Table 3-4 for definitions of Inner and Outer London
[32] Defined here as the London boroughs of City of London, Camden, Islington, Kensington and Chelsea, Lambeth, Southwark and Westminster – consistent with the Further Alterations to the London Plan (FALP), adopted March 2015 (see page 403 of the Annexes)
[33] Defined here as the London boroughs of Barnet, Enfield and Haringey – consistent with the Further Alterations to the London Plan (FALP), adopted March 2015 (see page 403 of the Annexes)
[34] Defined here as the London boroughs of Bromley, Croydon, Kingston upon Thames, Merton, Richmond upon Thames, Sutton and Wandsworth – consistent with the Further Alterations to the London Plan (FALP), adopted March 2015 (see page 403 of the Annexes)
[35] Defined here as the London boroughs of Greenwich, Hackney, Lewisham, Newham, Tower Hamlets, Barking and Dagenham, Bexley, Havering, Redbridge and Waltham Forest – consistent with the Further Alterations to the London Plan (FALP), adopted March 2015 (see page 403 of the Annexes)
[36] Defined here as the London boroughs of Brent, Ealing, Harrow, Hillingdon, Hounslow, and Hammersmith and Fulham – consistent with the Further Alterations to the London Plan (FALP), adopted March 2015 (see page 403 of the Annexes)

3.19 With regard to the **number of business units** (a reasonable proxy for firms):

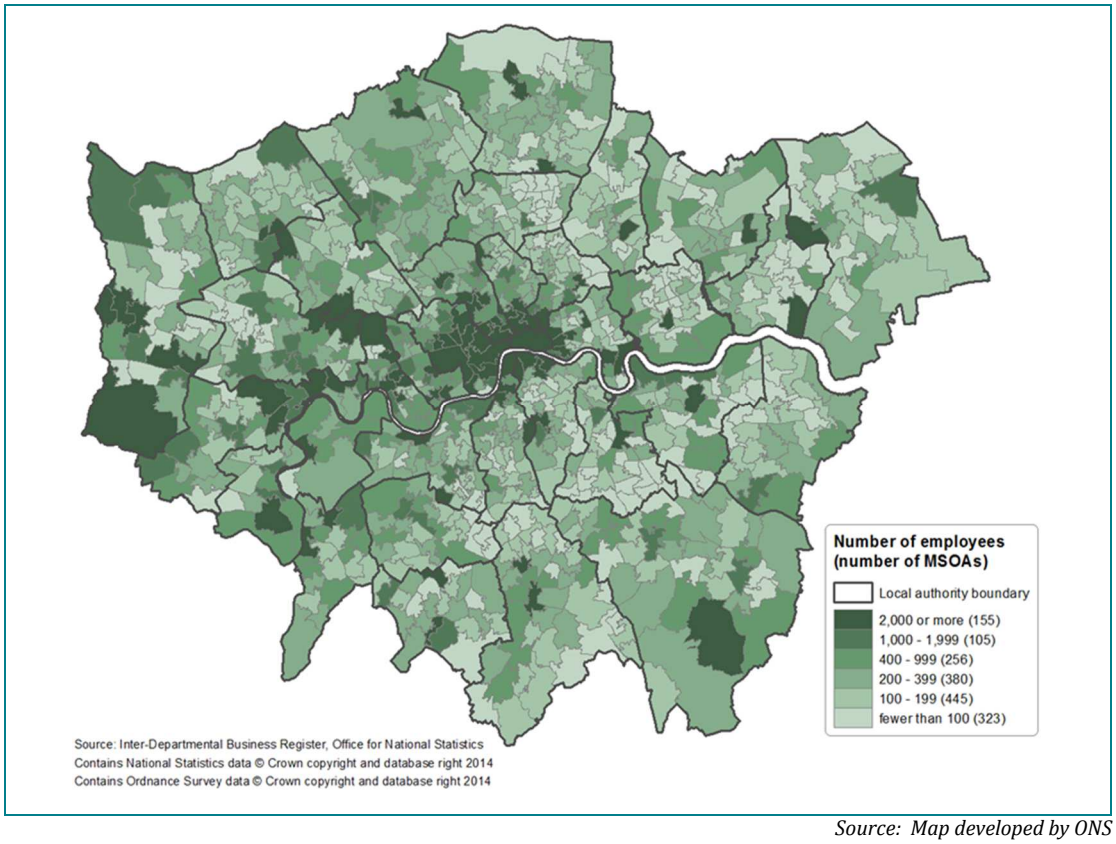
- London saw the number of business units in science and technology sectors increase by 37% between 2003 and 2013; across the economy as a whole (i.e. all sectors in London), the increase was 18%
- The differences between Inner and Outer London in terms of the changing S&T business stock were far smaller than with regard to employee jobs – suggesting that the differentiator was the activities of a relatively modest number of larger employers in different parts of London
- At a more granular scale, central London and east London have seen the fastest growth in the S&T business stock.

3.20 Consistent with this analysis of IDBR, ONS recently published a map of employees working in S&T sectors based on middle layer super output area boundaries. There is a need for some care in interpretation. MSOAs are defined in population terms and hence a spatially extensive MSOA is one where population densities are relatively low (and hence it is not actually "bigger" in economic activity terms). Taking this into account, the map shows the importance of central London in relation to S&T employees, and the significance of more localised pockets elsewhere, notably to the west (which is consistent with the observation in Table 3-4 that west London had the second greatest overall number of employee jobs in S&T sectors).

"London's technology sector is not confined to Silicon Roundabout (Old Street) and is increasingly moving towards the river, particularly Southbank. Tech and analytics firms, from start-ups to large established organisations, are beginning to accumulate on Bankside"

Extract from an analytics/software company's response to the London Tech Census, 2015

Figure 3-2: Number of employees working in science and technology sectors in London MSOAs, 2013

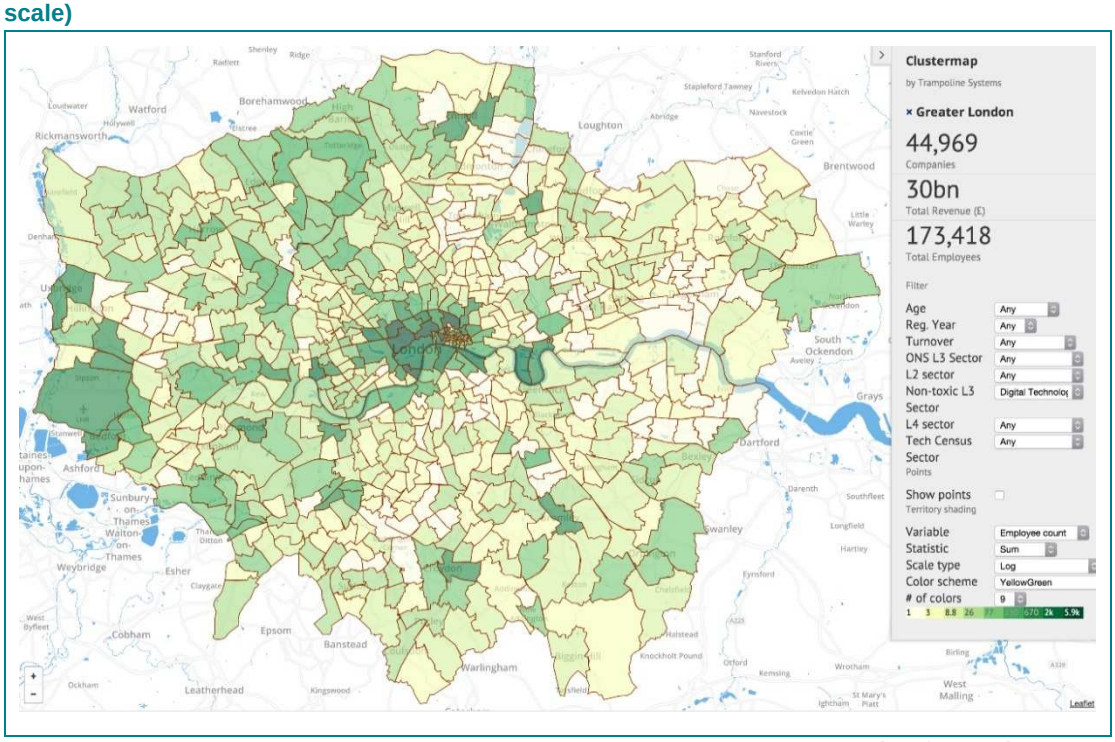


Source: Map developed by ONS

Perspectives from the Companies House database

3.21 Granular insights are also available through the Companies House database. The graphics below consider employment linked to businesses in the digital technologies sector (ONS-defined) and in the life sciences sector (informed by the ONS definition but excluding hospital-related activities)[37]. These data are not straightforward owing to the dependence on registered addresses, but the picture is similar to that described in the two tables above, and indeed in Figure 3-2.

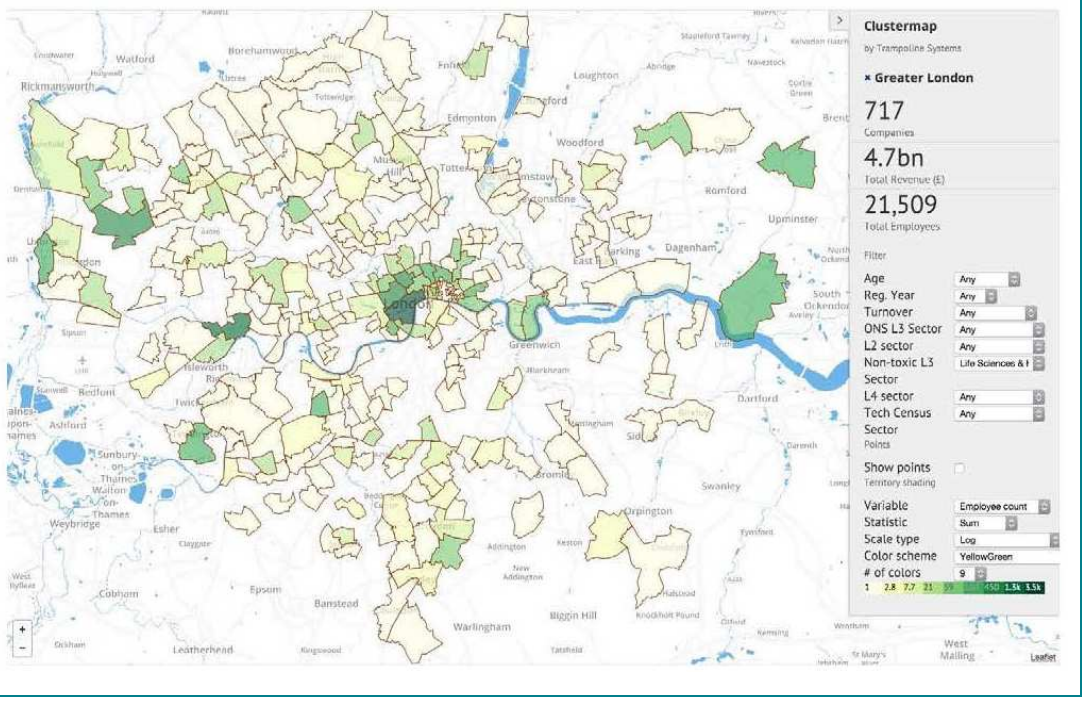
Figure 3-3: Heat map showing employment linked to companies in Digital Technologies (log scale)



Source: Companies House data / Trampoline Systems

[37] Note that additional maps based on the Companies House data are provided in Annex B

Figure 3-4: Heat map showing employment linked to companies in Life Sciences (log scale)



Source: Companies House data / Trampoline Systems

Conclusions

3.22 Estimating the scale of a fast-growing group of activities which by definition are chameleonic is a fraught exercise, and the tools and resources available to us are far from perfect. Looking across the different sources considered in this chapter, it is however possible to draw some tentative conclusions:

- Overall, we estimate that the number of S&T businesses in London is 90-95,000 and the total number of employee jobs is about 700,000. On these metrics, this equates to just over 15% of the London economy (noting that ONS's estimate, based on a broader definition of science and technology, is over 900,000 employee jobs which is about 20% of the economy)
- Within this, the sector that has grown very quickly over recent years is digital technology and its spatial footprint is heavily concentrated in central and east London
- S&T manufacturing sectors have lost employment from across London and at a rapid rate (more rapid than in the rest of the country). The reasons for this decline merit some reflection (and we will return to them later)
- Individual tech sectors as recognised by businesses, venture capitalists, and industry commentators – fintech, adtech, edtech, etc. – are very difficult to measure, and even with this nomenclature, individual companies (including very small ones) often see themselves as crossing boundaries. The reason for this lies in part with the pace of change and in part with the fact that most S&T activities are at once a sector and a service (and hence an input into another sector); thus they have traction across the whole economy making accurate measurement very difficult indeed.

4. London's digital sectors

4.1 In the course of our consultations, one (36 year old and Shoreditch-based) adtech/fintech entrepreneur commented, *"coding has been simplified, and the kids now… the 18 year olds… they are very impatient when technology can't solve problems… they are just coming up with solutions and ideas all of the time… it is amazing".* Later in the same conversation, he however observed that *"80% of businesses in Shoreditch will fail and most don't have a viable business plan. Shoreditch is not as big as you think and it has not [yet] produced the big stars."*

4.2 This set of paradoxical reflections captures both the opportunities/strengths and the challenges that characterise London's digital sectors. As evidenced in Chapter 3, digital sectors are collectively the fastest-growing component of London's science and technology sectors, and they are also the most fluid; they are changing at a tremendous pace. In this chapter, we will consider their characteristics and potentials, but also the constraints they must navigate as they seek to become *"big stars"*.

Characteristics and potentials of London's digital sectors

4.3 Without exception, the digital businesses we spoke to in the course of this study were extremely fluid/adaptable in their focus and intrinsically well networked. InSkin Media – an adtech firm which is now located in Soho – is one example. It was actually formed in Bournemouth, but it chose to relocate the business to Soho in order to be close to customers. This growth model was one that we observed several times. At one level, it breaks all the rules of economics: central London is expensive (and at the end of this chapter, we identify property costs as a major constraint), yet a location within it seems, for many digital technology firms, to be absolutely critical. For InSkin Media, London operations have opened the door to a networked global market, and it is this that has been essential.

Case Study: InSkin Media

InSkin Media (ISM) is an adtech business which creates and delivers online advertising solutions across multiple formats. It has developed proprietary 'PageSkin' technology and a creative toolkit and service platform for a wide range of international publishers and agencies.

ISM has won various awards, including Digital Media Innovator of the Year in the British Media Awards 2012 and Top Company in the 2013 IPA Media Owner Survey. In November 2014, InSkin Media was invited to join the 'Scale Up Club', a group of companies identified as having £100m turnover potential within 3-5 years, by Silicon Valley angel investors.

It is based in Soho, close to its main customers, the media agents, and currently employs 65 people in London, plus 8 in small overseas offices in Hong Kong, Germany (Hamburg) and Australia.

Overview of Inskin Media's development

ISM was formed in 2009, supported by two angel investors. It was originally located in Bournemouth, with two people based in a serviced office in London close to customers. However, it soon relocated all activities to an office in Soho and has since moved once more within the area to get more space. In late 2012, ISM secured additional investment of £2m from a media focused VCT, partly to support international expansion: an office in Germany was established in late 2012, and in Hong Kong in 2013. The International PageSkin technology was launched in 2013, with publisher deals in 11 countries. ISM has since funded further growth through retained earnings.

ISM now partners with over 100 publishers, represents over 230 websites globally, and has delivered successful campaigns for over 600 blue-chip brand clients. After a slow start over its first two years, building contacts and

developing the software, turnover has grown by 50% in each of the last three years, with staff numbers growing from 20 to 70 over this period. In 2013 it was ranked 50th in the Sunday Times Hiscox Tech Track 100.

Future growth

ISM expects to continue its growth, mainly in London. International expansion will be mainly through relationships with London based international media agencies. There are likely to be more overseas representative offices in Asia and Europe (not North America, due to the intensity of competition), primarily to promote collaborative relationships which can support delivery in overseas markets based on orders placed through international agents based in London.

ISM is likely to need to move again within the next year. The combination of cost of office space and the length of commitment required is a problem. Tech firms find it impossible to predict how big they will be in a year's time: they could expand dramatically, or contract if funding dries up: they cannot commit to a five years lease when they may need to move again within a year.

Some competitors have increased home working to manage this problem, but ISM is unconvinced that this will work well for a business which relies so much on close contact between software developers and with customers.

London as a business location

London is "*an incredibly vibrant, energetic, fluid, cosmopolitan place*", which has everything a tech start up needs. But it is also increasingly expensive, including in the areas the tech clusters focused on initially because they offered an abundance of relatively cheap, flexible accommodation around the fringe of the City and West End. The cost of good software developers, housing for employees, and transport congestion, are also growing problems.

Soho is the ideal location for ISM because its main customers are on the doorstep, and it is an attractive place to recruit staff to. Soho has a different feel from other technology clusters (e.g. Shoreditch) because of the sector focus. But increasingly all London clusters are a mixture of new and small firms, and big corporates, which is good for both by improving access to markets, innovative ideas and expertise.

4.4 Although based in a different part of London, the narrative surrounding the formation and growth of a second adtech start-up has many parallels. For this entrepreneur, a good concept/product is only one part of the growth process: developing a network of relationships, including many that are global, is imperative.

Case Study: The development of Race Yourself and We See Through

Alex Foster decided when he was 19 that he wanted to be an entrepreneur. He studied civil engineering at UCL and, as a student, he developed three business concepts. He reflected that UCL had provided a really good foundation: it "*generates really positive people who "get things done" and have fun, and it is a seed-bed for enterprise".*

On graduating, he went into investment banking for a short while – and he then left to convert some of his ideas into start-ups.

His first business was called **Race Yourself**. It was focused on games and the technology behind it was/is clever and sophisticated. It attracted funding from DM Capital and from Angel Lab. Alex took the business to San Francisco, as part of an accelerator programme, and it was really exciting – there was lots of interest and media coverage. However he felt that a games-based product might not take off on a world-wide basis. Currently he is not focusing on **Race Yourself** – although he may return to it in due course.

In parallel, he set up a second company, called **We See Through**. This is concerned with reviewing video footage and then applying machine learning and crowd sourcing approaches to allow meaningful interpretation. Early on, Unilever took notice, wanting to use the technology for all sorts of ethnographic/consumer research purposes. The business has subsequently grown. It received its last tranche of funding in August 2014 and it has been revenue generating since (roughly 100k US dollars per month). Its clients are mainly FMG businesses – Ben and Jerry's, SIF, etc. Currently six people work full time for **We See Through**, and there is also an extensive international network with research projects underway in 23 countries: the international element is absolutely critical.

We See Through has just moved from Camden to Shoreditch – and it occupies shared workspace in The Bakery (the adtech accelerator). The only difference between the two locations is the brand, but that is very significant. Alex explained that "*people in San Francisco have heard of Silicon Roundabout, and it is much easier to attract both talent and investment from a Shoreditch address".* For example, a recent recruit to **We See Through** was formerly a board member from a major global advertising and marketing communications services company. Alex commented that "*she is 1.8 times my age, and much more senior than me, but I am her boss. And that is what Shoreditch is all about*".

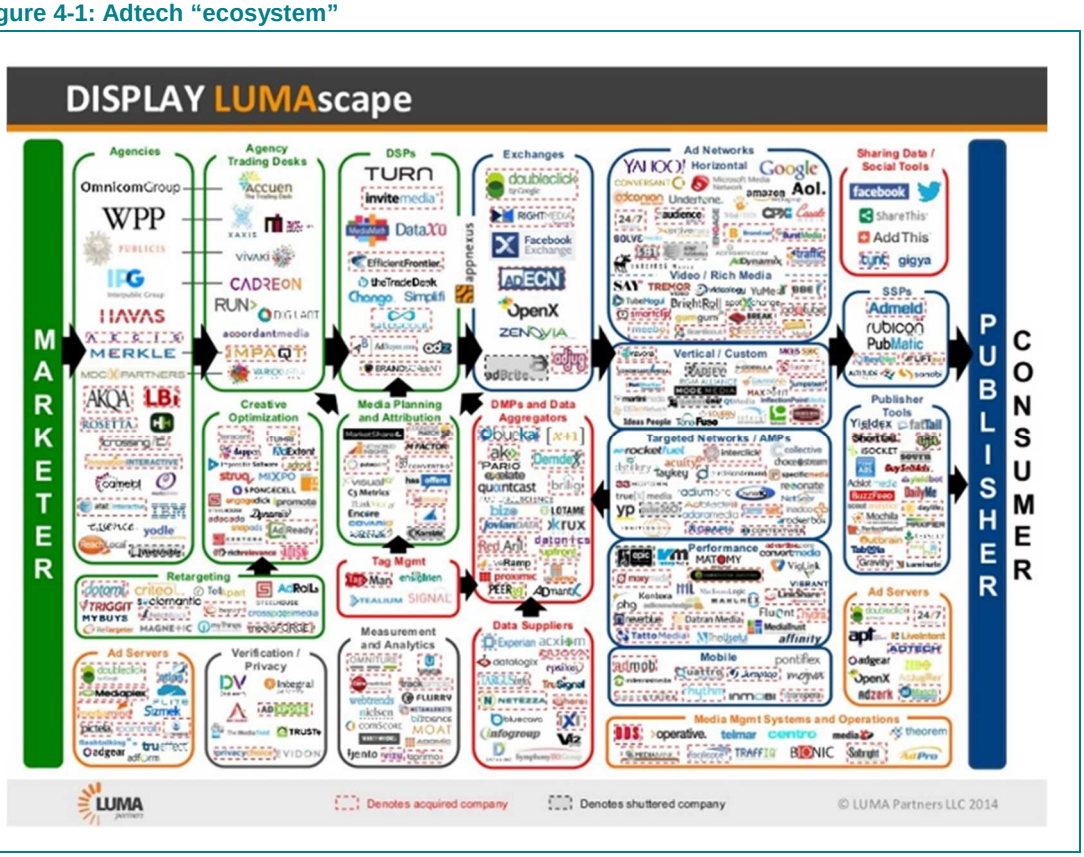
However, there is a lot of pressure for businesses such as **We See Through** to move to California, simply because "*everything is there*". Alex commented that in nine months of networking in London, he identified 75 serious potential investors; whereas after six months in California – and from a standing start – he found 250. Moreover, the California investors "*write much larger cheques*" and "*are much more direct*" (so things happen much more quickly). And in this sector, the need to move quickly is paramount.

4.5 Consistent with both of these case studies but for ***adtech*** as a whole, the complexity of the ecosystem is illustrated in the graphic below. This demonstrates amply why networks matter; why clusters of related businesses are so powerful; and why blue-chip clients are essential. It also explains why one knowledgeable commentator interviewed in the course of this study noted both that he could not name adtech "stars" in London; but at the same time, he recognised there to be a significant "London bandwagon", much of it centred on Shoreditch. *Arguably, in relation to adtech, it is the whole ecosystem which is giving London profile, not individual businesses within it.* But in this context – and compared to other science and technology sectors – the omission from Figure 4-1 of any apparent role for universities and research institutions is, perhaps, striking.

"The growth in the sector has meant there are more people with the experience required to assist growing tech companies around. We've benefited from this boom hugely. The advice from fellow founders, investors and advisors has been critical to positioning the business where it is today".

Extract from an adtech/travel tech company's response to the London Tech Census, 2015

Figure 4-1: Adtech "ecosystem"



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4.6 ***Fintech*** is another digital sector which has gained significant attention in the last 18 months. A study by Accenture – published in 2014 – examined patterns of investment into fintech. It observed that the lion's share of Europe's fintech deals and financing had taken place in the UK, with the vast majority occurring in London. Specifically, it reported that "*London and the region within its orbit*" had seen the volume of fintech deals triple since 2011. Moreover "*the region's five year compound growth rate for fintech financing was twice the global average and*

twice that of Silicon Valley. Growth in the number of deals was three times the global average and more than five times that of Silicon Valley"[38].

4.7 Explanations of the growth of fintech have some parallels to the adtech narrative; as the Accenture report notes, "*London offers fintech companies proximity to one of the largest potential customer bases in the world".* However this is, arguably, only part of the story. The financial crisis of 2008/09 created the "perfect storm" in relation to financial services, creating both the imperative and the opportunity for fintech to emerge. Ernst and Young comments on the "*cumulative effect of digital connectivity, customer dissatisfaction with banks, and a lack of innovation and investment by incumbent providers"*[39]. To this we might add the "shake out" of well qualified professionals with enough knowledge of financial services to understand in detail which problems needed a solution; and how these "solutions" might best be sold to very cautious and risk-averse customers. It is also worth noting – as one of our consultees mentioned – the relatively permissive regulatory environment for fintech in the UK (certainly as compared to North America), and the significance of this in fostering innovative approaches. For a host of reasons, financial services has therefore been ripe for disruption and fintech has grown quickly in this space.

4.8 The surrounding infrastructure has also developed quickly in this context. Reference has already been made to Level 39, but UKTI identifies three other fintech accelerators in London: Startupbootcamp fintech; Barclay's accelerator, and Bold Rocket. In addition, in August 2014, the Chancellor of the Exchequer launched Innovate Finance (based at Level 39) to "*directly support the next era of technology-led financial services innovators*" by *"connecting members to policymakers, regulators, investors, customers, educators, talent and key commercial partners"*[40]*;* the extent to which this aspiration chimes with the narrative in Chapter 2 is striking. In terms of the pace of evolution across the digital technology sectors, the following account is also striking:

> *I spent the last 10 years as an advertising technology entrepreneur in New York City. During that decade, I witnessed two things happen. New York became the Silicon Valley of the east coast, and AdTech radically transformed the marketing and advertising industry. It made sense that the two would be catalysts for their transformations. New York is home to the major media companies and agencies of the United States. The sheer concentration of talent and experience there converged with the opportunity of digital and data. In other words, the right people were in the right place at the right time.*
>
> *I now run the Barclays Accelerator here in London. Why would an ad-tech guy from New York run a financial technology accelerator in London? Investors talk about pattern recognition when judging start-up opportunities. What they mean is that history often repeats itself, just in a different guise. My investment thesis is that London is going to become the Silicon Valley of Europe and that FinTech will be its catalyst. While this transformation may take 10 years, for those of us who will be in the midst of it, the rate of technological change will be nothing short of breathtaking*[41].

[38] *The boom in global fintech investment: A new growth opportunity for London* Accenture, 2014
[39] *Landscaping UK fintech* – Report prepared by Ernst and Young for UKTI, 2014
[40] See http://innovatefinance.com/news/press-release
[41] "*Symbiotic fintech*" Greg Rogers, Managing Director at Techstars (Barclays Accelerator) – from *Fintech 50 2014*

4.9 In addition to adtech and fintech, various other digital technology sectors are growing quickly in London. They include:

- ***Edtech:*** The London edtech sector includes a combination of: companies based elsewhere but that use London as a sales base or for financing (e.g. Skillsoft, CIQ); indigenous London based edtech start-ups (e.g. Commelius Solutions, Zenosis, Saffron Interactive, BridgeU); and large publishing companies which have entered the market relatively late through acquisitions (e.g. Pearson, Reed Elsevier). Over the last few years there has been an increase in the infrastructure and networks in place to support the sector. This has included the launch of the first two edtech incubators in Europe, both based within London: the Edtech Incubator, launched in March 2013, and led by the Education Foundation in partnership with Tech City UK; and the Pearson Catalyst, a virtual initiative where start-ups work out of their existing location.
- ***Mediatech:*** Small media companies and institutions have tended to cluster around the major companies, particularly in a 'West London TV triangle' created by the BBC (Shepherds Bush), Virgin Media (Hammersmith) and BSkyB (Osterley), and also including UKTV and Talk, as well as STB manufacturer Humax and connected TV player Samsung. There is also the growing broadcast tech centre at Chiswick Park – with companies such as Teletext, France Telecom, Discovery, Disney, CBS and Viasat.
- ***Video games***: According to a recent report by Nordicity[42] for the GLA, London's games sector consists of over 390 companies, employing over 3,600 people. The analysis also found that London was home to one in four of all UK games companies. However, an earlier (2012) report by Creative Skillset[43] concluded that London accounted for only 14 per cent of the UK's computer games workforce. Within London, nearly three quarters of the computer games workforce is based in central London, 22 per cent in west London, and 5 per cent in East London[44]. The two areas with the greatest concentration of firms are Soho (including, for example, Microsoft's Xbox Studio, Sony Computer Entertainment, and King.com) and the Shoreditch area (including, for example, Sports Interactive, Stick Sports, Curve Studios, and Future Games)
- ***Digital healthcare:*** This involves the use of digital technologies in the health and healthcare areas, in order to reduce inefficiencies in healthcare delivery, improve access to healthcare, reduce costs and increase quality of delivery, and make medicine more personalized and precise. It is a rapidly growing area in London due to the combination of strong expertise in digital technologies and health, plus a large potential market for digital health products in the NHS and among a large, multi-cultural and young (and therefore generally early adopter) London population. The case study below illustrates both the market opportunities which draw digital health entrepreneurs to London, and the infrastructure which supports business formation and growth – in this case the role of Healthbox (which was also referenced in Chapter 2).

[42] 'Promoting the Games Sector in London: Draft Report' prepared for Greater London Authority by Nordicity (2014)
[43] the Sector Skills Council for Entertainment Media, Fashion and Textiles, Publishing and Advertising, Marketing and Communications
[44] 'Employment Census of the Creative Media Industries'. Creative Skillset (2012)

Case Study: Cosmin Mihaiu, Chief Executive and Founder, Mira Rehab

Mira is a software platform designed to make physiotherapy fun and convenient for patients recovering from surgery or injury. The software transforms existing physical therapy exercises into video-games, and uses an external sensor to track and assess patient compliance. On line tutorials are provided to take patients through exercises in order to increase patient engagement throughout their therapy. The application can also be used at home, in between rehab sessions at the clinic.

Mira Rehab was founded by Cosmin Mihaiu, a Romanian graduate who developed the business idea as a student project. In June 2012 he found the Healthbox accelerator website, applied and was accepted for a place. He started there in September 2012, and consequently incorporated his company in the UK.

Healthbox was very helpful, providing space, investment and advice. On graduating from the four month accelerator programme, Cosmin wanted to maintain the contacts he had established in the UK so remained in London. He has a hot desk arrangement in an office near Bond Street station.

Mira Rehab's market is healthcare providers in public and private sectors. The firm now has three customers in the UK, including the Central Manchester University Hospitals Foundation Trust, and one in Romania. Cosmin considers that success in the NHS market will guarantee success in international markets, so is focusing on increasing the number of NHS contracts secured by Mira Rehab.

Mira uses developers and graphic designers in Romania because they are much cheaper there than in London, but is not planning significant recruitment until it secures more customers.

Cosmin is currently in the early stages of seeking another investment, this time of around £100k, to support the next stage of growth.

At the time of applying for the Healthbox Accelerator it would not have mattered where Mira Rehab was located. However, having established his business in London, Cosmin now regards the city as the best business location in Europe. It has the best business environment and access to funding for early stage companies. The SEIS and EIS schemes are valuable to stimulate early stage investment in UK. The fact that London is English speaking is also important in comparison with other European cities. In addition, the NHS is a very large and important market.

For Mira, the only sensible alternative location is the US. It has a very large market and good access to investors at all levels of funding. Initially it would have been too big a step from Romania to start in the US. However, now the business is established, Cosmin would consider a move or expansion into the US.

Within London, a central location is important because of access to the main London hospitals, which are Mira's market, and national and international transport networks.

Based on an interview with Cosmin Mihaiu, founder of Mira Rehab Ltd.

- ***The Internet of Things (IoT):*** London and Cambridge are the two main UK hubs for growth of firms concerned with the Internet of Things. All seven of the winners of the inaugural national Internet of Things Launchpad competition are based in one of the two cities. The seven will share a £1m Tech City fund to grow their businesses, and will also benefit from business support from private sector partners including EE, Seedcamp, Cisco and Hive. Cisco's sponsorship of the IDEALondon incubator (see Chapter 2) is focused mainly on start-ups in the Internet of Things area. In addition, another incubator focused on funding and developing start-ups in the Internet of Things space was opened in London in late 2014 by the Reply Group[45].

- ***Smart cities:*** London is a focal point for the development of smart city technologies which cross-cut other areas such as the internet of things, cleantech/greentech, digital healthcare and traveltech. Specific initiatives include the Cognicity programme (see Chapter 2), the Greenwich accelerator programme and the Future Cities Catapult. The Catapult is a national initiative but its location in central London enhances the smart

[45] http://www.reply.eu/en/breed-reply/breed-reply-advanced-startup-incubator

city agenda in the capital, including through the Urban Innovation Centre (providing facilities and expertise to support the development of new products, services and working prototypes that can be tested in real urban settings) and the Cities Lab (providing data analysis, modelling and visualisation capabilities to understand and elucidate city problems).

Constraints facing London's digital sectors

4.10 The intrinsic demand-side potential for solutions deriving from London's digital sectors is substantial. However through our research, five main constraints to growth were also identified. These are explained in outline below.

Access to finance

4.11 First – and not unexpectedly – issues were raised relating to access to finance[46]. In this context, the case study above – relating to Race Yourself/We See Through – is both instructive and consistent with the messages we heard from a good number of firms. London is a good place for tech start-ups, but it remains well adrift of Silicon Valley when it comes to securing early stage, and high risk, investment. Among tech entrepreneurs, the belief is that London simply does not have the same scale or depth of resource: there are "more pockets" in Silicon Valley; these are judged to be much "deeper" than those in London; and the culture of the west coast is that decisions are made very quickly. At the present time, London's ecosystem cannot compete.

> *"If this is the next industrial revolution, then there is a need to have it open to all. The funding gap for truly disruptive technology (I am not talking about app ideas) is still there due to the UK's lack of appetite in viewing failure as a path to success. Therefore, the technology is either low risk or anything with a global appeal will get snapped up by the Americans and now perhaps the Chinese"*
>
> Extract from a productivity/hardware/software/fashion tech company's response to the London Tech Census, 2015

4.12 This same scenario was recognised by a digital health entrepreneur interviewed in the course of this study. He plans to grow his business quickly, but – despite a good track record – he is anticipating major challenges securing investment. His intention is to explore sources such as NHS Innovation Accelerator; Innovate UK; Digital Catapult; Rock Health and Health Box. If he cannot find the investment he needs in the UK, he will move the business to Stanford/Silicon Valley where he considers the supply of investment capital is much greater. In his view, the attractions of Silicon Valley reflect the fact that the founders of Google, Yahoo, etc., live locally; and that many individuals are prepared to invest significantly in digital businesses.

4.13 Our first case study in this chapter alluded to the overwhelming arguments in favour of a London location (vis-à-vis (in that case) Bournemouth) because – essentially – of access to clients. From our consultations, the strength of the argument favouring Silicon Valley over London was equally strong – but the key transatlantic factor was access to early stage finance. There is evidence that London might, gradually, be catching up (and our comments relating to investment in fintech are relevant here), but as it stands – and in relation to this key issue –

[46] In this context, it is worth noting the read-across to GLA Economics' London Business Survey (2014). This found that across London, 35% of SME business units attempted to access external finance in the 12 months to mid-2014; nearly half of those needing finance obtained all of the money they needed, while 30% obtained partial financing and 22% were unsuccessful or their cases had not yet been resolved. See http://www.london.gov.uk/sites/default/files/london-business-survey-main-findings_0.pdf

Silicon Valley continues to be seen as the overwhelmingly favoured location for firms in digital technology sectors.

Complexity of the offer and risk averse investors/customers

4.14 A second and related constraint surrounds the complexity of the offer that is provided by many digital technology firms and the ability and/or willingness of investors and (sometimes) customers to engage with it: intrinsically conservative investors and/or buyers do not sit easily with the uncertainty linked to disruptive technologies.

4.15 In its report on fintech, Accenture noted that *"although banks are eager to find new technologies, many fintech companies struggle to do business with them".* Various reasons were cited – including the regulatory environment and security issues. Accenture went on to observe that *"it is often easier for early stage fintech companies to set up consumer-facing companies of their own or to sell to tech competitors like Google, which are in a position to make faster technology decisions"*[47]. Innovative and disruptive products are not always very easy to "sell", either to customers or investors.

Broadband

"Broadband is too expensive relative to domestic packages. I pay 1/5th of our monthly bill at home and have 4 times the speed. Leased lines appear to be the only option but they are expensive and have ridiculous contract lengths that don't suit growing businesses"

Extract from a travel tech company's response to the London Tech Census, 2015

4.16 A third constraint identified during our consultations is, in some respects, a surprising one. It concerns broadband provision within London which is described as "*extremely patchy*". One Shoreditch-based fintech firm observed in a letter to the *Evening Standard,*

> *"At Seedrs, we operate an equity crowdfunding platform, an entirely online process from start to finish. Every video to be uploaded to a Seedrs campaign is sent to our Portugal office where they have 100mbps upload speed as it simply takes too long to get it ready here"*[48]

4.17 In general terms, small firms' requirements – which are neither residential nor akin to those of large corporates – continue to be challenging for telecoms operators. In this context, London's tech-based start-ups have raised concerns relating to the lead time for the connection of high bandwidth services and the current obligation to sign up for lengthy contracts. As one established start-up noted, "*we may not exist in six months' time, so how can we sign up to a three-year contract which itself takes months to sort out?".*

[47] *The boom in global fintech investment: A new growth opportunity for London* Accenture, 2014
[48] Thomas Davies, Seedrs, letter to the *Evening Standard*, 5th February 2015

Property

4.18 In similar vein, property costs in London were seen by many firms in the digital technology sector as prohibitive, creating major challenges once companies became more established. Central London undoubtedly is the prime location for these firms – either in Shoreditch or localised hubs elsewhere (e.g. Soho, Camden) – but small tech businesses struggle to afford commercial property prices in Central London, particularly when combined with the inflexibility imposed by conventional lease terms. As evidence, the findings for London-based respondents from Tech City UK's survey of digital technology businesses is quite compelling (see Figure 4-2), and consistent with the results of the London Business Survey[49]: property costs in London appear, by some margin, to be the factor that is causing the greatest discontent – and more so, even, than access to finance.

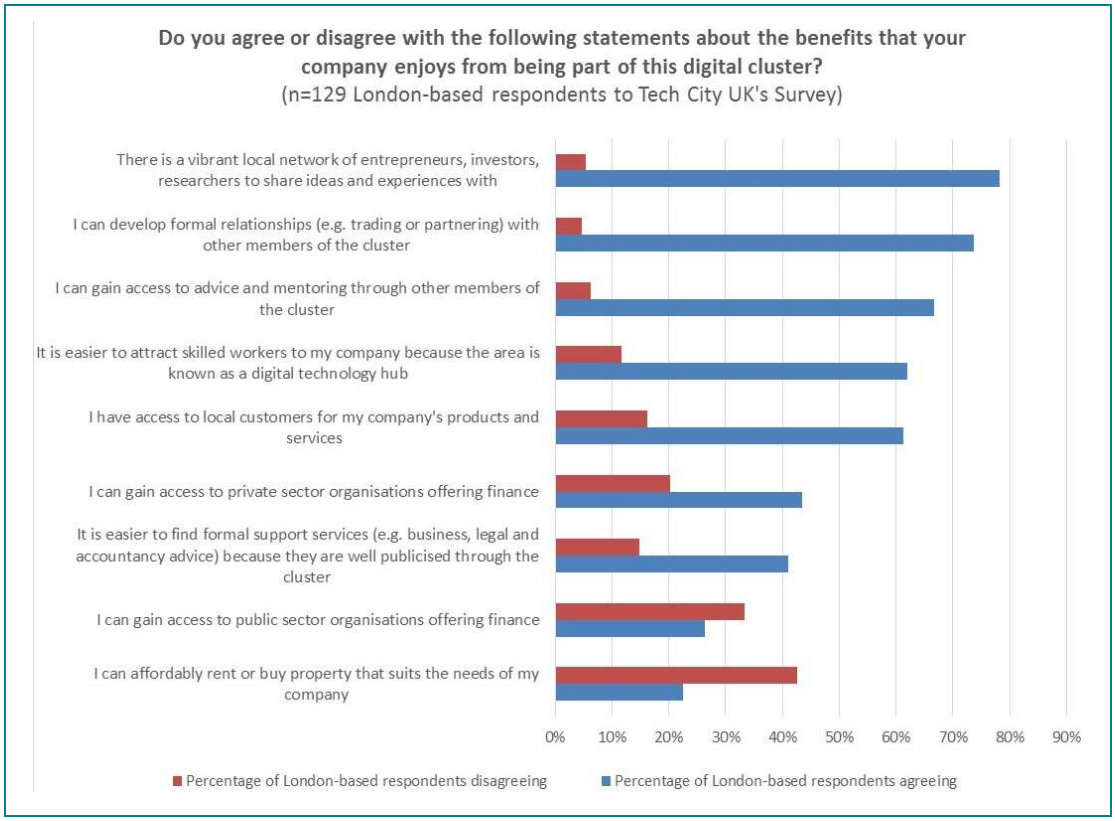
"We desperately need more virtual spaces and better connectivity. Most of my work is video based and there aren't many hubs with really fast Internet access for me to upload my work. Equally, it's actually quite hard to find space to work in as places keep selling out"

Extract from an adtech/media tech company's response to the London Tech Census, 2015

"Support for tech start-ups outside of hubs is poor and rents in hubs are ridiculous. You need a better support structure for microhubs"

Extract from an adtech/analytics/software/edtech/ mediatech company's response to the London Tech Census, 2015

Figure 4-2: London-based digital technology firms' assessments of the benefits they enjoy from being part of their digital cluster



Source: Tech City UK, 2015

4.19 That all said, there is little to suggest that businesses are moving out of central London in search of lower cost premises; indeed, all the evidence suggests the reverse. Although there is no counterfactual, it is probable that firms' pace of growth (in terms of conventional metrics such as staff numbers) is being slowed as a result of property prices. Anecdotally, there is some evidence also of firms offshoring at least part of their operation to lower cost locations

[49] London Business Survey 2014, table LBL1; GLA Economics

(and we talked to one business with a development team based in Portugal) and/or employing people remotely (another firm explained that its latest recruit was working from Luxembourg).

Regulations and standards

4.20 Our final observation on constraints facing London's digital sectors relates to regulations and standards. It would be more accurate to describe these as a series of "concerns" rather than constraints. One concern relates to the prospective European General Data Protection Regulation surrounding the use of personal data. This obviously would not be specific to London, but if European regulations are more onerous than those in USA, this would be damaging; it would make Silicon Valley look even more attractive. Separately and in addition, the ongoing establishment of a new generation of e-learning standards has led to short-term uncertainty and a fear that this could delay e-learning providers from developing new products.

5. London's life sciences sectors; and cleantech

5.1 This chapter considers those science and technology sectors in London which are – in general – more concerned with "science". The chapter is divided into two parts. The first reflects on London's life sciences sectors[50], while the second focuses on cleantech.

I: Life sciences

5.2 The life sciences sectors in London differ from those based on digital technologies in that business activities are primarily related to the research undertaken in London's universities and teaching hospitals. Hence there is a much stronger relationship to the supply of science and technology from the research base (and the related specialist expertise).

5.3 There are, however, exceptions to this generalisation. For example, some life science firms are based in London mainly to gain access to the NHS and the capital's population as a market, rather than to exploit technologies originating in London's research institutions. Equally, various major life science firms have their global or regional headquarters operations in London, some employing large numbers of people (e.g. GSK employs around 4,000 people at its HQ site in Brentford; Astra Zeneca has its corporate HQ in Paddington (although it will be moving to Cambridge in 2016); Bristol-Myers Squibb's UK operations are based in Uxbridge; Takeda Pharmaceuticals' European office is in the Aldwych; and Dr Foster, the healthcare analysts, are based in Farringdon).

5.4 Nevertheless, overall, the links to the research base set the life sciences sector apart. The structure of this chapter is therefore different from the preceding one, focusing more on the science and technology assets of London and their significance to the formation and growth of life sciences firms.

Definitions

5.5 The life sciences sector includes two main inter-related technology based areas, which in turn can be further sub-divided.

5.6 *Biotech* includes "*any technological application that uses biological systems, living organisms or derivatives thereof, to make or modify products or processes for specific use*" (UN Convention on Biological Diversity, Art. 2). It includes three main sub-divisions:

- *Medical biotechnology,* relating to the discovery or development of new therapeutics that principally act in or on the human body by pharmacological, immunological or metabolic means.

[50] Note that the definition of the life science sector used in this chapter *excludes* general healthcare services such as hospitals, primary care services, etc.

- *Pharmaceuticals,* including companies whose major activity is the research and development of therapeutic products irrespective of the underlying technology involved

- *Industrial biotechnology,* including the development, manufacture and sale of products and services that use or contain biological material as catalysts or feedstock to make industrial products, including the manufacture of feedstock chemicals, fine chemicals, biopolymers, bio-plastics and biofuels.

5.7 Also included in this sector are companies in the supply chain such as contract manufacturers, contract service organisations, and pharmaceutical wholesalers.

5.8 *Medtech* includes companies whose major business activity involves the development, manufacture, or distribution of medical devices and related specialist suppliers of products and services such as equipment, reagents and materials, manufacturing and regulatory and design services. According to BIS[51], nationally the service and supply chain segment accounts for the largest proportion of sector jobs, employment and turnover. Companies supplying equipment, reagents and consumables comprise the largest sub-segment, followed by contract manufacturing and specialist consultants. In terms of product segments, the largest are single use technology, in-vitro diagnostics and orthopaedic devices, accounting for one third of all non-service and supply chain sector employment and turnover. The fastest growing product segments are wound care and management in relation to turnover, and in-vitro diagnostic technology for employment.

5.9 Alongside these two main sub-sectors, the following definitional points are important:

- *Digital healthcare* can be considered as a sub-sector of the medical and healthcare sector, or of the digital technologies area. We have chosen to consider it in the previous chapter because the firms are by definition, using digital technologies focused specifically on a particular market, in this case healthcare[52]. However, there is no doubt that innovations in digital health could have major implications for the life science sectors, by complementing or in some cases replacing existing approaches – and also that there are substantial opportunities for the growth of digital healthcare in London because of the favourable combination of circumstances described earlier.

- *Health tech* is also used in some contexts - for example, Tech London Advocates refer to Health Tech as covering the "fitness, health and wellbeing markets". However, the technology content of this is likely to be covered by biotech, med tech and digital healthcare.

- Finally, there are also cross cutting links to other tech areas. For example, adtech includes specialist marketing companies for digital healthcare products and services, and cleantech includes aspects of industrial biotechnology such as waste clean-up and alternative energy.

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[51] Strength and Opportunity 2014 - the landscape of the medical technology, medical biotechnology, industrial biotechnology and pharmaceutical sectors in the UK. Department for Business, Innovation & Skills, 2014

[52] *ibid*. Note that the BIS definition of medical technologies includes a sub-category "ICT and e-health". However, the BIS database for 2014 included only 11 firms in this category in London, which is a tiny number compared with the – albeit limited – evidence on the number of digital health firms in London.

Size, growth and composition of the sector

Size

5.10 In Chapter 3 we presented various estimates of the size of the sector in London. Those which exclude general healthcare services (i.e. employment in hospitals, GP surgeries, etc.) are summarised in Table 5-1.

Table 5-1: Estimates of Life Science firms and employees in London

	Medical biotech	Industr'l Biotech	Pharma	Total Biotech	Medtech	Total Life Science
Firms						
BIS	122	6	87	215	200	415
McKinsey						995
Companies House						717
Jobs						
BIS	2,000	40	11,800	13,840	4,000	17,840
McKinsey						28,898
Companies House						21,500
Turnover						
BIS	£1.35bn	£25m	£11bn	£12.6bn	£1bn	£13.6bn
Companies House						£4.7bn

Sources: "Strength and Opportunity 2014: The landscape of the medical technology, medical biotechnology, industrial biotechnology and pharmaceutical sectors in the UK". BIS Annual Update; Life Sciences Strategy for London, McKinsey & Company, February 2012; analysis of Companies House data by Trampolines Systems and SQW.

5.11 Table 5-1 demonstrates that there are considerable differences in the figures from different sources. In our view, the Companies House data is the most reliable because we spent a considerable amount of time cleaning the data to eliminate anomalies (see Chapter 3). Therefore *the best estimate of the scale of the life science sector in London is that there are 717 firms employing approximately 21,500 people*[53] *and generating £4.7bn turnover per year*[54].

5.12 McKinsey appears to have used Companies House data, but produce a higher jobs estimate – which we suspect results from the anomalies mentioned above. The BIS data gives lower totals for firms and employees, but higher for turnover. However, we know that the BIS database is incomplete because some of the small life science firms we interviewed, and others we identified, are not in it. In addition, digital healthcare is largely excluded by BIS (except for the small sub sector they identify as "ICT and e-health", which includes only 14 firms in London in the 2014 BIS database), and is unlikely to be fully covered by the Companies House data (due to the fact that some digital healthcare firms classify themselves as digital sector, rather than health sector, businesses). The 2014 BIS figure for turnover is also likely to be an anomaly, because the 2013 figure was much lower (£5bn, compared with £13.6bn in 2014)

[53] Some of these employees may be based elsewhere in the UK.
[54] For completeness, it is also worth noting the estimates of private sector employment and workplaces within "life sciences and healthcare" generated from IDBR by ONS. It concluded that in 2013, private sector employment summed to 82,700 while the number of private sector workplaces was 9,905. See http://www.ons.gov.uk/ons/about-ons/business-transparency/freedom-of-information/what-can-i-request/published-ad-hoc-data/business-and-energy/april-2014/index.html. However, this definition includes many hospital and healthcare practices which are not included in the definition of life science used in this report.

and was comparable with the Companies House data. However, the BIS data provide the only source of a detailed breakdown by sub sector. We therefore use it below to provide an analysis of the make-up and relative importance of the life science sectors in London.

Growth

5.13 Tables 3-4 and 3-5 (in Chapter 3) provided information on growth of the "life science and healthcare" sector within London, 2003-13 (based on the ONS definition, which included employment in hospitals, clinics, etc., and using IDBR). These showed that employment in the sector grew by 27% over this period across London as a whole, but Inner London experienced by far the fastest growth (42%), compared with growth of 11% in Outer London. In contrast, the number of business units grew at a faster rate (74% in London as a whole over the period 2003-13, and growth was more evenly distributed across the different parts of London). However, these figures need to be treated with caution as they will have been strongly affected by the distribution of major hospitals, many of which are in Inner London.

Composition – and London's share of the national total

5.14 As is evident from Table 5-1, most life sciences employment and turnover is accounted for by pharmaceuticals, but most companies are in the medical biotechnology and medtech areas. Based on an analysis of the database that is maintained by BIS, in relation to the UK regional distribution of firms, employees and turnover, the following picture emerges:

- *Medical biotechnology* – London has the third highest number of companies (122), after the East (218) and South East (208) regions. The Greater South East as a whole accounts for over half of all medical biotechnology companies and associated employment and turnover in the UK. Specialist suppliers account for nearly half the medical biotechnology firms in London, and firms focused on small molecules for another quarter.

- *Pharmaceuticals* – the Greater South East contains 61% of the employment and 68% of the companies for the sector. Only the North West has anything approaching the same concentration of pharmaceutical companies. However, there are more pharmaceutical jobs in the East and South East regions than in London. Within London, nearly 60% of pharma firms are categorised by BIS as focused on small molecules, and 30% as specialist services.

- *Industrial biotechnology* – London has six industrial biotechnology companies out of the 112 in the UK, and 1.5% of all jobs. The largest companies (by turnover) in the sector are located in the South East, North West, Yorkshire & Humber and Scotland. Four of the six firms in London are in the biofuels sub sector.

- *Medical technologies* – London accounts for 6% of the national total of Medtech companies, 4.5% of the employment and 5.5% of turnover. In contrast, the South East accounts for 16% of the UK's medtech firms and 19% of its jobs. The East and South East regions have a relatively high proportion of large medtech firms, and London has a high proportion of small medtech firms, compared with the UK average. In addition, firms located outside London are more likely to be engaged in manufacturing as well as R&D and sales. Within London, one third of medtech firms are providers of

specialist services, with the remainder widely spread across 21 other sub sectors (the largest of which are invitro diagnostics and ICT and e health, accounting for 24 (13%) and 14 (8%) firms respectively).

Location of life science firms within London

5.15 There are two main sources of information on the location of life science firms within London: the BIS database, and Companies House data. However, only the former provides information by sub sector. The distribution is similar for both.

5.16 Using Companies House data, Figure 3-4 (in Chapter 3) shows the distribution of employment while maps showing the distribution of companies – from the same source – are provided in Annex B. In Figure 5-1 and Figure 5-2 (below), we use BIS data[55] to map firms across the whole of London, and within Central and Inner London[56]. The distribution is similar using both sources:

- firms are strongly concentrated in Central and Inner London, particularly those in medical biotechnology and industrial biotechnology
- pharmaceutical firms are more dispersed, with a much higher proportion to be found in Outer London, including all segments
- in Outer London, there are more biotech and medtech firms to the west than to the east
- within Central and Inner London, firms are quite widely distributed, although there appear to be minor concentrations around the main research facilities and bioincubators (the Imperial Incubator in South Kensington, around UCL and the London Bioscience Innovation Centre in the Knowledge Quarter[57], QMB Innovation Centre in Whitechapel, and at Guy's Hospital at London Bridge).

[55] The BIS data is for 2013. Detailed geographical information for 2014 was not available.
[56] This includes only one address and one sector per firm. 11 firms were included in two categories, mainly medical biotechnology and pharmaceuticals, and in these cases we randomly allocated each to only one of the two sectors.
[57] The Knowledge Quarter is the area around King's Cross, the Euston Road and Bloomsbury. It includes UCL, the Wellcome Trust, the Francis Crick Institute, the British Library, the MRC, the Digital Economy Catapult, Google, the Guardian, the University of the Arts, the Design Council, and various other science and technology resources. It also now comprises an active networking organisation involving these and many other organisations (http://www.knowledgequarter.london/)

Figure 5-1: Distribution of life science firms in London

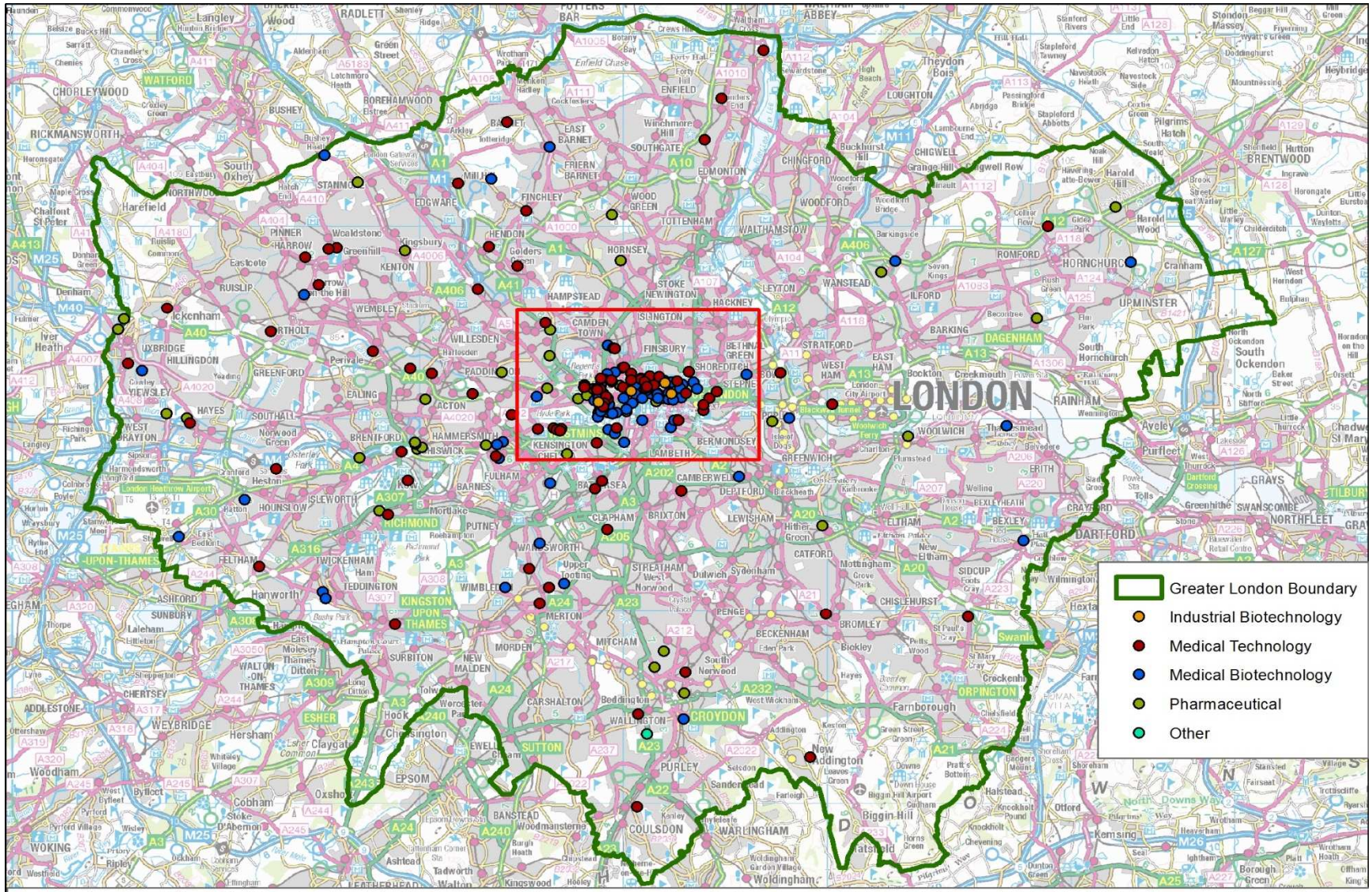
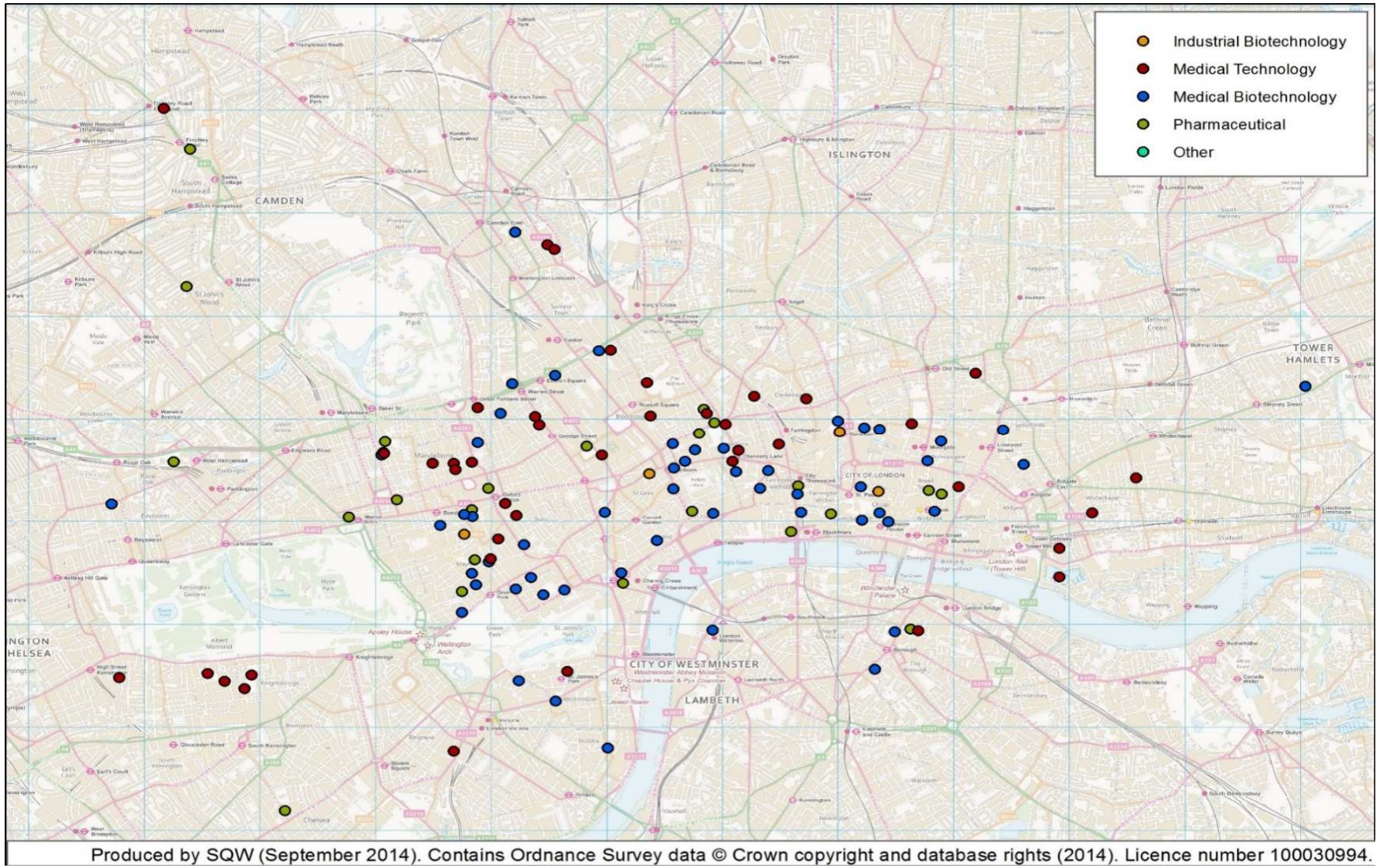


Figure 5-2: Distribution of life science firms in Central and Inner London



The infrastructure for life science firms in London

5.17 The scale and quality of the research infrastructure and related organisations is the main reason for the presence and growth of life science firms in London – both for start-ups and inward investors. Chapter 2 has already considered the infrastructure relating to both agglomeration and clustering for science and technology sectors as a whole, so this section will focus only on the particular characteristics of the life science infrastructure.

The research and commercialisation infrastructure

5.18 London's research and teaching quality is outstanding. It has five universities listed in the top 100 globally by the QS World University Rankings for 2014 for life sciences and medicine: Imperial (9th), UCL (10th), King's College London (24th), London School of Hygiene and Tropical Medicine (59th) and Queen Mary University (96th). On the same index, Oxford and Cambridge are ranked 2nd and 3rd respectively.

5.19 As explained in Chapter 2, the Research Excellence Framework, published in December 2014, assessed the scale of research[58] as well as its quality. Imperial, Kings, UCL, Cambridge and Oxford were all in the top ten for both measures.

5.20 London is also strong in relation to medical technology research, largely because the major research-based universities such as Imperial and UCL have strengths in both medicine and engineering, and it is the combination of these that lead to medical technology innovations. In addition, there are various London universities with medical technology departments. These include City University (ranked 18th nationally in the Complete University Guide), Kingston (ranked 21st), and St George's University of London (ranked 23rd). In addition, in the Greater South East, Surrey is ranked 3rd overall and is the strongest nationally on research.[59]

5.21 London's track record in the commercialisation of research is less impressive, although data below on recent technology transfer activity suggests the situation is improving. McKinsey's research into life science commercialisation indicators in London, Boston and San Francisco[60] refers to data from 2009/10, and shows that on publications London is a close 2nd to Boston, whereas on patents it is a distant 3rd behind both Boston and San Francisco (the number of patents does not give a complete picture of commercialisation, but in IP-based areas like life science and medicine it is nevertheless a useful indicator). In London, the ratio of patents to publications is 1%, compared with San Francisco (19%) and Boston (6%). The number of clinical trials undertaken in London is also well below the number in Boston, though ahead of San Francisco. These figures would be significantly improved by the inclusion of Oxford and Cambridge, but the discrepancy between commercialisation activity in London, Boston and San Francisco is significant.

5.22 In explaining London's relatively poor performance with regard to commercialisation, McKinsey observes that it is "*challenging to navigate with poor networking between*

[58] The REF considered scale in relation to the number of researchers for which research was submitted for assessment. Strictly speaking, therefore, it is really a combined assessment of scale and quality: many institutions and departments only submit outputs from their best researchers for REF assessment.
[59] http://www.thecompleteuniversityguide.co.uk/league-tables/rankings?s=Medical+Technology
[60] *Life Sciences Strategy for London*. McKinsey & Company, February 2012

groups…..platforms and infrastructure are not developed to get more than the sum of the parts from what London has….London is still viewed as being closed for business due to the lack of a single go-to portal leading to issues with accessibility of research"[61].

5.23 MedCity has been established since these comments by McKinsey, in part to address these weaknesses. Specifically, it provides a single go-to point for life sciences activities across London and the Greater South East, and will champion new areas of collaboration and commercialisation in the research and clinical community, and create and promote a joined up and globally distinctive life sciences offer.

5.24 In addition, all the main London Universities have strong technology transfer functions. Imperial Innovations is the most active, with 98 current investments of which two thirds of the value is in the therapeutics and medtech sectors. Of the top 20 investments by value, 13 are in biotech and medtech; nine are in therapeutics, totalling over £80.5m of investments from Imperial; and four are in medical technologies, in which £32m has been invested by Imperial Innovations. In total since its flotation in 2006, Imperial Innovations has invested £198.3 million and leveraged over £1 billion in investment for its portfolio.

5.25 Nine of the 13 top biotech and medtech investments by Imperial Innovations originated from London (7 from Imperial, 2 from UCL – the remainder were from Oxford and Cambridge), but of these, only four are based in London, including three in the Imperial incubator. The largest of the firms are all based in the rest of the Greater South East: Circassia, the most valuable company in Innovations' portfolio, is based in Oxford; Veryan is now based in West Sussex; and Stanmore Implants (a UCL/Royal Orthopaedic hospital spin out) is in Elstree (Hertfordshire, though very close to the Greater London boundary).

5.26 Medtech spin outs from Imperial are likely to increase as a result of a £40 million gift from a former student to build a biomedical engineering centre at Imperial West (see Chapter 2).

5.27 UCL and King's are also active: UCL claims 31 active life science spin outs, and King's identifies 17[62]. UCL has taken up lab space in the Stevenage Bioscience Catalyst (adjacent to, and part funded by, GSK's main research facility), in order to "*accelerate the translation of cutting edge research into new therapeutic opportunities*"[63] (Professor Sir John Tooke, Vice-Provost Health).

Other key institutions

5.28 In addition to the universities and the main teaching hospitals, London has various major life science and healthcare institutions which play a significant role in supporting related business activity.

5.29 Some of these institutions have been in existence for many years, such as the Wellcome Trust (whose vision is "*to improve health by supporting bright minds in science, the humanities and social sciences, and public engagement*"[64]) and the Institute of Cancer Research, which together with its hospital partner The Royal Marsden, is rated in the top four centres for cancer

[61] Appendix 2 to a report on "*Promoting Growth and Jobs in Life Sciences*" to the London Health Board, 17th March 2014
[62] Based on correspondence between the technology transfer offices of the relevant universities and London & Partners, June 2015
[63] http://www.uclb.com/news-and-events/news-post/ucl-establishes-its-presence-at-stevenage-bioscience-catalyst
[64] http://www.wellcome.ac.uk/Our-vision/index.htm

research and treatment worldwide. A major expansion of cancer research and treatment, and a new secondary school specialising in science, is proposed for the 20 acre site in Sutton which these two institutions occupy, together with the Epsom and St Helier University Hospitals NHS Trust. The site has potential to accommodate more than 3,500 jobs[65].

5.30 Other institutions are much more recent, such as MedCity, the Cell Therapy Catapult (one of seven in the UK sponsored by BIS, based at Guy's Hospital, London Bridge) and the three Academic Health Science Centres (AHSCs). In addition, the Francis Crick Institute, a 100,000 sq m centre of inter-disciplinary translational medical research, is due to open in 2015 adjacent to St Pancras station. When fully operational it will employ 1,500 staff, including 1,250 scientists, and have a budget of over £100m per year. It will have international significance, and will undoubtedly further strengthen London's position as a centre of research and development in life science.

5.31 As well as these major institutions, London has specialist life science networks and incubators. As discussed in Chapter 2, the networks include One Nucleus and OBN, which between them have over 800 members. Both extend beyond London and offer a variety of services including training, a purchasing scheme, networking events, specialist seminars and conferences, and information (e.g. on laboratory space availability).

5.32 There are two specialist life science incubators in London – the London Bioscience Innovation Centre at St Pancras and the Queen Mary Bioenterprises Innovation Centre in Whitechapel – which together offer 70,000 sq ft of mixed office and laboratory space (including a 10,000 sq ft expansion under construction at LBIC). In addition, the Imperial Incubator provides some lab space, and the Healthbox accelerator provides short term incubation space. However, all of these facilities are full and further additions to capacity are needed. A recent report by the London Stansted Cambridge Consortium[66] identified significant opportunities for growth of life sciences companies in the corridor, but most of the main specialist sites are outside London (an exception is Londoneast-UK, involving re-use of the former Sanofi manufacturing plant at Dagenham for small life science firms).

Life sciences – London's distinctive strengths and constraints

5.33 Life science markets are growing (despite rationalisation in some sub-sectors) due to increasing demand for healthcare globally. Life science firms in London are therefore benefitting from this global trend. However, there are also distinctive features in London that are driving exceptional growth. These include:

- the outstanding strength, scale and diversity of the research base
- the location of several major teaching hospitals in London, each with international quality specialisms and facilities
- the scale of the specialist labour market

[65] See http://www.newsroomsutton.co.uk/?p=577
[66] *A Prospectus for Life Sciences Growth - The London Stansted Cambridge Corridor",* London Stansted Cambridge Consortium, 2015

- the scale and diversity of the market for products and services. For example, the NHS provides access to an ethnically and genetically diverse patient population of over 8 million patients, over a third of whom were born outside the UK
- London's World City status and the resulting benefits such as excellent national and international networks and links, major conferences, exhibitions and other events which bring relevant people and organisations to London.
- the presence in London of specialist services, including in particular sources of funding (see below).

"London is well placed to attract staff from a wide catchment area. Proximity to airports and the variety of EU regulations/local regulations and diverse patient populations provide a great opportunity … to access EU development resources and reach towards commercial goals. Greater access to London NHS, Universities and other institutions as partners may be one of the paths worth exploring for future collaboration"

Extract from biotech company's response to the London Tech Census, 2015

Case Study: Chris Stanley, serial Medtech entrepreneur and investor

Chris Stanley has formed a large number of companies over the last 18 years based around the commercial exploitation of a new idea in the medical technology area. Typically the ideas are generated through attendance at conferences or meetings where a clear market need is identified. Chris then looks for an existing or new technology to meet that need.

Chris always works in partnership with people with complementary technology, management and financial skills. He self-funds the proof of concept stage, which is often in collaboration with a university and can take up to a year, then seeks seed funding of up to £2m from high net worth individuals. As far as possible he obtains match funding for the proof of concept process from grants from Innovate UK or the European Commission. He uses patent examiners in London (who he regards as the best in the world) to protect the IP.

His aim is always to sell within two to four years of forming the company. He achieves a one in three 'success' rate, making a return on average of two to three times the investment – more modest than VCs expect, but with a higher success rate. He estimates that over the years the Government has achieved a return through taxes of around 20 times the value of the grants awarded to his projects.

Chris operates from small offices in the London Bioscience Innovation Centre and Liverpool Science Park. He also has contacts with Copenhagen Science Park. Through his presence in these different locations he can obtain a greater range of grant funding, and can 'mix and match' the locations for his research and the partners he collaborates with.

Based on an interview with Chris Stanley, Director of Microsens Diagnostics Ltd.

5.34 There are also some significant constraints to growth, although many of these are being addressed by existing and new initiatives. The following are based on feedback from consultations that we have undertaken for this study, combined with that from a range of "high level stakeholders" interviewed in early 2014 by the Office of the London Health Board in order to gather expert opinion on the major challenges or barriers to growth and jobs in health and life sciences in London[67]. Based on these two sources, the key concerns are:

- **Lack of grow on space, particularly for firms requiring laboratory facilities**. Currently the incubators are full, and life science firms – particularly those requiring lab space – are often forced to move out of London to expand into and/or secure specialist facilities (e.g. to Milton Park, southern Oxfordshire, the Cambridge science parks, and Stevenage Bioscience Catalyst). More grow on space would help free up space in incubators to accommodate more new starts. Both Imperial West and UCL

[67] "*Promoting Growth and Jobs in Life Sciences*" Paper to the London Health Board, 17th March 2014

East could help address this problem by increasing the opportunities to scale up research based businesses in London, but they will not solve it.

- **Cost pressures and skills shortages for manufacturing firms in the medtech and industrial biotechnology areas**. For example, one firm we interviewed, based in Mitcham and manufacturing specialist plastics for medical and optical devices, employs 150 people and generates £15m of sales, 80% of which are for export. However, all of its future expansion will be overseas due to constraints on space and severe skill shortages[68].

> *"My perception is that London's technology sector is very innovative but also very early stage. With the exception of our parent company, and a few others, there is a distinct shortage of companies actually manufacturing within Greater London"*
>
> Extract from a medtech company's response to the London Tech Census, 2015

- **Lack of risk capital for scale up, compared with North America**. Comments we received from London based providers of venture capital included:
  - *"The strength of ecosystem, and particular access to finance, is still much stronger in California"*
  - *"The scale of investments in US bioscience companies is 10 times that in UK"*
  - *"95% of UK bioscience companies will make their money in the US"*
  - "*There is no comparator for NASDAQ in the UK. AIM doesn't work for bioscience companies*" [Although note that recent experience suggests that AIM does work for at least some bioscience companies – e.g. Cambridge-based Horizon Discovery]
- **Concerns about regulation, approval and adoption.** McKinsey refers to "prohibitive regulation" in the UK. However, evidence that we have obtained from interviews suggests that regulation in the UK is not significantly worse, or better, than in most developed countries. Nevertheless, regulation plays an increasing role across the life science sector, making approval for many types of products more expensive, uncertain and very time consuming. In addition, with the squeeze on NHS budgets, securing the adoption of new products is increasingly difficult
- **Obstacles to exploiting the opportunities London offers** – The London Health Board[69] is addressing a number of concerns including, for example, the need to increase the number of clinical trials in London, and to improve the interoperability of clinical data systems and access to patient information electronically, in order to increase research and commercialisation opportunities
- **Housing costs** and **transport infrastructure** were both identified as constraints to recruitment and retention of key staff in London.

[68] These observations are consistent with data presented in Chapter 3 which showed that employment in science and technology manufacturing activities in London has fallen sharply over recent years

[69] The LHB was set up in May 2013 by five funding partners – NHS England (London), Public Health England, GLA, London Councils and the London Clinical Commissioning Groups (CCGs) to provide leadership on health issues of pan-London significance

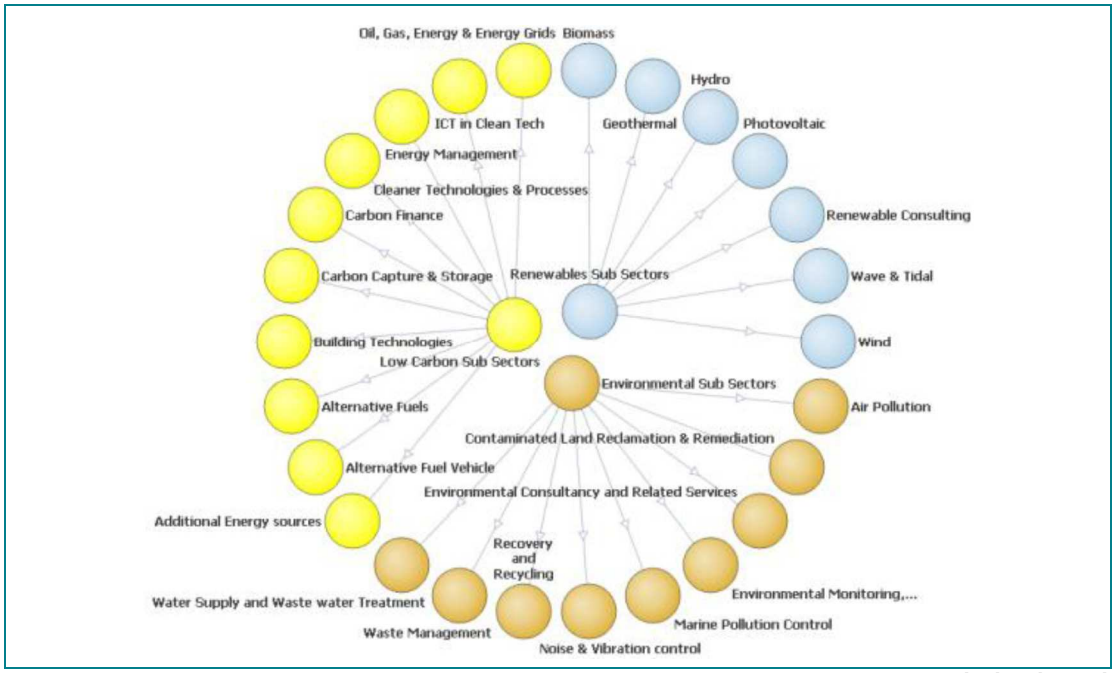
5.35 A final comment is that our research reinforces the importance of viewing the life science sector within a Greater South East context, rather than just London. Four factors stand out:

- *Many life science firms which start in London scale up elsewhere in the Greater South East*. This could be regarded as a loss to London's economy, but arguably it is an illustration of the market working effectively and firms (and their funders) responding to the different comparative advantages of different parts of the region. It is far better for London firms to scale up within the Greater South East than in the USA
- *The specialist labour market and seed and venture funding both extend across the whole of the Greater South East*, with particular hot spots in Cambridge and Oxfordshire in addition to London
- *There are strong and increasing research links between the major universities and institutions in Cambridge, London and Oxford*
- *The two main life science business networks – One Nucleus and OBN – extend across substantial parts of the Greater South East.*

II: Cleantech

5.36 Cleantech relates to a range of 'clean' processes and products, rather than a sector. EcoConnect, a UK based green industry business network, defines it as "*an umbrella term encompassing the investment asset class, technology, and business sectors which include clean energy, environmental, and sustainable or green, products and services*". Cambridge Cleantech, which claims over 400 members in the Greater South East, has produced the diagram below, which illustrates the diversity of activities that fall within the general definition.

Figure 5-3: Cleantech - range of activities



Source: Cambridge Cleantech

5.37 Using Low Carbon Environmental Goods and Services (LCEGS) as a proxy for cleantech, in 2011/12 London accounted for £25.4bn in sales, and contained over 9,200 companies

employing over 163,500 people[70]. London's international significance in cleantech is illustrated by the results of an analysis by the Guardian in 2013 of the 100 most important cleantech firms globally. Ten of these were located in the UK, including three in London (Solarcentury and Amee – both based in the Tech City area; and Novacem, a spin out from Imperial College). A further six are in the broader South East area, suggesting again that it may be logical to consider London as part of a wider South East cluster.

5.38 The infrastructure for cleantech in London includes two specialist incubators – the Green Enterprise Business Incubator (in Brixton) and the EcoMachines Incubator (near Tower Hill) – and the London Cleantech Cluster, set up to co-ordinate the existing initiatives, networks, research programmes, and financing opportunities within the sector in London. In addition, ecoConnect, which provides support to over 3,500 members nationally, holds regular networking sessions and 'Greenbacks programmes' (events where cleantech businesses can pitch for investment) in London.

5.39 Several of London's universities are also engaged in research relevant to cleantech businesses, including: Imperial; the Centre for Efficiency and Renewable Energy in Buildings (CEREB), a partnership between South Bank University, City University, and Kingston University; the Bartlett Energy Institute and the Environment Domain at UCL; and the Environment, Politics and Development Research Group at King's College.

5.40 For cleantech businesses, regulatory change has been a driver of growth, rather than a constraint. For example, the legally binding target to reduce the UK's carbon emissions by at least 80% by 2050 (based on 1990 levels) has resulted in a range of different measures (some specific to London), for example to improve energy efficiency in buildings, reduce vehicle emissions and promote 'smart city' technologies. In addition, the Landfill Tax has boosted waste reduction and recycling technologies.

[70] https://www.london.gov.uk/media/mayor-press-releases/2013/09/new-report-reveals-london-s-booming-green-economy-driving-our

6. International perspectives

6.1 This short chapter considers the scale and significance of the main digital and life science sectors in London in relation to international comparators. The context for these comparisons is important. "*London 2036: an agenda for jobs and growth*", recently published by London First and the London Enterprise Panel, states that "*London is already the leading global hub for business, for talent, for financial and business services and for visitors*". It has more FDI projects, more large international subsidiaries, more of the world's leading universities and the highest percentage of graduates of any major city globally. London's "*fundamental strengths in research, talent, creativity and finance should make it an unparalleled location for commercial innovation*".

6.2 This finding is supported by PwC's latest Cities of Opportunity report[71], in which it compares 30 major cities globally using 59 variables and concludes that "*London posts the highest score by a good margin,…The British capital finishes first in technology readiness, economic clout and city gateway – all measures of its stature as a thriving centre of the world economy*."

Digital sector

6.3 A recent comparative analysis of the digital sector in London, New York and San Francisco by Michael Mandell of South Mountain Economics and Dr Jonathan Liebenau of LSE[72] indicated that London accounts for a steadily rising share of the combined employment in the UK and USA in the "tech/info sector"[73], increasing from 5.8% in 2000 to 6.8% in 2013. Between 2009 and 2013, employment in London's tech/info sector increased by 11.2% to 382,000, compared with 411,000 in the New York metro area, and 397,000 in the San Francisco/Silicon Valley area (both statistical areas chosen to be broadly comparable in scale to London). In London, three times as many jobs were created in the tech/info sector between 2009 and 2013 (which was one dominated by recession) as during the preceding five years. London's employment in this sector grew faster between 2009 and 2013 than New York's, though less quickly than in San Francisco. In the Greater South East (including London, the South East and East), employment in the tech/info sector was 744,000 in 2013, more than in the whole of California, and the growth of 10.2% since 2009 was faster than in California.

6.4 The same analysis also compared the number of jobs in fintech and big data in the three cities, using a methodology based on reviewing the content of job advertisements. This concluded that London has 44,000 IT workers involved in fintech, compared with 43,000 in New York and just 11,000 in San Francisco/Silicon Valley. London's employment in big data is larger than in fintech, at 54,000, but below that in New York (57,000) and San Francisco/Silicon Valley (98,000).

6.5 The *London 2036* report notes that the characteristics of London's technology sector reflects its location within a global financial and business hub; "*compared to San Francisco, London's technology businesses are significantly more likely to be in digital media, sales and marketing or*

[71] Cities of Opportunity 6, PwC, 2014
[72] "London: Digital City on the Rise", by Dr Michael Mandel, South Mountain Economics, and Dr Jonathan Liebenau, LSE, June 2014
[73] The tech/info sector is defined in the report as equivalent to the Information and Communication SIC.

financial services, and significantly less likely to be in more 'pure-tech' sectors such as mobile and video".

6.6 Comparative data for European cities are difficult to source. An analysis of the digital economy in German cities[74] concluded that Berlin is by far the most successful German city in generating new digital companies - 469 in 2012, which is equivalent to 2.8 new companies for every 10,000 people in jobs in the city. Munich was a distant second in terms of the number of new companies (269), but had a similar growth rate in relation to the economy as a whole. In comparison there were about 1,000 new digital firms per year in London over the period 2003-13, which was equivalent to about 2.3 per 10,000 people in jobs (see Tables 3-4 and 3-5). At least on this basis, the scale of London's digital economy is therefore increasing faster, but the rate of growth relative to the total economy is slower, than in Berlin and Munich. Berlin is also identified as a fast growing competitor to London in other sources[75], and by some of our consultees.

Life sciences

6.7 We have assembled basic data on the number of firms and jobs in the life science sectors in eight clusters in Europe and North America (see Table 6-1). The data are broadly comparable, although international data sources are generally difficult to compare, and the provenance of the estimates varies[76].

6.8 In total, our best estimate is that the eight clusters account for approximately 362,500 biotech and medtech jobs (including over 100,000 jobs in pharmaceuticals) and nearly 9,000 biotech and medtech firms (including over 600 pharmaceuticals firms). London therefore accounts for approximately 6% of the total biotech and medtech jobs in these eight clusters, and the Greater South East (including London) for 15%. Not surprisingly, the largest number of biotech and medtech jobs and firms are located in and around the biggest cities: New York, Boston, San Francisco and London.

6.9 Pharmaceuticals is much more important in some clusters than in others – in particular, in the Greater South East including London, New York and Basle/Zurich, all of which are headquarters locations for some of the largest pharmaceutical companies in the world (e.g. Roche in Basle, GSK in London, Pfizer in New York).

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[74] "Digital Economy - – Analysis by comparing German cities", Berlin Actuell on behalf of Investitionsbank Berlin, November 2013

[75] For example: http://realbusiness.co.uk/article/28874-the-top-6-european-cities-for-startups-in-2015-and-the-companies-to-watch

[76] Life science firms and jobs are defined to include jobs in pharmaceuticals, medical biotechnology, medical devices and industrial biotechnology. The principal data sources are as follows:
Swiss Life Sciences database (http://www.swisslifesciences.ch/swiss/portal/search_companies.php);
Biotechnologie- und Pharmaindustrie in der Europäischen Metropolregion München (EMM) 2014. Study by the City of Munich, the local Chamber of Commerce, and BioM GmbH. URL:
http://www.m4.de/fileadmin/user_upload/Publikationen/Biotechnologie-_und_Pharmaindustrie_in_der_EMM_2014.pdf;
Facts and Figures on Sweden's Number One life Science Region, Stockholm-Uppsala Life Science (2014);
http://nybiomedreport.com/assets/Uploads/Battelle-MedTech-Upstate-NY-Bioscience-Report.pdf (2014);
Global-life-sciences-report-JLL, 2014;

Table 6-1: Estimates of the number of businesses and the number of jobs across eight life science clusters in Europe and USA

	Number of biotech & medtech businesses	Number of biotech & medtech jobs
London	717	21,500
Basel/Zurich	320	33,100
Geneva/Lausanne	400	25,000
Munich	370	23,000
Stockholm	600	c.21,000
New York metro area	3,000	98,000
Greater Boston	1,875	81,000
San Francisco	1,500	60,000
Total	**8,782**	**362,500**

Sources: London data are from Companies House/Trampoline. Other sources are based on SQW research

6.10 As noted in Chapter 5, the strength of life science in London and the Golden Triangle is strongly related to the area's outstanding research base. No other city, or city region, in the World has the same concentration of top ranking universities. Boston, San Francisco/Silicon Valley, New York City region and Los Angeles all have more than one outstanding university in both life science and medicine, but not three or five, as is the case for London and the Greater South East.

6.11 The outstanding research strengths are reflected in London's performance in the number and quality of published papers on life sciences research: the number is comparable with that of Boston and substantially exceeds San Francisco, and the overall quality of publications is better than both. However, as noted in Chapter 5, research undertaken by McKinsey[77] indicates that the number of patents granted, and clinical trials performed, is well below Boston and San Francisco, suggesting that there is less commercialisation of research in London, and a stronger focus on publication. This in turn is reflected in the fact that there are fewer life sciences jobs in London (21,500) than in Boston (50,000) and San Francisco (51,000).

6.12 McKinsey concludes that the life science community in London is less commercial, less networked and less collaborative than in either Boston or San Francisco, and the cluster infrastructure (e.g. venture capital, specialist and mixed tech incubators) is less well developed. This conclusion needs to be qualified by the recent progress that has been made in addressing the weaknesses identified by McKinsey. Nevertheless there is more catching up to be done.

[77] A comparative analysis of Boston, San Francisco and London by The McKinsey Group, appended to a report to the London Health Board, 17th March 2014, on "*Promoting Growth and Jobs in Life Sciences*"

Conclusions

6.13 There are four main conclusions from this brief consideration of London in an international context, combined with feedback from consultations undertaken for this study:

- *London is a highly successful world city, with an extremely rich 'asset base' for technology based business formation and growth.* Evidence from our consultations is consistent with the conclusions from other reports (e.g. the "London 2036" report by London First, PwC) that London is by some way the best place in Europe to *start* a tech business: it has a highly supportive ecosystem, it is entrepreneurial, and bright young people want to live and work in London

- *The technology sectors that are related to London's commercial assets (e.g. the market for tech products provided by London's financial, business and professional services) are larger and more internationally prominent than those related to London's science base.* This is not a reflection of the quality of research undertaken in London (PwC rank it first of 30 global cities on university research rankings[78]): rather it is an indication of London's strengths as a market for fintech and adtech products and services in particular, and also that the commercialisation process from London's science base could be more effective.

- *International comparisons need to take into account relative scale.* For example, San Francisco/Bay area/Silicon Valley and the New York Metropolitan Area are more comparable in extent with the Golden Triangle (Cambridge/London/Oxford) than with London alone. There are also strong functional linkages across all of these areas, which reinforces the case for considering them as a whole rather than in relation to each of their component parts.

- *London is a great place to start a tech business, but it is a more difficult place in which to scale a business – particularly one which requires long timescales, specialist property or large investment.* This is partly a reflection of London's success, which has resulted in high costs and increased congestion, but it also reflects some weaknesses relative to US competition – particularly in access to risk finance and flexible property solutions.

[78] Cities of Opportunity 6, PwC, 2014

7. Conclusions

7.1 By way of conclusion, it is pertinent to reflect back on the overarching research questions that went to the core of the overall study brief, and which were discussed and agreed with the study steering group at the mid-point of the work. Table 7-1 draws on the evidence presented in earlier chapters to respond to these questions.

Table 7-1: Key research questions – and some answers

Question	Answers – and wider reflections
There are a number of different growth models across London's science and technology sectors: • growth driven out of London's science • growth linked to London's market (and relating, fundamentally, to its size) • growth linked to London's own very established specialisms *Q1: What is the balance between these three, and are the growth opportunities and constraints very different?* .	All three models are important, and for many individual firms, there is some element of all three at play (as our various case studies demonstrate). However in terms of the scale of employment in science and technology sectors, we would have to conclude that the market-based driver for growth is the most prolific: the power of agglomeration is very strong indeed. In our view, all three growth models bring with them substantial opportunities – and the growth of S&T employment bears witness to these. However there are also some constraints, many of which are shared across the different growth models. Across the piece, the major constraints appear to be: • access to finance • the availability of affordable premises in central locations and on sufficiently flexible terms • for small and micro businesses, the availability of affordable high quality broadband on flexible terms[79]. In addition, major threats looking ahead relate to emerging regulations: notably the proposed European General Data Protection Regulation relating to the use of personal data; and controls on immigration which could severely disrupt recruitment and retention in what is a highly international labour market.
Given the tightness of the central London property market, the potential of the Golden Triangle seems to be extremely important for the S&T sectors which are driven out of London's science, but much less so when other growth processes are at play. *Q2: Is this distinction a valid one, and if so, what are the implications for the spatial footprint of future growth?* .	In the main, London's S&T businesses want to be in central London as the "upsides" of agglomeration and clustering processes are significant. However central London is space-constrained. For digital technology sectors, there is no evidence that businesses are being displaced from central London; indeed quite the reverse – the data, and the case studies, suggest that businesses are still moving in. However they are struggling with spiralling property costs and we suspect the upshot is that some are growing without increasing their local headcount. Often, growth models involve international collaborations of one form or another. In digital technology, the Golden Triangle concept has limited traction. However in the more strongly science-based sectors – particularly life science – the picture is very different. London has substantial research based strengths, but so do both Cambridge and Oxford, and there is increasing collaboration between all three. This will only increase with investments such as the Crick Institute, the Biomedical Campus at Cambridge and the proposed Bioescalator in Oxford. The upshot is that science-based businesses born in London are increasingly looking for growth solutions in the wider Golden Triangle. This may change as the major investments being led by Imperial College and UCL come on-stream, but these are unlikely to provide the total solution. Developments such as the Stevenage Bioscience Catalyst – linked to GSK – are playing an important role in this context. The fact that the largest of the AHSCs has a spatial footprint that extends into Hertfordshire and Essex is also noteworthy.

[79] See "Joining the Dots: building infrastructure for London Tech", by Tech London Advocates, for a detailed exposition of broadband, property and transport constraints to the growth of London's tech community and measures to overcome them.

Question	Answers – and wider reflections
Across the piece – as borne out by the IDBR data from ONS – Inner London seems to be benefitting disproportionately from the growth of the tech sectors *Q3: Is this correct, and what are the implications in terms of planning for the growth of these activities, and planning for economic growth in Outer London?* .	All of the evidence we have considered in the course of this study points to the increasing concentration of employment in S&T sectors in Central/Inner London. The reasons for it relate to the importance of interconnectedness and agglomeration. The growth processes we have observed present major challenges in relation to Outer London – which, despite a variety of initiatives to promote tech based growth, is perceived as "remote", particularly given the overwhelmingly young workforce in some S&T sectors. The solution is not, we suggest, to constrain Inner London – for Silicon Valley will become even more attractive to ambitious businesses. The "Outer London question" merits a level of consideration which is beyond the scope of this study. In answering it, it will be important to reflect that London's S&T landscape is essentially one of a networked cluster; and the attempts to promote localised hubs in some Outer London locations may prove successful in time.
Internationalisation is a feature across the board, although it takes very different forms *Q4: What are the associated risks and opportunities in this context?* .	London's S&T sectors are intrinsically international. They rely on an international workforce and international markets; and – given perceived constraints in London – they are increasingly enticed by the prospect of international finance. As it stands, London is superbly well positioned as an international hub. Indeed a recent report by PwC put London in top spot in a "league table" of Cities of Opportunity – ahead of New York and Singapore (which were ranked 2nd and 3rd)[80]. Any intervention that challenges London's international connectedness will pose a risk in this context. The risk that is uppermost in the minds of many in the S&T sector currently is any further restrictions that are put in place in respect of international migration. Skills shortages were not identified by many consultees as a major constraint on growth, largely because firms are able to recruit from a global workforce. However, if international recruitment becomes more difficult, it is likely that skills shortages would rise quickly up the list of constraints.
Regulatory change is likely to impact significantly on a number of tech sectors over the next few years *Q5: On balance, what does this mean for London?*	Regulation is a "fact of life". Evidence gathered through our consultations and case studies pointed to the London (and UK) situation being *relatively* favourable in these terms, certainly in relation to fintech and life sciences. That said, in general, businesses would favour less regulation. However there are examples – notably in cleantech – of regulation being a catalyst for growth. There is a cloud on the horizon for digital technology surrounding the prospective European General Data Protection Regulation which relates to the use of personal data. This obviously would not be specific to London, but it would be damaging; it could make Silicon Valley look even more attractive.
Despite their potential, many small tech businesses struggle to make money, and London can be very expensive *Q6: What evidence is there of tech-based activity being priced out of London?* .	As intimated above, there are major paradoxes in relation to commercial property in Inner/central London: S&T businesses complain consistently and stridently about the price of accommodation, and yet many continue to move in. The explanation must be that the advantages of an Inner/Central London location generally outweigh the (substantial) costs. However it is also true that many small S&T businesses struggle to make money – partly because they may be ahead of the market and partly because they may not be very disciplined "businesses" (as opposed to technology concepts). Where low cost accommodation has been provided in Inner/central London specifically aimed at small S&T businesses, it has been quickly taken up; a good example in this context is the Camden Collective. There may be scope for further ventures of this type. In terms of "being priced out", it is however important to be clear that the situation facing digital technology businesses appears somewhat different from that confronting life science firms (which may, for example, need specialist wet lab space). There is far more evidence of the latter moving out of London – although even here, it is less clear whether the issue is price *per se* or straightforward availability.

[80] *Cities of Opportunity – 6* Report by PwC, 2014

Question	Answers – and wider reflections
Major corporates appear both to be intrigued by tech-based sectors and concerned by them *Q7: What does this mean for London and its mega-city economy as it looks to the future?* .	The growth of S&T sectors in London is not only – or even mainly – a small firm phenomenon. Major corporates are thoroughly implicated – albeit in novel, and often indirect, ways. There are many examples of corporates supporting the process of enterprise – whether through the provision of accelerators/incubators or less visible forms of sponsorship. Business models have changed, and for the major corporates, small S&T firms are frequently the low risk route to innovation. This has long been apparent in relation to pharmaceuticals (where small biotech firms function, effectively, as a core part of the R&D function in relation to drug discovery). It is also becoming increasingly commonplace elsewhere. As Accenture has noted, "*banks are recognising that small fintech companies hold answers to many of the challenges they face. Only a few years ago, many banks were reluctant to engage smaller technology vendors. That has changed materially in recent years*"[81]. Equally, many entrepreneurs and small firms are benefitting from the increased attention from corporates and from their strong presence in London. The incubators and accelerators sponsored by the likes of Google, Cisco, DC Thomson and Telefonica are good examples, and acquisition by corporates (for example, Elsevier's purchase of Mendeley) is a means for many tech entrepreneurs to realise the value of their business
The relationship between the science and technology sectors and London's universities is patchy *Q8: Should positive steps be taken to strengthen the depth of those relationships, particularly outside of life science?*	The evidence gathered in the course of this study is consistent with the observation that the links between S&T sectors and London's universities are "inconsistent". The relationships are strongest – not surprisingly – in the sphere of "science", and London's universities have spun out a number of businesses. But when considered in relation to S&T in London as a whole, the footprint of the universities is relatively small. The universities do however contribute substantially in other ways. In particular, they attract many clever people to London – large numbers of whom are from overseas – and they play a key role in shaping the labour market on which S&T firms draw. An increasing number of London's universities - and not just the research intensive ones - are also making substantial progress in engaging with the tech business community. Moreover, there is some evidence that some universities are providing a good grounding in "enterprise". One of our case studies recounted one young entrepreneur's assessment of his own time spent at UCL: it "*generates really positive people who "get things done" and have fun, and it is a seed-bed for enterprise".* *However, given the number of universities in London, the scale of research activity, and the very large number of students and faculty, there is a strong case for strengthening the links between more London universities and science and technology based firms.*
In some tech sectors, there is the suggestion that concepts are too complicated to attract early stage funding *Q9: To what extent is London's early stage financing community adapting to the opportunities arising from the tech sector, and can anything be done to de-risk the process?*	Investing in very early stage and innovative concepts is always risky. There is a judgement call to make in assessing whether a failure to secure investment is a market failure or evidence that the market is in fact working. That said, there is evidence that London's early stage financing community is quickly adapting to the opportunities that are emerging. For example, over recent months, Fintech Circle has emerged in order to encourage early investment in fintech, and new funding sources such as crowdfunding are growing rapidly. There is a widely held view that London's early stage financing community is by some way the strongest is Europe, and that this is an important attraction for entrepreneurs. But it is also clear that it remains smaller, less well-resourced, and more risk averse than that which drives Silicon Valley. For many S&T entrepreneurs, the differences are both substantial and frustrating.
There is evidence of some level of networking, but much of it is informal – and also the suggestion that relationships are difficult to sustain because of London's scale and the amount of churn within it	London is very much bigger than either Oxford or Cambridge and the difference in scale is materially important in relation to the nature and extent of networking. Within London, there is not one "science and technology community", but multiple ones – and most are clustered in small areas of London. Shoreditch is the one that has received most attention, but there are a

[81] *The boom in global fintech investment: A new growth opportunity for London* Accenture, 2014

Question	Answers – and wider reflections
Q10: Is London too big to sustain a strong innovation ecosystem or is it, simply, very different from those characterising Oxford and Cambridge?	good number of others too – like adtech in Soho, life science in the Knowledge Quarter (around Kings Cross, St Pancras and Bloomsbury), fintech in Canary Wharf and mediatech in White City. London has a strong innovation ecosystem with localised networks within it, which are a major attraction for firms. Although they do not amount to one "uber network" they function effectively and in a way that reflects the realities, potentials and constraints of a global city. The key issue to address is whether facilitating more interaction between these different networks could generate additional benefits, by supporting cross fertilisation between technology areas and business models. The richness and diversity of London's tech clusters suggests that there should be more potential here than is currently being realised.
Many have commented that London has advantages over North America – partly because of time zones and partly because the "centre of tech" and the "centre of finance" are in the same place	London has tremendous advantages and its science and technology sectors are growing quickly. There are some constraints within this – although many are a product of success (and the cost and availability of commercial property is uppermost amongst these). Moreover, London remains adrift of some key international comparators in some respects – and access to finance is probably the main one.
Q11: Is London doing all that it should to exploit these geographical advantages, and what do they mean for different parts of the S&T sector?	"Is London doing all that it should"? London & Partners, the London Enterprise Panel and the GLA (and the Mayor) have all recognised the tremendous potential that surrounds science and technology. A plan for growth – that recognises the similarities and differences between particular science and technology sectors – would serve London's interests well. This should not be constrained by administrative boundaries, and across some S&T sectors, there is a need to consider London within the context of the Greater South East. Moreover, in many respects, the purpose of the Plan could be to avoid well-meant – but ineffective or unnecessary – interference from the public sector. However there are a number of areas in which there are clear market failures and in which London's institutions have a particular role to play.

Source: SQW

7.2 In sum, London provides an outstanding ecosystem for the formation of S&T businesses and it offers – and generates – substantial clustering and agglomeration benefits. It is certainly the best place in Europe to *start* a science and technology business. Moreover, the process of growth should accelerate: many of the supporting institutions and initiatives are either new (e.g. MedCity, Tech City UK, the Catapult Centres) or still "in development" (notably the Crick Institute, Imperial West and UCL East). Hence there is considerable emerging potential – and this will need to be exploited and harnessed to the full.

7.3 However *growing* a business locally is more difficult. Among the S&T business community, there are growing concerns about access to finance; access to affordable property on flexible terms; access to high quality broadband on a commercial basis that is affordable for start-ups; prospective controls on immigration which could severely disrupt recruitment and retention; and some potential regulatory changes.

7.4 Some of these concerns are – effectively – the costs of agglomeration. London is a victim of its own success: housing costs, transport congestion and the high costs of some expertise (e.g. development engineers) are ultimately constraints to growth. That all said – so far at least – none of this has prevented firms from starting in London or both firms and individuals moving to London to be part of the wider ecosystem.

7.5 There are, however, some challenges for GLA (and its partners) as it looks to support the S&T sector in the future. Four issues – some of which are genuine dilemmas for the London institutions – stand out in this context:

- *First, whilst some of the challenges outlined above are capable of being addressed at a London scale, many simply are not.* Decisions taken by UK government (and indeed at

an EU level) will have a major bearing on the future growth of London's S&T sectors (most immediately with regard to international migration).

- *Second, there are substantial differences within London*: all the evidence points to rapid growth in Inner/Central London but much slower growth (and in some cases decline) in Outer London. For the London authorities, there are real tensions across London's economic geography and appropriate solutions need to be found for Outer London. In general terms, the evidence suggests that London's science and technology firms simply do not want to locate there, whatever the upside *vis-à-vis* the cost of premises.

- *Third, particularly for life sciences, there is an urgent need to think creatively beyond London's boundaries*. There are natural synergies to be exploited across the Golden Triangle, with links to Cambridge and Oxford, and indeed the area in between. *Digital technologies sectors* also need to grow on their own functional economic footprints; these – in our view – are likely to be more networked and international, with clear links to other global cities and across the UK.

- *Finally, while noting that London comprises multiple clusters – all of which benefit from wider processes of agglomeration – there is a need to try and cross-fertilise ideas and opportunities*, preventing "*the ties that bind*" becoming "*ties that blind*" (to coin the phrase of the German academic, Gernot Grabher): the "*Shoreditch bubble*" (as one consultee described it) should not be institutionalised into a "*Shoreditch fortress*" and instead, its intrinsic "messiness" should be encouraged – even if it does make accurate measurement impossible. The scale, diversity and dynamism of tech sectors in London provides an extremely rich environment for exploiting market opportunities at convergence areas between technologies – an obvious example being digital health. However, organisational structures (including networks) tend to be sectorally focused, and there is a need to ensure that opportunities for cross-fertilisation are not overlooked.

Annex A: List of consultees

A.1 In the course of this study, we spoke to large numbers of people from different firms and institutions. We would like to acknowledge the time they made available to contribute to this piece of work.

Name	Organisation
Stephen Bunting	Abingworth Life Sciences
Samad Masood	Accenture & FinTech Innovation Lab
James Wise	Balderton Capital
Adrian Woolard	BBC Connected Studio
Sue Ellison	BIS, Office of Life Sciences
Lucy Stonehill	BridgeU
Maja Maricevic	British Library
John Spindler	Capital Enterprise
Martin Day	Carclo Technical Plastics Ltd
Dr Steve Taylor	Celbius
Carly Newman	Centre for Entrepreneurship, UCL
Tom Kneen	Cisco, British Incubation Gateway
John Cooper	Crick Institute
Nigel Stokes	deltaDOT
Julie Lake	FinTech 50; fintech city
Keith Roubaud	GID Ltd
Anna King	Health Innovation Network South London
Charles McIntyre	IBIS Capital
Prof David Gann	Imperial College
Hugo Drayton	Inskin Media
David Patterson	Learning Light
David Slater	London & Partners
Sarah Haywood	London & Partners, Acting Head MedCity
Dr Ken Larkin	London Bioscience Innovation Centre
Amit Khandewal	London Borough of Hounslow
Clive Hall	London Cleantech Cluster
Carolyn Ruston	London Health Board
Stephen King	London Stansted Cambridge Consortium
Dr Felix Jackson	MedDigital
Jan Reichelt	Mendeley

Name	Organisation
Alice Bonasio	Mendeley
Chris Stanley	Microsens Diagnostic
Cosmin Mihaiu	Mira Rehab
Julia Shalet	Mobile Monday
Harriet Fear	One Nucleus
Tony Jones	One Nucleus
Julie Bretland	Our Mobile Health, Digital health Professionals Network
Dr Ramsay Richmond	Queen Mary Bio Innovation Centre
Andrew Ward	Randox Health
Nigel Banister	Rare Biotech Ltd
Leah Moon	Seedrs
George Robinson	Sloane Robinson LLP
Jacoby Thwaites	SPARKL
Miriam Keshani	Sparrho
Richard Gorulay	Sussex Place Ventures
Chris Hollowood	Syncona
Gerard Grech	Tech City UK
Russ Shaw	Tech London Advocates
Gus Ferguson	Teltrad
Dr Maryam Atakhorrami	UCL Enterprise
Shaul David	UKTI
Alex Foster	We see through / Race yourself

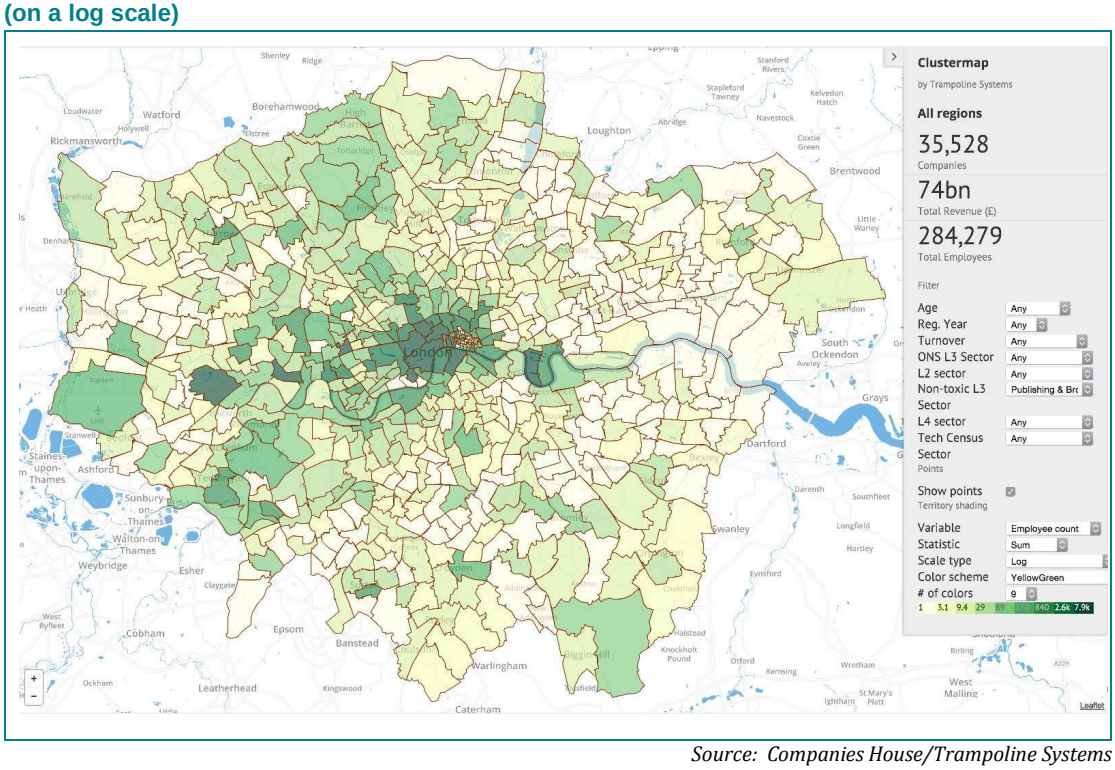
Annex B: Maps and other outputs produced by Trampoline Systems

B.1 Trampoline Systems used a range of methodologies to generate visual representations of London's science and technology sectors. Some of these have been presented within the main chapters of this report. Illustrations of other outputs are provided in this Annex.

Heat maps

B.2 Trampoline produced a series of "heat maps". Those relating to employment for digital technologies and life sciences were included in Chapter 3 (with data shown on a log scale). Below is a similar map for publishing and broadcasting.

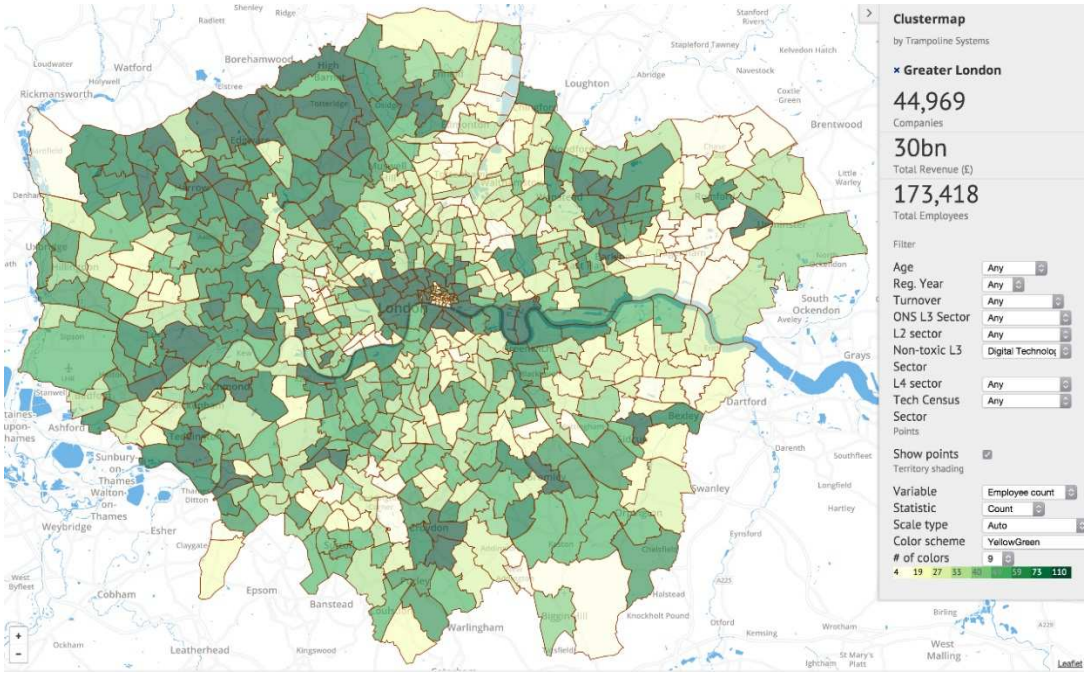
Figure B-1: Heat map for publishing and broadcasting – showing the distribution of employment (on a log scale)



Source: Companies House/Trampoline Systems

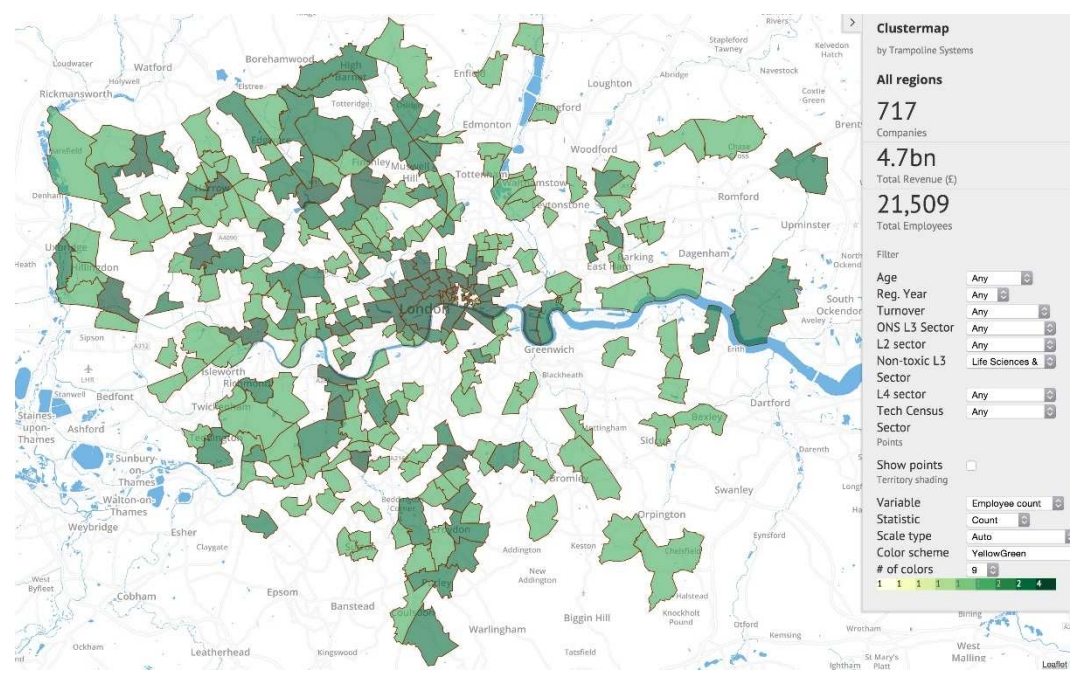
B.3 In addition, "heat maps" were produced where the variable was not the "sum" of employment but the "count" – so the maps show the distribution of companies. Three sector-specific maps are provided below. [Note that the log scale is not used here.]

Figure B-2: Heat map for digital technologies – showing the distribution of companies



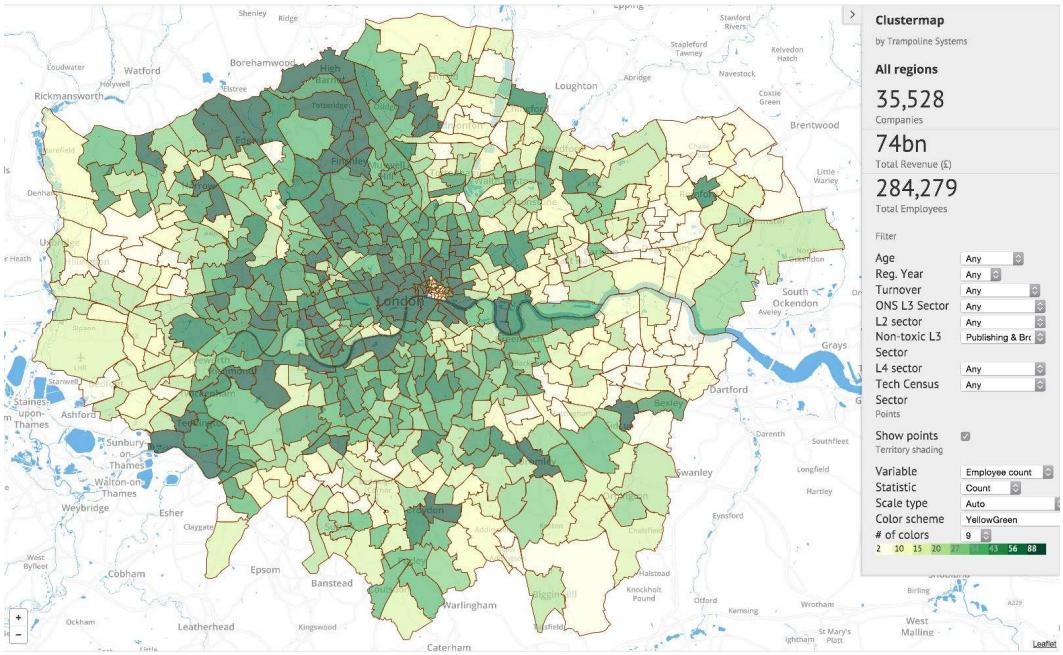
Source: Companies House/Trampoline Systems

Figure B-3: Heat map for Life Sciences – showing the distribution of companies



Source: Companies House/Trampoline Systems

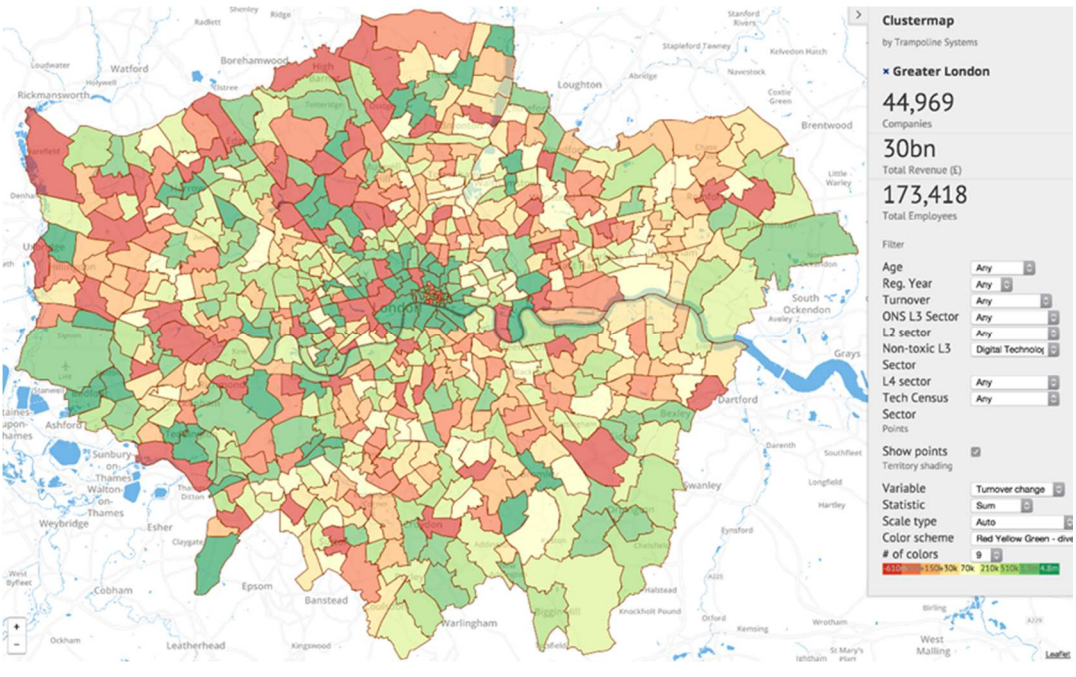
Figure B-4: Heat map for publishing and broadcasting – showing the distribution of companies



Source: Companies House/Trampoline Systems

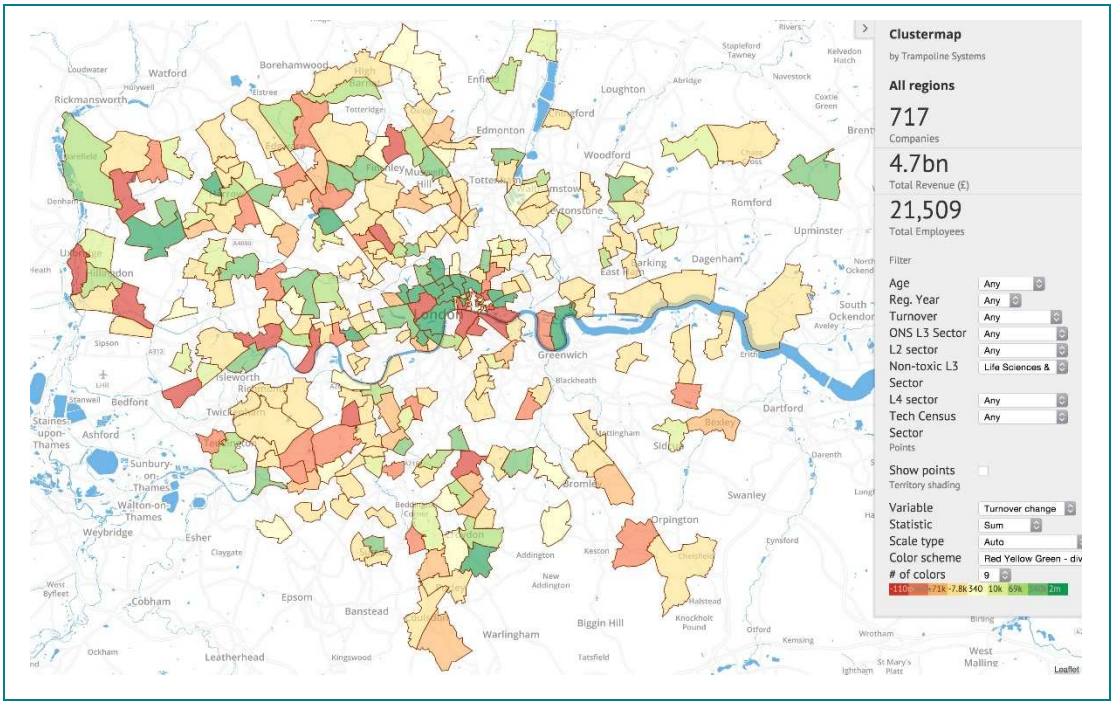
B.4 In addition, Trampoline produced evidence on change over time. The maps which follow provide evidence of change in revenue over the last year or so for digital technologies and life sciences. [The exact timescale is variable and imprecise because it depends on the last two occasions on which company accounts were filed]

Figure B-5: Change in revenue (over the last year or so) in Digital Technologies



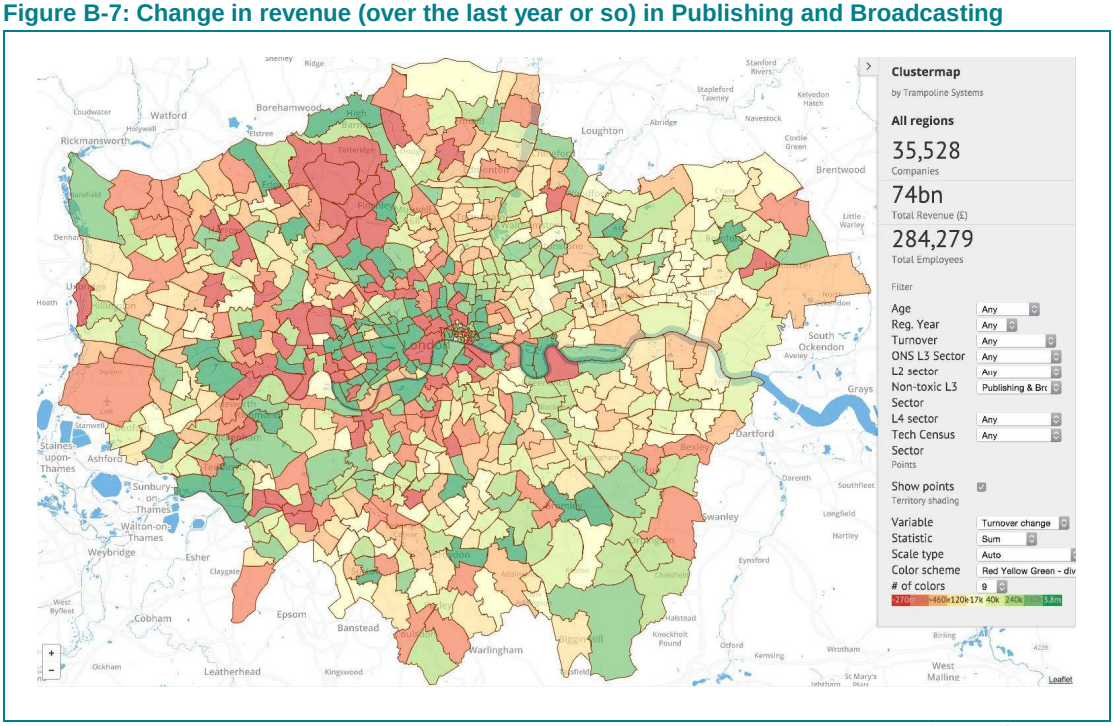
Source: Companies House/Trampoline Systems

Figure B-6: Change in revenue (over the last year or so) in Life Sciences



Source: Companies House/Trampoline Systems

Figure B-7: Change in revenue (over the last year or so) in Publishing and Broadcasting



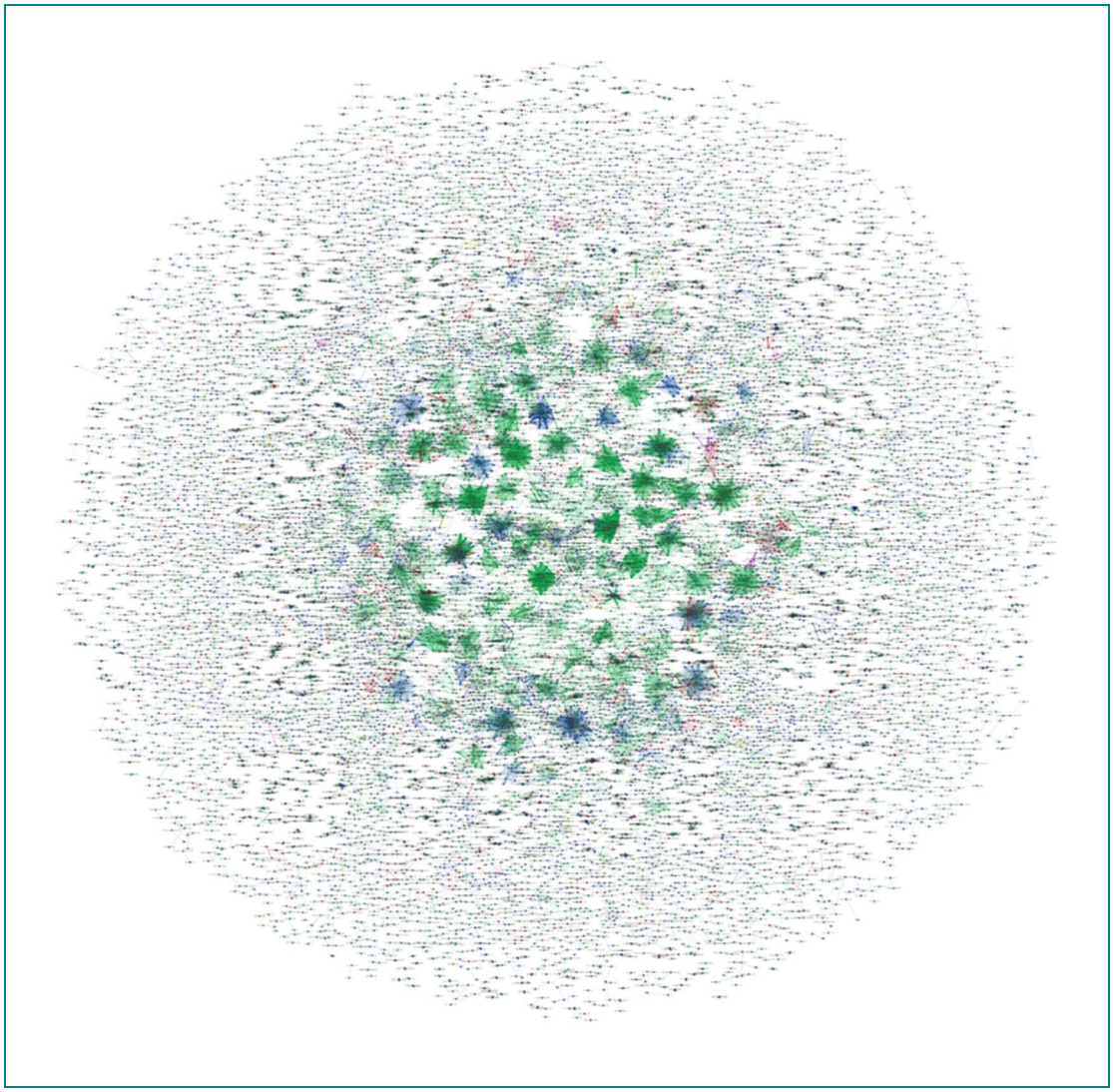
Source: Companies House/Trampoline Systems

Network maps

B.5 Finally, Trampoline produced a series of director network maps – charting the incidence of shared directorships of relevance to businesses in the Science and Technology Sector. This innovative analytic approach helps to reveal the underlying structure of London's science and technology ecosystem by looking at personal links between businesses. The map produced for

London is shown in the graphic below – although it is impossible to read at this scale. Electronic versions of various network maps have been provided to GLA; within these, it is possible to identify specific named companies and the links between them.

Figure B-8: London company directors – network map



Source: Companies House/Trampoline Systems